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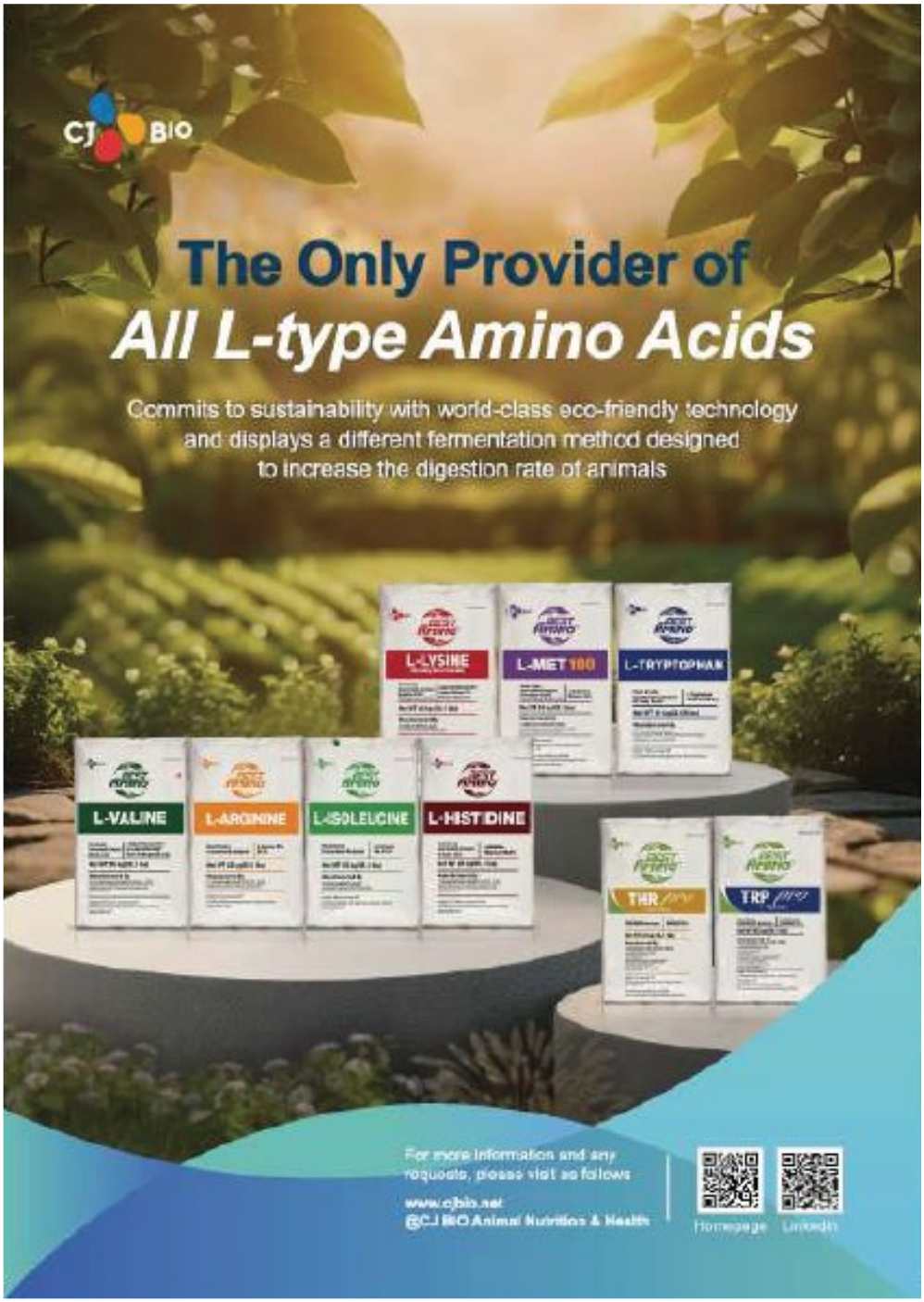
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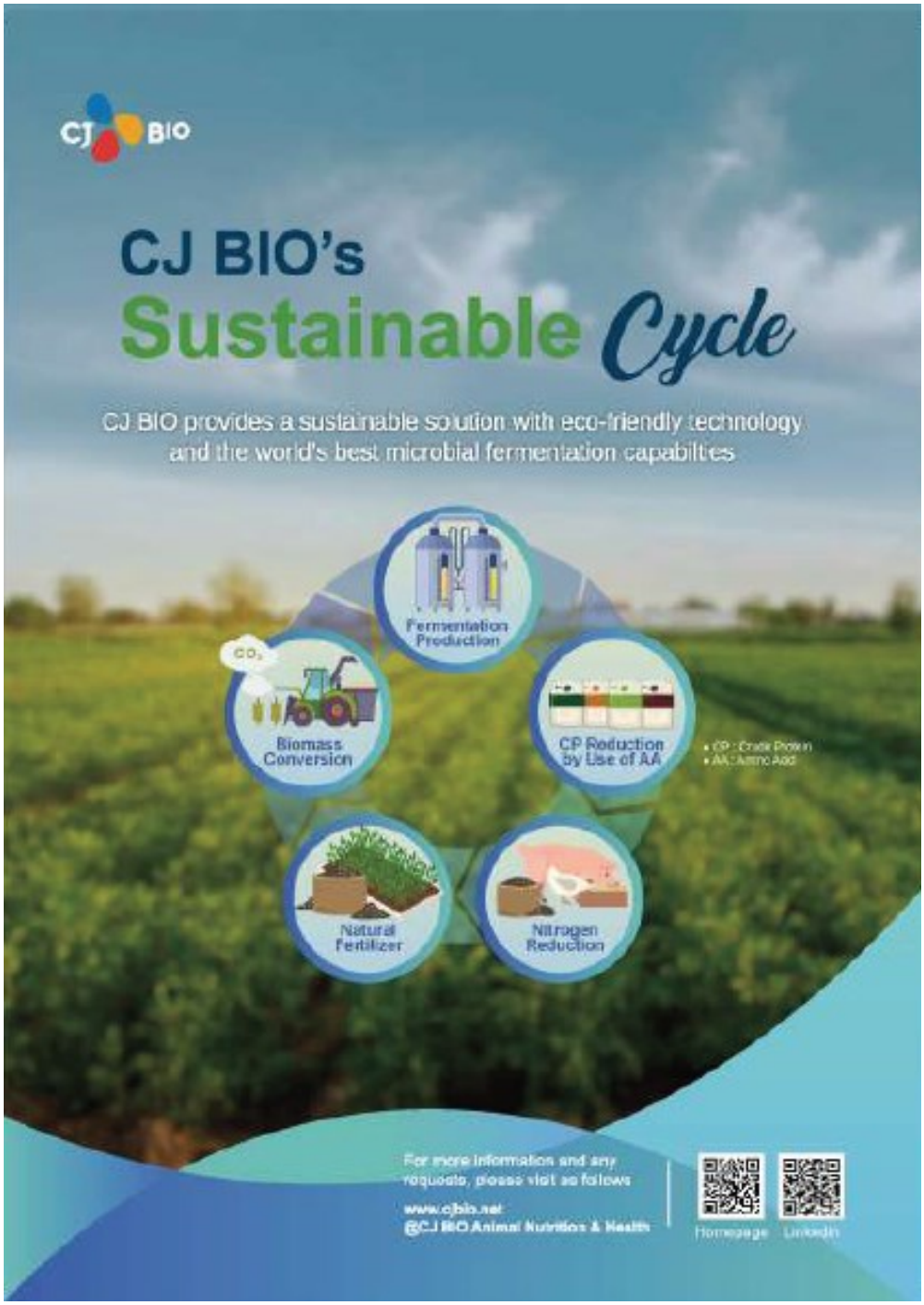
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We dedicate this book to the memory of Professor Luiz Fernando Teixeira Albino, an exceptional mentor and collaborator, whose vibrant presence and unwavering commitment to the advancement of science shaped not only our lives but also the content of these pages. His legacy will endure through the minds he touched and the lessons he taught. His wisdom and kindness will be forever remembered.

* 02.06.1953 † 02.13.2024

BRAZILIAN TABLES FOR POULTRY AND SWINE

Composition of Feedstuffs and Nutritional Requirements

5th Edition

Editors:

Horacio Santiago Rostagno
Luiz Fernando Teixeira Albino

Authors

Horacio Santiago Rostagno
Luiz Fernando Teixeira Albino
Arele Arlindo Calderano
Melissa Izabel Hannas
Nilva Kazue Sakomura
Fernando Guilherme Perazzo
Gabriel Cipriano Rocha
Alysson Saraiva
Márvio Lobão Teixeira de Abreu
Jansller Luiz Genova
Fernando de Castro Tavernari

Translated by:

Bettina Gertum Becker, Ph. D. in Animal Science
Carlos Henrique de Oliveira, MSc. in Animal Science
Kelly Morais Maia Dias, MSc. in Animal Science

Federal University of Viçosa
Department of Animal Science
2024

The authors of the Brazilian Tables for Poultry and Swine – Composition of Feedstuffs and Nutritional Requirements are *Horacio Santiago Rostagno*, Ph. D., Full Professor of Monogastric Nutrition (UFV); *Luiz Fernando Teixeira Albino*, D.S., Full Professor of Poultry Nutrition and Production (UFV); *Arele Arlindo Calderano*, D.S., Associate Professor of Poultry Nutrition and Production (UFV); *Melissa Izabel Hannas*, D.S., Associate Professor of Monogastric Nutrition and Production (UFV); *Nilva Kazue Sakomura*, D.S., Full Professor of Monogastric Nutrition (UNESP-Jaboticabal); *Fernando Guilherme Perazzo*, D.S., Associate Professor of Nutrition and Production of Monogastric (UFPB-Areia); *Gabriel Cipriano Rocha*, D.S., Associate Professor of Monogastric Nutrition (UFV); *Alysson Saraiva*, D.S., Associate Professor of Swine Nutrition and Production (UFV); *Márvio Lobão Teixeira de Abreu*, D.S., Associate Professor of Swine Nutrition and Production (UFLA); *Janslller Luiz Genova*, D.S., Associate Professor of Swine Production and Bioclimatology (UFV); and *Fernando de Castro Tavernari*, D.S., Researcher at Embrapa Swine and Poultry.

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The 5th edition of the Brazilian Tables was updated using data published until December 2023, including graduate theses, and national and international academic publications and books, all meticulously cited in Chapter 8.

We appreciate the companies that provided funding and technical support for various research projects on feedstuffs and nutritional requirements of poultry and swine, especially the companies Ajinomoto, Alltech, CJ, DSM, Evonik, Nova Mentis, and Suntaq.

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FOREWORD

Brazil stands out as one of the leading global poultry and swine producer, and consequently, it is a large manufacturer of balanced feeds.

The Brazilian poultry and swine industries apply cutting-edge technology, particularly in feed manufacturing. However, feed formulation practices in Brazil previously depended on feedstuff composition and nutritional requirement data generated internationally, particularly in the United States and Europe. The tables used for feed formulation in Brazil, both by the industry and academia, were developed abroad or were adapted from these foreign references.

Although those tables have introduced advanced technologies, contributing to the progress of the Brazilian poultry and swine industry, their applicability to local conditions is limited.

The Department of Animal Science at the Federal University of Viçosa has carried out research to develop nutritional tables for poultry and swine based on data collected in Brazil. These efforts resulted in the first draft of the BRAZILIAN TABLES FOR POULTRY AND SWINE – Composition of Feedstuffs and Nutritional Requirements, published in 1983. Subsequently, the 1st edition of the Brazilian Tables was published in 2000, the 2nd edition in 2005, the 3rd edition in 2011, and the 4th edition in 2017.

Since 2017, with the collaboration of state and federal universities, such as the São Paulo State University (UNESP), the Federal University of Paraíba, and the Federal University of Lavras, new research projects allowed updating the Tables, resulting in this 5th edition.

Most of the data presented here were previously published in Brazilian and international scientific journals, graduate theses, and proceedings of symposia and congresses.

Several feedstuffs produced in Brazil were analyzed. Energy values were evaluated in several trials with animals in Animal Nutrition Laboratories and an extensive number of chemical analyses.

Nutritional requirement levels were established in several biological tests with broilers, layers, quails, and pigs at different production phases and reared under various environmental and temperature conditions.

Data were validated under stringent experimental conditions, including those obtained in commercial poultry flocks and pig herds. Least-cost diets were formulated using the nutritional values determined at UFV associated with the nutritional requirements proposed here and compared with those formulated using international tables.

The results published here are crucial for nutritionists to formulate more efficient and economical poultry and swine feeds.

The authors' sole purpose was to improve animal production in Brazil.

Although this edition represents a significant advance relative to the previous editions of the Brazilian Tables, there is still room for progress. Therefore, the continuity of research and the engagement of Brazilian researchers, professionals, and producers will allow further improvements in the information provided.

Authors

Special Collaboration for the Preparation of the Brazilian Tables for Poultry and Swine

Chapter 01 - Feedstuff Composition and Nutritional Value
Heloísa Pagnussatt, Romário Duarte Bernardes, Samuel de Oliveira Borges and Kelly Morais Maia Dias

Chapter 02 - Nutritional Requirements of Broiler Chickens
Carlos Henrique de Oliveira, Filipe Antônio Monteiro, Gustavo Augusto C. C. de Aguiar, Maria Rogervânia Silva de Farias, Romário Duarte Bernardes and Rosa A. Reis de Léo

Chapter 03 - Nutritional Requirements of Replacement Pullets, Layers, and Broiler Breeders
Lucas Pimentel Bonagurio and Rony Riveros Lizana

Chapter 04 - Nutritional Requirements of Japanese and European Quails
Adiel Vieira de Lima and Jean Kaique Valentim

Chapter 05 - Nutritional Requirements of Growing Swine
Filipe Antônio Monteiro, Gustavo de Amorim Rodrigues, Heloisa Pagnussatt, Joyce Barcellos and Lucas Medina Teixeira

Chapter 06 - Nutritional Requirements of Swine Breeders – Gestation and Lactation

Chapter 07 - Vitamin and Trace Mineral Supplementation for Poultry and Swine
Fernanda Fialho Abranches, Lucas Medina Teixeira and Maykelly da Silva Gomes

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Carlos Henrique de Oliveira and Kelly Morais Maia Dias

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CHAPTER 1

Feedstuff Composition and Nutritional Value

Arele A. Calderano[1], Janslller L. Genova[1], Fernando C. Tavernari[2], Luiz F.T. Albino[1] and Horacio S. Rostagno[1]

[1]Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil.
[2]CNPSA, EMBRAPA, Concórdia, Brazil

INTRODUCTION

The feedstuffs' chemical analyses were mainly carried out in the Animal Nutrition Laboratories of the Department of Animal Science and Chemical Analysis of the Department of Soils of the Federal University of Viçosa (UFV). Some feedstuffs were analyzed in the laboratories of several animal nutrition companies.

The following procedures and methods were applied to determine nutrient levels: dry Matter (DM): drying samples in an oven at 105 °C for four to six hours; total nitrogen (Total N): mainly by the Kjedahl method, and the result was used to calculate the Crude Protein (CP) content as N multiplied by 6.25; ether extract (EE): by heating, using the Goldfisch extractor and petroleum ether as the solvent; starch: enzymatic method; crude fiber (CF): Weende method; fiber in neutral detergent (NDF) and fiber in acid detergent (ADF): Van Soest method; gross energy (GE): burned in a "Parr" bomb calorimeter; ash: burning at 600 °C for 4 hours; minerals: by atomic absorption spectrophotometer, except for sodium and potassium (flame emission spectrophotometer). Minerals from a limited number of feedstuffs were also analyzed by plasma induction spectrophotometer; phosphorus (P): by colorimetry; total amino acids: by High Performance Liquid Chromatography (HPLC); fatty acids in oils and fats commonly used in monogastric diets were determined by chromatography.

The quantification of the amino acids Glutamine (Gln) and Asparagine (Asn) in feedstuffs presents limitations due to the amidation reaction, which promotes the conversion (approximately 80%) of these amino acids into Glutamic (Glu) and Aspartic (Asp) acids, respectively. In this edition, Glu:Gln and Asp:Asn ratios were calculated using data from 16 feedstuffs analyzed by Li et al. (2011) and Li and Wu (2020). For other feedstuffs, these ratios were estimated based on the similarity of their proteins with those of the analyzed feedstuffs.

Determining the amino acid content and standardized ileal digestibility of feedstuffs for poultry and swine feedstuffs is difficult and

expensive. Thanks to the collaboration of the companies Adisseo, Ajinomoto, DSM, and Evonik, it was possible to analyze many feedstuffs and digesta samples.

Standardized ileal digestible amino acid (SID) values of poultry feedstuffs were determined using the Sibbald precision feeding method with cecectomized roosters; and mainly, by the ileal collection method in broilers (21 to 28 days). Endogenous amino acid excretion was estimated in fasting cecectomized roosters (Sibbald) and by the supply of a protein-free diet to broilers (ileal collection). In swine, amino acid ileal digestible content was determined using growing swine fitted with a T-cannula at the terminal ileum or ileorectal anastomosis for a few feedstuffs. Endogenous amino acid excretion was estimated using a protein-free diet. The standardized ileal digestibility coefficient of protein in poultry and swine was calculated as the ratio between the feedstuffs' SID amino acid content and total amino acid content. Amino acid digestibility coefficients available in literature were used for some feedstuffs.

Essential nitrogen content was calculated as the molecular nitrogen content in each essential amino acid multiplied by its percentage in the feedstuff. The essential nitrogen digestibility coefficient was calculated as the ratio between standardized digestible essential amino acid content and total essential amino acid content. For poultry, the calculations considered glycine and serine as essential amino acids.

In this 5th edition, two categories of corn grain and soybean meal (SBM) are included in addition to the average values. The nutritional values of the additional corn categories were calculated considering the average DM value ± 1 standard deviation and higher or lower hulls proportion for soybean meal relative to that present in the average SBM.

In plant feedstuffs, phytate phosphorus content was determined in addition to total phosphorus. We thank the company AB Vista, which kindly provided the results of phosphorus and phytic phosphorus analyses of Brazilian feedstuffs. Non-phytic phosphorus content (total phosphorus – phytic phosphorus) was considered as available phosphorus.

The calculation of available phosphorus content in animal feedstuffs was based on total phosphorus content considering 100% availability, except for pork and bovine meat and bone meals (90% availability). Standardized digestible phosphorus values determined in growing and finishing broilers and swine are also listed. Those values were obtained in experiments carried out at UFV or published in the literature. The apparent digestible phosphorus content of some feedstuffs mentioned in the literature was converted into standardized digestible values, applying endogenous P excretion values of 0.138 mg P/kg DM intake for poultry and 0.258 mg P/kg DM intake for pigs. The results of experiments conducted by Bunzen (2009; Ph.D. thesis at UFV) expressed in mg P/unit of metabolic weight ($W^{0.75}$) were transformed into mg P/kg DM intake.

The metabolizable energy (ME) content of most poultry feedstuffs was determined by the total excreta collection method. The ME content of some feedstuffs was measured using chromic oxide or acid-insoluble ash as a fecal marker. Feedstuffs ME Poultry values were corrected for nitrogen retention determined in broilers of different ages.

Research carried out at UFV to evaluate the influence of bird age on feedstuff ME values showed that hens and mature chickens generally obtain higher ME values from plant feedstuffs than broilers. Those experimental data estimated a 0.3 kcal/g ME increase from undigestible nitrogen-free extract + crude fiber (NDNFEF) fraction for mature poultry (Hens). That fraction was calculated as NDNFEF = (total nitrogen-free extract - digestible nitrogen-free extract) + crude fiber. Therefore, two ME values are presented for each feedstuff: one for poultry in general (ME Poultry) and the other for mature poultry or Hens (ME Hens = ME Poultry + 0.3 NDNFEF).

The net energy values (NE) of poultry feedstuffs were calculated by applying the following coefficients of ME utilization estimated by Carré et al. (2014): 76% (-24%) for digestible protein and 80% (-20%) for digestible starch, considered as digestible nitrogen-free extract. A 90% efficiency

(-10%) was considered for digestible EE, as proposed by De Groote (1974), which is similar to that determined in swine (Noblet et al., 1994).

Digestible Energy (DE) and ME values of feedstuffs for swine were determined in growing swine weighing between 20 and 75 kg and housed in metabolic cages. The total fecal collection method used ferric oxide as a fecal marker. Swine ME values are corrected for nitrogen retention. In addition to the results of research at UFV, feedstuff ME values for swine available in the literature were considered. Net energy values were calculated according to the equation proposed by Noblet et al. (1994).

Dr. Noblet calculated an increase of 1 kcal NE/g of undigested residue in mature pigs (sows) compared with growing swine, as published in the Food Composition Tables in France. This value was used to correct the DE Pigs, and 0.75 kcal/g to adjust the ME Pigs. Therefore, two DE (DE Pig and DE Sow) and ME (ME Pig and ME Sow) values are presented for each feedstuff. This correction was applied only for plant feedstuffs, using Undigested Organic Matter (Total Organic Matter - Digested Organic Matter) data.

Several digestibility tests were carried out with growing and finishing swine to determine the digestibility coefficients of EE, CF, NDF, and ADF in the feedstuffs. The coefficient of organic matter digestibility for swine was calculated as the DE to GE ratio.

The digestibility coefficients of EE and nitrogen-free extract in poultry feeds presented were obtained from experimental trials and the literature.

Alternative feedstuff practical levels and maximum inclusion levels, which do not negatively affect animal performance, are presented.

Equations to estimate ME and NE values of poultry feedstuffs (Table 1.02) and DE, ME, and NE values for swine and, in particular, for sows (Tables 1.03 and 1.04) are included to allow correcting feedstuff energy values according to their chemical composition. Composition data and digestibility coefficients of the main nutrients were used. The digestibility coefficients of EE (poultry and swine), nitrogen-free extract

(poultry), and organic matter (swine) of some feedstuffs were adjusted in the equations to obtain energy values similar to those presented in Table 1.01. Those equations can be used to calculate the energy values, when the feedstuff composition is different from those listed, allowing nutritionists to correct and adjust composition matrices.

Equations were developed to calculate the sum of all essential amino acid levels in corn, sorghum, and soybean (grain and meal) (Tables 1.06 and 1.07). Based on that sum and assuming a constant amino acid ratio in the feedstuff protein, the content of each essential amino acid can be estimated. The equations help adjust amino acid values as a function of feedstuff protein content.

The standardized ileal digestibility (SID) of crystalline amino acids was determined in broiler chicks, cecectomized roosters, and swine fitted with a T-cannula in the terminal ileum (Tables 1.08 and 1.09). Based on the gross energy (GE) and digestibility values of each amino acid, their Standardized Metabolizable Energy (SMEn) was calculated, considering a 50% conversion of nitrogen into uric acid in poultry, except for the conversion of arginine in urea. The SMEn for swine was calculated considering a 35% conversion of nitrogen into urea. Amino acid net energy levels were calculated assuming that the efficiency of utilization of amino acids is 70% for protein deposition and 30% for deamination and catabolism. SMEn utilization efficiency values of 85% (70 x 85/100 = 0.595) for protein deposition and 60% (30 x 60/100 = 0.18) for deaminated and catabolized amino acids were calculated. Therefore, NE = SMEn x 0.595 + SMEn x 0.18.

Phosphorus bioavailability in phosphate products was determined by comparison with a standard source (dicalcium phosphate), which was assigned an availability coefficient of 100% (Table 1.10). Therefore, the available phosphorus content of some phosphate sources is higher than 100%.

International literature reports that some phosphates may contain high levels of heavy metals. Table 1.11 presents the composition of

Brazilian phosphates, particularly their heavy metal contents, including lead, cadmium, and vanadium.

Exogenous phytases have been commonly added to poultry and swine feed to improve phytic phosphorus utilization since the 1990s, and research has proven the benefits of their supplementation. Meta-analyses were conducted to estimate the amount of phosphorus made available by phytases to broilers and pigs (Tables 1.12 and 1.13).

The non-starch polysaccharide (NSP) contents of some feedstuffs were determined by the company ABVista, according to the methodology described by Englyst et al. (1994) and expressed as ‘as-fed’ (Table 1.14).

Feedstuff List

Feedstuff	Page	Feedstuff	Page
Albumin	11	Milk Whey, Permeate	113
Algae (*Spirulina platensis*)	13	Milk Whole, Powder	115
Algaroba, Flour	15	Millet, Grain	117
Babassu, Meal	17	Oats, Grain	119
Babassu, Starch Flour	19	Ouricuri (*Syagrus coronata*), Meal	121
Bakery, By-products	21	Pasta/Spaghetti, By-product	123
Barley, Grain	23	Peanuts, Meal	125
Blood, Meal	25	Pork Meat and Bone, Meal	127
Blood, Plasma	27	Poultry, By-product Meal	129
Blood, Red Cells	29	Poultry, By-product High-fat Meal	131
Bovine Meat and Bone, Meal 38% CP	31	Poultry, Fat	133
Bovine Meat and Bone, Meal 43% CP	33	Poultry Feather and By-prod., Meal	135
Bovine Meat and Bone, Meal 48% CP	35	Rice, Bran	137
Bovine Meat and Bone, Meal 52% CP	37	Rice, Broken	139
Bovine Meat and Bone, Meal 58% CP	39	Rice, Defatted Bran	141
Bread, By-products	41	Rye, Grain	143
Canola, Meal	43	Shrimp, By-product Meal	145
Canola, Oil	45	Sorghum, Grain	147
Casein	47	Sorghum, Grain High Tannin	149
Cassava, Whole	49	Soybean, Acid Oil	151
Castor Plant, Meal	51	Soybean, Degummed Oil	153
Citrus Pulp	53	Soybean, Full-fat Extruded	155
Coconut, Meal	55	Soybean, Full-fat Micronized	157
Coconut, Oil	57	Soybean, Full-fat Roasted	159
Corn, Bran with Solubles	59	Soybean, Hulls	161
Corn, DDGS - 6 to 9% of EE	61	Soybean, Meal 44.5% CP	163
Corn, HP-DDG	63	Soybean, Meal 45.6% CP (Aver.)	165
Corn, Germ	65	Soybean, Meal 46.5% CP	167
Corn, Gluten Feed 21% CP	67	Soybean, Meal 48% CP	169
Corn, Gluten Meal 60% CP	69	Soybean, Protein Concentrate	171
Corn, Grain (- 1 SD of DM)	71	Soybean, Protein Isolate	173
Corn, Grain (Average)	73	Soybean, Semi-defatted Extruded	175
Corn, Grain (+ 1 SD of DM)	75	Soybean, Semi-defatted Roasted	177
Corn, High-lysine Gran	77	Starch	179
Corn, High-oil Gran	79	Sugar	181
Corn, Pre-cooked	81	Sugarcane, Juice	183
Corn, Oil	83	Sugarcane, Molasses	185
Cottonseed, Meal 28% CP	85	Sugarcane, Molasses Dried	187
Cottonseed, Meal 38% CP	87	Sunflower, Meal	189
Cottonseed, Meal 43% CP	89	Sweet Potato, Flour	191
Dendê Palm, Oil	91	Tallow	193
Feather, Meal 76% CP	93	Triticale, Gran	195
Feather, Meal 84% CP	95	Wheat, Bran	197
Fish, Meal 54% CP	97	Wheat, Dark Flour	199
Fish, Meal 62% CP	99	Wheat, Flour	201
Glucose	101	Wheat, Germ	203
Lactose	103	Wheat, Gluten	205
Lard	105	Wheat, Grain	207
Lecithin	107	Wheat, Screenings	209
Milk Skimmed, Powder	109	Yeast, Alcohol Distiller's	211
Milk Whey, Powder	111	Yeast, Brewer's	213

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Albumin

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.4	1	-	Organic Matter (OM)	-		
Crude Protein (CP)	85.7	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	-	-	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	-			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4700	1	-	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	3757			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	2.26	1	-
Macro Minerals (%)				Iron (Fe)	27.5	1	-
Potassium (K)	-	-	-	Copper (Cu)	6.19	1	-
Sodium (Na)	-	-	-	Zinc (Zn)	6.16	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Albumin

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	85.7	100	-	-	73.6	85.9
Lysine, %	5.22	6.09	-	-	4.36	83.6
Methionine, %	2.79	3.26	-	-	2.32	83.0
Met + Cys, %	4.90	5.72	-	-	4.09	83.4
Threonine, %	3.69	4.31	-	-	3.14	85.0
Tryptophan, %	1.00	1.17	-	-	-	-
Arginine, %	4.41	5.15	-	-	3.93	89.1
Gly + Ser, %	9.32	10.9	-	-		
Valine, %	5.19	6.06	-	-	4.51	86.9
Isoleucine, %	4.58	5.34	-	-	3.72	81.2
Leucine, %	6.84	7.98	-	-	5.81	84.9
Histidine, %	1.83	2.14	-	-	1.50	81.9
Phenylalanine, %	4.74	5.53	-	-	-	-
Phe + Tyr, %	7.79	9.09	-	-	-	-
Alanine, %	5.81	6.78	-	-	5.12	88.1
Cysteine, %	2.11	2.46	-	-	1.77	84.0
Tyrosine, %	3.05	3.56	-	-	-	-
Glycine, %	3.16	3.69	-	-	2.45	77.5
Serine, %	6.16	7.19	-	-	5.33	86.5
Proline, %	3.00	3.50	-	-	-	-
Glutamine[2], %	4.80	5.60	-	-	4.25	88.6
Glutamic Acid[2], %	6.60	7.70	-	-	5.85	88.6
Asparagine[2], %	4.32	5.04	-	-	3.86	89.4
Aspartic Acid[2], %	6.52	7.61	-	-	5.83	89.4
Total Nitrogen (PB/6.25), %	13.7	16.0	-	-	11.8	85.9
Essential Nitrogen Poultry, %	7.40	54.0*	-	-		
Essential Nitrogen Swine, %	5.99	43.7*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Algae (Spirulina platensis)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.0	1	-	Organic Matter (OM)	79.6		
Crude Protein (CP)	51.5	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	1.06	-	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.99	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	26.0			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4399	1	-	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	2493			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	9.44	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	0.002	1	-
Macro Minerals (%)				Iron (Fe)	0.065	1	-
Potassium (K)	1.40	1	-	Copper (Cu)	0.001	1	-
Sodium (Na)	1.59	1	-	Zinc (Zn)	0.002	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.33	1	-				
Total Phosphorus (P)	1.10	1	-				
Phytate P	-	-	-				
Available P (Pav)	1.10						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Algae (Spirulina platensis)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef	SID[1]	Coef
Crude Protein, %	51.5	100	40.6	78.9	-	-
Lysine, %	2.18	4.23	1.77	81.3	-	-
Methionine, %	0.81	1.57	0.67	82.4	-	-
Met + Cys, %	2.12	4.12	1.69	79.6	-	-
Threonine, %	2.49	4.83	2.08	83.4	-	-
Tryptophan, %	0.90	1.75	0.70	77.5	-	-
Arginine, %	3.92	7.61	3.05	77.9	-	-
Gly + Ser, %	5.50	10.7	4.09	74.3		
Valine, %	2.61	5.07	2.08	79.8	-	-
Isoleucine, %	2.71	5.26	2.16	79.7	-	-
Leucine, %	4.40	8.54	3.39	77.1	-	-
Histidine, %	0.73	1.42	0.58	80.0	-	-
Phenylalanine, %	2.23	4.33	1.90	85.4	-	-
Phe + Tyr, %	4.89	9.50	4.18	85.4	-	-
Alanine, %	4.14	8.04	3.22	77.8		-
Cysteine, %	1.31	2.54	1.02	77.8	-	-
Tyrosine, %	2.66	5.17	2.22	83.5	-	-
Glycine, %	2.89	5.61	2.11	72.9	-	-
Serine, %	2.61	5.07	1.98	75.9	-	-
Proline, %	2.18	4.23	1.88	86.4	-	-
Glutamine[2], %	2.75	5.35	2.18	79.0	-	-
Glutamic Acid[2], %	4.42	8.58	3.49	79.0	-	-
Asparagine[2], %	2.22	4.30	1.64	74.0	-	-
Aspartic Acid[2], %	2.84	5.52	2.10	74.0	-	-
Total Nitrogen (PB/6.25), %	8.24	16.0	6.50	78.9	-	-
Essential Nitrogen Poultry, %	4.52	54.8*	3.56	78.9		
Essential Nitrogen Swine, %	3.63	44.0*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	5		5	5	
Maximum	10		10	10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	5	5	5	5
Maximum	10	10	10	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Algaroba, Flour

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.7	1	-	Organic Matter (OM)	87.3		
Crude Protein (CP)	8.79	-	-	Coef. Dig. OM Swine	59.4		
Starch	-	-	-	Digestible OM Swine	51.9		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	35.4		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.52	1	-
NDF	17.7	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	77.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4501	1	-	***Swine***			
Poultry				Digestible Energy	2675		
Metabolizable Energy	1520			Metabolizable Energy	2432		
Std. Metab. Energy	1807			Net Energy	-		
Energy Líquída	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Energy Líquída	-		

Minerals							
	Mean	**N**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.45	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.91	1	-	Copper (Cu	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.27	1	-				
Total Phosphorus (P)	0.14	1	-				
Phytate P	0.09	1	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Algaroba, Flour

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef	SID[1]	Coef
Crude Protein, %	8.79	100.0	-	-	-	-
Lysine, %	0.28	3.19	-	-	-	-
Methionine, %	0.07	0.80	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	0.27	3.07	-	-	-	-
Tryptophan, %	0.05	0.57	-	-	-	-
Arginine, %	0.43	4.89	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	0.54	6.14	-	-	-	-
Isoleucine, %	0.26	2.96	-	-	-	-
Leucine, %	0.59	6.71	-	-	-	-
Histidine, %	0.12	1.37	-	-	-	-
Phenylalanine, %	0.20	2.28	-	-	-	-
Phe + Tyr, %	0.47	5.35	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	0.27	3.07	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	1.41	16.0	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	3		4	5	
Maximum	5		8	10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	5	7	7	5
Maximum	6	8	10	10	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Babassu, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.8	4	1.64	Organic Matter (OM)	87.1		
Crude Protein (CP)	20.3	4	0.60	Coef. Dig. OM Swine	-		
Starch	2.46	1	-	Digestible OM Swine	-		
Crude Fiber (CF)	47.5	2	0.00	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.96	3	0.32
NDF	66.2	3	5.24	Coef. Dig.EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	39.5	3	4.45	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	17.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4380	2	244	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	1116			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.68	3	1.07	***Trace Minerals, mg/kg***			
				Manganese (Mn)	118	1	-
Macro Minerals (%)				Iron (Fe)	350	1	-
Potassium (K)	-	-	-	Copper (Cu)	16.8	1	-
Sodium (Na)	-	-	-	Zinc (Zn)	38.2	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.38	1	-				
Total Calcium (Ca)	0.12	3	0.01				
Total Phosphorus (P)	0.94	3	0.50				
Phytate P	0.82	1	-				
Available P (Pav)	0.41						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Babassu Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	20.3	100	14.5	71.6	-	-
Lysine, %	0.67	3.30	0.39	57.6	-	-
Methionine, %	0.45	2.22	0.38	84.1	-	-
Met + Cys, %	0.62	3.05	0.41	66.3	-	-
Threonine, %	0.62	3.05	0.36	57.4	-	-
Tryptophan, %	0.12	0.59	-	-	-	-
Arginine, %	2.39	11.8	1.92	80.3	-	-
Gly + Ser, %	1.83	9.01	0.99	54.1		
Valine, %	0.95	4.68	0.73	77.1	-	-
Isoleucine, %	0.64	3.15	0.48	75.5	-	-
Leucine, %	1.26	6.21	0.97	76.8	-	-
Histidine, %	0.37	1.82	0.24	63.9	-	-
Phenylalanine, %	0.90	4.43	0.67	74.3	-	-
Phe + Tyr, %	1.36	6.70	0.94	69.1	-	-
Alanine, %	0.86	4.24	0.62	72.6	-	-
Cysteine, %	0.17	0.84	0.03	19.3	-	-
Tyrosine, %	0.46	2.27	0.27	58.9	-	-
Glycine, %	0.93	4.58	0.35	38.0	-	-
Serine, %	0.90	4.43	0.64	70.7	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	2.40	11.8	1.92	80.3	-	-
Glutamic Acid[2], %	1.50	7.41	1.21	80.3	-	-
Asparagine[2], %	0.77	3.78	0.55	71.2	-	-
Aspartic Acid[2], %	0.94	4.64	0.67	71.2	-	-
Total Nitrogen (PB/6.25), %	3.25	16.0	2.33	71.6	-	-
Essential Nitrogen Poultry, %	1.82	55.9*	1.27	69.8		
Essential Nitrogen Swine, %	1.52	46.8*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers		***Hens***		
	Starter	Grower			
Practical	3	4	5		
Maximum	6	8	8		
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	4	5	5	4
Maximum	5	7	8	10	7

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Babassu, Starch Flour

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	86.3	1	-	Organic Matter (OM)	83.8		
Crude Protein (CP)	1.91	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	9.69	1	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.29	1	-
NDF	37.1	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	15.1	1	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	71.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3687	1	-	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	1731			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.50	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Babassu, Starch Flour

Amino Acid Content and Digestibility						
			Poultry		Swine	
	Total	% CP	SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	1.91	100	-	-	-	-
Lysine, %	0.10	5.24	-	-	-	-
Methionine, %	0.03	1.57	-	-	-	-
Met + Cys, %	0.08	4.19	-	-	-	-
Threonine, %	0.11	5.76	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	0.11	5.76	-	-	-	-
Gly + Ser, %	0.26	13.6	-	-		
Valine, %	0.11	5.76	-	-	-	-
Isoleucine, %	0.08	4.19	-	-	-	-
Leucine, %	0.16	8.38	-	-	-	-
Histidine, %	0.05	2.62	-	-	-	-
Phenylalanine, %	0.10	5.24	-	-	-	-
Phe + Tyr, %	0.17	8.90	-	-	-	-
Alanine, %	0.12	6.28	-	-	-	-
Cistina. %	0.05	2.62	-	-	-	-
Tyrosine, %	0.07	3.66	-	-	-	-
Glycine, %	0.13	6.81	-	-	-	-
Serine, %	0.13	6.81	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	0.12	6.43	-	-	-	-
Glutamic Acid[2], %	0.08	4.04	-	-	-	-
Asparagine[2], %	0.09	4.70	-	-	-	-
Aspartic Acid[2], %	0.11	5.77	-	-	-	-
Total Nitrogen (PB/6.25), %	0.31	16.0	-	-	-	-
Essential Nitrogen Poultry, %	0.17	56.5*	-	-		
Essential Nitrogen Swine, %	0.13	42.9*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bakery, By-products

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	92.5	12	1.07	Organic Matter (OM)	91.2		
Crude Protein, %	8.76	14	2.14	Coef. Dig. OM Swine	79.1		
Starch	46.5	1	-	Digestible OM Swine	72.1		
Crude Fiber (CF)	1.57	6	0.37	Undig. OM Pigs	19.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	8.96	7	3.18
NDF	4.36	3	2.14	Coef. Dig. EE Poultry	99.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	8.87		
ADF	1.61	3	0.59	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	8.06		
N-Free Extract (NFE)	71.9			Linoleic Acid	1.79	2	0.27
Coef. Dig. NFE Poultry	96.5			Linolenic Acid	-	-	-
Digestible NFE Poultry	69.4						
Undig. NFE + CF Poultry	4.09						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4341	4	136	***Swine***			
Poultry				Digestible Energy	3551		
Metabolizable Energy	4010			Metabolizable Energy	3480		
Std. Metab. Energy	4217			Net Energy	2756		
Net Energy	3279			***Sows***			
Hens				Digestible Energy	3721		
Metabolizable Energy	4019			Metabolizable Energy	3619		
Net Energy	3287			Net Energy	2857		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.31	3	0.64	***Trace Minerals, mg/kg***			
				Manganese (Mn)	13.4	1	-
Macro Minerals (%)				Iron (Fe)	125.1	1	-
Potassium (K)	0.17	1	-	Copper (Cu)	3.20	1	-
Sodium (Na)	0.19	1	-	Zinc (Zn)	61.5	1	-
Chlorine (Cl)	0.30	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.04	1	-				
Total Calcium (Ca)	0.05	3	0.02				
Total Phosphorus (P)	0.15	3	0.02				
Phytate P	0.10	1	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	28.0						
Std. Dig. P Poultry	0.04						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.04						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bakery, By-products

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.76	100	7.21	82.4	7.80	89.1
Lysine, %	0.23	2.63	0.15	66.8	0.19	84.0
Methionine, %	0.13	1.48	0.11	84.1	0.11	86.7
Met + Cys, %	0.29	3.31	0.23	78.5	0.26	88.0
Threonine, %	0.27	3.08	0.16	60.7	0.23	83.5
Tryptophan, %	0.10	1.14	0.08	78.9	0.08	78.9
Arginine, %	0.36	4.11	0.30	84.4	0.30	83.5
Gly + Ser, %	0.79	9.02	0.61	77.8		
Valine, %	0.37	4.23	0.29	77.7	0.32	87.8
Isoleucine, %	0.30	3.43	0.25	83.7	0.26	88.2
Leucine, %	0.59	6.74	0.51	87.1	0.49	83.5
Histidine, %	0.19	2.17	0.14	76.3	0.16	83.5
Phenylalanine, %	0.39	4.45	0.35	88.7	0.33	83.5
Phe + Tyr, %	0.66	7.54	0.57	86.0	0.55	83.5
Alanine, %	0.34	3.88	0.25	74.9	0.30	87.6
Cysteine, %	0.16	1.83	0.12	74.0	0.14	89.1
Tyrosine, %	0.27	3.08	0.22	82.2	0.23	83.5
Glycine, %	0.40	4.57	0.32	79.5	0.36	89.9
Serine, %	0.39	4.45	0.30	76.1	0.36	91.5
Proline, %	0.90	10.3	0.71	78.6	0.76	84.9
Glutamine[2], %	1.00	11.5	0.93	93.0	0.97	97.0
Glutamic Acid[2], %	1.34	15.3	1.24	93.0	1.30	97.0
Asparagine[2], %	0.23	2.63	0.15	66.6	0.20	88.2
Aspartic Acid[2], %	0.26	2.96	0.17	66.6	0.23	88.2
Total Nitrogen (PB/6.25), %	1.40	16.0	1.15	82.4	1.25	89.1
Essential Nitrogen Poultry, %	0.57	40.5*	0.45	79.8		
Essential Nitrogen Swine, %	0.44	31.5*			0.37	84.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	8		8	
Maximum	10	15		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	8	10	15	10	10
Maximum	15	20	30	20	20

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Barley, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.7	36	0.85	Organic Matter (OM)	85.5		
Crude Protein (CP)	10.3	36	1.57	Coef. Dig. OM Swine	81.5		
Starch	52.1	4	0.66	Digestible OM Swine	69.7		
Crude Fiber (CF)	4.74	29	0.97	Undig. OM Pigs	15.8		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.02	36	0.37
NDF	16.2	6	1.98	Coef. Dig. EE Poultry	54.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.09		
ADF	5.31	4	0.66	Coef. Dig. EE Swine	56.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.13		
N-Free Extract (NFE)	68.5			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	79.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	54.1						
Undig. NFE + CF Poultry	19.1						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3857	12	48	***Swine***			
Poultry				Digestible Energy	3106		
Metabolizable Energy	2701			Metabolizable Energy	3019		
Std. Metab. Energy	-			Net Energy	2308		
Net Energy	2154			***Sows***			
Hens				Digestible Energy	3231		
Metabolizable Energy	2768			Metabolizable Energy	3133		
Net Energy	2221			Net Energy	2391		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.18	36	0.25	***Trace Minerals, mg/kg***			
				Manganese (Mn)	16.2	2	0.21
Macro Minerals (%)				Iron (Fe)	116	2	58.7
Potassium (K)	0.43	2	0.07	Copper (Cu)	7.22	2	2.52
Sodium (Na)	0.02	2	0.01	Zinc (Zn)	29.0	2	1.41
Chlorine (Cl)	0.12	2	0.01	Selenium (Se)	0.11	2	0.01
Sulfur (S)	0.13	2	0.00				
Magnesium (Mg)	0.13	2	0.02				
Total Calcium (Ca)	0.04	14	0.01				
Total Phosphorus (P)	0.35	14	0.06				
Phytate P	0.20	2	0.02				
Available P (Pav)	0.15						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.13						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Barley, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	10.3	100	8.57	83.5	8.42	82.1
Lysine, %	0.41	4.00	0.32	79.0	0.30	73.7
Methionine, %	0.18	1.75	0.15	82.4	0.15	82.0
Met + Cys, %	0.44	4.29	0.36	82.5	0.36	82.0
Threonine, %	0.36	3.51	0.27	74.3	0.27	74.3
Tryptophan, %	0.13	1.27	0.10	79.0	0.10	76.9
Arginine, %	0.53	5.17	0.44	83.3	0.44	83.3
Gly + Ser, %	0.90	8.77	0.76	84.2		
Valine, %	0.48	4.68	0.38	78.9	0.38	78.9
Isoleucine, %	0.36	3.51	0.29	80.6	0.29	80.6
Leucine, %	0.73	7.12	0.60	82.6	0.60	82.6
Histidine, %	0.25	2.44	0.22	86.4	0.20	81.8
Phenylalanine, %	0.52	5.07	0.45	85.7	0.44	83.7
Phe + Tyr, %	0.83	8.09	0.70	84.4	0.70	84.4
Alanine, %	0.43	4.19	0.31	73.2	0.30	70.7
Cysteine, %	0.26	2.53	0.21	82.6	0.21	82.0
Tyrosine, %	0.31	3.02	0.25	82.1	0.27	85.7
Glycine, %	0.44	4.29	0.40	90.0	0.34	77.5
Serine, %	0.46	4.48	0.36	78.6	0.37	81.0
Proline, %	1.12	10.9	0.98	87.2	0.95	84.4
Glutamine[2], %	1.57	15.3	1.40	89.2	1.38	88.3
Glutamic Acid[2], %	0.98	9.58	0.88	89.2	0.87	88.3
Asparagine[2], %	0.32	3.11	0.24	75.0	0.24	75.0
Aspartic Acid[2], %	0.39	3.82	0.29	75.0	0.29	75.0
Total Nitrogen (PB/6.25), %	1.64	16.0	1.37	83.5	1.35	82.1
Essential Nitrogen Poultry, %	0.76	46.0*	0.62	82.0		
Essential Nitrogen Swine, %	0.61	37.3*			0.49	80.3

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	8	10		12	
Maximum	15	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	10	15	15	10
Maximum	15	20	25	25	20

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	92.7	5	0.96	Organic Matter (OM)	89.3		
Crude Protein (CP)	85.8	6	2.98	Coef. Dig. OM Swine	66.3		
Starch	-	-	-	Digestible OM Swine	59.1		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	30.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.60	5	0.36
NDF	-	-	-	Coef. Dig. EE Poultry	30.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.18		
ADF	-	-	-	Coef. Dig. EE Swine	70.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.42		
N-Free Extract (NFE)	2.85			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5103	4	61	***Swine***			
Poultry				Digestible Energy	3381		
Metabolizable Energy	2857			Metabolizable Energy	2986		
Std. Metab. Energy	3067			Net Energy	1613		
Net Energy	2167			***Sows***			
Hens				Digestible Energy	3381		
Metabolizable Energy	2857			Metabolizable Energy	2986		
Net Energy	2167			Net Energy	1613		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.45	5	0.03	***Trace Minerals, mg/kg***			
				Manganese (Mn)	7.3	1	-
Macro Minerals (%)				Iron (Fe)	1664.2	1	-
Potassium (K)	0.23	4	0.05	Copper (Cu)	13.8	1	-
Sodium (Na)	0.57	3	0.18	Zinc (Zn)	36.1	1	-
Chlorine (Cl)	0.36	1	-	Selenium (Se)	0.58	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.10	1	-				
Total Calcium (Ca)	0.20	5	0.06				
Total Phosphorus (P)	0.24	5	0.05				
Phytate P	-	-	-				
Available P (Pav)	0.24						
Coef. Dig. P Poultry	92.0						
Std. Dig. P Poultry	0.22						
Coef. Dig. P Swine	92.0						
Std. Dig. P Swine	0.22						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	85.8	100	66.6	77.6	65.0	75.7
Lysine, %	7.70	8.97	6.08	78.9	6.08	79.0
Methionine, %	1.06	1.24	0.84	79.6	0.75	70.7
Met + Cys, %	1.70	1.98	1.32	77.6	1.25	73.8
Threonine, %	4.14	4.83	3.27	78.9	3.03	73.3
Tryptophan, %	1.46	1.70	1.17	80.2	1.12	76.4
Arginine, %	3.47	4.04	2.86	82.4	2.78	80.0
Gly + Ser, %	8.10	9.44	6.16	76.0		
Valine, %	7.49	8.73	5.96	79.6	5.48	73.2
Isoleucine, %	0.69	0.80	0.50	73.1	0.56	80.7
Leucine, %	11.2	13.1	9.18	82.0	7.78	69.5
Histidine, %	5.32	6.20	4.23	79.5	3.80	71.4
Phenylalanine, %	6.27	7.31	5.12	81.7	4.58	73.1
Phe + Tyr, %	8.50	9.91	6.52	76.7	6.42	75.5
Alanine, %	7.19	8.38	5.46	76.0	-	-
Cysteine, %	0.64	0.75	0.48	74.3	0.51	79.0
Tyrosine, %	2.23	2.60	1.40	62.8	1.83	82.2
Glycine, %	3.62	4.22	-	-	-	-
Serine, %	4.48	5.22	-	-	-	-
Proline, %	3.46	4.03	-	-	-	-
Glutamine[2], %	3.08	3.59	-	-	-	-
Glutamic Acid[2], %	4.56	5.31	-	-	-	-
Asparagine[2], %	4.03	4.69	-	-	-	-
Aspartic Acid[2], %	5.34	6.23	-	-	-	-
Total Nitrogen (PB/6.25), %	13.7	16.0	10.7	77.6	10.4	75.7
Essential Nitrogen Poultry, %	8.79	64.0*	-	-		
Essential Nitrogen Swine, %	7.52	54.7*			5.54	73.7

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	2		1	
Maximum	2	3		2	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	1	2	2	1
Maximum	2	3	4	4	3

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Plasma

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.3	10	1.73	Organic Matter (OM)	79.4		
Crude Protein (CP)	71.7	11	3.83	Coef. Dig. OM Swine	90.6		
Starch	-	-	-	Digestible OM Swine	71.9		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	7.47		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.03	5	0.41
NDF	-	-	-	Coef. Dig. EE Poultry	95.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.98		
ADF	-	-	-	Coef. Dig. EE Swine	95.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.98		
N-Free Extract (NFE)	6.67			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4550	5	177	***Swine***			
Poultry				Digestible Energy	4122		
Metabolizable Energy	3234			Metabolizable Energy	3763		
Std. Metab. Energy	3304			Net Energy	2280		
Net Energy	2534			***Sows***			
Hens				Digestible Energy	4122		
Metabolizable Energy	3234			Metabolizable Energy	3763		
Net Energy	2534			Net Energy	2280		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	11.9	5	2.35	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	106.0	1	-
Potassium (K)	0.56	1	-	Copper (Cu)	45.9	1	-
Sodium (Na)	3.12	1	-	Zinc (Zn)	89.2	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	0.42	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.02	1	-				
Total Calcium (Ca)	0.17	5	0.03				
Total Phosphorus (P)	0.46	4	0.02				
Phytate P	-	-	-				
Available P (Pav)	0.46						
Coef. Dig. P Poultry	92.0						
Std. Dig. P Poultry	0.42						
Coef. Dig. P Swine	92.0						
Std. Dig. P Swine	0.42						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Plasma

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	71.7	100	66.8	93.2	66.4	92.6
Lysine, %	6.52	9.09	6.09	93.4	6.20	95.1
Methionine, %	0.89	1.24	0.83	93.2	0.83	93.5
Met + Cys, %	3.07	4.28	2.81	91.5	2.85	92.9
Threonine, %	4.47	6.23	4.18	93.5	4.13	92.5
Tryptophan, %	1.31	1.83	1.13	86.4	1.18	90.2
Arginine, %	3.95	5.51	3.66	92.7	3.80	96.1
Gly + Ser, %	7.17	10.0	6.65	92.7		
Valine, %	4.92	6.86	4.42	89.9	4.60	93.5
Isoleucine, %	2.26	3.15	1.89	83.8	2.02	89.5
Leucine, %	6.97	9.72	6.57	94.3	6.50	93.2
Histidine, %	2.21	3.08	2.05	92.6	2.10	95.1
Phenylalanine, %	3.90	5.44	3.70	95.0	3.64	93.3
Phe + Tyr, %	6.97	9.72	6.68	95.8	6.48	93.0
Alanine, %	3.74	5.22	3.57	95.5	3.47	92.7
Cysteine, %	2.18	3.04	1.98	90.8	2.02	92.7
Tyrosine, %	3.07	4.28	2.97	96.9	2.85	92.7
Glycine, %	2.64	3.68	2.44	92.3	2.39	90.7
Serine, %	4.53	6.32	4.21	93.0	4.29	94.7
Proline, %	3.90	5.44	3.64	93.5	3.03	77.8
Glutamine[2], %	3.96	5.52	3.75	94.7	3.73	94.1
Glutamic Acid[2], %	5.85	8.16	5.54	94.7	5.50	94.1
Asparagine[2], %	3.06	4.27	2.87	93.8	2.84	92.7
Aspartic Acid[2], %	4.07	5.67	3.81	93.8	3.77	92.7
Total Nitrogen (PB/6.25), %	11.5	16.0	10.7	93.2	10.6	92.6
Essential Nitrogen Poultry, %	6.91	60.2*	6.38	92.4		
Essential Nitrogen Swine, %	5.81	50.7*			5.44	93.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	-		-	
Maximum	2	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	-	-	-	-
Maximum	8	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Red Cells

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.8	6	1.91	Organic Matter (OM)	86.9		
Crude Protein (CP)	88.0	6	3.29	Coef. Dig. OM Swine	86.8		
Starch	-	-	-	Digestible OM Swine	75.5		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	11.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.45	4	0.10
NDF	-	-	-	Coef. Dig. EE Poultry	30.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.14		
ADF	-	-	-	Coef. Dig. EE Swine	85.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.38		
N-Free Extract (NFE)	-			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4980	4	27	***Swine***			
Poultry				Digestible Energy	4300		
Metabolizable Energy	3200			Metabolizable Energy	3787		
Std. Metab. Energy	-			Net Energy	2181		
Net Energy	2326			***Sows***			
Hens				Digestible Energy	4300		
Metabolizable Energy	3200			Metabolizable Energy	3787		
Net Energy	2326			Net Energy	2181		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.86	4	0.03	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	2021	1	-
Potassium (K)	0.47	4	0.29	Copper (Cu)	13.8	1	-
Sodium (Na)	0.68	4	0.14	Zinc (Zn)	115	1	-
Chlorine (Cl)	0.80	1	-	Selenium (Se)	0.21	1	-
Sulfur (S)	0.30	1	-				
Magnesium (Mg)	0.02	2	0.01				
Total Calcium (Ca)	0.03	5	0.01				
Total Phosphorus (P)	0.25	5	0.07				
Phytate P	-	-	-				
Available P (Pav)	0.25						
Coef. Dig. P Poultry	92.0						
Std. Dig. P Poultry	0.23						
Coef. Dig. P Swine	92.0						
Std. Dig. P Swine	0.23						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Blood, Red Cells

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	88.0	100	84.3	95.8	75.2	85.5
Lysine, %	8.39	9.53	7.81	93.1	7.74	92.2
Methionine, %	1.16	1.32	1.07	92.3	1.08	92.7
Met + Cys, %	1.62	1.84	1.44	88.9	1.33	82.4
Threonine, %	4.06	4.61	3.72	91.7	3.47	85.5
Tryptophan, %	1.49	1.69	1.36	91.6	1.30	87.3
Arginine, %	3.37	3.83	3.19	94.7	3.12	92.5
Gly + Ser, %	8.19	9.31	7.82	95.5		
Valine, %	8.17	9.28	7.52	92.1	7.22	88.4
Isoleucine, %	0.40	0.45	0.31	76.8	0.22	55.1
Leucine, %	12.3	14.0	12.1	98.2	11.7	95.0
Histidine, %	5.89	6.69	5.61	95.3	5.71	97.0
Phenylalanine, %	6.91	7.85	6.80	98.4	6.52	94.3
Phe + Tyr, %	10.1	11.5	9.91	98.1	9.35	92.6
Alanine, %	7.69	8.74	7.55	98.2	-	-
Cysteine, %	0.46	0.52	0.37	80.4	0.26	56.5
Tyrosine, %	3.19	3.63	3.11	97.6	2.84	89.0
Glycine, %	3.84	4.36	3.67	95.5	-	-
Serine, %	4.35	4.94	4.15	95.5	-	-
Proline, %	3.11	3.53	2.92	93.9	-	-
Glutamine[2], %	2.80	3.18	2.74	97.8	-	-
Glutamic Acid[2], %	4.14	4.70	4.05	97.8	-	-
Asparagine[2], %	4.00	4.55	3.95	98.7	-	-
Aspartic Acid[2], %	5.32	6.04	5.25	98.7	-	-
Total Nitrogen (PB/6.25), %	14.1	16.0	13.5	95.8	12.0	85.5
Essential Nitrogen Poultry, %	9.29	66.0*	8.83	95.0		
Essential Nitrogen Swine, %	8.00	56.8*			7.37	92.2

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	-		-	
Maximum	2	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	-	-	-	-
Maximum	4	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 38% CP (35 – 40% CP)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	93.7	21	0.93	Organic Matter (OM)	53.1		
Crude Protein (CP)	38.0	121	1.34	Coef. Dig. OM Swine	61.5		
Starch	-	-	-	Digestible OM Swine	32.6		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	20.4		
Coef. Dig. CF Swine	-			Ether Extract (EE)	12.4	112	1.57
NDF	-	-	-	Coef. Dig. EE Poultry	37.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	4.58		
ADF	-	-	-	Coef. Dig. EE Swine	27.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	3.41		
N-Free Extract (NFE)	2.70			Linoleic Acid	0.34	4	0.03
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.08	4	0.01
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-	-	-				
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3145	5	62	***Swine***			
Poultry				Digestible Energy	1935		
Metabolizable Energy	1786			Metabolizable Energy	1738		
Std. Metab. Energy	1778			Net Energy	1176		
Net Energy	1417			***Sows***			
Hens				Digestible Energy	1935		
Metabolizable Energy	1786			Metabolizable Energy	1738		
Net Energy	1417			Net Energy	1176		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	40.7	112	2.37	Trace Minerals, mg/kg			
				Manganese (Mn)	11.7	1	-
Macro Minerals (%)				Iron (Fe)	816.0	1	-
Potassium (K)	0.70	1	-	Copper (Cu)	36.6	1	-
Sodium (Na)	0.41	1	-	Zinc (Zn)	66.9	1	-
Chlorine (Cl)	0.50	1	-	Selenium (Se)	0.42	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.22	1	-				
Total Calcium (Ca)	14.2	11	1.08				
Total Phosphorus (P)	7.41	11	0.51				
Phytate P	-	-	-				
Available P (Pav)	6.67						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	4.59						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	4.74						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 38% CP (35 – 40%PB)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	38.0	100	31.5	83.1	28.6	75.4
Lysine, %	1.76	4.64	1.38	78.5	1.28	72.7
Methionine, %	0.48	1.26	0.33	69.3	0.37	76.5
Met + Cys, %	0.60	1.58	0.42	70.2	0.44	73.2
Threonine, %	1.05	2.77	0.77	72.9	0.77	73.0
Tryptophan, %	0.15	0.40	0.11	74.3	0.11	73.6
Arginine, %	3.00	7.90	2.46	81.9	2.42	80.7
Gly + Ser, %	7.97	21.0	6.91	86.7		
Valine, %	1.40	3.69	1.06	75.6	1.04	74.4
Isoleucine, %	0.86	2.27	0.66	77.2	0.65	75.7
Leucine, %	1.84	4.85	1.40	76.0	1.41	76.5
Histidine, %	0.53	1.40	0.36	68.4	0.41	76.7
Phenylalanine, %	1.31	3.45	1.00	76.7	0.99	75.9
Phe + Tyr, %	1.67	4.40	1.27	76.3	1.22	73.3
Alanine, %	3.14	8.27	2.83	90.0	2.34	74.5
Cysteine, %	0.12	0.32	0.09	73.9	0.07	60.2
Tyrosine, %	0.36	0.95	0.27	74.7	0.23	63.9
Glycine, %	6.60	17.4	5.71	86.5	5.08	76.9
Serine, %	1.37	3.61	1.20	87.5	0.97	71.0
Proline, %	1.89	4.98	1.69	89.3	1.53	81.0
Glutamine[2], %	0.88	2.32	0.79	89.7	0.63	71.6
Glutamic Acid[2], %	1.27	3.34	1.14	89.7	0.91	71.6
Asparagine[2], %	0.55	1.44	0.47	86.0	0.38	68.6
Aspartic Acid[2], %	0.76	2.01	0.66	86.0	0.52	68.6
Total Nitrogen (PB/6.25), %	6.07	16.0	5.05	83.1	4.58	75.4
Essential Nitrogen Poultry, %	3.62	59.5*	2.92	80.8		
Essential Nitrogen Swine, %	2.20	36.3*			1.68	76.3

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	4	4		4	
Maximum	7	8		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	4	4	4
Maximum	5	6	7	7	7

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 43% CP (40.01 – 45.00% CP)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	93.9	166	1.53	Organic Matter (OM)	57.3		
Crude Protein (CP)	42.8	538	1.38	Coef. Dig. OM Swine	67.7		
Starch	-	-	-	Digestible OM Swine	38.8		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	18.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	12.0	473	1.66
NDF	-	-	-	Coef. Dig. EE Poultry	51.8		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	6.23		
ADF	-	-	-	Coef. Dig. EE Swine	33.3		
Coef. Dig. ADF Swine	-			Digestible EE Swine	4.01		
N-Free Extract (NFE)	2.44			Linoleic Acid	0.32	4	0.03
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.08	4	0.01
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3422	6	211	***Swine***			
Poultry				Digestible Energy	2315		
Metabolizable Energy	2124			Metabolizable Energy	2083		
Std. Metab. Energy	1899			Net Energy	1391		
Net Energy	1695			***Sows***			
Hens				Digestible Energy	2315		
Metabolizable Energy	2124			Metabolizable Energy	2083		
Net Energy	1695			Net Energy	1391		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	36.6	473	2.70	***Trace Minerals, mg/kg***			
				Manganese (Mn)	1.50	1	-
Macro Minerals (%)				Iron (Fe)	324	1	-
Potassium (K)	0.55	3	0.23	Copper (Cu)	48.0	1	-
Sodium (Na)	0.56	41	0.25	Zinc (Zn)	69.3	1	-
Chlorine (Cl)	0.62	2	0.02	Selenium (Se)	0.36	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.23	2	0.01				
Total Calcium (Ca)	13.0	150	1.54				
Total Phosphorus (P)	6.56	151	0.62				
Phytate P	-	-	-				
Available P (Pav)	5.91						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	4.07						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	4.20						

Pav = Non Phytate P (Total P – Phytate P).

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 43% CP (40.01 – 45.00%PB)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	42.8	100	35.9	83.7	34.4	80.4
Lysine, %	2.07	4.83	1.70	82.1	1.59	76.8
Methionine, %	0.56	1.31	0.45	80.4	0.44	78.6
Met + Cys, %	0.74	1.73	0.57	77.1	0.57	77.0
Threonine, %	1.29	3.01	1.01	78.3	0.98	76.0
Tryptophan, %	0.19	0.44	0.15	78.9	0.14	73.7
Arginine, %	3.21	7.49	2.71	84.4	2.66	82.9
Gly + Ser, %	9.20	21.5	7.61	82.7		
Valine, %	1.57	3.67	1.31	83.4	1.21	77.1
Isoleucine, %	1.03	2.40	0.87	84.5	0.81	78.6
Leucine, %	2.22	5.18	1.86	83.8	1.64	73.9
Histidine, %	0.65	1.52	0.51	78.5	0.49	75.4
Phenylalanine, %	1.35	3.15	1.13	83.7	1.07	79.3
Phe + Tyr, %	1.99	4.65	1.61	80.9	1.52	76.4
Alanine, %	3.46	8.08	2.99	86.4	2.86	82.7
Cysteine, %	0.18	0.42	0.12	66.7	0.13	72.2
Tyrosine, %	0.64	1.49	0.48	75.0	0.45	70.3
Glycine, %	7.69	18.0	6.30	81.9	6.74	87.6
Serine, %	1.51	3.53	1.31	86.8	1.20	79.5
Proline, %	4.02	9.39	3.38	84.1	3.26	81.1
Glutamine[2], %	1.91	4.46	1.68	88.0	1.48	77.5
Glutamic Acid[2], %	2.75	6.42	2.42	88.0	2.13	77.5
Asparagine[2], %	1.18	2.75	0.99	84.0	0.90	76.7
Aspartic Acid[2], %	1.63	3.81	1.37	84.0	1.25	76.7
Total Nitrogen (PB/6.25), %	6.85	16.0	5.74	83.7	5.51	80.4
Essential Nitrogen Poultry, %	4.12	60.1*	3.41	82.7		
Essential Nitrogen Swine, %	2.48	36.3*			1.94	78.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	4	4		4	
Maximum	7	8		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	4	4	4
Maximum	5	6	7	7	7

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 48% CP (45.01 – 50.00% CP)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	95.2	466	1.64	Organic Matter (OM)	60.9		
Crude Protein (CP)	47.4	808	2.45	Coef. Dig. OM Swine	71.9		
Starch	-	-	-	Digestible OM Swine	43.8		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	17.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	11.8	782	1.92
NDF	-	-	-	Coef. Dig. EE Poultry	62.2		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	7.33		
ADF	-	-	-	Coef. Dig. EE Swine	47.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	5.60		
N-Free Extract (NFE)	1.70			Linoleic Acid	0.36	2	0.01
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.08	2	0.00
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3665	4	276	***Swine***			
Poultry				Digestible Energy	2634		
Metabolizable Energy	2373			Metabolizable Energy	2389		
Std. Metab. Energy	-			Net Energy	1581		
Net Energy	1899			***Sows***			
Hens				Digestible Energy	2634		
Metabolizable Energy	2373			Metabolizable Energy	2389		
Net Energy	1899			Net Energy	1581		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	34.3	782	3.32	***Trace Minerals, mg/kg***			
				Manganese (Mn)	12.9	1	-
Macro Minerals (%)				Iron (Fe)	449.7	1	-
Potassium (K)	0.57	3	0.14	Copper (Cu)	14.0	1	-
Sodium (Na)	0.66	3	0.08	Zinc (Zn)	80.6	1	-
Chlorine (Cl)	0.60	1	-	Selenium (Se)	0.30	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.28	1	-				
Total Calcium (Ca)	12.0	440	1.33				
Total Phosphorus (P)	5.90	439	0.64				
Phytate P	-	-	-				
Available P (Pav)	5.31						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	3.66						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	3.78						

Pav = Non Phytate P (Total P – Phytate P).

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 48% CP (45.01 – 50.00% CP)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	47.4	100	39.2	82.7	37.5	79.0
Lysine, %	2.44	5.14	2.03	83.2	1.88	77.0
Methionine, %	0.62	1.31	0.50	80.6	0.49	79.0
Met + Cys, %	0.98	2.07	0.79	80.6	0.71	72.4
Threonine, %	1.53	3.23	1.23	80.4	1.19	77.8
Tryptophan, %	0.24	0.51	0.19	79.2	0.18	75.0
Arginine, %	3.54	7.46	2.93	82.8	3.08	87.0
Gly + Ser, %	9.30	19.6	7.78	83.7		
Valine, %	1.98	4.17	1.60	80.8	1.56	78.8
Isoleucine, %	1.29	2.72	1.08	83.7	1.00	77.5
Leucine, %	2.60	5.48	2.15	82.7	2.04	78.5
Histidine, %	0.78	1.64	0.63	80.8	0.62	79.5
Phenylalanine, %	1.32	2.78	1.07	81.1	1.05	79.5
Phe + Tyr, %	2.26	4.77	1.83	81.0	1.76	77.8
Alanine, %	3.82	8.05	3.33	87.2	3.09	80.9
Cysteine, %	0.36	0.76	0.29	80.6	0.22	61.1
Tyrosine, %	0.94	1.98	0.76	80.9	0.71	75.5
Glycine, %	7.45	15.7	6.28	84.3	5.92	79.5
Serine, %	1.85	3.90	1.50	81.1	1.40	75.7
Proline, %	4.19	8.83	3.45	82.3	3.46	82.6
Glutamine², %	2.22	4.67	1.95	87.8	1.75	79.0
Glutamic Acid², %	3.19	6.73	2.80	87.8	2.52	79.0
Asparagine², %	1.37	2.89	0.96	70.0	0.97	70.5
Aspartic Acid², %	1.90	4.01	1.33	70.0	1.34	70.5
Total Nitrogen (PB/6.25), %	7.59	16.0	6.27	82.7	6.00	79.0
Essential Nitrogen Poultry, %	4.49	59.2*	3.71	82.7		
Essential Nitrogen Swine, %	2.85	37.6*			2.28	80.1

[1]SID = Standardized Ileal Digestibility.
²Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	5		5	
Maximum	8	10		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	4	4	4	4
Maximum	6	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 52% CP (50.01 – 55.00% CP)

Main Components (%)							
	Mean	n	SD		Mean	n	SD
Dry Matter	95.8	139	1.51	Organic Matter (OM)	65.8		
Crude Protein (CP)	51.9	246	1.53	Coef. Dig. OM Swine	72.4		
Starch	-	-	-	Digestible OM Swine	47.6		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	18.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	12.2	246	1.70
NDF	-	-	-	Coef. Dig. EE Poultry	75.6		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	9.23		
ADF	-	-	-	Coef. Dig. EE Swine	38.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	4.64		
N-Free Extract (NFE)	1.70			Linoleic Acid	0.31	4	0.04
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.07	4	0.01
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	n	SD		Mean	n	SD
Gross Energy	3988	7	105	***Swine***			
Poultry				Digestible Energy	2888		
Metabolizable Energy	2602			Metabolizable Energy	2599		
Std. Metab. Energy	2705			Net Energy	1709		
Net Energy	2098			***Sows***			
Hens				Digestible Energy	2888		
Metabolizable Energy	2602			Metabolizable Energy	2599		
Net Energy	2098			Net Energy	1709		

Minerals							
	Mean	n	SD		Mean	n	SD
Ash, %	30.0	246	3.52	***Trace Minerals, mg/kg***			
				Manganese (Mn)	20.0	1	-
Macro Minerals (%)				Iron (Fe)	248	1	-
Potassium (K)	0.53	6	0.07	Copper (Cu)	8.50	1	-
Sodium (Na)	0.57	40	0.07	Zinc (Zn)	80.8	1	-
Chlorine (Cl)	0.61	6	0.06	Selenium (Se)	0.37	1	-
Sulfur (S)	0.89	1	-				
Magnesium (Mg)	0.42	1	-				
Total Calcium (Ca)	10.0	128	1.36				
Total Phosphorus (P)	4.93	128	0.74				
Phytate P	-	-	-				
Available P (Pav)	4.44						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	3.06						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	3.16						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 52% CP (50.01 – 55.00% CP)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	51.9	100	40.4	78.0	43.8	84.5
Lysine, %	2.73	5.26	2.21	81.0	2.18	79.9
Methionine, %	0.70	1.35	0.58	82.9	0.58	82.9
Met + Cys, %	1.21	2.33	0.93	76.9	0.96	79.4
Threonine, %	1.71	3.30	1.32	77.2	1.34	78.4
Tryptophan, %	0.28	0.54	0.23	82.1	0.23	82.1
Arginine, %	3.82	7.37	3.23	84.6	3.27	85.6
Gly + Ser, %	9.20	17.8	6.51	70.8		
Valine, %	2.30	4.44	1.88	81.7	1.83	79.6
Isoleucine, %	1.51	2.91	1.25	82.8	1.22	80.8
Leucine, %	2.94	5.67	2.48	84.4	2.44	83.0
Histidine, %	0.89	1.72	0.71	79.8	0.74	83.1
Phenylalanine, %	1.53	2.95	1.29	84.3	1.27	83.0
Phe + Tyr, %	2.58	4.98	2.11	81.8	2.13	82.6
Alanine, %	4.05	7.81	3.28	81.0	3.58	88.4
Cysteine, %	0.51	0.98	0.35	68.6	0.38	74.5
Tyrosine, %	1.05	2.02	0.82	78.1	0.86	81.9
Glycine, %	7.09	13.7	5.04	71.1	6.53	92.1
Serine, %	2.11	4.07	1.47	69.7	1.73	82.0
Proline, %	4.68	9.03	3.88	82.9	3.88	82.9
Glutamine[2], %	2.50	4.82	1.91	76.4	2.13	85.3
Glutamic Acid[2], %	3.60	6.95	2.75	76.4	3.07	85.3
Asparagine[2], %	1.54	2.98	1.04	67.5	1.26	81.8
Aspartic Acid[2], %	2.15	4.14	1.45	67.5	1.75	81.8
Total Nitrogen (PB/6.25), %	8.30	16.0	6.47	78.0	7.01	84.5
Essential Nitrogen Poultry, %	4.78	57.6*	3.76	78.6		
Essential Nitrogen Swine, %	3.18	38.3*			2.61	82.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	5		5	
Maximum	8	10		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	4	4	4	4
Maximum	6	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 58% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	95.9	20	0.86	Organic Matter (OM)	70.7		
Crude Protein (CP)	58.0	32	2.25	Coef. Dig. OM Swine	75.7		
Starch	-	-	-	Digestible OM Swine	53.5		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	17.2		
Coef. Dig. CF Swine	-			Ether Extract (EE)	11.5	12	0.60
NDF	-	-	-	Coef. Dig. EE Poultry	74.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	8.50		
ADF	-	-	-	Coef. Dig. EE Swine	44.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	5.05		
N-Free Extract (NFE)	1.19			Linoleic Acid	0.24	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.05	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4176	3	284	***Swine***			
Poultry				Digestible Energy	3161		
Metabolizable Energy	2800			Metabolizable Energy	2834		
Std. Metab. Energy	2872			Net Energy	1831		
Net Energy	2237			***Sows***			
Hens				Digestible Energy	3161		
Metabolizable Energy	2800			Metabolizable Energy	2834		
Net Energy	2237			Net Energy	1831		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	24.2	15	2.54	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.46	3	0.02	Copper (Cu)	-	-	-
Sodium (Na)	0.56	6	0.13	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.58	3	0.05	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	8.59	18	1.14				
Total Phosphorus (P)	4.44	20	0.61				
Phytate P	-						
Available P (Pav)	4.00						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	2.75						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	2.84						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bovine Meat and Bone, Meal 58% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	58.0	100	46.8	80.7	47.6	82.1
Lysine, %	3.03	5.23	2.45	80.9	2.55	84.2
Methionine, %	0.76	1.31	0.65	85.5	0.65	85.5
Met + Cys, %	1.45	2.50	1.06	73.1	1.00	68.9
Threonine, %	1.82	3.14	1.47	80.8	1.49	81.9
Tryptophan, %	0.36	0.62	-	-	0.29	80.6
Arginine, %	3.99	6.88	3.36	84.2	3.43	86.0
Gly + Ser, %	9.65	16.6	-	-		
Valine, %	2.60	4.48	2.13	81.9	2.16	83.1
Isoleucine, %	1.61	2.78	1.34	83.2	1.35	83.9
Leucine, %	3.39	5.85	2.85	84.1	2.88	85.0
Histidine, %	1.10	1.90	0.91	82.7	0.87	79.1
Phenylalanine, %	1.93	3.33	1.62	83.9	1.64	85.0
Phe + Tyr, %	3.27	5.64	-	-	2.74	83.8
Alanine, %	4.47	7.71	-	-	3.71	83.0
Cysteine, %	0.69	1.19	0.41	59.4	0.35	50.7
Tyrosine, %	1.34	2.31	-	-	1.10	82.1
Glycine, %	7.24	12.5	-	-	5.86	80.9
Serine, %	2.41	4.16	-	-	1.93	80.1
Proline, %	4.68	8.07	-	-	3.93	84.0
Glutamine[2], %	2.87	4.95	-	-	2.38	83.0
Glutamic Acid[2], %	4.14	7.14	-	-	3.44	83.0
Asparagine[2], %	1.85	3.20	-	-	1.41	76.0
Aspartic Acid[2], %	2.58	4.44	-	-	1.96	76.0
Total Nitrogen (PB/6.25), %	9.28	16.0	7.48	80.7	7.61	82.1
Essential Nitrogen Poultry, %	5.18	55.8*	-	-		
Essential Nitrogen Swine, %	3.51	37.8*			2.95	84.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	5		5	
Maximum	8	10		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	4	4	4	4
Maximum	6	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bread, By-products

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.2	6	1.13	Organic Matter (OM)	84.6		
Crude Protein (CP)	12.1	6	2.58	Coef. Dig. OM Swine	94.6		
Starch	39.3	1	-	Digestible OM Swine	80.1		
Crude Fiber (CF)	1.17	3	0.25	Undig. OM Pigs	4.54		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.57	1	-
NDF	6.48	3	0.60	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.37		
ADF	1.28	3	0.85	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	69.8			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	98.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	68.4						
Undig. NFE + CF Poultry	2.57						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4061	3	234	***Swine***			
Poultry				Digestible Energy	3843		
Metabolizable Energy	3474			Metabolizable Energy	3678		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	2780			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	3447			Metabolizable Energy	-		
Net Energy	2752			Net Energy	-		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.58	4	0.06	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.31	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.44	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.16	3	0.05				
Total Phosphorus (P)	0.30	3	0.05				
Phytate P	0.21	1	-				
Available P (Pav)	0.09						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.09						
Coef. Dig. P Swine	34.7						
Std. Dig. P Swine	0.10						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Bread, By-products

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	12.1	100	11.2	92.6	10.6	87.2
Lysine, %	0.24	1.98	0.20	85.0	0.19	80.0
Methionine, %	0.17	1.40	0.15	89.5	0.15	90.0
Met + Cys, %	0.44	3.64	0.38	86.9	0.41	92.5
Threonine, %	0.33	2.73	0.26	78.8	0.26	78.0
Tryptophan, %	0.11	0.91	0.09	84.0	0.09	83.0
Arginine, %	0.47	3.88	0.42	90.2	0.42	90.0
Gly + Ser, %	1.04	8.60	0.93	89.5		
Valine, %	0.47	3.88	0.44	92.7	0.41	87.0
Isoleucine, %	0.39	3.22	0.36	93.5	0.35	90.0
Leucine, %	0.77	6.36	0.74	95.5	0.70	91.0
Histidine, %	0.23	1.90	0.21	92.3	0.21	90.0
Phenylalanine, %	0.52	4.30	0.50	95.2	0.49	94.0
Phe + Tyr, %	0.90	7.44	0.85	94.7	0.84	93.2
Alanine, %	0.41	3.39	0.36	88.6	0.34	82.2
Cysteine, %	0.27	2.23	0.23	85.3	0.25	94.0
Tyrosine, %	0.38	3.14	0.36	94.1	0.35	92.0
Glycine, %	0.49	4.05	0.44	90.2	0.41	84.5
Serine, %	0.55	4.55	0.49	88.9	0.46	83.9
Proline, %	1.11	9.17	1.00	89.9	1.04	93.9
Glutamine[2], %	2.11	17.4	2.06	97.8	1.81	86.1
Glutamic Acid[2], %	1.32	10.9	1.29	97.8	1.14	86.1
Asparagine[2], %	0.23	1.93	0.20	84.8	0.17	74.9
Aspartic Acid[2], %	0.29	2.37	0.24	84.8	0.21	74.9
Total Nitrogen (PB/6.25), %	1.94	16.0	1.79	92.6	1.69	87.2
Essential Nitrogen Poultry, %	0.72	37.1*	0.65	90.9		
Essential Nitrogen Swine, %	0.55	28.6*			0.49	88.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	10	15		15	
Maximum	20	25		25	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	12	20	20	25	25
Maximum	20	40	40	40	40

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Canola, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.5	38	1.16	Organic Matter (OM)	82.9		
Crude Protein (CP)	36.2	37	2.24	Coef. Dig. OM Swine	70.3		
Starch	5.10	4	1.27	Digestible OM Swine	58.3		
Crude Fiber (CF)	10.9	14	0.81	Undig. OM Pigs	24.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.55	31	1.32
NDF	25.1	21	4.76	Coef. Dig. EE Poultry	72.5		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.85		
ADF	8.45	3	11.1	Coef. Dig. EE Swine	72.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.85		
N-Free Extract (NFE)	33.3			Linoleic Acid	0.48	1	-
Coef. Dig. NFE Poultry	16.5			Linolenic Acid	0.24	1	-
Digestible NFE Poultry	5.49						
Undig. NFE + CF Poultry	38.7						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4230	30	74	***Swine***			
Poultry				Digestible Energy	2983		
Metabolizable Energy	1743			Metabolizable Energy	2746		
Std. Metab. Energy	1932			Net Energy	1709		
Net Energy	1358			***Sows***			
Hens				Digestible Energy	3197		
Metabolizable Energy	1856			Metabolizable Energy	2933		
Net Energy	1470			Net Energy	1845		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.57	32	0.49	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.55	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.10	2	0.01	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.11	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-	Iodine (I)	-	-	-
Magnesium (Mg)	0.52	1	-				
Total Calcium (Ca)	0.63	22	0.07				
Total Phosphorus (P)	1.14	22	0.14				
Phytate P	0.75	1	-				
Available P (Pav)	0.39						
Coef. Dig. P Poultry	43.1						
Std. Dig. P Poultry	0.49						
Coef. Dig. P Swine	35.2						
Std. Dig. P Swine	0.40						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Canola, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	36.2	100	31.9	86.1	29.1	80.4
Lysine, %	2.02	5.58	1.63	80.7	1.54	76.2
Methionine, %	0.78	2.15	0.70	89.7	0.67	85.9
Met + Cys, %	1.75	4.83	1.42	81.1	1.43	81.7
Threonine, %	1.57	4.34	1.26	80.3	1.17	74.5
Tryptophan, %	0.46	1.27	0.39	84.8	0.35	76.1
Arginine, %	2.25	6.22	2.03	90.2	1.92	85.3
Gly + Ser, %	3.19	8.81	2.71	85.0		
Valine, %	1.67	4.61	1.38	82.6	1.27	76.0
Isoleucine, %	1.31	3.62	1.09	83.2	1.02	77.9
Leucine, %	2.53	6.99	2.20	87.0	2.04	80.6
Histidine, %	1.00	2.76	0.88	88.0	0.83	83.0
Phenylalanine, %	1.41	3.90	1.23	87.2	1.15	81.6
Phe + Tyr, %	2.34	6.46	2.01	85.9	1.87	79.9
Alanine, %	1.55	4.28	1.31	84.5	1.19	76.8
Cysteine, %	0.97	2.68	0.72	74.2	0.76	78.4
Tyrosine, %	0.93	2.57	0.78	83.9	0.72	77.4
Glycine, %	1.69	4.67	1.47	87.0	1.31	77.5
Serine, %	1.50	4.14	1.24	82.7	1.13	75.3
Proline, %	1.95	5.39	1.60	82.1	1.79	91.8
Glutamine[2], %	2.80	7.74	2.54	90.7	2.35	84.0
Glutamic Acid[2], %	3.13	8.64	2.84	90.7	2.63	84.0
Asparagine[2], %	1.09	3.01	0.99	91.0	0.83	76.0
Aspartic Acid[2], %	1.62	4.48	1.47	91.0	1.23	76.0
Total Nitrogen (PB/6.25), %	5.79	16.0	4.99	86.1	4.65	80.4
Essential Nitrogen Poultry, %	2.95	50.9*	2.51	85.2		
Essential Nitrogen Swine, %	2.43	42.0*			1.94	79.7

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	6	8		8	
Maximum	8	12		12	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	6	8	9	8	6
Maximum	8	12	13	12	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Canola, Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.5	1	-	Organic Matter (OM)	99.5		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	91.8		
Starch	-	-	-	Digestible OM Swine	91.4		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	8.14		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.5	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	95.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	94.5		
ADF	-	-	-	Coef. Dig. EE Swine	91.8		
Coef. Dig. ADF Swine	-			Digestible EE Swine	91.3		
N-Free Extract (NFE)	-			Linoleic Acid	18.7	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	9.50	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9399	1	-	***Swine***			
Poultry				Digestible Energy	8630		
Metabolizable Energy	8784			Metabolizable Energy	8455		
Std. Metab. Energy	9130			Net Energy	7476		
Net Energy	7906			***Sows***			
Hens				Digestible Energy	8630		
Metabolizable Energy	8784			Metabolizable Energy	8455		
Net Energy	7906			Net Energy	7476		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Canola, Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers		***Hens***		
	Starter	Grower			
Practical	3	3	3		
Maximum	6	7	7		
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Casein

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.5	7	0.77	Organic Matter (OM)	87.9		
Crude Protein (CP)	86.2	6	2.92	Coef. Dig. OM Swine	79.3		
Starch	-	-	-	Digestible OM Swine	69.7		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	18.2		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.55	4	0.31
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	48.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.26	-	-
N-Free Extract (NFE)	1.12			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5467	4	300	***Swine***			
Poultry				Digestible Energy	4151		
Metabolizable Energy	3900			Metabolizable Energy	3529		
Std. Metab. Energy	-			Net Energy	2006		
Net Energy	-			***Sows***			
Hens				Digestible Energy	4251		
Metabolizable Energy	-			Metabolizable Energy	3665		
Net Energy	-			Net Energy	2105		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.63	3	1.79	***Trace Minerals, mg/kg***			
				Manganese (Mn)	1.67	1	-
Macro Minerals (%)				Iron (Fe)	21.4	1	-
Potassium (K)	0.01	2	0.00	Copper (Cu)	2.96	1	-
Sodium (Na)	0.01	4	0.00	Zinc (Zn)	88.6	1	-
Chlorine (Cl)	0.03	3	0.02	Selenium (Se)	3.34	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.40	1	-				
Total Phosphorus (P)	0.79	3	0.18				
Phytate P	-	-	-				
Available P (Pav)	0.79						
Coef. Dig. P Poultry	90.0						
Std. Dig. P Poultry	0.71						
Coef. Dig. P Swine	90.0						
Std. Dig. P Swine	0.71						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Casein

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	86.2	100	79.2	91.8	77.4	89.8
Lysine, %	7.29	8.46	7.01	96.2	7.14	97.9
Methionine, %	2.67	3.10	2.60	97.4	2.63	98.5
Met + Cys, %	3.11	3.61	2.97	95.5	3.02	97.1
Threonine, %	4.05	4.70	3.85	95.1	3.84	94.8
Tryptophan, %	1.20	1.39	1.16	96.7	1.17	97.5
Arginine, %	3.23	3.75	3.19	98.8	3.14	97.2
Gly + Ser, %	6.64	7.70	6.45	97.2		
Valine, %	5.97	6.93	5.86	98.2	5.73	96.0
Isoleucine, %	4.80	5.57	4.70	97.9	4.60	95.8
Leucine, %	8.32	9.65	8.27	99.4	8.16	98.1
Histidine, %	2.64	3.06	2.59	98.1	2.57	97.3
Phenylalanine, %	4.55	5.28	4.48	98.5	4.44	97.6
Phe + Tyr, %	7.87	9.13	7.77	98.7	7.66	97.3
Alanine, %	2.72	3.16	1.90	69.9	2.69	98.9
Cysteine, %	0.44	0.51	0.37	84.1	0.39	88.6
Tyrosine, %	3.32	3.85	3.29	99.0	3.22	97.0
Glycine, %	1.74	2.02	1.69	97.1	1.51	86.8
Serine, %	4.90	5.68	4.77	97.3	4.51	92.0
Proline, %	10.2	11.8	8.87	86.9	9.07	88.9
Glutamine[2], %	10.7	12.4	8.90	83.4	8.21	77.0
Glutamic Acid[2], %	8.93	10.4	7.45	83.4	6.88	77.0
Asparagine[2], %	2.46	2.86	2.07	84.2	1.75	71.0
Aspartic Acid[2], %	3.74	4.33	3.14	84.2	2.65	71.0
Total Nitrogen (PB/6.25), %	13.8	16.0	12.7	91.8	12.4	89.8
Essential Nitrogen Poultry, %	7.52	54.5*	7.35	97.7		
Essential Nitrogen Swine, %	6.54	47.4*			6.35	97.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	-		-	-	
Maximum	-		-	-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cassava, Whole

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.7	2	0.01	Organic Matter (OM)	84.2		
Crude Protein (CP)	2.64	2	0.23	Coef. Dig. OM Swine	85.7		
Starch	73.7	2	8.23	Digestible OM Swine	72.2		
Crude Fiber (CF)	4.21	2	1.72	Undig. OM Pigs	12.0		
Coef. Dig. CF Swine	64.6			Ether Extract (EE)	0.52	2	0.09
NDF	13.2	2	2.02	Coef. Dig. EE Poultry	20.0		
Coef. Dig. NDF Swine	59.0			Digestible EE Poultry	0.10		
ADF	5.73	2	2.07	Coef. Dig. EE Swine	42.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.22		
N-Free Extract (NFE)	76.9			Linoleic Acid	0.08	1	-
Coef. Dig. NFE Poultry	91.4			Linolenic Acid	-	-	-
Digestible NFE Poultry	70.3						
Undig. NFE + CF Poultry	10.8						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3621	1	-	***Swine***			
Poultry				Digestible Energy	3048		
Metabolizable Energy	2973			Metabolizable Energy	3020		
Std. Metab. Energy	3192			Net Energy	2426		
Net Energy	2378			***Sows***			
Hens				Digestible Energy	3154		
Metabolizable Energy	3003			Metabolizable Energy	3108		
Net Energy	2408			Net Energy	2490		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.44	2	0.23	***Trace Minerals, mg/kg***			
				Manganese (Mn)	23.9	1	-
Macro Minerals (%)				Iron (Fe)	92.6	1	-
Potassium (K)	0.35	2	0.24	Copper (Cu)	4.50	1	-
Sodium (Na)	0.02	2	0.01	Zinc (Zn)	11.1	1	-
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.15	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.05	2	0.05				
Total Calcium (Ca)	0.21	2	0.01				
Total Phosphorus (P)	0.08	2	0.01				
Phytate P	0.06	1	-				
Available P (Pav)	0.02						
Coef. Dig. P Poultry	0.38						
Std. Dig. P Poultry	0.03						
Coef. Dig. P Swine	0.38						
Std. Dig. P Swine	0.03						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cassava, Whole

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	2.64	100	1.21	46.0	2.18	82.6
Lysine, %	0.10	3.79	-	-	0.07	71.0
Methionine, %	0.03	1.14	-	-	0.03	84.0
Met + Cys, %	0.07	2.65	-	-	0.06	79.4
Threonine, %	0.07	2.65	-	-	0.05	73.0
Tryptophan, %	0.02	0.76	-	-	0.02	77.0
Arginine, %	0.16	6.06	-	-	0.14	90.0
Gly + Ser, %	0.17	6.44	-	-		
Valine, %	0.12	4.55	-	-	0.09	76.0
Isoleucine, %	0.10	3.79	-	-	0.08	81.0
Leucine, %	0.13	4.92	-	-	0.10	79.0
Histidine, %	0.09	3.41	-	-	0.07	80.0
Phenylalanine, %	0.09	3.41	-	-	0.07	80.0
Phe + Tyr, %	0.17	6.44	-	-	0.12	73.4
Alanine, %	0.12	4.55	-	-	0.10	85.0
Cysteine, %	0.04	1.52	-	-	0.03	76.0
Tyrosine, %	0.08	3.03	-	-	0.05	66.0
Glycine, %	0.09	3.41	-	-	0.08	86.0
Serine, %	0.08	3.03	-	-	0.07	87.0
Proline, %	0.11	4.17	-	-	0.10	87.0
Glutamine², %	0.18	6.75	-	-	0.16	90.0
Glutamic Acid², %	0.11	4.24	-	-	0.10	90.0
Asparagine², %	0.07	2.72	-	-	0.06	86.0
Aspartic Acid², %	0.09	3.34	-	-	0.08	86.0
Total Nitrogen (PB/6.25), %	0.42	16.0	-	-	0.35	82.6
Essential Nitrogen Poultry, %	0.18	43.3*	-	-		
Essential Nitrogen Swine, %	0.16	36.8*			0.12	79.7

[1]SID = Standardized Ileal Digestibility.
²Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	10		10	
Maximum	20	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	15	15	15	15
Maximum	20	30	30	30	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Castor Plant, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.4	1	-	Organic Matter (OM)	82.6		
Crude Protein (CP)	39.2	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	18.5	1	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.55	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	23.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	-	-	-	***Swine***			
Poultry				Digestible Energy	2230		
Metabolizable Energy	1484			Metabolizable Energy	2084		
Std. Metab. Energy	-			Net Energy	1100		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.80	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	23.7	1	-
Macro Minerals (%)				Iron (Fe)	1.00	1	-
Potassium (K)	0.60	1	-	Copper (Cu)	3.90	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	11.3	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.35	1	-				
Total Calcium (Ca)	0.62	1	-				
Total Phosphorus (P)	0.62	1	-				
Phytate P	0.42	1	-				
Available P (Pav)	0.20						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Castor Plant, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	39.2	100	-	-	-	-
Lysine, %	0.78	1.99	-	-	-	-
Methionine, %	0.61	1.56	-	-	-	-
Met + Cys, %	1.07	2.73	-	-	-	-
Threonine, %	1.13	2.88	-	-	-	-
Tryptophan, %	0.58	1.48	-	-	-	-
Arginine, %	3.21	8.19	-	-	-	-
Gly + Ser, %	3.18	8.11	-	-		
Valine, %	1.78	4.54	-	-	-	-
Isoleucine, %	1.75	4.46	-	-	-	-
Leucine, %	2.68	6.84	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	1.35	3.44	-	-	-	-
Phe + Tyr, %	2.26	5.77	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	0.46	1.17	-	-	-	-
Tyrosine, %	0.91	2.32	-	-	-	-
Glycine, %	1.59	4.05	-	-	-	-
Serine, %	1.59	4.05	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	6.27	16.0	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Citrus Pulp

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.7	23	1.58	Organic Matter (OM)	83.5		
Crude Protein (CP)	6.10	22	0.52	Coef. Dig. OM Swine	80.0		
Starch	6.00	1	-	Digestible OM Swine	66.8		
Crude Fiber (CF)	12.4	1	-	Undig. OM Pigs	16.7		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.11	2	0.13
NDF	19.3	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	13.8	1	-	Coef. Dig. EE Swine	55.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.16		
N-Free Extract (NFE)	62.9			Linoleic Acid	0.45	2	0.02
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.08	2	0.00
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3701	1	-	***Swine***			
Poultry				Digestible Energy	2956		
Metabolizable Energy	1100			Metabolizable Energy	2863		
Std. Metab. Energy	-			Net Energy	1979		
Net Energy	-			***Sows***			
Hens				Digestible Energy	3068		
Metabolizable Energy	-			Metabolizable Energy	2992		
Net Energy	-			Net Energy	2073		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.28	2	0.03	***Trace Minerals, mg/kg***	-	-	-
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.79	2	0.06	Copper (Cu)	-	-	-
Sodium (Na)	0.11	2	0.05	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.04	2	0.02	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.11	1	-				
Total Calcium (Ca)	1.61	23	0.38				
Total Phosphorus (P)	0.11	22	0.03				
Phytate P	0.04	1	-				
Available P (Pav)	0.07						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	33.0						
Std. Dig. P Swine	0.04						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Citrus Pulp

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	6.10	100	-	-	4.91	80.5
Lysine, %	0.23	3.77	-	-	0.18	77.0
Methionine, %	0.07	1.15	-	-	0.06	85.0
Met + Cys, %	0.15	2.46	-	-	0.13	85.5
Threonine, %	0.20	3.28	-	-	0.15	76.0
Tryptophan, %	0.06	0.98	-	-	0.05	77.0
Arginine, %	0.26	4.27	-	-	0.23	89.0
Gly + Ser, %	0.50	8.20	-	-		
Valine, %	0.26	4.27	-	-	0.20	78.0
Isoleucine, %	0.20	3.28	-	-	0.16	81.0
Leucine, %	0.34	5.58	-	-	0.28	83.0
Histidine, %	0.13	2.13	-	-	0.11	84.0
Phenylalanine, %	0.25	4.10	-	-	0.21	84.0
Phe + Tyr, %	0.42	6.89	-	-	0.35	83.6
Alanine, %	0.28	4.59	-	-	0.22	79.0
Cysteine, %	0.08	1.31	-	-	0.07	86.0
Tyrosine, %	0.17	2.79	-	-	0.14	83.0
Glycine, %	0.26	4.27	-	-	0.20	76.0
Serine, %	0.24	3.94	-	-	0.19	80.0
Proline, %	0.48	7.87	-	-	0.39	81.0
Glutamine[2], %	0.33	5.34	-	-	0.28	86.0
Glutamic Acid[2], %	0.20	3.35	-	-	0.18	86.0
Asparagine[2], %	0.27	4.42	-	-	0.20	73.0
Aspartic Acid[2], %	0.33	5.43	-	-	0.24	73.0
Total Nitrogen (PB/6.25), %	0.98	16.0	-	-	0.79	80.5
Essential Nitrogen Poultry, %	0.39	40.2*	-	-		
Essential Nitrogen Swine, %	0.31	31.9*			0.25	81.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	3	4	5	2
Maximum	2	5	6	8	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Coconut, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.5	6	1.40	Organic Matter (OM)	84.1		
Crude Protein (CP)	22.0	7	1.14	Coef. Dig. OM Swine	76.3		
Starch	-	-	-	Digestible OM Swine	64.2		
Crude Fiber (CF)	13.7	3	0.76	Undig. OM Pigs	19.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.92	3	0.27
NDF	50.7	4	0.80	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	2.69		
ADF	29.0	4	5.58	Coef. Dig. EE Swine	65.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.90		
N-Free Extract (NFE)	45.5			Linoleic Acid	0.06	1	-
Coef. Dig. NFE Poultry	49.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	22.3						
Undig. NFE + CF Poultry	36.9						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4151	4	158	***Swine***			
Poultry				Digestible Energy	3020		
Metabolizable Energy	1921			Metabolizable Energy	2873		
Std. Metab. Energy	-			Net Energy	1855		
Net Energy	1532			***Sows***			
Hens				Digestible Energy	3160		
Metabolizable Energy	2033			Metabolizable Energy	3017		
Net Energy	1643			Net Energy	1960		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.37	3	0.17	***Trace Minerals, mg/kg***			
				Manganese (Mn)	68.2	1	-
Macro Minerals (%)				Iron (Fe)	423.0	1	-
Potassium (K)	0.61	1	-	Copper (Cu)	25.6	1	-
Sodium (Na)	1.63	4	0.17	Zinc (Zn)	62.3	1	-
Chlorine (Cl)	0.70	1	-	Selenium (Se)	-	-	-
Sulfur (S)	0.30	3	0.01				
Magnesium (Mg)	0.42	3	0.18				
Total Calcium (Ca)	0.15	1	-				
Total Phosphorus (P)	0.63	4	0.25				
Phytate P	0.41	1	-				
Available P (Pav)	0.22						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	35.2						
Std. Dig. P Swine	0.22						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Coconut, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	22.0	100	17.4	79.0	13.4	60.8
Lysine, %	0.59	2.68	0.47	78.9	0.30	51.0
Methionine, %	0.34	1.55	0.30	87.8	0.23	67.0
Met + Cys, %	0.67	3.05	0.47	70.3	0.40	59.4
Threonine, %	0.65	2.95	0.42	65.1	0.33	51.0
Tryptophan, %	0.21	0.95	0.16	77.0	0.13	63.0
Arginine, %	2.48	11.3	2.14	86.4	2.01	81.0
Gly + Ser, %	1.79	8.14	1.32	73.7		
Valine, %	1.06	4.82	0.89	83.5	0.72	68.0
Isoleucine, %	0.71	3.23	0.59	83.6	0.45	64.0
Leucine, %	1.31	5.95	1.06	80.7	0.89	68.0
Histidine, %	0.41	1.86	0.31	74.4	0.26	63.0
Phenylalanine, %	0.88	4.00	0.76	86.6	0.62	71.0
Phe + Tyr, %	1.35	6.14	1.10	81.6	0.85	62.6
Alanine, %	0.86	3.91	0.67	78.0	0.46	53.0
Cysteine, %	0.33	1.50	0.17	52.2	0.17	51.5
Tyrosine, %	0.47	2.14	0.34	72.3	0.22	47.0
Glycine, %	0.89	4.05	0.66	73.7	0.44	49.0
Serine, %	0.90	4.09	0.66	73.7	0.46	51.0
Proline, %	0.72	3.27	0.53	73.1	0.42	58.8
Glutamine[2], %	2.32	10.5	1.86	80.4	1.27	55.0
Glutamic Acid[2], %	1.45	6.61	1.17	80.4	0.80	55.0
Asparagine[2], %	0.75	3.41	0.57	75.8	0.40	54.0
Aspartic Acid[2], %	0.92	4.18	0.70	75.8	0.50	54.0
Total Nitrogen (PB/6.25), %	3.52	16.0	2.78	79.0	2.14	60.8
Essential Nitrogen Poultry, %	1.86	52.9*	1.50	80.7		
Essential Nitrogen Swine, %	1.58	44.8*			1.09	68.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	3		4	5	
Maximum	6		8	8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	4	5	5	4
Maximum	5	7	8	10	7

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Coconut, Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.3	1	-	Organic Matter (OM)	99.3		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	92.8		
Starch	-	-	-	Digestible OM Swine	92.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	7.14		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.3	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	85.9		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	85.3		
ADF	-	-	-	Coef. Dig. EE Swine	88.2		
Coef. Dig. ADF Swine	-			Digestible EE Swine	87.6		
N-Free Extract (NFE)	-			Linoleic Acid	1.79	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9229	1	-	***Swine***			
Poultry				Digestible Energy	8565		
Metabolizable Energy	7924			Metabolizable Energy	8262		
Std. Metab. Energy	-			Net Energy	7332		
Net Energy	7132			***Sows***			
Hens				Digestible Energy	8565		
Metabolizable Energy	7924			Metabolizable Energy	8262		
Net Energy	7132			Net Energy	7332		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Coconut, Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Bran with Solubles[#]

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.9	8	2.09	Organic Matter (OM)	83.9		
Crude Protein (CP)	15.6	8	2.04	Coef. Dig. OM Swine	63.7		
Starch	5.10	1	-	Digestible OM Swine	53.5		
Crude Fiber (CF)	9.29	5	1.59	Undig. OM Pigs	30.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	8.64	7	1.12
NDF	40.7	5	3.41	Coef. Dig. EE Poultry	79.0		
Coef. Dig. NDF Swine	48.9			Digestible EE Poultry	6.83		
ADF	11.6	4	1.52	Coef. Dig. EE Swine	76.0		
Coef. Dig. ADF Swine	52.5			Digestible EE Swine	6.57		
N-Free Extract (NFE)	50.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	30.1			Linolenic Acid	-	-	-
Digestible NFE Poultry	15.2						
Undig. NFE + CF Poultry	44.5						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4400	5	141	***Swine***			
Poultry				Digestible Energy	2840		
Metabolizable Energy	1850			Metabolizable Energy	2650		
Std. Metab. Energy	-			Net Energy	1872		
Net Energy	1520			***Sows***			
Hens				Digestible Energy	3023		
Metabolizable Energy	1982			Metabolizable Energy	2875		
Net Energy	1652			Net Energy	2036		
Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	4.96	7	0.43	***Trace Minerals, mg/kg***			
				Manganese (Mn)	17.2	3	0.55
Macro Minerals (%)				Iron (Fe)	67.0	3	18.2
Potassium (K)	1.46	4	0.08	Copper (Cu)	5.34	3	2.39
Sodium (Na)	0.19	4	0.07	Zinc (Zn)	64.9	3	3.19
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.34	4	0.04				
Total Calcium (Ca)	0.03	4	0.04				
Total Phosphorus (P)	0.79	3	0.16				
Phytate P	0.32	1	-				
Available P (Pav)	0.47						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	46.0						
Std. Dig. P Swine	0.36						

Pav = Non Phytate P (Total P – Phytate P). [#]Corn desilaria co-product.

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Bran with Solubles

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	15.6	100	13.6	87.2	10.2	65.4
Lysine, %	0.50	3.21	0.40	79.3	0.23	45.9
Methionine, %	0.15	0.96	0.14	91.5	0.11	73.2
Met + Cys, %	0.31	1.99	0.28	89.0	0.20	65.7
Threonine, %	0.46	2.95	0.36	78.9	0.25	54.0
Tryptophan, %	0.12	0.77	0.10	83.0	0.08	65.7
Arginine, %	0.65	4.17	0.60	92.3	0.48	74.2
Gly + Ser, %	1.15	7.38	0.88	76.7		
Valine, %	0.51	3.27	0.46	91.0	0.33	64.8
Isoleucine, %	0.35	2.25	0.33	93.4	0.23	65.2
Leucine, %	0.99	6.35	0.91	92.3	0.71	72.1
Histidine, %	0.37	2.37	0.32	87.5	0.25	68.8
Phenylalanine, %	0.46	2.95	0.41	88.8	0.30	64.3
Phe + Tyr, %	0.82	5.26	0.73	88.7	0.52	63.5
Alanine, %	0.84	5.39	0.74	87.9	0.67	79.2
Cysteine, %	0.16	1.03	0.14	86.7	0.09	58.7
Tyrosine, %	0.36	2.31	0.32	88.5	0.22	62.4
Glycine, %	0.60	3.85	0.47	78.4	0.48	80.3
Serine, %	0.55	3.53	0.41	74.9	0.35	63.0
Proline, %	1.00	6.42	0.87	87.3	0.52	52.2
Glutamine[2], %	1.09	7.02	1.00	91.1	0.76	69.4
Glutamic Acid[2], %	0.69	4.40	0.63	91.1	0.48	69.4
Asparagine[2], %	0.35	2.28	0.30	85.4	0.19	52.9
Aspartic Acid[2], %	0.44	2.80	0.37	85.4	0.23	52.9
Total Nitrogen (PB/6.25), %	2.49	16.0	2.17	87.2	1.63	65.4
Essential Nitrogen Poultry, %	0.92	36.8*	0.79	86.1		
Essential Nitrogen Swine, %	0.73	29.4*			0.48	65.2

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	9		10	
Maximum	7	11		13	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	8	10	12	14	14
Maximum	10	12	15	18	18

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Distillers Dried Grains with Solubles (DDGS) - 6 to 9% of EE

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.2	13	1.43	Organic Matter (OM)	86.8		
Crude Protein (CP)	30.5	13	1.67	Coef. Dig. OM Swine	66.7		
Starch	3.09	2	0.80	Digestible OM Swine	57.9		
Crude Fiber (CF)	7.90	7	1.99	Undig. OM Pigs	28.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	7.68	13	0.91
NDF	48.5	6	7.81	Coef. Dig. EE Poultry	88.4		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	6.79		
ADF	11.9	2	3.43	Coef. Dig. EE Swine	85.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	6.53		
N-Free Extract (NFE)	40.7			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	42.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	17.1						
Undig. NFE + CF Poultry	31.5						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4779	8	152	***Swine***			
Poultry				Digestible Energy	3123		
Metabolizable Energy	2410			Metabolizable Energy	2930		
Std. Metab. Energy	-			Net Energy	1970		
Net Energy	1948			***Sows***			
Hens				Digestible Energy	3381		
Metabolizable Energy	2504			Metabolizable Energy	3148		
Net Energy	2042			Net Energy	2129		
Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	3.43	13	1.15	***Trace Minerals, mg/kg***			
				Manganese (Mn)	9.33	1	-
Macro Minerals (%)				Iron (Fe)	402.7	1	-
Potassium (K)	0.17	1	-	Copper (Cu)	4.38	1	-
Sodium (Na)	0.03	2	0.01	Zinc (Zn)	36.9	1	-
Chlorine (Cl)	0.14	1	-	Selenium (Se)	-	-	-
Sulfur (S)	0.29	2	0.02				
Magnesium (Mg)	0.06	1	-				
Total Calcium (Ca)	0.04	3	0.05				
Total Phosphorus (P)	0.38	3	0.14				
Phytate P	0.26	2	0.01				
Available P (Pav)	0.12						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Distillers Dried Grains with Solubles (DDGS) - 6 to 9% of EE

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	30.5	100	24.9	81.4	23.1	75.6
Lysine, %	0.77	2.51	0.53	69.6	0.45	59.1
Methionine, %	0.38	1.24	0.32	85.0	0.31	81.9
Met + Cys, %	0.76	2.49	0.68	89.8	0.63	83.5
Threonine, %	1.07	3.50	0.79	73.6	0.73	68.0
Tryptophan, %	0.16	0.51	0.13	85.3	0.11	73.6
Arginine, %	1.19	3.88	0.99	83.3	0.95	80.2
Gly + Ser, %	2.48	8.12	1.93	77.8		
Valine, %	1.51	4.93	1.19	79.1	1.10	73.2
Isoleucine, %	1.13	3.68	0.91	80.6	0.83	74.1
Leucine, %	3.95	12.9	3.38	85.5	3.26	82.6
Histidine, %	0.83	2.70	0.65	78.8	0.60	73.2
Phenylalanine, %	1.55	5.06	1.29	83.5	1.24	80.4
Phe + Tyr, %	2.57	8.42	2.09	81.2	2.05	79.9
Alanine, %	2.29	7.48	1.90	83.1	1.77	77.4
Cysteine, %	0.47	1.54	0.36	76.5	0.32	68.8
Tyrosine, %	1.02	3.32	0.80	78.5	0.81	80.0
Glycine, %	1.10	3.60	0.81	73.2	0.68	61.6
Serine, %	1.38	4.52	1.12	81.5	1.03	74.3
Proline, %	2.80	9.16	2.28	81.5	2.09	74.8
Glutamine[2], %	3.55	11.6	3.04	85.8	2.78	78.4
Glutamic Acid[2], %	2.23	7.29	1.91	85.8	1.74	78.4
Asparagine[2], %	0.88	2.87	0.64	73.6	0.59	66.9
Aspartic Acid[2], %	1.08	3.52	0.79	73.6	0.72	66.9
Total Nitrogen (PB/6.25), %	4.88	16.0	3.98	81.4	3.69	75.6
Essential Nitrogen Poultry, %	2.18	44.5*	1.76	80.8		
Essential Nitrogen Swine, %	1.79	36.6*			1.37	76.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	5		9	10	
Maximum	7		11	13	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	8	10	12	14	14
Maximum	10	12	15	18	18

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-Protein Distillers Dried Grains (HP-DDG)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.6	14	1.11	Organic Matter (OM)	89.0		
Crude Protein (CP)	42.1	14	1.01	Coef. Dig. OM Swine	76.0		
Starch	1.62	1	-	Digestible OM Swine	67.6		
Crude Fiber (CF)	6.87	8	1.07	Undig. OM Pigs	21.3		
Coef. Dig. CF Swine	-			Ether Extract (EE)	11.9	12	0.85
NDF	30.1	4	5.44	Coef. Dig. EE Poultry	88.4		
Coef. Dig. NDF Swine	79.5			Digestible EE Poultry	10.5		
ADF	17.0	4	1.40	Coef. Dig. EE Swine	85.0		
Coef. Dig. ADF Swine	83.5			Digestible EE Swine	10.1		
N-Free Extract (NFE)	28.0			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	45.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	12.6						
Undig. NFE + CF Poultry	22.3						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5313	6	37	***Swine***			
Poultry				Digestible Energy	4060		
Metabolizable Energy	3060			Metabolizable Energy	3620		
Std. Metab. Energy	-			Net Energy	2456		
Net Energy	2484			***Sows***			
Hens				Digestible Energy	4079		
Metabolizable Energy	3126			Metabolizable Energy	3781		
Net Energy	2550			Net Energy	2573		
Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	2.62	8	0.20	***Trace Minerals, mg/kg***			
				Manganese (Mn)	7.23	5	1.61
Macro Minerals (%)				Iron (Fe)	126.4	5	31.2
Potassium (K)	0.51	5	0.10	Copper (Cu)	8.39	5	2.01
Sodium (Na)	0.07	5	0.02	Zinc (Zn)	58.4	5	16.1
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.10	1	-				
Total Calcium (Ca)	0.01	6	0.01				
Total Phosphorus (P)	0.48	6	0.10				
Phytate P	0.21	1	-				
Available P (Pav)	0.27						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	48.0						
Std. Dig. P Swine	0.23						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-Protein Distillers Dried Grains (HP-DDG)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	42.1	100	36.1	85.8	32.6	83.2
Lysine, %	1.32	3.13	1.06	80.3	0.82	79.2
Methionine, %	0.79	1.86	0.71	90.5	0.68	89.6
Met + Cys, %	1.56	3.69	1.33	85.3	1.26	87.2
Threonine, %	1.56	3.69	1.18	75.6	1.14	78.3
Tryptophan, %	0.23	0.55	0.18	78.0	0.18	92.4
Arginine, %	1.74	4.13	1.56	89.6	1.42	86.4
Gly + Ser, %	3.48	8.25	2.72	78.2		
Valine, %	2.02	4.78	1.73	85.8	1.47	80.5
Isoleucine, %	1.49	3.54	1.29	86.4	1.08	80.6
Leucine, %	4.78	11.3	4.33	90.6	3.75	85.9
Histidine, %	1.19	2.81	1.01	84.9	0.89	83.1
Phenylalanine, %	2.06	4.89	1.83	88.7	1.53	84.8
Phe + Tyr, %	3.71	8.80	3.29	88.6	2.76	84.7
Alanine, %	3.04	7.20	2.67	88.0	2.45	83.8
Cysteine, %	0.77	1.83	0.61	79.3	0.58	84.9
Tyrosine, %	1.65	3.92	1.46	88.6	1.23	84.5
Glycine, %	1.56	3.69	1.17	75.4	1.41	75.3
Serine, %	1.92	4.56	1.55	80.5	1.54	83.1
Proline, %	3.60	8.54	3.13	87.0	1.95	81.0
Glutamine[2], %	4.40	10.4	3.91	88.9	3.43	85.0
Glutamic Acid[2], %	2.76	6.55	2.45	88.9	2.16	85.0
Asparagine[2], %	1.19	2.83	0.93	77.7	0.83	81.2
Aspartic Acid[2], %	1.47	3.48	1.14	77.7	1.02	81.2
Total Nitrogen (PB/6.25), %	6.74	16.0	5.78	85.8	5.61	83.2
Essential Nitrogen Poultry, %	3.05	45.3*	2.60	85.2		
Essential Nitrogen Swine, %	2.51	37.2*			2.09	83.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	7	10		12	
Maximum	8	12		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	8	10	12	14	15
Maximum	10	12	15	18	20

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Germ

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.2	5	0.96	Organic Matter (OM)	86.4		
Crude Protein (CP)	10.3	7	0.41	Coef. Dig. OM Swine	77.5		
Starch	48.6	1	-	Digestible OM Swine	66.9		
Crude Fiber (CF)	5.14	3	1.10	Undig. OM Pigs	19.4		
Coef. Dig. CF Swine	-			Ether Extract (EE)	10.1	4	1.45
NDF	27.8	4	1.74	Coef. Dig. EE Poultry	82.5		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	8.33		
ADF	8.50	5	0.95	Coef. Dig. EE Swine	79.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	8.03		
N-Free Extract (NFE)	60.8			Linoleic Acid	3.08	2	0.03
Coef. Dig. NFE Poultry	79.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	48.1						
Undig. NFE + CF Poultry	17.9						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4276	4	87	***Swine***			
Poultry				Digestible Energy	3355		
Metabolizable Energy	3144			Metabolizable Energy	3257		
Std. Metab. Energy	3396			Net Energy	2571		
Net Energy	2577			***Sows***			
Hens				Digestible Energy	3501		
Metabolizable Energy	3199			Metabolizable Energy	3401		
Net Energy	2632			Net Energy	2676		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.83	5	1.10	***Trace Minerals, mg/kg***			
				Manganese (Mn)	19.6	1	-
Macro Minerals (%)				Iron (Fe)	116.0	1	-
Potassium (K)	0.62	1	-	Copper (Cu)	10.0	1	-
Sodium (Na)	0.02	1	-	Zinc (Zn)	45.9	1	-
Chlorine (Cl)	0.08	1	-	Selenium (Se)	0.10	1	-
Sulfur (S)	0.22	1	-				
Magnesium (Mg)	0.31	1	-				
Total Calcium (Ca)	0.03	5	0.02				
Total Phosphorus (P)	0.43	5	0.12				
Phytate P	0.19	1	-				
Available P (Pav)	0.24						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.13						
Coef. Dig. P Swine	25.0						
Std. Dig. P Swine	0.11						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Germ

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	10.3	100	8.85	86.0	7.37	71.5
Lysine, %	0.47	4.56	0.40	85.6	0.29	62.3
Methionine, %	0.20	1.94	0.18	90.0	0.16	77.6
Met + Cys, %	0.42	4.08	0.35	83.6	0.30	71.2
Threonine, %	0.39	3.79	0.30	77.2	0.27	70.5
Tryptophan, %	0.11	1.07	0.09	83.1	0.08	68.5
Arginine, %	0.70	6.80	0.67	96.2	0.59	84.6
Gly + Ser, %	0.98	9.51	0.77	78.3		
Valine, %	0.51	4.95	0.43	85.0	0.37	72.5
Isoleucine, %	0.33	3.20	0.28	86.2	0.25	74.5
Leucine, %	0.89	8.64	0.82	91.7	0.69	77.0
Histidine, %	0.31	3.01	0.28	90.8	0.24	78.0
Phenylalanine, %	0.44	4.27	0.39	89.2	0.32	73.5
Phe + Tyr, %	0.70	6.80	0.64	91.0	0.51	73.2
Alanine, %	0.67	6.50	0.56	83.1	0.45	66.6
Cysteine, %	0.22	2.14	0.17	77.8	0.14	65.3
Tyrosine, %	0.26	2.52	0.24	93.9	0.19	72.6
Glycine, %	0.51	4.95	0.40	78.3	0.35	68.0
Serine, %	0.47	4.56	0.37	78.3	0.32	68.3
Proline, %	0.73	7.09	0.64	87.2	0.54	74.6
Glutamine[2], %	0.93	9.01	0.80	86.4	0.66	70.6
Glutamic Acid[2], %	0.58	5.65	0.50	86.4	0.41	70.6
Asparagine[2], %	0.35	3.40	0.28	80.6	0.22	61.6
Aspartic Acid[2], %	0.43	4.17	0.35	80.6	0.26	61.6
Total Nitrogen (PB/6.25), %	1.65	16.0	1.42	86.0	1.18	71.5
Essential Nitrogen Poultry, %	0.87	52.5*	0.75	86.7		
Essential Nitrogen Swine, %	0.71	42.9*			0.53	74.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	10		10	
Maximum	10	15		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	13	13	15	15
Maximum	15	18	18	20	20

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Gluten Feed 21% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.8	9	1.38	Organic Matter (OM)	84.3		
Crude Protein (CP)	21.0	10	1.85	Coef. Dig. OM Swine	66.0		
Starch	19.2	4	2.88	Digestible OM Swine	55.6		
Crude Fiber (CF)	8.26	8	0.62	Undig. OM Pigs	28.7		
Coef. Dig. CF Swine	51.1			Ether Extract (EE)	3.20	8	0.55
NDF	36.9	5	2.56	Coef. Dig. EE Poultry	56.0		
Coef. Dig. NDF Swine	55.7			Digestible EE Poultry	1.79		
ADF	10.7	5	1.12	Coef. Dig. EE Swine	76.2		
Coef. Dig. ADF Swine	59.0			Digestible EE Swine	2.44		
N-Free Extract (NFE)	51.8			Linoleic Acid	1.46	1	-
Coef. Dig. NFE Poultry	45.4			Linolenic Acid	0.03	1	-
Digestible NFE Poultry	23.5						
Undig. NFE + CF Poultry	36.6						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3930	5	136	***Swine***			
Poultry				Digestible Energy	2700		
Metabolizable Energy	1880			Metabolizable Energy	2560		
Std. Metab. Energy	1895			Net Energy	1761		
Net Energy	1489			***Sows***			
Hens				Digestible Energy	2963		
Metabolizable Energy	1998			Metabolizable Energy	2778		
Net Energy	1607			Net Energy	1920		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.55	8	0.87	***Trace Minerals, mg/kg***			
				Manganese (Mn)	19.2	1	-
Macro Minerals (%)				Iron (Fe)	134.0	1	-
Potassium (K)	0.98	4	0.60	Copper (Cu)	16.9	1	-
Sodium (Na)	0.18	3	0.06	Zinc (Zn)	72.9	1	-
Chlorine (Cl)	0.21	2	0.01	Selenium (Se)	0.21	1	-
Sulfur (S)	0.28	1	-				
Magnesium (Mg)	0.32	2	0.03				
Total Calcium (Ca)	0.12	5	0.05				
Total Phosphorus (P)	0.74	5	0.09				
Phytate P	0.45	2	0.28				
Available P (Pav)	0.29						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.22						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.21						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Gluten Feed 21% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	21.0	100	17.4	82.8	16.2	77.2
Lysine, %	0.52	2.48	0.38	72.8	0.34	65.6
Methionine, %	0.33	1.57	0.27	82.9	0.27	82.0
Met + Cys, %	0.82	3.90	0.61	74.3	0.59	72.1
Threonine, %	0.78	3.71	0.59	76.2	0.55	71.0
Tryptophan, %	0.13	0.62	0.10	77.2	0.08	63.5
Arginine, %	0.86	4.09	0.77	89.5	0.72	83.2
Gly + Ser, %	1.76	8.38	1.26	71.6		
Valine, %	1.06	5.05	0.88	83.3	0.79	74.6
Isoleucine, %	0.64	3.05	0.53	82.9	0.50	78.3
Leucine, %	1.87	8.90	1.68	90.0	1.57	83.8
Histidine, %	0.71	3.38	0.58	82.3	0.51	72.4
Phenylalanine, %	0.74	3.52	0.64	86.9	0.63	85.2
Phe + Tyr, %	1.09	5.19	0.94	86.3	0.92	84.7
Alanine, %	1.51	7.19	1.30	86.0	1.24	82.0
Cysteine, %	0.49	2.33	0.34	68.5	0.32	65.5
Tyrosine, %	0.35	1.67	0.30	84.9	0.29	83.5
Glycine, %	0.96	4.57	0.69	71.6	0.61	63.5
Serine, %	0.80	3.81	0.57	71.6	0.61	76.5
Proline, %	1.91	9.09	1.60	84.0	1.46	76.5
Glutamine[2], %	2.03	9.65	1.76	87.0	1.63	80.5
Glutamic Acid[2], %	1.27	6.06	1.11	87.0	1.02	80.5
Asparagine[2], %	0.48	2.29	0.36	76.0	0.34	71.0
Aspartic Acid[2], %	0.59	2.81	0.45	76.0	0.42	71.0
Total Nitrogen (PB/6.25), %	3.36	16.0	2.78	82.8	2.59	77.2
Essential Nitrogen Poultry, %	1.45	43.2*	1.19	81.9		
Essential Nitrogen Swine, %	1.17	34.7*			0.91	78.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	4		4	
Maximum	8	8		12	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	5	5	4
Maximum	8	10	10	10	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Gluten Meal 60% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.2	16	1.32	Organic Matter (OM)	89.4		
Crude Protein (CP)	61.7	15	1.71	Coef. Dig. OM Swine	91.7		
Starch	13.4	4	2.72	Digestible OM Swine	81.9		
Crude Fiber (CF)	1.23	6	0.22	Undig. OM Pigs	7.42		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.98	6	0.66
NDF	6.28	5	1.28	Coef. Dig. EE Poultry	95.0		
Coef. Dig. NDF Swine	73.5			Digestible EE Poultry	1.88		
ADF	6.18	5	2.56	Coef. Dig. EE Swine	69.0		
Coef. Dig. ADF Swine	44.7			Digestible EE Swine	1.37		
N-Free Extract (NFE)	24.5			Linoleic Acid	1.21	1	-
Coef. Dig. NFE Poultry	98.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	24.0						
Undig. NFE + CF Poultry	1.72						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4977	6	60	***Swine***			
Poultry				Digestible Energy	4341		
Metabolizable Energy	3705			Metabolizable Energy	3929		
Std. Metab. Energy	3868			Net Energy	2518		
Net Energy	2891			***Sows***			
Hens				Digestible Energy	4389		
Metabolizable Energy	3665			Metabolizable Energy	3977		
Net Energy	2851			Net Energy	2553		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.86	6	0.41	***Trace Minerals, mg/kg***			
				Manganese (Mn)	3.1	1	-
Macro Minerals (%)				Iron (Fe)	113	1	-
Potassium (K)	0.30	3	0.16	Copper (Cu)	19.1	1	-
Sodium (Na)	0.02	3	0.01	Zinc (Zn)	25.3	1	-
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.20	1	-
Sulfur (S)	0.53	1	-				
Magnesium (Mg)	0.08	3	0.02				
Total Calcium (Ca)	0.03	6	0.01				
Total Phosphorus (P)	0.52	7	0.14				
Phytate P	0.47	3	0.07				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.16						
Coef. Dig. P Swine	30.0						
Std. Dig. P Swine	0.16						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Gluten Meal 60% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	61.7	100	57.9	93.8	56.4	91.4
Lysine, %	1.05	1.70	0.95	90.7	0.92	87.6
Methionine, %	1.48	2.40	1.41	95.0	1.38	93.1
Met + Cys, %	2.41	3.91	2.19	90.8	2.18	90.6
Threonine, %	2.10	3.40	1.94	92.6	1.89	90.1
Tryptophan, %	0.30	0.49	0.27	90.5	0.24	80.5
Arginine, %	2.00	3.24	1.89	94.7	1.88	94.2
Gly + Ser, %	4.98	8.07	4.50	90.4		
Valine, %	2.90	4.69	2.72	93.8	2.61	90.1
Isoleucine, %	2.55	4.13	2.37	93.3	2.30	90.2
Leucine, %	10.2	16.6	9.85	96.2	9.49	92.7
Histidine, %	1.32	2.14	1.19	90.5	1.22	92.1
Phenylalanine, %	3.94	6.39	3.48	88.2	3.64	92.5
Phe + Tyr, %	7.07	11.5	6.48	91.6	6.47	91.5
Alanine, %	5.71	9.26	5.46	95.6	5.31	93.0
Cysteine, %	0.93	1.51	0.78	84.0	0.80	86.5
Tyrosine, %	3.13	5.07	3.00	95.9	2.83	90.3
Glycine, %	1.64	2.66	1.35	82.1	1.42	86.5
Serine, %	3.34	5.41	3.16	94.5	3.14	94.0
Proline, %	4.29	6.95	4.04	94.2	3.54	82.5
Glutamine[2], %	8.32	13.5	7.93	95.4	7.78	93.5
Glutamic Acid[2], %	5.22	8.46	4.98	95.4	4.88	93.5
Asparagine[2], %	1.65	2.67	1.50	91.0	1.50	91.0
Aspartic Acid[2], %	2.02	3.28	1.84	91.0	1.84	91.0
Total Nitrogen (PB/6.25), %	9.87	16.0	9.26	93.8	9.02	91.4
Essential Nitrogen Poultry, %	4.42	44.8*	4.12	93.1		
Essential Nitrogen Swine, %	3.67	37.2*			3.37	91.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	4	4		4	
Maximum	8	8		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	5	5	4
Maximum	8	10	10	12	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Mean – 1 SD of Dry Matter)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	86.8	-	-	Organic Matter (OM)	85.7		
Crude Protein (CP)	7.65	-	-	Coef. Dig. OM Swine	86.4		
Starch	62.1	-	-	Digestible OM Swine	74.0		
Crude Fiber (CF)	1.69	-	-	Undig. OM Pigs	11.7		
Coef. Dig. CF Swine	41.4			Ether Extract (EE)	3.65	-	-
NDF	13.5	-	-	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	66.4			Digestible EE Poultry	3.36		
ADF	3.10	-	-	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	68.2			Digestible EE Swine	3.29		
N-Free Extract (NFE)	72.7			Linoleic Acid	1.87	-	-
Coef. Dig. NFE Poultry	89.2			Linolenic Acid	0.03	-	-
Digestible NFE Poultry	64.9						
Undig. NFE + CF Poultry	9.54						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3850	-	-	***Swine***			
Poultry				Digestible Energy	3373		
Metabolizable Energy	3296			Metabolizable Energy	3292		
Std. Metab. Energy	3411			Net Energy	2613		
Net Energy	2656			***Sows***			
Hens				Digestible Energy	3455		
Metabolizable Energy	3324			Metabolizable Energy	3379		
Net Energy	2684			Net Energy	2677		
Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	1.10	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	6.75	-	-
Macro Minerals (%)				Iron (Fe)	22.3	-	-
Potassium (K)	0.31	-	-	Copper (Cu)	2.18	-	-
Sodium (Na)	0.01	-	-	Zinc (Zn)	21.1	-	-
Chlorine (Cl)	0.09	-	-	Selenium (Se)	0.07	-	-
Sulfur (S)	0.08	-	-				
Magnesium (Mg)	0.11	-	-				
Total Calcium (Ca)	0.01	-	-				
Total Phosphorus (P)	0.22	-	-				
Phytate P	0.18	-	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.09						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.10						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Mean – 1 SD of Dry Matter)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	7.65	100	6.88	89.9	6.58	86.0
Lysine, %	0.25	3.23	0.20	82.5	0.20	78.9
Methionine, %	0.15	2.02	0.14	93.4	0.13	86.4
Met + Cys, %	0.32	4.19	0.28	88.3	0.28	88.1
Threonine, %	0.30	3.87	0.28	93.9	0.23	78.8
Tryptophan, %	0.06	0.81	0.06	95.2	0.05	75.7
Arginine, %	0.38	5.03	0.35	91.0	0.34	89.6
Gly + Ser, %	0.71	9.22	0.56	78.9		
Valine, %	0.39	5.06	0.34	87.3	0.34	88.5
Isoleucine, %	0.27	3.52	0.25	94.0	0.24	89.9
Leucine, %	0.94	12.2	0.89	95.4	0.84	89.5
Histidine, %	0.23	3.01	0.21	93.3	0.20	86.5
Phenylalanine, %	0.36	4.64	0.32	90.5	0.32	89.7
Phe + Tyr, %	0.64	8.36	0.59	92.7	0.58	91.0
Alanine, %	0.59	7.72	0.48	81.0	0.51	85.6
Cysteine, %	0.17	2.18	0.14	83.6	0.15	89.7
Tyrosine, %	0.28	3.71	0.27	95.4	0.26	92.6
Glycine, %	0.31	4.10	0.24	76.0	0.25	79.2
Serine, %	0.39	5.12	0.32	81.2	0.33	83.8
Proline, %	0.75	9.80	0.71	94.5	0.62	82.7
Glutamine[2], %	0.89	11.6	0.84	94.4	0.78	87.6
Glutamic Acid[2], %	0.56	7.27	0.53	94.4	0.49	87.6
Asparagine[2], %	0.27	3.52	0.22	82.4	0.22	81.7
Aspartic Acid[2], %	0.33	4.33	0.27	82.4	0.27	81.7
Total Nitrogen (PB/6.25), %	1.22	16.0	1.10	89.9	1.05	86.0
Essential Nitrogen Poultry, %	0.61	49.6*	0.54	89.7		
Essential Nitrogen Swine, %	0.50	40.6*			0.43	87.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	65	65		65	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	60	65	70	65	70
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Average)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.6	351	1.85	Organic Matter (OM)	87.5		
Crude Protein (CP)	7.81	508	0.86	Coef. Dig. OM Swine	86.4		
Starch	63.4	148	2.51	Digestible OM Swine	75.6		
Crude Fiber (CF)	1.72	121	0.20	Undig. OM Pigs	11.9		
Coef. Dig. CF Swine	41.4			Ether Extract (EE)	3.73	233	0.29
NDF	13.8	3	1.20	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	66.4			Digestible EE Poultry	3.43		
ADF	3.16	3	0.29	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	68.2			Digestible EE Swine	3.36		
N-Free Extract (NFE)	74.2			Linoleic Acid	1.91	1	-
Coef. Dig. NFE Poultry	89.2			Linolenic Acid	0.03	1	-
Digestible NFE Poultry	66.2						
Undig. NFE + CF Poultry	9.74						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3929	18	38	***Swine***			
Poultry				Digestible Energy	3442		
Metabolizable Energy	3364			Metabolizable Energy	3360		
Std. Metab. Energy	3481			Net Energy	2667		
Net Energy	2711			***Sows***			
Hens				Digestible Energy	3529		
Metabolizable Energy	3391			Metabolizable Energy	3452		
Net Energy	2738			Net Energy	2734		

Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	1.12	40	0.19	***Trace Minerals, mg/kg***			
				Manganese (Mn)	6.89	2	2.24
Macro Minerals (%)				Iron (Fe)	22.8	2	1.00
Potassium (K)	0.32	4	0.04	Copper (Cu)	2.23	2	0.18
Sodium (Na)	0.01	4	0.01	Zinc (Zn)	21.5	1	-
Chlorine (Cl)	0.09	3	0.04	Selenium (Se)	0.07	1	-
Sulfur (S)	0.08	2	0.04				
Magnesium (Mg)	0.11	4	0.02				
Total Calcium (Ca)	0.02	37	0.01				
Total Phosphorus (P)	0.23	30	0.09				
Phytate P	0.18	70	0.03				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.09						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.10						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Average)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	7.81	100	7.02	89.9	6.72	86.0
Lysine, %	0.25	3.23	0.21	82.5	0.20	78.9
Methionine, %	0.16	2.02	0.15	93.4	0.14	86.4
Met + Cys, %	0.33	4.19	0.29	88.3	0.29	88.1
Threonine, %	0.30	3.87	0.28	93.9	0.24	78.8
Tryptophan, %	0.06	0.81	0.06	95.2	0.05	75.7
Arginine, %	0.39	5.03	0.36	91.0	0.35	89.6
Gly + Ser, %	0.72	9.22	0.57	78.9		
Valine, %	0.40	5.06	0.34	87.3	0.35	88.5
Isoleucine, %	0.28	3.52	0.26	94.0	0.25	89.9
Leucine, %	0.96	12.2	0.91	95.4	0.85	89.5
Histidine, %	0.24	3.01	0.22	93.3	0.20	86.5
Phenylalanine, %	0.36	4.64	0.33	90.5	0.33	89.7
Phe + Tyr, %	0.65	8.36	0.60	92.7	0.59	91.0
Alanine, %	0.60	7.72	0.49	81.0	0.52	85.6
Cysteine, %	0.17	2.18	0.14	83.6	0.15	89.7
Tyrosine, %	0.29	3.71	0.28	95.4	0.27	92.6
Glycine, %	0.32	4.10	0.24	76.0	0.25	79.2
Serine, %	0.40	5.12	0.32	81.2	0.34	83.8
Proline, %	0.77	9.80	0.72	94.5	0.63	82.7
Glutamine[2], %	0.90	11.6	0.85	94.4	0.79	87.6
Glutamic Acid[2], %	0.57	7.27	0.54	94.4	0.50	87.6
Asparagine[2], %	0.27	3.52	0.23	82.4	0.22	81.7
Aspartic Acid[2], %	0.34	4.33	0.28	82.4	0.28	81.7
Total Nitrogen (PB/6.25), %	1.25	16.0	1.12	89.9	1.07	86.0
Essential Nitrogen Poultry, %	0.62	49.6*	0.56	89.7		
Essential Nitrogen Swine, %	0.51	40.9*			0.44	87.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	65	65		65	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	60	65	70	65	70
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Mean + 1 SD of Dry Matter)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.5	-	-	Organic Matter (OM)	89.4		
Crude Protein (CP)	7.98	-	-	Coef. Dig. OM Swine	86.4		
Starch	64.8	-	-	Digestible OM Swine	77.2		
Crude Fiber (CF)	1.76	-	-	Undig. OM Pigs	12.2		
Coef. Dig. CF Swine	41.4			Ether Extract (EE)	3.81	-	-
NDF	14.1	-	-	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	66.4			Digestible EE Poultry	3.50		
ADF	3.23	-	-	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	68.2			Digestible EE Swine	3.43		
N-Free Extract (NFE)	75.8			Linoleic Acid	1.95	-	-
Coef. Dig. NFE Poultry	89.2			Linolenic Acid	0.03	-	-
Digestible NFE Poultry	67.6						
Undig. NFE + CF Poultry	9.95						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4014	-	-	***Swine***			
Poultry				Digestible Energy	3517		
Metabolizable Energy	3437			Metabolizable Energy	3433		
Std. Metab. Energy	3556			Net Energy	2725		
Net Energy	2766			***Sows***			
Hens				Digestible Energy	3604		
Metabolizable Energy	3463			Metabolizable Energy	3525		
Net Energy	2796			Net Energy	2793		
Minerals							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Ash, %	1.14	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	7.03	-	-
Macro Minerals (%)				Iron (Fe)	23.3	-	-
Potassium (K)	0.33	-	-	Copper (Cu)	2.27	-	-
Sodium (Na)	0.01	-	-	Zinc (Zn)	22.0	-	-
Chlorine (Cl)	0.09	-	-	Selenium (Se)	0.07	-	-
Sulfur (S)	0.08	-	-				
Magnesium (Mg)	0.11	-	-				
Total Calcium (Ca)	0.02	-	-				
Total Phosphorus (P)	0.23	-	-				
Phytate P	0.18	-	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.09						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.10						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Grain (Mean + 1 SD of Dry Matter)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	7.98	100	7.17	89.9	6.86	86.0
Lysine, %	0.26	3.23	0.21	82.5	0.20	78.9
Methionine, %	0.16	2.02	0.15	93.4	0.14	86.4
Met + Cys, %	0.33	4.19	0.30	88.3	0.29	88.1
Threonine, %	0.31	3.87	0.29	93.9	0.24	78.8
Tryptophan, %	0.06	0.81	0.06	95.2	0.05	75.7
Arginine, %	0.40	5.03	0.36	91.0	0.36	89.6
Gly + Ser, %	0.74	9.22	0.58	78.9		
Valine, %	0.40	5.06	0.35	87.3	0.36	88.5
Isoleucine, %	0.28	3.52	0.26	94.0	0.25	89.9
Leucine, %	0.98	12.2	0.93	95.4	0.87	89.5
Histidine, %	0.24	3.01	0.22	93.3	0.21	86.5
Phenylalanine, %	0.37	4.64	0.34	90.5	0.33	89.7
Phe + Tyr, %	0.67	8.36	0.62	92.7	0.61	91.0
Alanine, %	0.62	7.72	0.50	81.0	0.53	85.6
Cysteine, %	0.17	2.18	0.15	83.6	0.16	89.7
Tyrosine, %	0.30	3.71	0.28	95.4	0.27	92.6
Glycine, %	0.33	4.10	0.25	76.0	0.26	79.2
Serine, %	0.41	5.12	0.33	81.2	0.34	83.8
Proline, %	0.78	9.80	0.74	94.5	0.65	82.7
Glutamine[2], %	0.92	11.6	0.87	94.4	0.81	87.6
Glutamic Acid[2], %	0.58	7.27	0.55	94.4	0.51	87.6
Asparagine[2], %	0.28	3.52	0.23	82.4	0.23	81.7
Aspartic Acid[2], %	0.34	4.33	0.28	82.4	0.28	81.7
Total Nitrogen (PB/6.25), %	1.28	16.0	1.15	89.9	1.10	86.0
Essential Nitrogen Poultry, %	0.63	49.6*	0.57	89.7		
Essential Nitrogen Swine, %	0.52	40.6*			0.45	87.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	65	65		65	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	60	65	70	65	70
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-lysine Gran

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.4	1	-	Organic Matter (OM)	87.3		
Crude Protein (CP)	8.26	1	-	Coef. Dig. OM Swine	88.0		
Starch	65.4	1	-	Digestible OM Swine	76.8		
Crude Fiber (CF)	1.52	1	-	Undig. OM Pigs	10.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	3.66	1	-
NDF	10.8	1	-	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	3.37		
ADF	3.35	1	-	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	3.29		
N-Free Extract (NFE)	73.8			Linoleic Acid	1.92	1	-
Coef. Dig. NFE Poultry	90.8			Linolenic Acid	0.03	1	-
Digestible NFE Poultry	67.1						
Undig. NFE + CF Poultry	8.31						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3907	1	-	***Swine***			
Poultry				Digestible Energy	3508		
Metabolizable Energy	3405			Metabolizable Energy	3409		
Std. Metab. Energy	3579			Net Energy	2708		
Net Energy	2743			***Sows***			
Hens				Digestible Energy	3569		
Metabolizable Energy	3428			Metabolizable Energy	3492		
Net Energy	2766			Net Energy	2769		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.12	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	10.3	1	-
Macro Minerals (%)				Iron (Fe)	53.4	1	-
Potassium (K)	0.21	1	-	Copper (Cu)	2.60	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	17.6	1	-
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.05	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.05	1	-				
Total Calcium (Ca)	0.04	1	-				
Total Phosphorus (P)	0.20	1	-				
Phytate P	0.15	1	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.08						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.09						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-lysine Gran

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.26	100	7.30	88.3	7.26	87.9
Lysine, %	0.35	4.24	0.30	86.8	0.27	78.4
Methionine, %	0.15	1.82	0.13	89.9	0.14	93.8
Met + Cys, %	0.33	4.00	0.28	85.6	0.30	91.2
Threonine, %	0.34	4.12	0.26	77.8	0.27	80.0
Tryptophan, %	0.11	1.33	0.10	90.9	0.09	81.8
Arginine, %	0.51	6.17	0.47	92.2	0.47	92.9
Gly + Ser, %	0.82	9.93	0.72	87.8		
Valine, %	0.45	5.45	0.38	85.4	0.39	86.4
Isoleucine, %	0.26	3.15	0.22	84.6	0.22	84.6
Leucine, %	0.73	8.84	0.66	90.9	0.67	92.2
Histidine, %	0.31	3.75	0.29	95.1	0.28	90.0
Phenylalanine, %	0.34	4.12	0.31	91.0	0.31	91.7
Phe + Tyr, %	0.57	6.90	0.52	90.4	0.51	89.4
Alanine, %	-	-	-	-	-	-
Cysteine, %	0.18	2.18	0.15	82.1	0.16	89.0
Tyrosine, %	0.23	2.78	0.21	89.4	0.20	86.1
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	1.32	16.0	1.17	88.3	1.16	87.9
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Poedeira Produção***	
	Starter	Grower			
Practical	65	65		65	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	60	65	70	65	70
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-oil Gran

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.7	1	-	Organic Matter (OM)	86.5		
Crude Protein (CP)	8.21	1	-	Coef. Dig. OM Swine	90.0		
Starch	59.0	1	-	Digestible OM Swine	77.9		
Crude Fiber (CF)	2.60	1	-	Undig. OM Pigs	8.65		
Coef. Dig. CF Swine	-			Ether Extract (EE)	6.30	1	-
NDF	10.8	1	-	Coef. Dig. EE Poultry	93.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	5.86		
ADF	3.35	1	-	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	5.67		
N-Free Extract (NFE)	69.4			Linoleic Acid	3.30	1	-
Coef. Dig. NFE Poultry	94.0			Linolenic Acid	0.04	1	-
Digestible NFE Poultry	65.3						
Undig. NFE + CF Poultry	6.76						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4216	1	-	***Swine***			
Poultry				Digestible Energy	3630		
Metabolizable Energy	3560			Metabolizable Energy	3582		
Std. Metab. Energy	-			Net Energy	2835		
Net Energy	2890			***Sows***			
Hens				Digestible Energy	3720		
Metabolizable Energy	3579			Metabolizable Energy	3649		
Net Energy	2909			Net Energy	2884		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.18	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	4.30	1	-
Macro Minerals (%)				Iron (Fe)	93.0	1	-
Potassium (K)	0.35	1	-	Copper (Cu)	3.00	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	21.5	1	-
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.19	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.10	1	-				
Total Calcium (Ca)	0.02	1	-				
Total Phosphorus (P)	0.27	1	-				
Phytate P	0.20	1	-				
Available P (Pav)	0.07						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.11						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.12						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, High-oil Gran

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.21	100	7.26	88.5	7.05	85.8
Lysine, %	0.26	3.17	0.21	81.8	0.21	79.8
Methionine, %	0.18	2.19	0.16	91.4	0.14	76.9
Met + Cys, %	0.39	4.75	0.34	86.3	0.33	83.8
Threonine, %	0.31	3.78	0.27	87.4	0.26	84.2
Tryptophan, %	0.07	0.85	0.06	81.5	0.06	82.8
Arginine, %	0.40	4.87	0.37	93.3	0.37	91.4
Gly + Ser, %	0.79	9.62	0.62	78.8		
Valine, %	0.41	4.99	0.34	82.6	0.36	86.7
Isoleucine, %	0.32	3.90	0.27	84.7	0.28	87.8
Leucine, %	1.03	12.6	0.95	92.1	0.90	87.1
Histidine, %	0.27	3.29	0.25	91.4	0.24	89.0
Phenylalanine, %	0.42	5.12	0.37	88.1	0.38	90.9
Phe + Tyr, %	0.71	8.65	0.65	91.1	0.64	90.2
Alanine, %	0.64	7.80	0.52	81.0	0.55	85.6
Cysteine, %	0.21	2.56	0.17	82.0	0.19	89.7
Tyrosine, %	0.29	3.53	0.28	95.4	0.26	89.3
Glycine, %	0.37	4.51	0.28	76.0	0.29	79.2
Serine, %	0.42	5.12	0.34	81.2	0.35	83.8
Proline, %	0.84	10.2	0.79	94.5	0.69	82.7
Glutamine[2], %	0.98	11.9	0.92	94.4	0.86	87.6
Glutamic Acid[2], %	0.61	7.47	0.58	94.4	0.54	87.6
Asparagine[2], %	0.25	3.06	0.21	82.4	0.21	81.7
Aspartic Acid[2], %	0.31	3.76	0.25	82.4	0.25	81.7
Total Nitrogen (PB/6.25), %	1.31	16.0	1.16	88.5	1.13	85.8
Essential Nitrogen Poultry, %	0.67	50.9*	0.58	86.9		
Essential Nitrogen Swine, %	0.54	41.4*			0.47	86.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Poedeira Produção***	
	Starter	Grower			
Practical	60	55		60	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	50	65	70	50	70
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Pre-cooked

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.6	3	0.54	Organic Matter (OM)	87.7		
Crude Protein (CP)	7.94	3	0.57	Coef. Dig. OM Swine	91.0		
Starch	62.0	3	1.73	Digestible OM Swine	79.8		
Crude Fiber (CF)	1.34	3	0.19	Undig. OM Pigs	7.89		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.64	3	0.12
NDF	10.1	3	0.87	Coef. Dig. EE Poultry	92.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.51		
ADF	2.33	3	0.08	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.48		
N-Free Extract (NFE)	76.8			Linoleic Acid	0.62	1	-
Coef. Dig. NFE Poultry	94.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	72.2						
Undig. NFE + CF Poultry	5.95						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3987	1	-	***Swine***			
Poultry				Digestible Energy	3519		
Metabolizable Energy	3429			Metabolizable Energy	3444		
Std. Metab. Energy	3514			Net Energy	2699		
Net Energy	2744			***Sows***			
Hens				Digestible Energy	3565		
Metabolizable Energy	3451			Metabolizable Energy	3498		
Net Energy	2766			Net Energy	2738		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.92	3	0.12	***Trace Minerals, mg/kg***			
				Manganese (Mn)	11.4	1	-
Macro Minerals (%)				Iron (Fe)	43.9	1	-
Potassium (K)	0.23	3	0.03	Copper (Cu)	2.70	1	-
Sodium (Na)	0.02	2	0.00	Zinc (Zn)	26.5	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	0.16	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.04	1	-				
Total Calcium (Ca)	0.02	3	0.01				
Total Phosphorus (P)	0.19	3	0.02				
Phytate P	0.16	1	-				
Available P (Pav)	0.03						
Coef. Dig. P Poultry	40.8						
Std. Dig. P Poultry	0.08						
Coef. Dig. P Swine	44.0						
Std. Dig. P Swine	0.08						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Pre-cooked

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	7.94	100	7.11	89.5	6.90	86.9
Lysine, %	0.25	3.15	0.21	85.0	0.22	86.0
Methionine, %	0.18	2.27	0.16	90.9	0.16	89.9
Met + Cys, %	0.34	4.28	0.30	89.5	0.31	91.0
Threonine, %	0.31	3.90	0.26	83.5	0.27	85.9
Tryptophan, %	0.07	0.88	0.06	86.4	0.06	85.0
Arginine, %	0.34	4.28	0.31	91.3	0.32	93.5
Gly + Ser, %	0.64	8.06	0.50	78.8		
Valine, %	0.40	5.04	0.35	86.4	0.35	88.1
Isoleucine, %	0.31	3.90	0.29	93.8	0.28	90.3
Leucine, %	1.02	12.9	0.95	93.5	0.92	90.2
Histidine, %	0.26	3.27	0.24	92.4	0.23	89.5
Phenylalanine, %	0.40	5.04	0.37	92.0	0.37	91.9
Phe + Tyr, %	0.67	8.44	0.61	91.4	0.59	88.6
Alanine, %	0.63	7.93	0.51	81.0	0.54	85.6
Cysteine, %	0.16	2.02	0.14	87.9	0.15	92.2
Tyrosine, %	0.27	3.40	0.24	90.6	0.23	83.7
Glycine, %	0.29	3.65	0.22	76.0	0.23	79.2
Serine, %	0.35	4.41	0.28	81.2	0.29	83.8
Proline, %	0.89	11.2	0.84	94.5	0.74	82.7
Glutamine[2], %	0.97	12.2	0.92	94.4	0.85	87.6
Glutamic Acid[2], %	0.61	7.67	0.58	94.4	0.53	87.6
Asparagine[2], %	0.22	2.77	0.18	82.4	0.18	81.7
Aspartic Acid[2], %	0.27	3.40	0.22	82.4	0.22	81.7
Total Nitrogen (PB/6.25), %	1.27	16.0	1.14	89.5	1.10	86.9
Essential Nitrogen Poultry, %	0.62	48.4*	0.55	88.7		
Essential Nitrogen Swine, %	0.51	40.5*			0.46	89.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.3	1	-	Organic Matter (OM)	99.3		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	91.8		
Starch	-	-	-	Digestible OM Swine	91.1		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	8.18		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.3	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	95.1		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	94.4		
ADF	-	-	-	Coef. Dig. EE Swine	88.8		
Coef. Dig. ADF Swine	-			Digestible EE Swine	88.2		
N-Free Extract (NFE)	-			Linoleic Acid	51.9	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.69	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9350	1	-	***Swine***			
Poultry				Energy Dig.	8580		
Energy Met.	8773			Energy Met.	8280		
Std. Metab. Energy	9250			Net Energy	7345		
Net Energy	7896			***Sows***			
Hens				Energy Dig.	8580		
Energy Met.	8773			Energy Met.	8280		
Net Energy	7896			Net Energy	7345		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Corn, Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 28% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.6	12	2.67	Organic Matter (OM)	85.6		
Crude Protein (CP)	28.3	12	2.37	Coef. Dig. OM Swine	50.0		
Starch	3.08	4	0.95	Digestible OM Swine	42.8		
Crude Fiber (CF)	23.7	6	2.98	Undig. OM Pigs	42.8		
Coef. Dig. CF Swine	31.9			Ether Extract (EE)	1.28	4	0.57
NDF	42.7	5	3.69	Coef. Dig. EE Poultry	85.0		
Coef. Dig. NDF Swine	43.8			Digestible EE Poultry	1.09		
ADF	33.1	5	2.94	Coef. Dig. EE Swine	75.3		
Coef. Dig. ADF Swine	47.7			Digestible EE Swine	0.96		
N-Free Extract (NFE)	32.7			Linoleic Acid	0.84	1	-
Coef. Dig. NFE Poultry	43.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	13.9						
Undig. NFE + CF Poultry	42.2						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4173	3	12	***Swine***			
Poultry				Digestible Energy	2222		
Metabolizable Energy	1622			Metabolizable Energy	1996		
Std. Metab. Energy	1768			Net Energy	1066		
Net Energy	1270			***Sows***			
Hens				Digestible Energy	2577		
Energy Met. Hens	1749			Metabolizable Energy	2319		
Net Energy	1397			Net Energy	1302		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.98	8	0.25	***Trace Minerals, mg/kg***			
				Manganese (Mn)	9.70	1	-
Macro Minerals (%)				Iron (Fe)	53.9	1	-
Potassium (K)	0.83	3	0.42	Copper (Cu)	6.70	1	-
Sodium (Na)	0.04	3	0.00	Zinc (Zn)	23.9	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	0.31	1	-
Sulfur (S)	0.34	1	-				
Magnesium (Mg)	0.52	1	-				
Total Calcium (Ca)	0.22	5	0.01				
Total Phosphorus (P)	0.75	5	0.05				
Phytate P	0.56	1	-				
Available P (Pav)	0.19						
Coef. Dig. P Poultry	37.8						
Std. Dig. P Poultry	0.29						
Coef. Dig. P Swine	39.2						
Std. Dig. P Swine	0.30						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 28% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	28.3	100.0	22.0	77.6	21.6	76.4
Lysine, %	1.27	4.49	0.93	73.3	0.74	58.0
Methionine, %	0.46	1.63	0.35	75.5	0.32	69.7
Met + Cys, %	0.96	3.40	0.68	70.9	0.69	72.2
Threonine, %	0.94	3.32	0.68	71.9	0.60	63.9
Tryptophan, %	0.51	1.80	0.37	73.3	0.33	63.9
Arginine, %	3.35	11.9	2.41	72.0	2.96	88.4
Gly + Ser, %	2.50	8.84	1.82	72.7		
Valine, %	1.33	4.70	1.00	75.2	0.87	65.7
Isoleucine, %	0.96	3.40	0.82	85.4	0.61	63.1
Leucine, %	1.79	6.33	1.41	79.0	1.19	66.6
Histidine, %	0.77	2.72	0.56	72.8	0.63	82.1
Phenylalanine, %	1.54	5.45	1.17	76.1	1.20	78.2
Phe + Tyr, %	2.33	8.24	1.80	77.2	1.81	77.8
Alanine, %	1.15	4.07	0.82	71.0	0.80	69.5
Cysteine, %	0.50	1.77	0.33	66.7	0.37	74.5
Tyrosine, %	0.79	2.79	0.63	79.4	0.61	77.0
Glycine, %	1.16	4.10	0.85	72.9	0.81	70.0
Serine, %	1.34	4.74	0.97	72.5	1.01	75.0
Proline, %	1.26	4.46	0.94	74.7	1.06	84.0
Glutamine[2], %	2.71	9.58	2.35	86.9	2.29	84.5
Glutamic Acid[2], %	3.12	11.0	2.71	86.9	2.64	84.5
Asparagine[2], %	1.18	4.18	0.94	79.9	0.91	77.0
Aspartic Acid[2], %	1.46	5.16	1.17	79.9	1.12	77.0
Total Nitrogen (PB/6.25), %	4.52	16.0	3.51	77.6	3.45	76.4
Essential Nitrogen Poultry, %	2.73	60.4*	2.04	74.7		
Essential Nitrogen Swine, %	2.34	51.6*			1.71	73.2

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	3		3	
Maximum	4	5		5	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	4	5	5	3
Maximum	4	7	8	8	6

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 38% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.0	15	0.68	Organic Matter (OM)	83.9		
Crude Protein (CP)	38.1	15	1.94	Coef. Dig. OM Swine	60.0		
Starch	3.96	6	1.98	Digestible OM Swine	50.4		
Crude Fiber (CF)	15.4	10	2.13	Undig. OM Pigs	33.6		
Coef. Dig. CF Swine	19.1			Ether Extract (EE)	2.65	8	2.07
NDF	29.6	8	2.76	Coef. Dig. EE Poultry	85.0		
Coef. Dig. NDF Swine	17.9			Digestible EE Poultry	2.25		
ADF	17.4	7	7.22	Coef. Dig. EE Swine	78.7		
Coef. Dig. ADF Swine	17.3			Digestible EE Swine	2.09		
N-Free Extract (NFE)	27.8			Linoleic Acid	0.84	3	0.20
Coef. Dig. NFE Poultry	40.0			Linolenic Acid	0.01	1	-
Digestible NFE Poultry	11.1						
Undig. NFE + CF Poultry	32.0						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4254	5	112	***Swine***			
Poultry				Digestible Energy	2634		
Energy Met. Poultry	1951			Metabolizable Energy	2432		
Std. Metab. Energy	2173			Net Energy	1425		
Net Energy	1530			***Sows***			
Hens				Digestible Energy	2982		
Metabolizable Energy	2050			Metabolizable Energy	2691		
Net Energy	1629			Net Energy	1609		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.10	11	0.21	***Trace Minerals, mg/kg***			
				Manganese (Mn)	14.3	1	-
Macro Minerals (%)				Iron (Fe)	157.9	1	-
Potassium (K)	1.41	4	0.11	Copper (Cu	10.5	1	-
Sodium (Na)	0.09	4	0.03	Zinc (Zn)	56.7	1	-
Chlorine (Cl)	0.05	4	0.01	Selenium (Se)	0.58	1	-
Sulfur (S)	0.34	1	-	Iodine (I)	14.3	1	-
Magnesium (Mg)	0.53	2	0.04				
Total Calcium (Ca)	0.30	6	0.06				
Total Phosphorus (P)	1.03	6	0.06				
Phytate P	0.65	2	0.08				
Available P (Pav)	0.38						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	40.8						
Std. Dig. P Swine	0.42						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 38% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	38.1	100.0	29.82	78.2	29.7	77.9
Lysine, %	1.57	4.12	1.15	73.5	0.97	62.1
Methionine, %	0.58	1.52	0.46	78.9	0.42	72.8
Met + Cys, %	1.22	3.20	0.87	71.1	0.90	73.7
Threonine, %	1.26	3.30	0.92	73.2	0.86	68.5
Tryptophan, %	0.51	1.34	0.36	70.6	0.35	68.1
Arginine, %	4.14	10.9	3.62	87.5	3.68	88.8
Gly + Ser, %	3.26	8.55	2.32	71.5		
Valine, %	1.71	4.48	1.25	73.1	1.25	73.1
Isoleucina	1.21	3.17	0.85	70.1	0.86	71.1
Leucine, %	2.19	5.74	1.71	78.2	1.61	73.5
Histidine, %	1.08	2.83	0.85	78.6	0.81	75.1
Phenylalanine, %	2.00	5.25	1.68	84.2	1.62	81.3
Phe + Tyr, %	3.03	7.95	2.42	79.8	2.42	79.8
Alanine, %	1.51	3.96	0.98	64.9	1.05	69.5
Cysteine, %	0.64	1.68	0.41	64.0	0.48	74.5
Tyrosine, %	1.03	2.70	0.73	71.2	0.79	77.0
Glycine, %	1.60	4.20	1.14	71.4	1.12	70.0
Serine, %	1.66	4.35	1.19	71.6	1.25	75.0
Proline, %	1.47	3.86	1.04	70.9	1.23	84.0
Glutamine[2], %	3.34	8.76	2.88	86.1	2.82	84.5
Glutamic Acid[2], %	3.85	10.1	3.31	86.1	3.25	84.5
Asparagine[2], %	1.54	4.04	1.19	77.3	1.18	77.0
Aspartic Acid[2], %	1.90	4.99	1.47	77.3	1.46	77.0
Total Nitrogen (PB/6.25), %	6.10	16.0	4.77	78.2	4.75	77.9
Essential Nitrogen Poultry, %	3.45	56.6*	2.69	77.9		
Essential Nitrogen Swine, %	2.93	48.1*			2.25	76.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	3		5	5	
Maximum	7		8	8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	5	6	6	5
Maximum	5	8	10	10	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 43% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.9	5	1.20	Organic Matter (OM)	84.1		
Crude Protein (CP)	42.9	5	1.76	Coef. Dig. OM Swine	63.5		
Starch	2.55	2	0.20	Digestible OM Swine	53.4		
Crude Fiber (CF)	12.6	3	2.74	Undig. OM Pigs	30.7		
Coef. Dig. CF Swine	19.1			Ether Extract (EE)	3.26	4	2.07
NDF	28.7	2	5.56	Coef. Dig. EE Poultry	75.7		
Coef. Dig. NDF Swine	17.9			Digestible EE Poultry	2.47		
ADF	17.9	2	1.94	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	17.3			Digestible EE Swine	2.61		
N-Free Extract (NFE)	25.3			Linoleic Acid	1.12	1	-
Coef. Dig. NFE Poultry	33.0			Linolenic Acid	0.01	1	-
Digestible NFE Poultry	8.35						
Undig. NFE + CF Poultry	29.5						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4346	2	169	***Swine***			
Poultry				Digestible Energy	2877		
Metabolizable Energy	2000			Metabolizable Energy	2630		
Std. Metab. Energy	2204			Net Energy	1595		
Net Energy	1565			***Sows***			
Hens				Digestible Energy	3174		
Metabolizable Energy	2093			Metabolizable Energy	2858		
Net Energy	1658			Net Energy	1761		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.85	3	1.19	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	1.56	2	0.01	Copper (Cu	-	-	-
Sodium (Na)	0.13	2	0.17	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.03	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.48	2	0.18				
Total Calcium (Ca)	0.23	2	0.03				
Total Phosphorus (P)	1.07	2	0.14				
Phytate P	0.61	1	-				
Available P (Pav)	0.46						
Coef. Dig. P Poultry	37.8						
Std. Dig. P Poultry	0.40						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.41						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Cottonseed, Meal 43% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef	SID[1]	Coef
Crude Protein, %	42.9	100.0	33.2	77.4	34.3	80.0
Lysine, %	1.73	4.03	1.11	64.0	1.18	68.0
Methionine, %	0.54	1.26	0.40	73.5	0.40	74.0
Met + Cys, %	1.34	3.12	0.93	69.6	1.00	74.3
Threonine, %	1.37	3.19	0.94	68.5	1.04	76.0
Tryptophan, %	0.52	1.21	0.40	77.5	0.41	79.0
Arginine, %	4.64	10.8	3.99	86.0	4.22	91.0
Gly + Ser, %	3.59	8.37	2.49	69.3		
Valine, %	1.90	4.43	1.42	74.5	1.50	79.0
Isoleucine, %	1.32	3.08	0.94	71.0	1.02	77.0
Leucine, %	2.41	5.62	1.77	73.5	1.88	78.0
Histidine, %	1.14	2.66	0.86	75.5	0.91	80.0
Phenylalanine, %	2.23	5.20	1.84	82.5	1.90	85.0
Phe + Tyr, %	3.43	8.00	2.81	82.0	2.82	82.2
Alanine, %	1.77	4.13	1.15	64.9	1.23	69.5
Cysteine, %	0.80	1.86	0.54	67.0	0.60	74.5
Tyrosine, %	1.20	2.80	0.97	81.0	0.92	77.0
Glycine, %	1.76	4.10	1.26	71.6	1.23	70.0
Serine, %	1.83	4.27	1.23	67.0	1.37	75.0
Proline, %	1.53	3.57	1.13	74.0	1.29	84.0
Glutamine[2], %	3.78	8.80	3.25	86.1	3.19	84.5
Glutamic Acid[2], %	4.35	10.2	3.75	86.1	3.68	84.5
Asparagine[2], %	1.77	4.13	1.37	77.3	1.36	77.0
Aspartic Acid[2], %	2.19	5.10	1.69	77.3	1.69	77.0
Total Nitrogen (PB/6.25), %	6.86	16.0	5.31	77.4	5.49	80.0
Essential Nitrogen Poultry, %	3.80	55.4*	2.87	75.5		
Essential Nitrogen Swine, %	3.23	47.1*			2.62	81.2

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	5		5	
Maximum	7	8		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	5	6	6	5
Maximum	5	8	10	10	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Dendê Palm, Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.5	1	-	Organic Matter (OM)	99.5		
Crude Protein (CP)				Coef. Dig. OM Swine	85.2		
Starch	-	-	-	Digestible OM Swine	84.8		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	14.7		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.5	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	95.5		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	95.0		
ADF	-	-	-	Coef. Dig. EE Swine	84.7		
Coef. Dig. ADF Swine	-			Digestible EE Swine	84.3		
N-Free Extract (NFE)	-			Linoleic Acid	10.3	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9400	1	-	***Swine***			
Poultry				Digestible Energy	8010		
Metabolizable Energy	8817			Metabolizable Energy	7690		
Std. Metab. Energy	-			Net Energy	6917		
Net Energy	7935			***Sows***			
Hens				Digestible Energy	8010		
Metabolizable Energy	8817			Metabolizable Energy	7690		
Net Energy	7935			Net Energy	6917		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Dendê Palm, Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Feather, Meal 76% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.4	54	0.11	Organic Matter (OM)	87.3		
Crude Protein (CP)	76.3	54	0.17	Coef. Dig. OM Swine	61.7		
Starch	-	-	-	Digestible OM Swine	53.9		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	33.4		
Coef. Dig. CF Swine	-			Ether Extract (EE)	7.41	34	0.79
NDF	-	-	-	Coef. Dig. EE Poultry	45.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	3.33		
ADF	-	-	-	Coef. Dig. EE Swine	48.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	3.56		
N-Free Extract (NFE)	3.55			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5137	3	119	***Swine***			
Poultry				Digestible Energy	3170		
Metabolizable Energy	2656			Metabolizable Energy	2805		
Std. Metab. Energy	2766			Net Energy	1634		
Net Energy	2061			***Sows***			
Hens				Digestible Energy	3170		
Metabolizable Energy	2656			Metabolizable Energy	2805		
Net Energy	2061			Net Energy	1634		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.10	34	0.08	***Trace Minerals, mg/kg***			
				Manganese (Mn)	3.30	1	-
Macro Minerals (%)				Iron (Fe)	568.0	1	-
Potassium (K)	0.16	1	-	Copper (Cu)	20.9	1	-
Sodium (Na)	0.22	1	-	Zinc (Zn)	72.4	1	-
Chlorine (Cl)	0.19	1	-	Selenium (Se)	0.29	1	-
Sulfur (S)	0.14	1	-				
Magnesium (Mg)	0.03	1	-				
Total Calcium (Ca)	0.34	6	0.01				
Total Phosphorus (P)	0.67	7	0.03				
Phytate P	-	-	-				
Available P (Pav)	0.67						
Coef. Dig. P Poultry	0.56						
Std. Dig. P Poultry	0.38						
Coef. Dig. P Swine	0.56						
Std. Dig. P Swine	0.38						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Feather, Meal 76% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	76.3	100	54.6	71.5	52.7	69.0
Lysine, %	2.41	3.16	1.73	71.6	1.84	76.3
Methionine, %	0.73	0.96	0.57	77.4	0.55	74.9
Met + Cys, %	3.98	5.21	2.35	59.1	2.66	66.8
Threonine, %	3.42	4.48	2.34	68.3	2.69	78.8
Tryptophan, %	0.62	0.81	0.46	74.6	0.45	71.8
Arginine, %	5.07	6.64	4.04	79.7	4.46	87.9
Gly + Ser, %	13.4	17.5	10.8	80.7		
Valine, %	5.27	6.91	3.96	75.2	4.13	78.3
Isoleucine, %	3.22	4.22	2.58	80.0	2.62	81.5
Leucine, %	6.20	8.12	4.81	77.5	4.91	79.2
Histidine, %	1.10	1.44	0.78	71.1	0.82	74.4
Phenylalanine, %	3.54	4.64	2.87	81.1	2.91	82.2
Phe + Tyr, %	5.69	7.46	4.46	78.3	4.49	78.9
Alanine, %	3.72	4.87	2.98	80.1	2.94	79.0
Cysteine, %	3.25	4.26	1.79	55.0	2.11	65.0
Tyrosine, %	2.15	2.82	1.59	73.8	1.58	73.5
Glycine, %	6.13	8.03	4.80	78.3	4.97	81.0
Serine, %	7.26	9.51	6.01	82.8	5.95	82.0
Proline, %	7.26	9.51	6.43	88.6	5.59	77.0
Glutamine[2], %	2.97	3.89	2.67	89.7	2.17	73.0
Glutamic Acid[2], %	5.02	6.57	4.50	89.7	3.66	73.0
Asparagine[2], %	1.86	2.44	1.33	71.6	1.17	63.0
Aspartic Acid[2], %	3.19	4.18	2.29	71.6	2.01	63.0
Total Nitrogen (PB/6.25), %	12.2	16.0	8.73	71.5	8.43	69.0
Essential Nitrogen Poultry, %	6.99	57.3*	5.43	77.7		
Essential Nitrogen Swine, %	4.88	40.0*			3.92	80.3

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	2		2	
Maximum	2	4		4	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	2	2	2	2
Maximum	2	4	5	5	4

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Feather, Meal 84% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.8	30	2.19	Organic Matter (OM)	89.0		
Crude Protein (CP)	83.1	31	2.01	Coef. Dig. OM Swine	64.3		
Starch	-	-	-	Digestible OM Swine	57.3		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	31.8		
Coef. Dig. CF Swine	-			Ether Extract (EE)	6.83	7	1.23
NDF	-	-	-	Coef. Dig. EE Poultry	30.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	2.05		
ADF	-	-	-	Coef. Dig. EE Swine	35.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	2.39		
N-Free Extract (NFE)	-			Linoleic Acid	0.70	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5256	7	25	***Swine***			
Poultry				Digestible Energy	3380		
Metabolizable Energy	2666			Metabolizable Energy	2922		
Std. Metab. Energy	2849			Net Energy	1666		
Net Energy	2039			***Sows***			
Hens				Digestible Energy	3380		
Metabolizable Energy	2666			Metabolizable Energy	2922		
Net Energy	2039			Net Energy	1666		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.72	19	0.35	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.27	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.25	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.33	5	0.05				
Total Phosphorus (P)	0.47	6	0.18				
Phytate P	-	-	-				
Available P (Pav)	0.47						
Coef. Dig. P Poultry	56.0						
Std. Dig. P Poultry	0.26						
Coef. Dig. P Swine	56.0						
Std. Dig. P Swine	0.26						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Feather, Meal 84% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	83.1	100	58.8	70.7	55.7	67.0
Lysine, %	2.45	2.95	1.72	70.2	1.83	74.7
Methionine, %	0.71	0.85	0.54	76.6	0.57	80.5
Met + Cys, %	4.63	5.57	2.71	58.6	3.03	65.4
Threonine, %	3.79	4.56	2.78	73.3	3.09	81.6
Tryptophan, %	0.66	0.79	0.49	74.2	0.43	65.8
Arginine, %	5.62	6.76	4.54	80.8	4.83	85.9
Gly + Ser, %	16.1	19.3	13.2	82.1		
Valine, %	5.86	7.05	4.64	79.1	4.93	84.2
Isoleucine, %	3.61	4.35	2.89	80.0	3.17	87.8
Leucine, %	6.95	8.37	5.32	76.6	5.85	84.2
Histidine, %	1.16	1.40	0.89	76.6	0.93	80.3
Phenylalanine, %	3.96	4.77	3.18	80.3	3.39	85.6
Phe + Tyr, %	6.46	7.78	5.26	81.5	5.32	82.3
Alanine, %	4.33	5.21	3.42	79.0	3.42	79.0
Cysteine, %	3.92	4.72	2.17	55.3	2.46	62.7
Tyrosine, %	2.50	3.01	2.09	83.5	1.93	77.1
Glycine, %	6.69	8.05	5.42	81.0	5.27	78.8
Serine, %	9.37	11.3	7.76	82.8	8.54	91.1
Proline, %	7.12	8.57	6.31	88.6	5.27	74.0
Glutamine[2], %	3.39	4.08	3.04	89.7	2.58	76.0
Glutamic Acid[2], %	5.72	6.89	5.13	89.7	4.35	76.0
Asparagine[2], %	2.16	2.60	1.55	71.6	1.42	65.8
Aspartic Acid[2], %	3.72	4.47	2.66	71.6	2.45	65.8
Total Nitrogen (PB/6.25), %	13.3	16.0	9.40	70.7	8.91	67.0
Essential Nitrogen Poultry, %	7.86	59.1*	6.21	79.0		
Essential Nitrogen Swine, %	5.36	40.3*			4.47	83.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	2		2	
Maximum	2	4		4	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	2	2	2	2
Maximum	2	4	5	5	4

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Fish, Meal 54% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	92.2	14	1.63	Organic Matter (OM)	71.5		
Crude Protein (CP)	54.9	15	1.73	Coef. Dig. OM Swine	75.5		
Starch	-	-	-	Digestible OM Swine	53.9		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	17.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	8.06	5	1.75
NDF	-	-	-	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	7.01		
ADF	-	-	-	Coef. Dig. EE Swine	91.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	7.33		
N-Free Extract (NFE)	8.53			Linoleic Acid	0.11	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.08	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4040	4	61	***Swine***			
Poultry				Digestible Energy	3050		
Metabolizable Energy	2851			Metabolizable Energy	2740		
Std. Metab. Energy	3065			Net Energy	1738		
Net Energy	2293			***Sows***			
Hens				Digestible Energy	3050		
Metabolizable Energy	2851			Metabolizable Energy	2740		
Net Energy	2293			Net Energy	1738		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	21.7	8	1.25	***Trace Minerals, mg/kg***			
				Manganese (Mn)	41.4	1	-
Macro Minerals (%)				Iron (Fe)	444	1	-
Potassium (K)	0.68	3	0.13	Copper (Cu)	12.0	1	-
Sodium (Na)	0.86	3	0.31	Zinc (Zn)	84.3	1	-
Chlorine (Cl)	0.90	1	-	Selenium (Se)	0.79	1	-
Sulfur (S)	0.64	1	-				
Magnesium (Mg)	0.16	1	-				
Total Calcium (Ca)	5.72	7	0.24				
Total Phosphorus (P)	2.92	7	0.17				
Phytate P	-	-	-				
Available P (Pav)	2.92						
Coef. Dig. P Poultry	75.0						
Std. Dig. P Poultry	2.19						
Coef. Dig. P Swine	80.7						
Std. Dig. P Swine	2.36						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Fish, Meal 54% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	54.9	100	47.6	86.8	41.7	76.0
Lysine, %	3.33	6.07	2.89	86.9	2.57	77.1
Methionine, %	1.29	2.35	1.15	89.1	0.96	74.3
Met + Cys, %	2.25	4.10	1.92	85.3	1.45	64.4
Threonine, %	2.20	4.01	1.86	84.7	1.49	67.6
Tryptophan, %	0.44	0.80	0.38	87.0	0.32	73.5
Arginine, %	3.25	5.92	2.90	89.3	2.70	83.1
Gly + Ser, %	7.68	14.1	6.60	85.9		
Valine, %	2.59	4.72	2.22	85.6	1.82	70.1
Isoleucine, %	2.08	3.79	1.91	91.6	1.59	76.5
Leucine, %	3.52	6.42	3.06	87.0	2.57	73.1
Histidine, %	1.03	1.88	0.85	82.3	0.75	73.2
Phenylalanine, %	2.05	3.74	1.79	87.3	1.51	73.7
Phe + Tyr, %	3.58	6.53	3.00	83.7	2.80	78.3
Alanine, %	3.51	6.40	3.12	89.0	-	-
Cysteine, %	0.96	1.75	0.77	80.3	0.49	51.0
Tyrosine, %	1.53	2.79	1.21	78.8	1.29	84.4
Glycine, %	5.01	9.13	4.19	83.6	-	-
Serine, %	2.67	4.87	2.41	90.1	-	-
Proline, %	3.87	7.05	3.42	88.5	-	-
Glutamine[2], %	2.47	4.50	2.21	89.7	-	-
Glutamic Acid[2], %	3.76	6.86	3.38	89.7	-	-
Asparagine[2], %	1.73	3.15	1.44	83.1	-	-
Aspartic Acid[2], %	2.57	4.69	2.14	83.1	-	-
Total Nitrogen (PB/6.25), %	8.78	16.0	7.62	86.8	6.67	76.0
Essential Nitrogen Poultry, %	4.77	54.4*	4.15	86.9		
Essential Nitrogen Swine, %	3.48	39.7*			2.60	74.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	2		2	
Maximum	7	5		5	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	5	5	5	5
Maximum	10	10	5	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Fish, Meal 62% CP

Main Components (%)							
	Means	**n**	**SD**		**Means**	**n**	**SD**
Dry Matter	93.5	19	1.89	Organic Matter (OM)	72.4		
Crude Protein (CP)	62.5	20	2.98	Coef. Dig. OM Swine	79.0		
Starch	-	-	-	Digestible OM Swine	57.3		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	15.2		
Coef. Dig. CF Swine	-			Ether Extract (EE)	6.68	8	1.57
NDF	-	-	-	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	5.81		
ADF	-	-	-	Coef. Dig. EE Swine	91.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	6.08		
N-Free Extract (NFE)	3.26			Linoleic Acid	0.13	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.10	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Means	**n**	**SD**		**Means**	**n**	**SD**
Gross Energy	4413	3	177	***Swine***			
Poultry				Digestible Energy	3488		
Metabolizable Energy	2949			Metabolizable Energy	3136		
Std. Metab. Energy	-			Net Energy	1958		
Net Energy	2333			***Sows***			
Hens				Digestible Energy	3488		
Metabolizable Energy	2949			Metabolizable Energy	3136		
Net Energy	2333			Net Energy	1958		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	21.0	17	2.31	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.58	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.50	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	5.86	15	1.11				
Total Phosphorus (P)	3.46	15	0.42				
Phytate P	-	-	-				
Available P (Pav)	3.46						
Coef. Dig. P Poultry	75.0						
Std. Dig. P Poultry	2.60						
Coef. Dig. P Swine	80.7						
Std. Dig. P Swine	2.79						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Fish, Meal 62% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	62.5	100	54.4	87.0	55.6	88.9
Lysine, %	4.65	7.43	4.11	88.4	4.09	88.1
Methionine, %	1.74	2.78	1.57	90.7	1.51	87.2
Met + Cys, %	2.44	3.90	1.12	86.9	2.06	84.6
Threonine, %	2.67	4.27	2.33	87.3	2.27	84.9
Tryptophan, %	0.61	0.98	0.53	86.4	0.51	84.4
Arginine, %	3.90	6.24	3.54	90.7	3.45	88.5
Gly + Ser, %	8.55	13.7	7.01	82.0		
Valine, %	3.03	4.85	2.68	88.3	2.60	85.9
Isoleucine, %	2.55	4.07	2.32	91.3	2.24	88.2
Leucine, %	4.35	6.96	3.91	89.8	3.79	87.1
Histidine, %	1.53	2.45	1.34	87.3	1.30	85.0
Phenylalanine, %	2.43	3.89	2.19	90.2	2.10	86.3
Phe + Tyr, %	4.32	6.91	3.82	88.4	3.73	86.3
Alanine, %	4.37	6.98	3.84	88.0	4.02	92.0
Cysteine, %	0.70	1.11	0.55	78.7	0.54	77.0
Tyrosine, %	1.89	3.02	1.63	86.3	1.63	86.3
Glycine, %	5.57	8.90	4.56	82.0	4.95	89.0
Serine, %	2.98	4.77	2.44	82.0	2.71	91.0
Proline, %	3.86	6.17	3.20	83.0	3.59	93.0
Glutamine[2], %	2.87	4.58	2.58	90.0	2.69	94.0
Glutamic Acid[2], %	4.37	6.99	3.93	90.0	4.11	94.0
Asparagine[2], %	2.02	3.23	1.66	82.0	1.78	88.0
Aspartic Acid[2], %	3.00	4.81	2.46	82.0	2.64	88.0
Total Nitrogen (PB/6.25), %	10.0	16.0	8.70	87.0	8.89	88.9
Essential Nitrogen Poultry, %	5.86	58.6*	5.13	87.6		
Essential Nitrogen Swine, %	4.42	44.2*			3.85	87.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	2		2	
Maximum	7	5		5	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	5	5	5	5
Maximum	12	10	5	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Glucose

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.4	1	-	Organic Matter (OM)	90.4		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	95.5		
Starch	-	-	-	Digestible OM Swine	86.3		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	4.07		
Coef. Dig. CF Swine	-			Ether Extract (EE)	-	-	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-	-	-	Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	90.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	90.7			Linolenic Acid	-	-	-
Digestible NFE Poultry	82.0						
Undig. NFE + CF Poultry	8.40						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4017	1	-	***Swine***			
Poultry				Digestible Energy	3652		
Metabolizable Energy	3393			Metabolizable Energy	3579		
Std. Metab. Energy	-			Net Energy	2613		
Net Energy	2714			***Sows***			
Hens				Digestible Energy	3614		
Metabolizable Energy	3420			Metabolizable Energy	3604		
Net Energy	2741			Net Energy	2631		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Glucose

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lactose

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	96.4	2	3.15	Organic Matter (OM)	96.2		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	88.5		
Starch	-	-	-	Digestible OM Swine	85.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	11.0		
Coef. Dig. CF Swine	-			Ether Extract (EE)	-	-	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	-			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**N**	**SD**
Gross Energy	4026	2	88	***Swine***			
Poultry				Digestible Energy	3565		
Metabolizable Energy	-			Metabolizable Energy	3518		
Std. Metab. Energy	-			Net Energy	2568		
Net Energy	-			***Sows***			
Hens				Digestible Energy	3637		
Metabolizable Energy	-			Metabolizable Energy	3610		
Net Energy	-			Net Energy	2635		

Minerals							
	Mean	**n**	**SD**		**Means**	**n**	**SD**
Ash, %	0.17	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lactose

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %						
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	12	-	-	-	-
Maximum	20	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lard

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.6	1	-	Organic Matter (OM)	99.6		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	87.3		
Starch	-	-	-	Digestible OM Swine	87.0		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	12.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.6	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	87.3		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	87.0		
ADF	-	-	-	Coef. Dig. EE Swine	84.6		
Coef. Dig. ADF Swine	-			Digestible EE Swine	84.3		
N-Free Extract (NFE)	-			Linoleic Acid	9.63	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.94	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9369	1	-	***Swine***			
Poultry				Digestible Energy	8180		
Metabolizable Energy	8080			Metabolizable Energy	7939		
Std. Metab. Energy	-			Net Energy	7100		
Net Energy	7272			***Sows***			
Hens				Digestible Energy	8180		
Metabolizable Energy	8080			Metabolizable Energy	7939		
Net Energy	7272			Net Energy	7100		

Minerals							
	Means	**n**	**SD**		**Means**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lard

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lecithin

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.4	1	-	Organic Matter (OM)	93.3		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	71.2		
Starch	-	-	-	Digestible OM Swine	66.4		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	26.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	92.8	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	70.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	65.0		
ADF	-	-	-	Coef. Dig. EE Swine	73.7		
Coef. Dig. ADF Swine	-			Digestible EE Swine	68.4		
N-Free Extract (NFE)	0.49			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	8188	1	-	***Swine***			
Poultry				Digestible Energy	6615		
Metabolizable Energy	6036			Metabolizable Energy	6375		
Std. Metab. Energy	6240			Net Energy	5869		
Net Energy	5433			***Sows***			
Hens				Digestible Energy	6615		
Metabolizable Energy	6036			Metabolizable Energy	6375		
Net Energy	5433			Net Energy	5869		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.11	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Lecithin

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Skimmed, Powder

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	94.1	7	0.78	Organic Matter (OM)	86.0		
Crude Protein (CP)	33.4	9	2.72	Coef. Dig. OM Swine	94.3		
Starch	-	-	-	Digestible OM Swine	81.1		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	4.90		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.79	3	0.10
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	95.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.75		
N-Free Extract (NFE)	51.8			Linoleic Acid	0.02	2	0.00
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4238	5	128	***Swine***			
Poultry				Digestible Energy	3876		
Metabolizable Energy	2736			Metabolizable Energy	3646		
Std. Metab. Energy	-			Net Energy	2448		
Net Energy	-			***Sows***			
Hens				Digestible Energy	3901		
Metabolizable Energy	-			Metabolizable Energy	3678		
Net Energy	-			Net Energy	2472		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	8.10	5	0.38	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	1.53	4	0.07	Copper (Cu)	-	-	-
Sodium (Na)	0.47	4	0.08	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.94	4	0.05	Selenium (Se)	-	-	-
Sulfur (S)	0.00	1	-				
Magnesium (Mg)	0.11	1	-				
Total Calcium (Ca)	1.30	5	0.13				
Total Phosphorus (P)	0.90	5	0.18				
Phytate P	-	-	-				
Available P (Pav)	0.90						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	90.0						
Std. Dig. P Swine	0.81						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Skimmed, Powder

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	33.4	100	-	-	30.1	90.1
Lysine, %	2.61	7.81	-	-	2.43	93.0
Methionine, %	0.84	2.51	-	-	0.80	95.2
Met + Cys, %	1.12	3.35	-	-	1.04	92.7
Threonine, %	1.51	4.52	-	-	1.35	89.3
Tryptophan, %	0.37	1.11	-	-	0.34	91.0
Arginine, %	1.19	3.56	-	-	1.13	95.3
Gly + Ser, %	2.41	7.22	-	-		
Valine, %	2.17	6.50	-	-	1.91	88.1
Isoleucine, %	1.84	5.51	-	-	1.62	87.8
Leucine, %	3.21	9.61	-	-	3.01	93.7
Histidine, %	0.94	2.81	-	-	0.88	93.1
Phenylalanine, %	1.66	4.97	-	-	1.58	95.4
Phe + Tyr, %	3.04	9.10	-	-	2.86	94.1
Alanine, %	1.09	3.26	-	-	0.92	84.5
Cysteine, %	0.28	0.84	-	-	0.24	85.0
Tyrosine, %	1.38	4.13	-	-	1.28	92.5
Glycine, %	0.66	1.98	-	-	0.52	78.5
Serine, %	1.75	5.24	-	-	1.40	80.0
Proline, %	3.25	9.73	-	-	3.12	96.0
Glutamine[2], %	3.68	11.0	-	-	3.22	87.5
Glutamic Acid[2], %	3.09	9.24	-	-	2.70	87.5
Asparagine[2], %	0.99	2.98	-	-	0.88	88.5
Aspartic Acid[2], %	1.51	4.51	-	-	1.33	88.5
Total Nitrogen (PB/6.25), %	5.34	16.0	-	-	4.81	90.1
Essential Nitrogen Poultry, %	2.74	51.3*	-	-		
Essential Nitrogen Swine, %	2.38	44.6*			2.19	92.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	7	-	-	-	-
Maximum	20	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whey, Powder

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	95.2	2	0.28	Organic Matter (OM)	86.5		
Crude Protein (CP)	12.3	3	0.44	Coef. Dig. OM Swine	90.5		
Starch	-	-	-	Digestible OM Swine	78.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	8.21		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.93	2	0.04
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	95.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.88		
N-Free Extract (NFE)	73.2			Linoleic Acid	0.02	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3703	1	-	***Swine***			
Poultry				Energy Dig.	3486		
Energy Met.	1947			Energy Met.	3371		
Std. Metab. Energy	-			Net Energy	2391		
Net Energy	-			***Sows***			
Hens				Energy Dig.	3530		
Energy Met.	-			Energy Met.	3434		
Net Energy	-			Net Energy	2437		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	8.74	2	0.41	***Trace Minerals, mg/kg***			
				Manganese (Mn)	3.00	1	-
Macro Minerals (%)				Iron (Fe)	12.3	1	-
Potassium (K)	2.08	1	-	Copper (Cu)	16.5	1	-
Sodium (Na)	0.79	1	-	Zinc (Zn)	115	1	-
Chlorine (Cl)	1.34	1	-	Selenium (Se)	0.21	1	-
Sulfur (S)	0.30	1	-				
Magnesium (Mg)	0.11	1	-				
Total Calcium (Ca)	0.75	1	-				
Total Phosphorus (P)	0.68	1	-				
Phytate P	-	-	-				
Available P (Pav)	0.68						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	90.0						
Std. Dig. P Swine	0.61						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whey, Powder

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	12.3	100	-	-	10.9	88.2
Lysine, %	0.95	7.72	-	-	0.87	91.4
Methionine, %	0.22	1.79	-	-	0.20	90.5
Met + Cys, %	0.44	3.58	-	-	0.39	89.3
Threonine, %	0.72	5.85	-	-	0.62	86.1
Tryptophan, %	0.19	1.54	-	-	0.16	83.6
Arginine, %	0.35	2.85	-	-	0.32	91.9
Gly + Ser, %	1.15	9.35	-	-		
Valine, %	0.65	5.28	-	-	0.57	87.2
Isoleucine, %	0.66	5.37	-	-	0.59	89.5
Leucine, %	1.08	8.78	-	-	1.00	92.5
Histidine, %	0.24	1.95	-	-	0.22	91.7
Phenylalanine, %	0.40	3.25	-	-	0.36	90.5
Phe + Tyr, %	0.65	5.28	-	-	0.58	89.5
Alanine, %	0.51	4.15	-	-	0.43	84.0
Cysteine, %	0.22	1.79	-	-	0.19	88.0
Tyrosine, %	0.25	2.03	-	-	0.22	88.0
Glycine, %	0.65	5.28	-	-	0.49	75.0
Serine, %	0.50	4.07	-	-	0.41	81.0
Proline, %	0.47	3.82	-	-	0.41	87.0
Glutamine[2], %	0.97	7.88	-	-	0.88	91.0
Glutamic Acid[2], %	0.81	6.60	-	-	0.74	91.0
Asparagine[2], %	0.41	3.33	-	-	0.36	89.0
Aspartic Acid[2], %	0.62	5.05	-	-	0.55	89.0
Total Nitrogen (PB/6.25), %	1.97	16.0	-	-	1.74	88.2
Essential Nitrogen Poultry, %	0.98	49.6*	-	-		
Essential Nitrogen Swine, %	0.79	40.1*			0.71	89.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	-	-	-	-
Maximum	20	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whey, Permeate

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	94.5	1	-	Organic Matter (OM)	88.8		
Crude Protein (CP)	3.00	1	-	Coef. Dig. OM Swine	96.1		
Starch	-	-	-	Digestible OM Swine	85.3		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	3.48		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.20	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	85.6			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3446	1	-	***Swine***			
Poultry				Digestible Energy	3311		
Metabolizable Energy	-			Metabolizable Energy	3225		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.70	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	2.10	1	-	Copper (Cu)	-	-	-
Sodium (Na)	1.00	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	2.00	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.57	1	-				
Total Phosphorus (P)	0.50	1	-				
Phytate P	-	-	-				
Available P (Pav)	0.50						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	90.0						
Std. Dig. P Swine	0.45						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whey, Permeate

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	3.00	100	-	-	-	-
Lysine, %	0.14	4.67	-	-	-	-
Methionine, %	0.02	0.67	-	-	-	-
Met + Cys, %	0.06	2.00	-	-	-	-
Threonine, %	0.11	3.67	-	-	-	-
Tryptophan, %	0.02	0.67	-	-	-	-
Arginine, %	0.05	1.67	-	-	-	-
Gly + Ser, %	-	-	-	-	-	-
Valine, %	0.10	3.33	-	-	-	-
Isoleucine, %	0.13	4.33	-	-	-	-
Leucine, %	0.17	5.67	-	-	-	-
Histidine, %	0.04	1.33	-	-	-	-
Phenylalanine, %	0.05	1.67	-	-	-	-
Phe + Tyr, %	0.07	2.33	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	0.04	1.33	-	-	-	-
Tyrosine, %	0.02	0.67	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	0.48	16.0	-	-	-	-
Essential Nitrogen Poultry, %	0.12	25.0*	-	-		
Essential Nitrogen Swine, %	0.12	25.0*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	-	-	-	-
Maximum	20	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whole, Powder

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	95.9	5	0.12	Organic Matter (OM)	89.5		
Crude Protein (CP)	24.6	5	2.70	Coef. Dig. OM Swine	94.5		
Starch	-	-	-	Digestible OM Swine	84.5		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	4.92		
Coef. Dig. CF Swine	-			Ether Extract (EE)	26.0	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	92.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	23.9		
N-Free Extract (NFE)	38.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5431	1	-	***Swine***			
Poultry				Digestible Energy	5137		
Metabolizable Energy	2635			Metabolizable Energy	4948		
Std. Metab. Energy	-			Net Energy	3788		
Net Energy	-			***Sows***			
Hens				Digestible Energy	5161		
Metabolizable Energy	-			Metabolizable Energy	4990		
Net Energy	-			Net Energy	3819		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.41	5	0.69	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	1.17	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.32	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.71	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.83	4	0.13				
Total Phosphorus (P)	0.65	4	0.04				
Phytate P	-	-	-				
Available P (Pav)	0.65						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	90.0						
Std. Dig. P Swine	0.59						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Milk Whole, Powder

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	24.6	100	-	-	22.8	92.5
Lysine, %	1.95	7.93	-	-	1.80	92.3
Methionine, %	0.61	2.48	-	-	0.59	96.0
Met + Cys, %	0.84	3.42	-	-	0.79	93.5
Threonine, %	1.14	4.64	-	-	1.06	92.6
Tryptophan, %	0.31	1.26	-	-	0.30	95.8
Arginine, %	0.91	3.70	-	-	0.83	91.1
Gly + Ser, %	1.66	6.75	-	-		
Valine, %	1.56	6.34	-	-	1.43	91.6
Isoleucine, %	1.33	5.41	-	-	1.19	89.6
Leucine, %	2.44	9.92	-	-	2.36	96.9
Histidine, %	0.71	2.89	-	-	0.68	95.9
Phenylalanine, %	1.22	4.96	-	-	1.19	97.7
Phe + Tyr, %	2.20	8.95	-	-	2.10	95.5
Alanine, %	0.70	2.85			0.63	90.0
Cysteine, %	0.23	0.94	-	-	0.20	86.9
Tyrosine, %	0.98	3.99	-	-	0.91	92.8
Glycine, %	0.45	1.83	-	-	0.44	97.3
Serine, %	1.21	4.92	-	-	0.97	80.0
Proline, %	1.38	5.61	-	-	1.32	96.0
Glutamine[2], %	2.51	10.2	-	-	2.29	91.0
Glutamic Acid[2], %	2.11	8.56	-	-	1.92	91.0
Asparagine[2], %	0.64	2.60	-	-	0.60	94.0
Aspartic Acid[2], %	0.97	3.94	-	-	0.91	94.0
Total Nitrogen (PB/6.25), %	3.93	16.0	-	-	3.64	92.5
Essential Nitrogen Poultry, %	2.03	51.6*	-	-		
Essential Nitrogen Swine, %	1.79	45.4*			1.67	93.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	7	-	-	-	-
Maximum	20	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Millet, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.3	30	0.89	Organic Matter (OM)	87.6		
Crude Protein (CP)	11.6	30	0.93	Coef. Dig. OM Swine	77.0		
Starch	62.4	5	1.75	Digestible OM Swine	67.4		
Crude Fiber (CF)	2.36	25	1.17	Undig. OM Pigs	20.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	4.59	25	0.62
NDF	20.5	6	3.34	Coef. Dig. EE Poultry	72.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	3.30		
ADF	6.66	6	2.27	Coef. Dig. EE Swine	72.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	3.32		
N-Free Extract (NFE)	69.0			Linoleic Acid	1.63	1	-
Coef. Dig. NFE Poultry	85.0			Linolenic Acid	0.13	1	-
Digestible NFE Poultry	58.7						
Undig. NFE + CF Poultry	12.7						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3963	6	81	***Swine***			
Poultry				Digestible Energy	3159		
Metabolizable Energy	3189			Metabolizable Energy	3046		
Std. Metab. Energy	3354			Net Energy	2414		
Net Energy	2563			***Sows***			
Hens				Digestible Energy	3324		
Metabolizable Energy	3230			Metabolizable Energy	3201		
Net Energy	2604			Net Energy	2527		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.72	15	0.67	***Trace Minerals, mg/kg***			
				Manganese (Mn)	17.8	1	-
Macro Minerals (%)				Iron (Fe)	96.8	1	-
Potassium (K)	0.34	3	0.01	Copper (Cu)	17.6	1	-
Sodium (Na)	0.01	2	0.00	Zinc (Zn)	29.0	1	-
Chlorine (Cl)	0.03	2	0.00	Selenium (Se)	0.06	1	-
Sulfur (S)	0.14	1	-				
Magnesium (Mg)	0.13	1	-				
Total Calcium (Ca)	0.04	7	0.01				
Total Phosphorus (P)	0.29	7	0.11				
Phytate P	0.21	76	-				
Available P (Pav)	0.08						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.11						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.11						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Millet, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	11.6	100	10.6	91.0	10.4	89.1
Lysine, %	0.35	3.01	0.31	89.7	0.28	81.2
Methionine, %	0.27	2.32	0.25	93.2	0.24	88.9
Met + Cys, %	0.56	4.82	0.51	90.6	0.49	87.6
Threonine, %	0.50	4.30	0.43	85.8	0.41	81.1
Tryptophan, %	0.17	1.46	0.16	92.9	0.15	86.1
Arginine, %	0.54	4.65	0.52	97.0	0.50	92.2
Gly + Ser, %	1.10	9.47	0.94	85.0		
Valine, %	0.68	5.85	0.63	92.1	0.60	87.5
Isoleucine, %	0.56	4.82	0.52	92.5	0.49	87.6
Leucine, %	1.29	11.1	1.23	95.0	1.16	90.3
Histidine, %	0.32	2.75	0.31	95.7	0.30	93.9
Phenylalanine, %	0.62	5.34	0.59	94.7	0.55	89.5
Phe + Tyr, %	0.99	8.52	0.93	94.3	0.84	84.6
Alanine, %	1.13	9.73	1.04	91.9	1.03	91.0
Cysteine, %	0.29	2.50	0.26	88.2	0.25	86.4
Tyrosine, %	0.37	3.19	0.35	93.6	0.28	76.3
Glycine, %	0.43	3.70	0.32	74.9	0.36	84.0
Serine, %	0.67	5.77	0.61	91.4	0.60	90.0
Proline, %	0.97	8.35	0.74	76.0	0.92	95.0
Glutamine[2], %	1.35	11.6	1.28	94.9	1.24	92.0
Glutamic Acid[2], %	0.85	7.30	0.80	94.9	0.78	92.0
Asparagine[2], %	0.41	3.52	0.37	91.1	0.35	86.0
Aspartic Acid[2], %	0.50	4.32	0.46	91.1	0.43	86.0
Total Nitrogen (PB/6.25), %	1.86	16.0	1.69	91.0	1.66	89.1
Essential Nitrogen Poultry, %	0.94	50.4*	0.86	91.8		
Essential Nitrogen Swine, %	0.77	41.2*			0.68	88.3

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	15	20		20	
Maximum	40	45		45	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	20	30	40	40	30
Maximum	40	50	60	60	50

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Oats, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.0	40	0.49	Organic Matter (OM)	86.4		
Crude Protein (CP)	12.6	40	2.47	Coef. Dig. OM Swine	63.5		
Starch	45.9	5	9.88	Digestible OM Swine	54.9		
Crude Fiber (CF)	3.73	31	2.94	Undig. OM Pigs	31.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	4.55	40	0.84
NDF	28.7	14	3.23	Coef. Dig.EE Poultry	72.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	3.28		
ADF	11.1	3	7.07	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	3.64		
N-Free Extract (NFE)	65.5			Linoleic Acid	1.61	1	-
Coef. Dig.NFE Poultry	81.0			Linolenic Acid	0.06	1	-
Digestible NFE Poultry	53.1						
Undig. NFE + CF Poultry	16.2						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4117	31	71	***Swine***			
Poultry				Digestible Energy	2645		
Metabolizable Energy	2976			Metabolizable Energy	2546		
Std. Metab. Energy	-			Net Energy	1967		
Net Energy	2391			***Sows***			
Hens				Digestible Energy	2933		
Metabolizable Energy	3030			Metabolizable Energy	2784		
Net Energy	2445			Net Energy	2141		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.54	32	0.40	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.44	2	0.03	Copper (Cu)	-	-	-
Sodium (Na)	0.01	2	0.00	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.10	1	-	Selenium (Se)	-	-	-
Sulfur (S)	0.18	1	-				
Magnesium (Mg)	0.15	3	0.08				
Total Calcium (Ca)	0.07	18	0.02				
Total Phosphorus (P)	0.38	10	0.13				
Phytate P	0.16	1	-				
Available P (Pav)	0.22						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Oats, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	12.6	100	11.1	87.9	10.1	79.7
Lysine, %	0.52	4.11	0.45	86.5	0.39	75.0
Methionine, %	0.21	1.66	0.19	90.5	0.19	90.5
Met + Cys, %	0.59	4.67	0.51	86.4	0.47	79.7
Threonine, %	0.43	3.40	0.36	83.7	0.32	74.4
Tryptophan, %	0.16	1.27	0.12	75.0	0.13	81.3
Arginine, %	0.86	6.80	0.80	93.0	0.76	88.4
Gly + Ser, %	1.24	9.81	1.01	81.5		
Valine, %	0.66	5.22	0.57	86.4	0.53	80.3
Isoleucine, %	0.48	3.80	0.42	87.5	0.39	81.3
Leucine, %	0.93	7.36	0.82	88.2	0.76	81.7
Histidine, %	0.28	2.22	0.25	89.3	0.23	82.1
Phenylalanine, %	0.65	5.14	0.59	90.8	0.55	84.6
Phe + Tyr, %	0.88	6.96	0.78	88.7	0.73	83.0
Alanine, %	0.60	4.75	0.50	83.3	0.41	68.3
Cysteine, %	0.38	3.01	0.32	84.2	0.28	73.7
Tyrosine, %	0.23	1.82	0.19	82.6	0.18	78.3
Glycine, %	0.63	4.98	0.51	81.0	0.43	68.3
Serine, %	0.61	4.83	0.50	82.0	0.46	75.4
Proline, %	0.72	5.70	0.65	90.3	0.53	73.6
Glutamine[2], %	1.43	11.3	1.33	92.9	1.24	86.4
Glutamic Acid[2], %	0.90	7.11	0.84	93.5	0.77	86.0
Asparagine[2], %	0.48	3.83	0.42	86.0	0.37	76.0
Aspartic Acid[2], %	0.60	4.71	0.51	86.2	0.45	75.9
Total Nitrogen (PB/6.25), %	2.02	16.0	1.78	87.9	1.61	79.7
Essential Nitrogen Poultry, %	1.03	50.8*	0.89	86.9		
Essential Nitrogen Swine, %	0.83	41.0*			0.68	82.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	5		7	7	
Maximum	8		10	10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	8	10	10	5
Maximum	8	12	15	20	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Ouricuri (Syagrus coronata), Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.0	1	-	Organic Matter (OM)	83.7		
Crude Protein (CP)	23.0	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	17.6	1	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.82	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	42.3			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	-	-	-	***Swine***			
Poultry				Digestible Energy	1982		
Metabolizable Energy	1431			Metabolizable Energy	1766		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.32	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	39.30	1	-
Macro Minerals (%)				Iron (Fe)	310.0	1	-
Potassium (K)	0.62	1	-	Copper (Cu)	15.60	1	-
Sodium (Na)	0.03	1	-	Zinc (Zn)	68.70	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.25	1	-				
Total Calcium (Ca)	0.10	1	-				
Total Phosphorus (P)	0.70	1	-				
Phytate P	0.47	1	-				
Available P (Pav)	0.23						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.21						
Coef. Dig. P Swine	34.7						
Std. Dig. P Swine	0.24						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Ouricuri (Syagrus coronata), Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	23.0	100	-	-	-	-
Lysine, %	0.70	3.04	-	-	-	-
Methionine, %	0.36	1.57	-	-	-	-
Met + Cys, %	0.68	2.96	-	-	-	-
Threonine, %	0.59	2.57	-	-	-	-
Tryptophan, %	0.21	0.91	-	-	-	-
Arginine, %	2.71	11.8	-	-	-	-
Gly + Ser, %	1.68	7.30	-	-		
Valine, %	1.06	4.61	-	-	-	-
Isoleucine, %	0.76	3.30	-	-	-	-
Leucine, %	1.30	5.65	-	-	-	-
Histidine, %	0.38	1.65	-	-	-	-
Phenylalanine, %	0.92	4.00	-	-	-	-
Phe + Tyr, %	1.39	6.04	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	0.32	1.39	-	-	-	-
Tyrosine, %	0.47	2.04	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	3.68	16.0	-	-	-	-
Essential Nitrogen Poultry, %	-	-*	-	-		
Essential Nitrogen Swine, %	-	-*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	3		4	
Maximum	4	6		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	4	5	4	3
Maximum	4	6	8	8	6

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Pasta/Spaguetti, By-product

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.6	8	0.47	Organic Matter (OM)	87.7		
Crude Protein (CP)	11.7	8	0.83	Coef. Dig. OM Swine	95.5		
Starch	-	-	-	Digestible OM Swine	83.7		
Crude Fiber (CF)	1.75	5	0.23	Undig. OM Pigs	4.00		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.81	3	0.63
NDF	1.07	3	0.24	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.70		
ADF	0.62	3	0.04	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	73.5			Linoleic Acid	0.46	1	-
Coef. Dig. NFE Poultry	97.5			Linolenic Acid	-	-	-
Digestible NFE Poultry	71.6						
Undig. NFE + CF Poultry	3.59						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3860	3	70	***Swine***			
Poultry				Digestible Energy	3685		
Metabolizable Energy	3494			Metabolizable Energy	3538		
Std. Metab. Energy	-			Net Energy	2495		
Net Energy	2782			***Sows***			
Hens				Digestible Energy	3725		
Metabolizable Energy	3510			Metabolizable Energy	3568		
Net Energy	2798			Net Energy	2517		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.85	5	0.27	***Trace Minerals, mg/kg***			
				Manganese (Mn)	9.4	1	-
Macro Minerals (%)				Iron (Fe)	195.8	1	-
Potassium (K)	0.18	1	-	Copper (Cu)	3.4	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	35.6	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.05	1	-				
Total Calcium (Ca)	0.08	3	0.00				
Total Phosphorus (P)	0.18	3	0.08				
Phytate P	0.09	1	-				
Available P (Pav)	0.09						
Coef. Dig. P Poultry	28.0						
Std. Dig. P Poultry	0.05						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.05						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Pasta/Spaguetti, By-product

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	11.7	100	10.9	93.1	10.4	88.7
Lysine, %	0.23	1.97	0.21	89.9	0.19	83.6
Methionine, %	0.18	1.54	0.17	92.8	0.17	92.7
Met + Cys, %	0.45	3.85	0.42	93.2	0.41	90.9
Threonine, %	0.32	2.74	0.25	77.7	0.27	82.9
Tryptophan, %	0.13	1.11	0.12	92.3	-	-
Arginine, %	0.45	3.85	0.42	94.3	0.42	92.6
Gly + Ser, %	0.94	8.04	0.84	89.5		
Valine, %	0.46	3.94	0.41	89.5	0.41	88.2
Isoleucine, %	0.39	3.34	0.36	93.5	0.35	90.3
Leucine, %	0.79	6.76	0.74	93.2	0.73	92.0
Histidine, %	0.25	2.14	0.23	92.7	0.23	92.6
Phenylalanine, %	0.54	4.62	0.52	96.0	0.49	91.3
Phe + Tyr, %	0.84	7.19	0.80	95.4	-	-
Alanine, %	0.36	3.08	0.32	89.2	0.29	81.1
Cysteine, %	0.27	2.31	0.25	93.5	0.24	89.7
Tyrosine, %	0.30	2.57	0.28	94.4	-	-
Glycine, %	0.40	3.42	0.38	94.8	0.36	89.2
Serine, %	0.54	4.62	0.46	85.5	0.49	90.8
Proline, %	1.34	11.5	1.22	91.2	1.27	95.0
Glutamine[2], %	1.55	13.2	1.51	97.7	1.50	96.7
Glutamic Acid[2], %	2.06	17.7	2.02	97.7	1.99	96.7
Asparagine[2], %	0.22	1.89	0.18	83.6	0.18	82.2
Aspartic Acid[2], %	0.25	2.13	0.21	83.6	0.20	82.2
Total Nitrogen (PB/6.25), %	1.87	16.0	1.74	93.1	1.66	88.7
Essential Nitrogen Poultry, %	0.70	37.6*	0.64	91.2		
Essential Nitrogen Swine, %	0.56	29.7*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	10	12		12	
Maximum	15	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	15	20	20	20
Maximum	15	25	30	30	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Peanuts, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.8	8	1.39	Organic Matter (OM)	84.0		
Crude Protein (CP)	48.2	8	4.46	Coef. Dig. OM Swine	80.2		
Starch	12.3	1	-	Digestible OM Swine	67.4		
Crude Fiber (CF)	6.88	5	0.87	Undig. OM Pigs	16.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.91	4	0.20
NDF	15.3	6	0.92	Coef. Dig. EE Poultry	83.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.76		
ADF	11.0	6	1.22	Coef. Dig. EE Swine	55.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.50		
N-Free Extract (NFE)	28.0			Linoleic Acid	0.28	1	-
Coef. Dig. NFE Poultry	31.6			Linolenic Acid	-	-	-
Digestible NFE Poultry	8.84						
Undig. NFE + CF Poultry	26.0						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4438	6	276	***Swine***			
Poultry				Digestible Energy	3455		
Metabolizable Energy	2228			Metabolizable Energy	3155		
Std. Metab. Energy	2394			Net Energy	1971		
Net Energy	1718			***Sows***			
Hens				Digestible Energy	3607		
Metabolizable Energy	2306			Metabolizable Energy	3277		
Net Energy	1796			Net Energy	2060		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.82	5	0.77	***Trace Minerals, mg/kg***			
				Manganese (Mn)	37.0	1	-
Macro Minerals (%)				Iron (Fe)	195.0	1	-
Potassium (K)	1.25	4	0.04	Copper (Cu	17.5	1	-
Sodium (Na)	0.05	4	0.02	Zinc (Zn)	48.3	1	-
Chlorine (Cl)	0.05	4	0.02	Selenium (Se)	0.25	1	-
Sulfur (S)	0.31	1	-				
Magnesium (Mg)	0.32	2	0.01				
Total Calcium (Ca)	0.20	6	0.09				
Total Phosphorus (P)	0.63	6	0.05				
Phytate P	0.42	1	-				
Available P (Pav)	0.21						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Peanuts, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	48.2	100.0	41.6	86.2	41.3	85.7
Lysine, %	1.58	3.28	1.16	73.7	1.18	74.7
Methionine, %	0.52	1.08	0.43	82.0	0.42	81.2
Met + Cys, %	1.13	2.34	0.90	79.3	0.90	79.3
Threonine, %	1.27	2.63	1.00	78.7	0.99	78.1
Tryptophan, %	0.48	1.00	0.40	84.0	0.38	79.8
Arginine, %	5.45	11.3	4.83	88.7	5.08	93.3
Gly + Ser, %	5.01	10.4	4.10	81.9		
Valine, %	1.87	3.88	1.56	83.3	1.54	82.5
Isoleucine, %	1.59	3.30	1.30	81.7	1.33	83.8
Leucine, %	2.95	6.12	2.49	84.3	2.50	84.9
Histidine, %	1.10	2.28	0.95	86.3	0.92	83.3
Phenylalanine, %	2.30	4.77	2.02	87.7	2.06	89.6
Phe + Tyr, %	4.01	8.32	3.57	89.1	3.63	90.6
Alanine, %	1.89	3.92	1.68	89.0	1.59	84.0
Cysteine, %	0.61	1.27	0.47	77.0	0.47	77.7
Tyrosine, %	1.71	3.55	1.56	91.0	1.57	92.0
Glycine, %	2.78	5.77	2.14	77.0	2.11	76.0
Serine, %	2.23	4.63	1.96	88.0	1.92	86.0
Proline, %	1.81	3.76	1.61	89.0	1.41	78.0
Glutamine[2], %	3.27	6.79	3.01	92.0	2.91	89.0
Glutamic Acid[2], %	5.14	10.7	4.73	92.0	4.57	89.0
Asparagine[2], %	1.98	4.12	1.69	85.0	1.73	87.0
Aspartic Acid[2], %	2.78	5.76	2.36	85.0	2.42	87.0
Total Nitrogen (PB/6.25), %	7.71	16.0	6.65	86.2	6.61	85.7
Essential Nitrogen Poultry, %	4.34	56.2*	3.64	83.9		
Essential Nitrogen Swine, %	3.52	45.7*			3.03	85.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	3		5	5	
Maximum	7		10	10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	6	6	6	6
Maximum	7	10	10	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Pork Meat and Bone, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	96.1	444	0.84	Organic Matter (OM)	70.5		
Crude Protein (CP)	52.5	444	1.93	Coef. Dig. OM Swine	72.7		
Starch	-	-	-	Digestible OM Swine	51.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	19.3		
Coef. Dig. CF Swine	-			Ether Extract (EE)	14.1	440	1.35
NDF	-	-	-	Coef. Dig. EE Poultry	62.5		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	8.22		
ADF	-	-	-	Coef. Dig. EE Swine	60.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	8.54		
N-Free Extract (NFE)	3.92			Linoleic Acid	1.42	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.14	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4127	9	76	***Swine***			
Poultry				Digestible Energy	2999		
Metabolizable Energy	2784			Metabolizable Energy	2780		
Std. Metab. Energy	-			Net Energy	1862		
Net Energy	2231			***Sows***			
Hens				Digestible Energy	2999		
Metabolizable Energy	2784			Metabolizable Energy	2780		
Net Energy	2231			Net Energy	1862		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	25.7	438	2.51	***Trace Minerals, mg/kg***			
				Manganese (Mn)	23.9	1	-
Macro Minerals (%)				Iron (Fe)	655.0	1	-
Potassium (K)	-	-	-	Copper (Cu)	16.7	1	-
Sodium (Na)	-	-	-	Zinc (Zn)	115.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.15	1	-				
Total Calcium (Ca)	7.85	437	1.12				
Total Phosphorus (P)	4.08	437	0.46				
Phytate P	-	-	-				
Available P (Pav)	3.67						
Coef. Dig. P Poultry	62.0						
Std. Dig. P Poultry	2.53						
Coef. Dig. P Swine	64.0						
Std. Dig. P Swine	2.61						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Pork Meat and Bone, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	52.5	100	45.5	86.8	39.9	76.0
Lysine, %	2.65	5.05	2.31	87.4	2.01	75.9
Methionine, %	0.85	1.61	0.75	88.4	0.69	82.0
Met + Cys, %	1.29	2.46	1.10	85.9	1.03	80.4
Threonine, %	1.77	3.37	1.50	85.1	1.46	82.4
Tryptophan, %	0.33	0.63	0.28	86.0	0.26	78.0
Arginine, %	3.48	6.64	3.18	91.2	2.87	82.5
Gly + Ser, %	8.40	16.0	7.25	86.3		
Valine, %	2.16	4.12	1.91	88.4	1.77	81.8
Isoleucine, %	1.52	2.91	1.35	88.5	1.26	82.4
Leucine, %	3.21	6.13	2.90	90.2	2.65	82.5
Histidine, %	0.99	1.88	0.87	87.6	0.52	52.2
Phenylalanine, %	1.78	3.39	1.61	90.3	1.45	81.6
Phe + Tyr, %	2.93	5.59	2.64	90.0	2.39	81.5
Alanine, %	3.52	6.71	3.07	87.2	2.68	76.0
Cysteine, %	0.44	0.84	0.36	81.8	0.34	78.0
Tyrosine, %	1.15	2.18	1.03	89.9	0.93	81.6
Glycine, %	6.11	11.7	5.23	85.6	4.67	76.4
Serine, %	2.29	4.37	2.02	88.2	1.78	77.6
Proline, %	4.02	7.66	3.33	82.9	2.66	66.1
Glutamine[2], %	2.56	4.88	2.22	86.7	1.94	75.7
Glutamic Acid[2], %	3.69	7.03	3.20	86.7	2.79	75.7
Asparagine[2], %	1.64	3.13	1.33	81.1	1.07	65.2
Aspartic Acid[2], %	2.28	4.35	1.85	81.1	1.49	65.2
Total Nitrogen (PB/6.25), %	8.39	16.0	7.28	86.8	6.38	76.0
Essential Nitrogen Poultry, %	4.59	54.7*	4.04	88.1		
Essential Nitrogen Swine, %	3.14	37.4*			2.50	89.7

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	5		5	
Maximum	8	10		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	4	4	4	4
Maximum	6	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, By-product Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	93.6	10	1.67	Organic Matter (OM)	77.1		
Crude Protein (CP)	57.4	10	1.06	Coef. Dig. OM Swine	78.8		
Starch	-	-	-	Digestible OM Swine	60.8		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	16.4		
Coef. Dig. CF Swine	-			Ether Extract (EE)	14.0	10	1.63
NDF	-	-	-	Coef. Dig. EE Poultry	91.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	12.7		
ADF	-	-	-	Coef. Dig. EE Swine	89.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	12.4		
N-Free Extract (NFE)	5.72			Linoleic Acid	2.93	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.18	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4957	3	193	***Swine***			
Poultry				Digestible Energy	3905		
Metabolizable Energy	3294			Metabolizable Energy	3566		
Std. Metab. Energy	3421			Net Energy	2402		
Net Energy	2689			***Sows***			
Hens				Digestible Energy	3905		
Metabolizable Energy	3294			Metabolizable Energy	3566		
Net Energy	2689			Net Energy	2402		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	16.5	10	2.96	***Trace Minerals, mg/kg***			
				Manganese (Mn)	2.10	1	-
Macro Minerals (%)				Iron (Fe)	177.0	1	-
Potassium (K)	0.50	3	0.02	Copper (Cu)	19.3	1	-
Sodium (Na)	0.36	3	0.03	Zinc (Zn)	80.4	1	-
Chlorine (Cl)	0.51	1	-	Selenium (Se)	0.52	1	-
Sulfur (S)	0.55	1	-				
Magnesium (Mg)	0.08	3	0.07				
Total Calcium (Ca)	4.01	6	0.82				
Total Phosphorus (P)	2.72	6	0.74				
Phytate P	-	-	-				
Available P (Pav)	2.72						
Coef. Dig. P Poultry	53.0						
Std. Dig. P Poultry	1.44						
Coef. Dig. P Swine	53.0						
Std. Dig. P Swine	1.44						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, By-product Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	57.4	100	47.1	82.0	46.5	81.0
Lysine, %	3.33	5.80	2.66	80.0	2.48	74.5
Methionine, %	1.10	1.92	0.92	83.9	0.87	78.7
Met + Cys, %	1.95	3.40	1.54	79.2	1.44	73.6
Threonine, %	2.36	4.11	1.85	78.4	1.82	77.3
Tryptophan, %	0.54	0.94	0.42	78.3	0.41	76.6
Arginine, %	4.09	7.12	3.60	87.9	3.50	85.5
Gly + Ser, %	8.41	14.6	6.23	74.1		
Valine, %	2.93	5.10	2.41	82.2	2.09	71.2
Isoleucine, %	2.31	4.02	1.93	83.5	1.76	76.2
Leucine, %	4.10	7.14	3.40	82.9	3.12	76.2
Histidine, %	1.10	1.92	0.78	71.0	0.87	79.5
Phenylalanine, %	2.39	4.16	2.03	84.9	1.85	77.2
Phe + Tyr, %	3.99	6.95	3.38	84.8	3.06	76.6
Alanine, %	3.74	6.51	2.78	74.4	3.03	81.0
Cysteine, %	0.85	1.48	0.62	73.1	0.57	66.9
Tyrosine, %	1.60	2.79	1.36	84.7	1.21	75.8
Glycine, %	5.46	9.51	4.02	73.7	4.31	79.0
Serine, %	2.95	5.14	2.21	74.9	2.24	76.0
Proline, %	3.52	6.13	2.75	78.0	2.85	81.0
Glutamine[2], %	2.74	4.77	2.13	77.6	2.14	78.0
Glutamic Acid[2], %	3.77	6.56	2.92	77.6	2.94	78.0
Asparagine[2], %	1.74	3.04	1.16	66.7	1.10	63.0
Aspartic Acid[2], %	2.64	4.59	1.76	66.7	1.66	63.0
Total Nitrogen (PB/6.25), %	9.19	16.0	7.54	82.0	7.44	81.0
Essential Nitrogen Poultry, %	5.36	58.3*	4.30	80.3		
Essential Nitrogen Swine, %	3.94	42.9*			3.05	77.4

[1]Div = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	7	8		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	4	4	4
Maximum	5	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, By-product High-fat Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	94.6	3	1.58	Organic Matter (OM)	82.1		
Crude Protein (CP)	55.6	3	0.33	Coef. Dig. OM Swine	78.9		
Starch	-	-	-	Digestible OM Swine	64.7		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	17.3		
Coef. Dig. CF Swine	-			Ether Extract (EE)	21.0	3	2.51
NDF	-	-	-	Coef. Dig. EE Poultry	90.2		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	18.9		
ADF	-	-	-	Coef. Dig. EE Swine	90.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	18.9		
N-Free Extract (NFE)	5.48			Linoleic Acid	4.26	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.27	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5343	1	-	***Swine***			
Poultry				Digestible Energy	4215		
Metabolizable Energy	3682			Metabolizable Energy	3905		
Std. Metab. Energy	3850			Net Energy	2753		
Net Energy	3055			***Sows***			
Hens				Digestible Energy	4215		
Metabolizable Energy	3682			Metabolizable Energy	3905		
Net Energy	3011			Net Energy	2753		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	12.6	3	0.97	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.47	2	0.09	Copper (Cu)	-	-	-
Sodium (Na)	0.41	2	0.15	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.51	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.06	1	-				
Total Calcium (Ca)	3.58	2	0.68				
Total Phosphorus (P)	2.19	2	0.25				
Phytate P	-	-	-				
Available P (Pav)	2.19						
Coef. Dig. P Poultry	53.0						
Std. Dig. P Poultry	1.16						
Coef. Dig. P Swine	53.0						
Std. Dig. P Swine	1.16						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, By-product High-fat Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	55.6	100	43.7	78.5	42.8	76.8
Lysine, %	3.09	5.55	2.47	80.0	2.30	74.5
Methionine, %	1.06	1.90	0.89	83.9	0.83	78.7
Met + Cys, %	1.84	3.31	1.46	79.3	1.36	73.7
Threonine, %	2.16	3.88	1.69	78.4	1.67	77.3
Tryptophan, %	0.52	0.93	0.41	78.3	0.40	76.6
Arginine, %	3.90	7.01	3.43	87.9	3.33	85.5
Gly + Ser, %	7.75	13.9	5.74	74.1		
Valine, %	2.67	4.80	2.19	82.2	1.90	71.2
Isoleucine, %	2.07	3.72	1.73	83.5	1.58	76.2
Leucine, %	3.89	6.99	3.22	82.9	2.96	76.2
Histidine, %	1.07	1.92	0.76	71.0	0.85	79.5
Phenylalanine, %	2.24	4.03	1.90	84.9	1.73	77.2
Phe + Tyr, %	3.71	6.67	3.15	84.8	2.84	76.6
Alanine, %	3.24	5.82	2.41	74.4	2.62	81.0
Cysteine, %	0.78	1.40	0.57	73.1	0.52	66.9
Tyrosine, %	1.47	2.64	1.25	84.7	1.11	75.8
Glycine, %	5.33	9.58	3.93	73.7	4.21	79.0
Serine, %	2.42	4.35	1.81	74.9	1.84	76.0
Proline, %	3.38	6.07	2.64	78.0	2.74	81.0
Glutamine[2], %	2.33	4.19	1.81	77.6	1.82	78.0
Glutamic Acid[2], %	3.21	5.76	2.49	77.6	2.50	78.0
Asparagine[2], %	1.41	2.54	0.94	66.7	0.89	63.0
Aspartic Acid[2], %	2.14	3.84	1.42	66.7	1.35	63.0
Total Nitrogen (PB/6.25), %	8.90	16.0	6.99	78.5	6.84	76.8
Essential Nitrogen Poultry, %	5.02	56.4*	4.04	80.3		
Essential Nitrogen Swine, %	3.71	41.6*			2.87	77.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	7	8		8	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	4	4	4	4
Maximum	5	7	8	8	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, Fat

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.6	1	-	Organic Matter (OM)	99.6		
Crude Protein (CP)				Coef. Dig. OM Swine	91.3		
Starch	-	-	-	Digestible OM Swine	91.0		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	8.64		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.6	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	93.9		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	93.5		
ADF	-	-	-	Coef. Dig. EE Swine	85.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	85.2		
N-Free Extract (NFE)	-			Linoleic Acid	20.5	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	1.29	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-	-	-				

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9373	56	114	***Swine***			
Poultry				Digestible Energy	8560		
Metabolizable Energy	8681			Metabolizable Energy	8228		
Std. Metab. Energy	9159			Net Energy	7311		
Net Energy	7812			***Sows***			
Hens				Digestible Energy	8560		
Metabolizable Energy	8681			Metabolizable Energy	8228		
Net Energy	7812			Net Energy	7311		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry, Fat

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers		***Hens***		
	Starter	Grower			
Practical	3	3	3		
Maximum	6	7	7		
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry Feather and By-product, Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.8	4	1.27	Organic Matter (OM)	85.1		
Crude Protein (CP)	66.6	4	3.32	Coef. Dig. OM Swine	68.4		
Starch	-	-	-	Digestible OM Swine	58.1		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	26.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	14.3	3	0.61
NDF	-	-	-	Coef. Dig. EE Poultry	77.5		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	11.1		
ADF	-	-	-	Coef. Dig. EE Swine	75.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	10.7		
N-Free Extract (NFE)	4.15			Linoleic Acid	2.00	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.23	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5219	3	24	***Swine***			
Poultry				Digestible Energy	3568		
Metabolizable Energy	3264			Metabolizable Energy	3263		
Std. Metab. Energy	3482			Net Energy	2123		
Net Energy	2624			***Sows***			
Hens				Digestible Energy	3568		
Metabolizable Energy	3264			Metabolizable Energy	3263		
Net Energy	2624			Net Energy	2123		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.75	4	1.17	***Trace Minerals, mg/kg***			
				Manganese (Mn)	6.80	1	-
Macro Minerals (%)				Iron (Fe)	221.1	1	-
Potassium (K)	0.33	1	-	Copper (Cu)	9.50	1	-
Sodium (Na)	0.34	1	-	Zinc (Zn)	95.2	1	-
Chlorine (Cl)	0.34	-	-	Selenium (Se)	0.61	1	-
Sulfur (S)	0.52	1	-				
Magnesium (Mg)	0.13	1	-				
Total Calcium (Ca)	2.47	3	0.13				
Total Phosphorus (P)	1.15	3	0.38				
Phytate P	-	-	-				
Available P (Pav)	1.15						
Coef. Dig. P Poultry	53.0						
Std. Dig. P Poultry	0.61						
Coef. Dig. P Swine	53.0						
Std. Dig. P Swine	0.61						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Poultry Feather and By-product, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	66.6	100	51.9	77.9	51.2	76.8
Lysine, %	2.84	4.26	2.04	71.9	2.14	75.2
Methionine, %	0.89	1.34	0.72	81.2	0.69	77.2
Met + Cys, %	2.80	4.20	1.98	70.8	1.95	69.8
Threonine, %	2.81	4.22	2.19	78.1	2.19	77.9
Tryptophan, %	0.56	0.84	0.46	82.2	0.42	74.7
Arginine, %	4.47	6.71	3.61	80.7	3.87	86.5
Gly + Ser, %	10.1	15.2	7.74	76.5		
Valine, %	3.86	5.80	3.02	78.2	2.86	74.0
Isoleucine, %	2.82	4.23	2.34	82.9	2.21	78.3
Leucine, %	4.98	7.48	3.83	76.9	3.85	77.4
Histidine, %	1.18	1.77	0.86	72.9	0.91	77.5
Phenylalanine, %	2.93	4.40	2.42	82.6	2.32	79.2
Phe + Tyr, %	4.75	7.13	3.88	81.7	3.69	77.6
Alanine, %	3.73	5.60	2.86	76.7	2.99	80.2
Cysteine, %	1.91	2.87	1.26	65.9	1.26	66.1
Tyrosine, %	1.82	2.73	1.46	80.3	1.36	74.9
Glycine, %	5.73	8.60	4.33	75.5	4.57	79.8
Serine, %	4.37	6.56	3.41	78.1	3.43	78.4
Proline, %	5.02	7.54	4.18	83.3	3.99	79.4
Glutamine[2], %	2.82	4.23	2.32	82.4	2.14	76.0
Glutamic Acid[2], %	4.28	6.43	3.53	82.4	3.26	76.0
Asparagine[2], %	1.78	2.68	1.22	68.7	1.12	63.0
Aspartic Acid[2], %	2.87	4.31	1.97	68.7	1.81	63.0
Total Nitrogen (PB/6.25), %	10.7	16.0	8.30	77.9	8.19	76.8
Essential Nitrogen Poultry, %	5.99	56.2*	4.67	78.1		
Essential Nitrogen Swine, %	4.34	40.7*			3.40	78.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	2		2	
Maximum	4	4		4	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	2	2	2	2
Maximum	2	4	5	5	4

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Bran

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.4	32	1.06	Organic Matter (OM)	80.4		
Proteína Bruta	13.1	35	0.75	Coef. Dig. OM Swine	72.2		
Starch	23.8	7	2.56	Digestible OM Swine	56.5		
Crude Fiber (CF)	7.35	22	1.35	Undig. OM Pigs	23.9		
Coef. Dig. CF Swine	39.7			Ether Extract (EE)	15.3	23	1.36
NDF	22.5	8	1.75	Coef. Dig. EE Poultry	70.3		
Coef. Dig. NDF Swine	50.7			Digestible EE Poultry	10.7		
ADF	12.3	6	1.15	Coef. Dig. EE Swine	75.0		
Coef. Dig. ADF Swine	52.9			Digestible EE Swine	11.5		
N-Free Extract (NFE)	44.7			Linoleic Acid	3.15	3	1.35
Coef. Dig. NFE Poultry	62.3			Linolenic Acid	0.08	3	0.10
Digestible NFE Poultry	27.8						
Undig. NFE + CF Poultry	24.2						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4428	19	189	***Swine***			
Poultry				Digestible Energy	3110		
Metabolizable Energy	2583			Metabolizable Energy	3027		
Std. Metab. Energy	3152			Net Energy	2339		
Net Energy	2148			***Sows***			
Hens				Digestible Energy	3329		
Energy Met.	2658			Metabolizable Energy	3203		
Net Energy	2223			Net Energy	2468		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	9.01	21	0.85	***Trace Minerals, mg/kg***			
				Manganese (Mn)	194.5	1	-
Macro Minerals (%)				Iron (Fe)	98.2	11	44.5
Potassium (K)	1.41	5	0.09	Copper (Cu)	28.2	1	-
Sodium (Na)	0.04	5	0.01	Zinc (Zn)	54.9	11	3.59
Chlorine (Cl)	0.07	3	0.01	Selenium (Se)	0.35	1	-
Sulfur (S)	0.18	3	0.01				
Magnesium (Mg)	1.00	11	0.12				
Total Calcium (Ca)	0.07	16	0.02				
Total Phosphorus (P)	2.00	18	0.21				
Phytate P	1.37	2	0.10				
Available P (Pav)	0.63						
Coef. Dig. P Poultry	29.0						
Std. Dig. P Poultry	0.58						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.56						

Pav = Non Phytate P (Total P – Phytate P).

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Bran

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	13.1	100	10.1	77.1	9.40	71.7
Lysine, %	0.63	4.81	0.49	77.0	0.47	74.8
Methionine, %	0.24	1.83	0.19	78.0	0.18	73.7
Met + Cys, %	0.47	3.58	0.33	79.9	0.34	71.4
Threonine, %	0.55	4.19	0.40	72.3	0.41	74.2
Tryptophan, %	0.15	1.14	0.11	75.4	0.11	72.0
Arginine, %	1.05	7.97	0.91	86.7	0.90	86.2
Gly + Ser, %	1.33	10.1	1.02	76.9		
Valine, %	0.76	5.80	0.59	77.1	0.55	73.0
Isoleucina	0.46	3.47	0.35	76.0	0.33	72.0
Leucine, %	0.92	7.02	0.70	75.6	0.66	72.0
Histidine, %	0.37	2.82	0.31	83.4	0.31	83.3
Phenylalanine, %	0.58	4.42	0.42	73.2	0.42	72.8
Phe + Tyr, %	1.02	7.78	0.78	76.7	0.78	76.3
Alanine, %	0.82	6.25	0.62	75.1	0.54	66.0
Cysteine, %	0.23	1.72	0.14	62.8	0.16	70.5
Tyrosine, %	0.44	3.36	0.36	81.3	0.36	81.0
Glycine, %	0.70	5.30	0.57	81.4	0.41	59.0
Serine, %	0.63	4.81	0.46	72.5	0.43	69.0
Proline, %	0.60	4.58	0.43	71.0	0.40	67.0
Glutamine[2], %	1.07	8.15	0.86	80.1	0.76	71.0
Glutamic Acid[2], %	0.67	5.12	0.54	80.1	0.48	71.0
Asparagine[2], %	0.59	4.47	0.43	73.5	0.37	64.0
Aspartic Acid[2], %	0.72	5.49	0.53	73.5	0.46	64.0
Total Nitrogen (PB/6.25), %	2.10	16.0	1.62	77.1	1.50	71.7
Essential Nitrogen Poultry, %	1.17	55.6*	0.91	77.9		
Essential Nitrogen Swine, %	0.95	45.4*			0.72	76.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	3		6	6	
Maximum	8		12	12	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	7	10	10	5
Maximum	10	15	20	20	15

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Broken

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.2	24	1.23	Organic Matter (OM)	87.3		
Crude Protein (CP)	8.00	24	0.53	Coef. Dig. OM Swine	93.0		
Starch	74.9	5	1.29	Digestible OM Swine	81.2		
Crude Fiber (CF)	0.60	7	0.24	Undig. OM Pigs	6.14		
Coef. Dig. CF Swine	-	-	-	Ether Extract (EE)	1.48	19	0.50
NDF	6.33	7	2.81	Coef. Dig.EE Poultry	84.0		
Coef. Dig. NDF Swine	14.5			Digestible EE Poultry	1.24		
ADF	2.09	1	-	Coef. Dig. EE Swine	86.0		
Coef. Dig. ADF Swine	93.0			Digestible EE Swine	1.27		
N-Free Extract (NFE)	77.2			Linoleic Acid	0.37	3	0.03
Coef. Dig. NFE Poultry	89.0			Linolenic Acid	0.14	3	0.10
Digestible NFE Poultry	68.7						
Undig. NFE + CF Poultry	9.10						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3842	7	205	***Swine***			
Poultry				Digestible Energy	3572		
Metabolizable Energy	3219			Metabolizable Energy	3489		
Std. Metab. Energy	3507			Net Energy	2784		
Net Energy	2575			***Sows***			
Hens				Digestible Energy	3597		
Metabolizable Energy	3254			Metabolizable Energy	3532		
Net Energy	2609			Net Energy	2816		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.89	6	0.06	***Trace Minerals, mg/kg***			
				Manganese (Mn)	16.6	1	-
Macro Minerals (%)				Iron (Fe)	15.6	1	-
Potassium (K)	0.20	5	0.07	Copper (Cu)	2.30	1	-
Sodium (Na)	0.02	6	0.01	Zinc (Zn)	10.3	1	-
Chlorine (Cl)	0.05	4	0.02	Selenium (Se)	0.31	1	-
Sulfur (S)	0.80	1	-				
Magnesium (Mg)	0.08	1	-				
Total Calcium (Ca)	0.05	8	0.01				
Total Phosphorus (P)	0.18	8	0.02				
Phytate P	0.13	2	0.02				
Available P (Pav)	0.06						
Coef. Dig. P Poultry	36.0						
Std. Dig. P Poultry	0.06						
Coef. Dig. P Swine	36.0						
Std. Dig. P Swine	0.06						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Broken

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.00	100	6.20	77.5	7.07	88.4
Lysine, %	0.30	3.75	0.24	80.8	0.25	84.8
Methionine, %	0.20	2.50	0.16	78.6	0.17	86.5
Met + Cys, %	0.37	4.63	0.26	69.2	0.30	80.3
Threonine, %	0.28	3.50	0.22	76.8	0.23	82.4
Tryptophan, %	0.10	1.25	0.08	80.1	0.08	82.0
Arginine, %	0.61	7.63	0.54	88.4	0.57	92.8
Gly + Ser, %	0.78	9.76	0.55	70.7		
Valine, %	0.48	6.00	0.37	78.0	0.41	85.5
Isoleucine, %	0.34	4.25	0.27	78.1	0.30	87.8
Leucine, %	0.68	8.51	0.55	81.3	0.61	89.3
Histidine, %	0.20	2.50	0.15	74.8	0.18	88.4
Phenylalanine, %	0.40	5.00	0.30	73.8	0.35	88.0
Phe + Tyr, %	0.78	9.76	0.60	76.6	0.68	87.4
Alanine, %	0.46	5.75	0.33	71.2	0.40	86.3
Cysteine, %	0.17	2.13	0.10	58.2	0.12	73.0
Tyrosine, %	0.38	4.75	0.30	79.6	0.33	86.8
Glycine, %	0.37	4.63	0.26	69.2	0.35	95.4
Serine, %	0.41	5.13	0.30	72.1	0.37	89.9
Proline, %	0.41	5.13	0.26	63.5	0.38	91.9
Glutamine[2], %	0.88	11.0	0.71	81.1	0.79	90.2
Glutamic Acid[2], %	0.55	6.90	0.45	81.1	0.50	90.2
Asparagine[2], %	0.33	4.15	0.27	81.1	0.29	87.2
Aspartic Acid[2], %	0.41	5.10	0.33	81.1	0.36	87.2
Total Nitrogen (PB/6.25), %	1.28	16.0	0.99	77.5	1.13	88.4
Essential Nitrogen Poultry, %	0.70	54.5*	0.55	78.3		
Essential Nitrogen Swine, %	0.57	44.8*			0.50	87.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	30	30		30	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	40	40	40	40
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Defatted Bran

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.8	8	1.50	Organic Matter (OM)	79.1		
Crude Protein (CP)	15.9	9	1.37	Coef. Dig. OM Swine	64.7		
Starch	26.8	6	1.67	Digestible OM Swine	51.2		
Crude Fiber (CF)	10.5	4	0.78	Undig. OM Pigs	27.9		
Coef. Dig. CF Swine	39.7			Ether Extract (EE)	1.60	3	0.09
NDF	24.7	6	1.15	Coef. Dig. EE Poultry	62.0		
Coef. Dig. NDF Swine	50.7			Digestible EE Poultry	0.99		
ADF	14.3	4	2.12	Coef. Dig. EE Swine	70.0		
Coef. Dig. ADF Swine	52.9			Digestible EE Swine	1.12		
N-Free Extract (NFE)	51.1			Linoleic Acid	0.58	3	0.16
Coef. Dig. NFE Poultry	58.2			Linolenic Acid	0.03	1	-
Digestible NFE Poultry	29.7						
Undig. NFE + CF Poultry	31.9						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3833	4	150	***Swine***			
Poultry				Digestible Energy	2364		
Metabolizable Energy	1843			Metabolizable Energy	2270		
Std. Metab. Energy	-			Net Energy	1569		
Net Energy	1463			***Sows***			
Hens				Digestible Energy	2630		
Metabolizable Energy	1937			Metabolizable Energy	2481		
Net Energy	1558			Net Energy	1723		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	10.7	6	0.69	***Trace Minerals, mg/kg***			
				Manganese (Mn)	170.3	1	-
Macro Minerals (%)				Iron (Fe)	170.1	1	-
Potassium (K)	1.51	4	0.27	Copper (Cu)	14.7	-	-
Sodium (Na)	0.04	4	0.02	Zinc (Zn)	47.7	1	-
Chlorine (Cl)	0.08	3	0.02	Selenium (Se)	-	-	-
Sulfur (S)	0.18	2	0.92				
Magnesium (Mg)	0.75	1	-				
Total Calcium (Ca)	0.12	5	0.05				
Total Phosphorus (P)	1.82	6	0.08				
Phytate P	1.50	4	0.08				
Available P (Pav)	0.32						
Coef. Dig. P Poultry	29.0						
Std. Dig. P Poultry	0.53						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.51						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rice, Defatted Bran

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef	SID[1]	Coef
Crude Protein, %	15.9	100	12.0	75.7	11.4	71.5
Lysine, %	0.71	4.47	0.54	75.6	0.52	72.9
Methionine, %	0.33	2.08	0.25	75.7	0.25	74.4
Met + Cys, %	0.66	4.15	0.46	70.3	0.47	71.2
Threonine, %	0.60	3.77	0.41	69.1	0.44	74.1
Tryptophan, %	0.20	1.26	0.15	75.4	0.14	73.7
Arginine, %	1.24	7.80	1.05	84.3	1.05	84.3
Gly + Ser, %	1.59	10.0	1.18	73.9		
Valine, %	0.86	5.41	0.63	73.0	0.64	74.2
Isoleucine, %	0.56	3.52	0.40	71.0	0.41	73.8
Leucine, %	1.12	7.04	0.80	71.6	0.82	73.0
Histidine, %	0.42	2.64	0.35	82.7	0.33	79.3
Phenylalanine, %	0.71	4.47	0.50	71.0	0.51	72.4
Phe + Tyr, %	1.07	6.73	0.81	75.3	0.82	77.0
Alanine, %	0.98	6.16	0.72	73.2	0.65	66.0
Cysteine, %	0.33	2.08	0.21	64.9	0.22	68.0
Tyrosine, %	0.36	2.26	0.30	83.6	0.31	86.0
Glycine, %	0.85	5.35	0.64	75.3	0.50	59.0
Serine, %	0.74	4.65	0.54	72.3	0.51	69.0
Proline, %	0.72	4.53	0.48	67.3	0.48	67.0
Glutamine[2], %	1.35	8.50	1.09	80.6	0.96	71.0
Glutamic Acid[2], %	0.85	5.33	0.68	80.6	0.60	71.0
Asparagine[2], %	0.63	3.98	0.50	78.6	0.40	64.0
Aspartic Acid[2], %	0.78	4.89	0.61	78.6	0.50	64.0
Total Nitrogen (PB/6.25), %	2.54	16.0	1.92	75.7	1.82	71.5
Essential Nitrogen Poultry, %	1.38	54.1*	1.03	75.0		
Essential Nitrogen Swine, %	1.12	44.0*			0.85	75.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	5		5	
Maximum	6	8		10	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	5	7	10	5
Maximum	8	12	20	20	12

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rye, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.3	1	-	Organic Matter (OM)	85.2		
Crude Protein (CP)	10.3	2	1.77	Coef. Dig. OM Swine	84.0		
Starch	59.6	2	8.20	Digestible OM Swine	71.5		
Crude Fiber (CF)	1.90	1	-	Undig. OM Pigs	13.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.60	2	0.57
NDF	14.10	1		Coef. Dig. EE Poultry	32.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.51		
ADF	3.10	1	-	Coef. Dig. EE Swine	37.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.59		
N-Free Extract (NFE)	71.4			Linoleic Acid	0.48	1	-
Coef. Dig. NFE Poultry	86.8			Linolenic Acid	0.06	1	-
Digestible NFE Poultry	61.9						
Undig. NFE + CF Poultry	11.3						

Energy (kcal/kg)							
	Mean	**N**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3749	1	-	***Swine***			
Poultry				Digestible Energy	3128		
Metabolizable Energy	2870			Metabolizable Energy	3057		
Std. Metab. Energy	-			Net Energy	2385		
Net Energy	2289			***Sows***			
Hens				Digestible Energy	3247		
Metabolizable Energy	2912			Metabolizable Energy	3158		
Net Energy	2330			Net Energy	2459		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.15	2	0.50	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.45	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.06	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.11	1	-				
Total Calcium (Ca)	0.04	1	-				
Total Phosphorus (P)	0.31	1	-				
Phytate P	0.19	1	-				
Available P (Pav)	0.12						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.12						
Coef. Dig. P Swine	30.0						
Std. Dig. P Swine	0.09						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Rye, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	10.3	100	6.15	60.0	7.94	77.0
Lysine, %	0.39	3.79	-	-	0.28	71.8
Methionine, %	0.17	1.65	-	-	0.14	82.4
Met + Cys, %	0.89	8.64	-	-	0.65	73.0
Threonine, %	0.35	3.40	-	-	0.25	71.4
Tryptophan, %	0.10	0.97	-	-	0.07	70.0
Arginine, %	0.51	4.95	-	-	0.41	80.4
Gly + Ser, %	0.91	8.83	-	-		
Valine, %	0.49	4.76	-	-	0.37	75.5
Isoleucine, %	0.35	3.40	-	-	0.27	77.1
Leucine, %	0.63	6.12	-	-	0.50	79.4
Histidine, %	0.22	2.14	-	-	0.18	81.8
Phenylalanine, %	0.46	4.47	-	-	0.38	82.6
Phe + Tyr, %	0.73	7.09	-	-	0.59	80.8
Alanine, %	0.44	4.27	-	-	0.30	68.2
Cysteine, %	0.72	6.99	-	-	0.51	70.8
Tyrosine, %	0.27	2.62	-	-	0.21	77.8
Glycine, %	0.45	4.37	-	-	0.33	73.3
Serine, %	0.46	4.47	-	-	0.35	76.1
Proline, %	0.99	9.61	-	-	0.89	89.9
Glutamine[2], %	1.45	14.1	-	-	1.12	77.0
Glutamic Acid[2], %	0.91	8.83	-	-	0.70	77.0
Asparagine[2], %	0.34	3.27	-	-	0.24	71.0
Aspartic Acid[2], %	0.41	4.01	-	-	0.29	71.0
Total Nitrogen (PB/6.25), %	1.65	16.0	0.99	60.0	1.27	77.0
Essential Nitrogen Poultry, %	0.72	43.5*	-	-		
Essential Nitrogen Swine, %	0.57	34.7*			0.44	77.7

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	4		7	7	
Maximum	8		15	15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	4	8	8	8	8
Maximum	8	15	15	15	15

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Shrimp, By-product Meal [#]

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.0	1	-	Organic Matter (OM)	47.9		
Crude Protein (CP)	32.6	1	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	3.90	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	11.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	2386	1	-	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	1163			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	41.1	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	14.1	1	-
Macro Minerals (%)				Iron (Fe)	149.0	1	-
Potassium (K)	-	-	-	Copper (Cu)	32.2	1	-
Sodium (Na)	1.33	1	-	Zinc (Zn)	57.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	12.2	1	-				
Total Phosphorus (P)	2.31	1	-				
Phytate P	-	-	-				
Available P (Pav)	2.31						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P). [#]By-product after processing to remove shrimp fillets from extractive fishing.

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Shrimp, By-product Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	32.6	100	22.0	67.5	-	-
Lysine, %	1.67	5.12	1.27	76.1	-	-
Methionine, %	0.54	1.66	0.29	53.7	-	-
Met + Cys, %	0.85	2.61	0.61	71.8	-	-
Threonine, %	1.08	3.31	0.53	49.1	-	-
Tryptophan, %	0.68	2.09	0.54	79.4	-	-
Arginine, %	1.43	4.39	0.98	68.5	-	-
Gly + Ser, %	2.77	8.50	0.70	25.3		
Valine, %	1.51	4.63	1.03	68.2	-	-
Isoleucine, %	1.26	3.87	0.80	63.5	-	-
Leucine, %	1.93	5.92	1.35	70.0	-	-
Histidine, %	0.52	1.60	0.34	65.4	-	-
Phenylalanine, %	2.29	7.02	1.85	80.8	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	1.58	-	-	-	-	-
Cysteine, %	0.31	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	1.70	-	-	-	-	-
Serine, %	1.07	-	-	-	-	-
Proline, %	1.17	-	-	-	-	-
Glutamine[2], %	1.45	-	-	-	-	-
Glutamic Acid[2], %	2.20	-	-	-	-	-
Asparagine[2], %	1.07	-	-	-	-	-
Aspartic Acid[2], %	1.59	-	-	-	-	-
Total Nitrogen (PB/6.25), %	5.22	16.0	3.52	67.5	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sorghum, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.5	125	1.21	Organic Matter (OM)	86.2		
Crude Protein (CP)	8.65	324	0.99	Coef. Dig. OM Swine	88.7		
Starch	66.6	10	4.44	Digestible OM Swine	76.5		
Crude Fiber (CF)	2.58	100	0.52	Undig. OM Pigs	9.74		
Coef. Dig. CF Swine	75.5			Ether Extract (EE)	3.13	79	0.47
NDF	11.2	11	1.41	Coef. Dig. EE Poultry	79.0		
Coef. Dig. NDF Swine	73.2			Digestible EE Poultry	2.47		
ADF	5.24	11	0.75	Coef. Dig. EE Swine	77.0		
Coef. Dig. ADF Swine	85.4			Digestible EE Swine	2.41		
N-Free Extract (NFE)	71.9			Linoleic Acid	1.05	1	-
Coef. Dig. NFE Poultry	88.5			Linolenic Acid	0.08	1	-
Digestible NFE Poultry	63.6						
Undig. NFE + CF Poultry	10.8						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3988	10	226	***Swine***			
Poultry				Digestible Energy	3410		
Metabolizable Energy	3204			Metabolizable Energy	3358		
Std. Metab. Energy	3374			Net Energy	2656		
Net Energy	2572			***Sows***			
Hens				Digestible Energy	3512		
Metabolizable Energy	3234			Metabolizable Energy	3432		
Net Energy	2602			Net Energy	2710		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.30	101	0.34	***Trace Minerals, mg/kg***			
				Manganese (Mn)	10.9	1	-
Macro Minerals (%)				Iron (Fe)	59.7	1	-
Potassium (K)	0.36	6	0.05	Copper (Cu)	5.60	1	-
Sodium (Na)	0.02	6	0.01	Zinc (Zn)	49.8	1	-
Chlorine (Cl)	0.06	3	0.02	Selenium (Se)	0.35	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.14	1	-				
Total Calcium (Ca)	0.03	11	0.01				
Total Phosphorus (P)	0.23	19	0.06				
Phytate P	0.16	5	0.02				
Available P (Pav)	0.07						
Coef. Dig. P Poultry	36.0						
Std. Dig. P Poultry	0.08						
Coef. Dig. P Swine	36.0						
Std. Dig. P Swine	0.08						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sorghum, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.65	100	7.61	91.7	7.07	87.9
Lysine, %	0.20	2.31	0.18	90.2	0.16	81.3
Methionine, %	0.15	1.73	0.13	86.7	0.13	89.6
Met + Cys, %	0.30	3.47	0.27	90.0	0.26	88.2
Threonine, %	0.28	3.24	0.25	89.4	0.24	84.1
Tryptophan, %	0.10	1.16	0.09	87.0	0.08	79.8
Arginine, %	0.35	4.05	0.31	89.9	0.32	90.2
Gly + Ser, %	0.70	8.09	0.57	81.1		
Valine, %	0.44	5.09	0.41	93.2	0.40	90.1
Isoleucine, %	0.35	4.05	0.33	95.0	0.31	89.4
Leucine, %	1.17	13.5	1.12	95.3	1.04	89.1
Histidine, %	0.20	2.31	0.19	93.9	0.17	84.8
Phenylalanine, %	0.46	5.32	0.45	97.8	0.42	91.6
Phe + Tyr, %	0.82	9.48	0.78	95.1	0.76	92.3
Alanine, %	0.82	9.48	0.77	93.4	0.72	87.6
Cysteine, %	0.15	1.73	0.14	93.3	0.13	86.7
Tyrosine, %	0.36	4.16	0.33	91.7	0.34	93.1
Glycine, %	0.31	3.58	0.24	77.4	0.30	97.7
Serine, %	0.39	4.51	0.33	84.1	0.36	91.5
Proline, %	0.76	8.79	0.71	93.3	0.56	74.0
Glutamine[2], %	0.86	9.92	0.81	94.4	0.76	88.9
Glutamic Acid[2], %	1.19	13.8	1.12	94.4	1.06	88.9
Asparagine[2], %	0.29	3.37	0.23	80.1	0.26	89.1
Aspartic Acid[2], %	0.34	3.91	0.27	80.1	0.30	89.1
Total Nitrogen (PB/6.25), %	1.38	16.0	1.27	91.7	1.22	87.9
Essential Nitrogen Poultry, %	0.63	45.5*	0.58	91.5		
Essential Nitrogen Swine, %	0.52	37.6*			0.46	88.4

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	30	30		30	
Maximum	65	65		65	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	35	35	35	35
Maximum	60	65	70	65	70

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sorghum, Grain High Tannin

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	85.9	1	-	Organic Matter (OM)	84.0		
Crude Protein (CP)	8.97	1	-	Coef. Dig. OM Swine	81.6		
Starch	56.8	1	-	Digestible OM Swine	68.6		
Crude Fiber (CF)	2.78	1	-	Undig. OM Pigs	15.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.35	1	-
NDF	9.80	1	-	Coef. Dig. EE Poultry	83.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.95		
ADF	4.60	1	-	Coef. Dig. EE Swine	68.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.60		
N-Free Extract (NFE)	69.9			Linoleic Acid	1.13	1	-
Coef. Dig. NFE Poultry	86.5			Linolenic Acid	-	-	-
Digestible NFE Poultry	60.5						
Undig. NFE + CF Poultry	12.2						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3860	1	-	***Swine***			
Poultry				Digestible Energy	3081		
Metabolizable Energy	2956			Metabolizable Energy	2984		
Std. Metab. Energy	3037			Net Energy	2332		
Net Energy	2374			***Sows***			
Hens				Digestible Energy	3179		
Metabolizable Energy	2985			Metabolizable Energy	3095		
Net Energy	2403			Net Energy	2413		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.86	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	10.9	1	-
Macro Minerals (%)				Iron (Fe)	59.7	1	-
Potassium (K)	0.31	1	-	Copper (Cu)	7.60	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	18.6	1	-
Chlorine (Cl)	0.01	1	-	Selenium (Se)	0.25	1	-
Sulfur (S)	0.10	1	-				
Magnesium (Mg)	0.11	1	-				
Total Calcium (Ca)	0.03	1	-				
Total Phosphorus (P)	0.26	1	-				
Phytate P	0.18	1	-				
Available P (Pav)	0.08						
Coef. Dig. P Poultry	36.0						
Std. Dig. P Poultry	0.09						
Coef. Dig. P Swine	36.0						
Std. Dig. P Swine	0.09						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sorghum, Grain High Tannin

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	8.97	100	6.10	68.0	6.61	73.7
Lysine, %	0.20	2.23	0.15	72.7	0.15	72.7
Methionine, %	0.15	1.67	0.11	75.0	0.12	81.3
Met + Cys, %	0.30	3.34	0.21	69.7	0.22	72.7
Threonine, %	0.29	3.23	0.20	69.7	0.22	75.8
Tryptophan, %	0.10	1.11	0.07	66.7	0.08	77.8
Arginine, %	0.35	3.90	0.26	73.7	0.24	68.4
Gly + Ser, %	0.70	7.80	-	-		
Valine, %	0.44	4.91	0.32	73.6	0.35	79.2
Isoleucine, %	0.36	4.01	0.27	74.4	0.29	81.4
Leucine, %	1.16	12.9	0.66	56.7	0.99	85.1
Histidine, %	0.20	2.23	0.12	59.1	0.16	81.8
Phenylalanine, %	0.46	5.13	0.35	77.1	0.38	83.3
Phe + Tyr, %	0.82	9.14	0.61	75.3	0.68	83.9
Alanine, %	0.82	9.14	-	-	-	-
Cysteine, %	0.15	1.67	0.10	64.4	0.10	64.1
Tyrosine, %	0.36	4.01	0.26	72.9	0.30	84.6
Glycine, %	0.31	3.46	-	-	-	-
Serine, %	0.39	4.35	-	-	-	-
Proline, %	0.76	8.47	-	-	-	-
Glutamine[2], %	0.86	9.57	-	-	-	-
Glutamic Acid[2], %	1.19	13.3	-	-	-	-
Asparagine[2], %	0.29	3.25	-	-	-	-
Aspartic Acid[2], %	0.34	3.77	-	-	-	-
Total Nitrogen (PB/6.25), %	1.44	16.0	0.98	68.0	1.06	73.7
Essential Nitrogen Poultry, %	0.63	43.9*	-	-		
Essential Nitrogen Swine, %	0.52	36.3*			0.42	80.3

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	15	20		20	
Maximum	30	30		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	15	20	20	20	20
Maximum	30	35	35	35	35

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Acid Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.2	2	0.42	Organic Matter (OM)	-		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	95.8	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	88.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	84.3		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	-			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9271	2	21	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	7830			Metabolizable Energy	7689		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	7047			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	7830			Metabolizable Energy	-		
Net Energy	7047			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Acid Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	2		2	
Maximum	2	3		3	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	2	-	2	2
Maximum	2	3	-	3	3

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Degummed Oil

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.7	2	0.13	Organic Matter (OM)	99.7		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	92.0		
Starch	-	-	-	Digestible OM Swine	91.8		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	7.94		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.5	2	0.14
NDF	-	-	-	Coef. Dig. EE Poultry	95.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	94.5		
ADF	-	-	-	Coef. Dig. EE Swine	88.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	88.1		
N-Free Extract (NFE)	-			Linoleic Acid	52.2	2	0.67
Coef. Dig. NFE Poultry	-			Linolenic Acid	6.80	2	0.21
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9344	2	16	***Swine***			
Poultry				Digestible Energy	8600		
Metabolizable Energy	8790			Metabolizable Energy	8300		
Std. Metab. Energy	9200			Net Energy	7362		
Net Energy	7912			***Sows***			
Hens				Digestible Energy	8600		
Metabolizable Energy	8790			Metabolizable Energy	8300		
Net Energy	7912			Net Energy	7362		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Degummed Oil

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	3		3	
Maximum	6	7		7	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	5	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Extruded

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	92.6	42	1.80	Organic Matter (OM)	87.9		
Crude Protein (CP)	37.3	79	1.44	Coef. Dig. OM Swine	80.4		
Starch	6.70	1	-	Digestible OM Swine	70.7		
Crude Fiber (CF)	5.55	6	1.57	Undig. OM Pigs	17.2		
Coef. Dig. CF Swine	76.6			Ether Extract (EE)	18.6	6	1.43
NDF	14.4	3	3.01	Coef. Dig. EE Poultry	84.5		
Coef. Dig. NDF Swine	76.7			Digestible EE Poultry	15.7		
ADF	10.1	3	3.21	Coef. Dig. EE Swine	77.0		
Coef. Dig. ADF Swine	85.1			Digestible EE Swine	14.3		
N-Free Extract (NFE)	26.4			Linoleic Acid	9.45	1	-
Coef. Dig. NFE Poultry	44.0			Linolenic Acid	1.35	1	-
Digestible NFE Poultry	11.6						
Undig. NFE + CF Poultry	20.4						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5074	4	262	***Swine***			
Poultry				Digestible Energy	4071		
Metabolizable Energy	3393			Metabolizable Energy	3956		
Std. Metab. Energy	3538			Net Energy	2853		
Net Energy	2804			***Sows***			
Hens				Digestible Energy	4351		
Metabolizable Energy	3451			Metabolizable Energy	4081		
Net Energy	2861			Net Energy	2944		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.66	6	0.24	***Trace Minerals, mg/kg***			
				Manganese (Mn)	24.8	1	-
Macro Minerals (%)				Iron (Fe)	179.0	1	-
Potassium (K)	1.72	3	0.11	Copper (Cu)	13.7	1	-
Sodium (Na)	0.03	3	0.04	Zinc (Zn)	41.6	1	-
Chlorine (Cl)	0.03	3	0.01	Selenium (Se)	0.21	1	-
Sulfur (S)	0.28	1	-				
Magnesium (Mg)	0.32	1	-				
Total Calcium (Ca)	0.24	4	0.05				
Total Phosphorus (P)	0.53	4	0.11				
Phytate P	0.36	2	0.13				
Available P (Pav)	0.17						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.20						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.20						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Extruded

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	37.3	100	33.6	90.0	33.0	86.8
Lysine, %	2.32	6.22	2.02	87.0	2.00	86.4
Methionine, %	0.50	1.34	0.46	92.8	0.46	91.1
Met + Cys, %	1.08	2.90	0.89	82.7	0.90	85.1
Threonine, %	1.44	3.86	1.27	88.0	1.24	86.2
Tryptophan, %	0.51	1.37	0.47	92.6	0.40	78.2
Arginine, %	2.67	7.16	2.59	96.9	2.47	92.6
Gly + Ser, %	3.50	9.38	3.11	88.9		
Valine, %	1.77	4.75	1.58	89.1	1.51	85.1
Isoleucine, %	1.71	4.58	1.54	90.3	1.46	85.3
Leucine, %	2.86	7.67	2.57	89.9	2.44	85.2
Histidine, %	0.96	2.57	0.85	88.7	0.88	91.6
Phenylalanine, %	1.89	5.07	1.69	89.6	1.64	87.0
Phe + Tyr, %	3.15	8.45	2.84	90.2	2.75	87.4
Alanine, %	1.60	4.29	1.40	87.7	1.33	83.0
Cysteine, %	0.58	1.56	0.43	74.0	0.46	80.0
Tyrosine, %	1.26	3.38	1.15	91.0	1.11	88.0
Glycine, %	1.60	4.29	1.45	90.4	1.31	82.0
Serine, %	1.90	5.09	1.67	87.7	1.62	85.0
Proline, %	1.92	5.15	1.59	83.0	1.69	88.0
Glutamine[2], %	3.32	8.91	3.13	94.3	2.90	88.0
Glutamic Acid[2], %	3.71	9.94	3.50	94.3	3.28	88.0
Asparagine[2], %	1.73	4.63	1.51	87.5	1.50	87.0
Aspartic Acid[2], %	2.57	6.90	2.25	87.5	2.24	87.0
Total Nitrogen (PB/6.25), %	5.97	16.0	5.37	90.0	5.18	86.8
Essential Nitrogen Poultry, %	3.26	54.6*	2.94	90.2		
Essential Nitrogen Swine, %	2.71	45.4*			2.36	87.2

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	8	10		10	
Maximum	15	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	10	10	5	10
Maximum	25	25	25	25	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Micronized

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	94.0	13	1.45	Organic Matter (OM)	89.1		
Crude Protein (CP)	39.4	15	1.30	Coef. Dig. OM Swine	86.8		
Starch	6.70	1	-	Digestible OM Swine	77.3		
Crude Fiber (CF)	2.51	5	1.52	Undig. OM Pigs	11.8		
Coef. Dig. CF Swine	77.7			Ether Extract (EE)	21.2	10	0.90
NDF	10.1	2	2.26	Coef. Dig. EE Poultry	86.0		
Coef. Dig. NDF Swine	98.3			Digestible EE Poultry	18.2		
ADF	5.28	2	0.25	Coef. Dig. EE Swine	81.0		
Coef. Dig. ADF Swine	82.6			Digestible EE Swine	17.2		
N-Free Extract (NFE)	26.0			Linoleic Acid	10.6	1	-
Coef. Dig. NFE Poultry	42.0			Linolenic Acid	1.61	-	-
Digestible NFE Poultry	10.9						
Undig. NFE + CF Poultry	17.6						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5354	5	72	***Swine***			
Poultry				Digestible Energy	4607		
Metabolizable Energy	3680			Metabolizable Energy	4400		
Std. Metab. Energy	4171			Net Energy	3226		
Net Energy	3050			***Sows***			
Hens				Digestible Energy	4770		
Metabolizable Energy	3742			Metabolizable Energy	4492		
Net Energy	3112			Net Energy	3294		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.93	10	0.39	***Trace Minerals, mg/kg***			
				Manganese (Mn)	19.2	1	-
Macro Minerals (%)				Iron (Fe)	56.2	1	-
Potassium (K)	1.65	1	-	Copper (Cu)	13.7	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	36.2	1	-
Chlorine (Cl)	0.03	1	-	Selenium (Se)	0.20	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.20	1	-				
Total Calcium (Ca)	0.25	7	0.04				
Total Phosphorus (P)	0.57	7	0.06				
Phytate P	0.37	6	0.03				
Available P (Pav)	0.20						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.22						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.22						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Micronized

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	39.4	100	35.8	91.0	35.3	89.7
Lysine, %	2.43	6.17	2.26	93.0	2.25	92.7
Methionine, %	0.54	1.37	0.50	91.8	0.50	93.0
Met + Cys, %	1.08	2.74	0.96	88.5	0.97	90.2
Threonine, %	1.57	3.99	1.33	84.6	1.32	84.1
Tryptophan, %	0.53	1.35	0.47	88.0	0.45	84.7
Arginine, %	3.02	7.67	2.79	92.4	2.85	94.4
Gly + Ser, %	3.66	9.30	3.11	85.1		
Valine, %	1.96	4.98	1.72	87.8	1.74	88.7
Isoleucine, %	1.87	4.75	1.71	91.5	1.68	89.8
Leucine, %	3.08	7.82	2.84	92.1	2.78	90.1
Histidine, %	1.10	2.79	1.00	90.5	1.01	92.1
Phenylalanine, %	2.08	5.28	2.00	96.2	1.91	91.6
Phe + Tyr, %	3.48	8.84	3.33	95.7	3.14	90.1
Alanine, %	1.71	4.34	1.27	74.4	-	-
Cysteine, %	0.54	1.37	0.46	85.1	0.47	87.4
Tyrosine, %	1.40	3.56	1.33	95.0	1.23	87.9
Glycine, %	1.70	4.32	1.45	85.1	-	-
Serine, %	1.96	4.98	1.67	85.1	-	-
Proline, %	1.98	5.03	1.88	94.9	-	-
Glutamine[2], %	3.47	8.81	3.31	95.4	-	-
Glutamic Acid[2], %	3.87	9.83	3.69	95.4	-	-
Asparagine[2], %	1.76	4.47	1.61	91.2	-	-
Aspartic Acid[2], %	2.62	6.66	2.39	91.2	-	-
Total Nitrogen (PB/6.25), %	6.30	16.0	5.73	91.0	5.65	89.7
Essential Nitrogen Poultry, %	3.56	56.5*	3.22	90.3		
Essential Nitrogen Swine, %	2.98	47.3*			2.70	90.7

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	8	10		10	
Maximum	15	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	10	10	5	10
Maximum	25	25	25	25	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Roasted

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	92.7	59	1.90	Organic Matter (OM)	88.0		
Crude Protein (CP)	37.2	96	1.43	Coef. Dig. OM Swine	72.5		
Starch	6.70	1	-	Digestible OM Swine	63.8		
Crude Fiber (CF)	4.47	11	1.82	Undig. OM Pigs	24.2		
Coef. Dig. CF Swine	76.6			Ether Extract (EE)	19.9	14	1.56
NDF	14.4	3	3.01	Coef. Dig. EE Poultry	83.0		
Coef. Dig. NDF Swine	76.7			Digestible EE Poultry	16.5		
ADF	10.1	3	3.21	Coef. Dig. EE Swine	78.0		
Coef. Dig. ADF Swine	85.1			Digestible EE Swine	15.5		
N-Free Extract (NFE)	26.4			Linoleic Acid	9.45	1	-
Coef. Dig. NFE Poultry	30.0			Linolenic Acid	1.35	1	-
Digestible NFE Poultry	7.91						
Undig. NFE + CF Poultry	22.9						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5170	10	91	***Swine***			
Poultry				Digestible Energy	3930		
Metabolizable Energy	3267			Metabolizable Energy	3706		
Std. Metab. Energy	3454			Net Energy	2698		
Net Energy	2709			***Sows***			
Hens				Digestible Energy	4149		
Metabolizable Energy	3344			Metabolizable Energy	3885		
Net Energy	2786			Net Energy	2829		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.75	4	0.30	***Trace Minerals, mg/kg***			
				Manganese (Mn)	24.8	1	-
Macro Minerals (%)				Iron (Fe)	179.1	1	-
Potassium (K)	1.72	3	0.11	Copper (Cu)	13.7	1	-
Sodium (Na)	0.03	3	0.04	Zinc (Zn)	41.6	1	-
Chlorine (Cl)	0.03	3	0.01	Selenium (Se)	0.21	1	-
Sulfur (S)	0.28	1	-				
Magnesium (Mg)	0.32	1	-				
Total Calcium (Ca)	0.24	4	0.05				
Total Phosphorus (P)	0.53	4	0.11				
Phytate P	0.36	2	0.13				
Available P (Pav)	0.17						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.20						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.20						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Full-fat Roasted

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	37.2	100	32.8	88.0	29.3	78.6
Lysine, %	2.32	6.23	2.09	90.2	1.89	81.5
Methionine, %	0.50	1.34	0.45	89.9	0.39	77.3
Met + Cys, %	1.08	2.90	0.90	82.9	0.82	76.2
Threonine, %	1.44	3.87	1.17	81.6	1.16	80.7
Tryptophan, %	0.51	1.37	0.42	83.2	0.41	80.6
Arginine, %	2.67	7.17	2.47	92.3	2.27	85.0
Gly + Ser, %	3.50	9.40	2.89	82.7		
Valine, %	1.77	4.75	1.49	84.1	1.41	79.5
Isoleucine, %	1.71	4.59	1.49	87.1	1.37	80.0
Leucine, %	2.86	7.68	2.54	88.7	2.26	79.0
Histidine, %	0.96	2.58	0.88	92.0	0.77	79.7
Phenylalanine, %	1.89	5.07	1.67	88.5	1.51	80.0
Phe + Tyr, %	3.15	8.46	2.77	88.1	2.49	79.2
Alanine, %	1.60	4.30	1.35	84.4	1.18	74.0
Cysteine, %	0.58	1.56	0.45	76.9	0.44	75.0
Tyrosine, %	1.26	3.38	1.10	87.4	0.98	78.0
Glycine, %	1.60	4.30	1.29	80.4	1.18	74.0
Serine, %	1.90	5.10	1.61	84.6	1.48	78.0
Proline, %	1.92	5.16	1.64	85.6	1.40	73.0
Glutamine[2], %	3.32	8.92	3.04	91.6	2.59	78.0
Glutamic Acid[2], %	3.71	9.96	3.40	91.6	2.89	78.0
Asparagine[2], %	1.73	4.64	1.55	89.6	1.35	78.0
Aspartic Acid[2], %	2.61	7.06	2.34	89.6	2.04	78.0
Total Nitrogen (PB/6.25), %	5.96	16.0	5.24	88.0	4.68	78.6
Essential Nitrogen Poultry, %	3.26	54.7*	2.85	87.3		
Essential Nitrogen Swine, %	2.71	45.5*			2.19	80.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	8		10	
Maximum	10	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	10	10	5	10
Maximum	20	20	20	25	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Hulls

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.7	45	1.59	Organic Matter (OM)	85.5		
Crude Protein (CP)	11.6	45	2.15	Coef. Dig. OM Swine	53.8		
Starch	3.65	1	-	Digestible OM Swine	46.0		
Crude Fiber (CF)	36.5	42	3.23	Undig. OM Pigs	39.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.53	20	0.94
NDF	58.1	5	0.42	Coef. Dig. EE Poultry	60.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.52		
ADF	46.1	5	1.97	Coef. Dig. EE Swine	65.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.64		
N-Free Extract (NFE)	34.8			Linoleic Acid	1.11	2	0.01
Coef. Dig. NFE Poultry	30.0			Linolenic Acid	0.21	1	-
Digestible NFE Poultry	10.5						
Undig. NFE + CF Poultry	60.9						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3959	6	189	***Swine***			
Poultry				Digestible Energy	2162		
Metabolizable Energy	841			Metabolizable Energy	2046		
Std. Metab. Energy	-			Net Energy	1109		
Net Energy	672			***Sows***			
Hens				Digestible Energy	2495		
Metabolizable Energy	1021			Metabolizable Energy	2346		
Net Energy	857			Net Energy	1328		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.23	18	0.26	***Trace Minerals, mg/kg***			
				Manganese (Mn)	19.0	1	-
Macro Minerals (%)				Iron (Fe)	534	1	-
Potassium (K)	1.16	1	-	Copper (Cu)	76.2	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	35.7	1	-
Chlorine (Cl)	0.03	1	-	Selenium (Se)	0.22	1	-
Sulfur (S)	0.11	1	-				
Magnesium (Mg)	0.17	1	-				
Total Calcium (Ca)	0.49	9	0.03				
Total Phosphorus (P)	0.14	9	0.03				
Phytate P	0.03	1	-				
Available P (Pav)	0.11						
Coef. Dig. P Poultry	30.0						
Std. Dig. P Poultry	0.04						
Coef. Dig. P Swine	30.0						
Std. Dig. P Swine	0.04						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Hulls

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	11.6	100	6.08	52.3	7.21	62.1
Lysine, %	0.83	7.15	0.51	61.0	0.52	63.0
Methionine, %	0.16	1.38	0.11	66.7	0.12	75.3
Met + Cys, %	0.37	3.19	0.16	43.8	0.25	68.3
Threonine, %	0.48	4.13	0.22	45.8	0.31	64.2
Tryptophan, %	0.14	1.21	0.08	55.2	0.09	64.5
Arginine, %	0.80	6.89	0.64	79.5	0.70	87.6
Gly + Ser, %	1.71	14.7	0.55	31.9		
Valine, %	0.63	5.42	0.34	53.3	0.40	64.1
Isoleucine, %	0.55	4.74	0.30	54.2	0.39	70.4
Leucine, %	0.92	7.92	0.53	58.0	0.66	72.0
Histidine, %	0.36	3.10	0.18	49.1	0.22	60.4
Phenylalanine, %	0.55	4.74	0.35	63.2	0.42	75.5
Phe + Tyr, %	1.08	9.30	0.60	55.5	0.74	68.9
Alanine, %	0.56	4.82	0.19	34.5	0.30	54.0
Cysteine, %	0.21	1.81	0.06	26.4	0.13	62.9
Tyrosine, %	0.53	4.56	0.25	47.6	0.33	62.1
Glycine, %	0.98	8.44	0.25	26.0	0.53	54.0
Serine, %	0.73	6.28	0.29	39.9	0.39	54.0
Proline, %	0.55	4.74	0.37	67.0	0.30	54.0
Glutamine[2], %	0.78	6.75	0.48	60.9	0.42	54.0
Glutamic Acid[2], %	0.88	7.54	0.53	60.9	0.47	54.0
Asparagine[2], %	0.51	4.39	0.23	44.8	0.28	54.0
Aspartic Acid[2], %	0.76	6.54	0.34	44.8	0.41	54.0
Total Nitrogen (PB/6.25), %	1.86	16.0	0.97	52.3	1.15	62.1
Essential Nitrogen Poultry, %	1.16	62.6*	0.62	53.1		
Essential Nitrogen Swine, %	0.88	47.5*			0.62	60.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		0	
Maximum	-	-		5	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	0	0	0	5	0
Maximum	0	3	5	12	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 44.5% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.5	-	-	Organic Matter (OM)	83.6		
Crude Protein (CP)	44.5	-	-	Coef. Dig. OM Swine	79.6		
Starch	4.70	-	-	Digestible OM Swine	66.6		
Crude Fiber (CF)	5.84	-	-	Undig. OM Pigs	17.1		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.93	-	-
NDF	13.1	-	-	Coef. Dig. EE Poultry	50.3		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.97		
ADF	8.30	-	-	Coef. Dig. EE Swine	60.2		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.16		
N-Free Extract (NFE)	31.4			Linoleic Acid	0.68	-	-
Coef. Dig. NFE Poultry	31.9			Linolenic Acid	0.09	-	-
Digestible NFE Poultry	10.0						
Undig. NFE + CF Poultry	27.2						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4147	-	-	***Swine***			
Poultry				Digestible Energy	3396		
Metabolizable Energy	2212			Metabolizable Energy	3142		
Std. Metab. Energy	-			Net Energy	1982		
Net Energy	1715			***Sows***			
Hens				Digestible Energy	3587		
Metabolizable Energy	2276			Metabolizable Energy	3269		
Net Energy	1778			Net Energy	2074		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.86	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	30.1	-	-
Macro Minerals (%)				Iron (Fe)	159.4	-	-
Potassium (K)	1.94	-	-	Copper (Cu)	18.8	-	-
Sodium (Na)	0.01	-	-	Zinc (Zn)	47.5	-	-
Chlorine (Cl)	0.05	-	-	Selenium (Se)	0.43	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.31	-	-				
Total Phosphorus (P)	0.57	-	-				
Phytate P	0.35	-	-				
Available P (Pav)	0.22						
Coef. Dig. P Poultry	41.6						
Std. Dig. P Poultry	0.24						
Coef. Dig. P Swine	45.2						
Std. Dig. P Swine	0.26						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 44.5% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	44.5	100	39.2	88.1	39.4	88.6
Lysine, %	2.81	6.31	2.52	89.6	2.51	89.2
Methionine, %	0.60	1.35	0.55	90.9	0.55	91.3
Met + Cys, %	1.23	2.76	1.08	87.5	1.12	90.7
Threonine, %	1.80	4.04	1.52	84.7	1.54	85.7
Tryptophan, %	0.62	1.39	0.55	88.0	0.55	88.4
Arginine, %	3.25	7.30	3.00	92.4	3.05	93.8
Gly + Ser, %	4.41	9.91	3.72	84.3		
Valine, %	2.16	4.85	1.87	86.7	1.89	87.3
Isoleucine, %	2.04	4.58	1.79	87.7	1.81	88.8
Leucine, %	3.43	7.71	3.02	88.1	3.03	88.5
Histidine, %	1.17	2.63	1.03	87.7	1.05	89.6
Phenylalanine, %	2.28	5.12	2.02	88.7	2.04	89.5
Phe + Tyr, %	3.95	8.88	3.47	88.0	3.53	89.3
Alanine, %	2.04	4.58	1.69	83.0	1.75	85.8
Cysteine, %	0.64	1.44	0.53	82.9	0.57	88.7
Tyrosine, %	1.67	3.75	1.45	87.0	1.48	88.9
Glycine, %	2.01	4.52	1.62	80.4	1.71	84.9
Serine, %	2.40	5.39	2.10	87.6	2.10	87.7
Proline, %	2.33	5.24	2.06	88.5	2.06	88.5
Glutamine[2], %	3.93	8.83	3.58	91.2	3.50	89.1
Glutamic Acid[2], %	4.39	9.87	4.00	91.2	3.91	89.1
Asparagine[2], %	2.21	4.97	1.93	87.4	1.94	87.7
Aspartic Acid[2], %	3.30	7.42	2.88	87.4	2.89	87.7
Total Nitrogen (PB/6.25), %	7.12	16.0	6.27	88.1	6.31	88.6
Essential Nitrogen Poultry, %	4.98	56.0*	3.50	87.9		
Essential Nitrogen Swine, %	3.29	46.2*			2.94	89.4

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	35	35		30	
Maximum	35	35		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	25	20	15	25
Maximum	30	25	20	15	25

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 45.6% CP (Average)

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.5	311	1.36	Organic Matter (OM)	83.6		
Crude Protein (CP)	45.6	284	1.02	Coef. Dig. OM Swine	80.5		
Starch	4.74	20	1.88	Digestible OM Swine	67.3		
Crude Fiber (CF)	4.82	173	0.63	Undig. OM Pigs	16.3		
Coef. Dig. CF Swine	68.6			Ether Extract (EE)	1.91	189	0.80
NDF	11.6	11	1.70	Coef. Dig. EE Poultry	50.0		
Coef. Dig. NDF Swine	82.6			Digestible EE Poultry	0.95		
ADF	7.07	11	1.36	Coef. Dig. EE Swine	60.0		
Coef. Dig. ADF Swine	77.7			Digestible EE Swine	1.15		
N-Free Extract (NFE)	31.3			Linoleic Acid	0.67	1	-
Coef. Dig. NFE Poultry	32.0			Linolenic Acid	0.09	1	-
Digestible NFE Poultry	10.0						
Undig. NFE + CF Poultry	26.1						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4153	27	71	***Swine***			
Poultry				Digestible Energy	3437		
Metabolizable Energy	2258			Metabolizable Energy	3179		
Std. Metab. Energy	2538			Net Energy	2011		
Net Energy	1746			***Sows***			
Hens				Digestible Energy	3626		
Metabolizable Energy	2332			Metabolizable Energy	3301		
Net Energy	1820			Net Energy	2100		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.91	66	0.41	***Trace Minerals, mg/kg***			
				Manganese (Mn)	30.4	4	4.63
Macro Minerals (%)				Iron (Fe)	146.9	4	28.1
Potassium (K)	1.97	9	0.23	Copper (Cu)	16.9	4	3.10
Sodium (Na)	0.01	15	0.01	Zinc (Zn)	47.9	4	5.64
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.44	1	-
Sulfur (S)	0.31	1	-				
Magnesium (Mg)	0.33	9	0.02				
Total Calcium (Ca)	0.30	34	0.05				
Total Phosphorus (P)	0.58	97	0.06				
Phytate P	0.36	65	0.04				
Available P (Pav)	0.22						
Coef. Dig. P Poultry	42.0						
Std. Dig. P Poultry	0.24						
Coef. Dig. P Swine	45.7						
Std. Dig. P Swine	0.26						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 45.6% CP (Average)

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	45.6	100	40.7	89.3	40.8	89.5
Lysine, %	2.88	6.31	2.60	90.6	2.59	90.1
Methionine, %	0.61	1.34	0.56	91.7	0.56	91.8
Met + Cys, %	1.26	2.77	1.11	88.1	1.15	90.7
Threonine, %	1.84	4.04	1.58	86.0	1.59	86.4
Tryptophan, %	0.64	1.40	0.57	89.1	0.57	89.2
Arginine, %	3.33	7.31	3.09	92.8	3.13	94.0
Gly + Ser, %	4.50	9.86	3.87	86.0		
Valine, %	2.21	4.85	1.94	87.8	1.95	88.1
Isoleucine, %	2.09	4.59	1.86	88.8	1.87	89.4
Leucine, %	3.51	7.69	3.12	89.1	3.12	89.0
Histidine, %	1.20	2.63	1.07	89.0	1.09	90.6
Phenylalanine, %	2.34	5.13	2.10	89.6	2.11	90.0
Phe + Tyr, %	4.05	8.88	3.60	89.1	3.64	89.9
Alanine, %	2.09	4.58	1.77	84.6	1.81	86.9
Cysteine, %	0.65	1.43	0.55	84.8	0.58	89.6
Tyrosine, %	1.71	3.75	1.51	88.3	1.53	89.8
Glycine, %	2.04	4.47	1.67	82.2	1.75	85.9
Serine, %	2.46	5.40	2.19	89.2	2.18	88.8
Proline, %	2.39	5.24	2.13	89.2	2.14	89.7
Glutamine[2], %	4.04	8.87	3.73	92.2	3.65	90.3
Glutamic Acid[2], %	4.51	9.90	4.16	92.2	4.07	90.3
Asparagine[2], %	2.27	4.98	2.02	88.8	2.02	88.8
Aspartic Acid[2], %	3.38	7.41	3.00	88.8	3.00	88.8
Total Nitrogen (PB/6.25), %	7.29	16.0	6.51	89.3	6.52	89.5
Essential Nitrogen Poultry, %	4.08	55.9*	3.63	89.0		
Essential Nitrogen Swine, %	3.37	46.2*			3.03	90.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	35	35		30	
Maximum	35	35		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	25	20	15	25
Maximum	30	25	20	15	25

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 46.5% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.5	-	-	Organic Matter (OM)	83.5		
Crude Protein (CP)	46.5	-	-	Coef. Dig. OM Swine	81.2		
Starch	4.77	-	-	Digestible OM Swine	67.8		
Crude Fiber (CF)	3.98	-	-	Undig. OM Pigs	15.7		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.89	-	-
NDF	10.41	-	-	Coef. Dig. EE Poultry	49.7		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.94		
ADF	6.04	-	-	Coef. Dig. EE Swine	59.9		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.13		
N-Free Extract (NFE)	31.2			Linoleic Acid	0.66	-	-
Coef. Dig. NFE Poultry	32.1			Linolenic Acid	0.09	-	-
Digestible NFE Poultry	10.0						
Undig. NFE + CF Poultry	25.2						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4158	-	-	***Swine***			
Poultry				Digestible Energy	3471		
Metabolizable Energy	2296			Metabolizable Energy	3209		
Std. Metab. Energy	-			Net Energy	2035		
Net Energy	1771			***Sows***			
Hens				Digestible Energy	3657		
Metabolizable Energy	2385			Metabolizable Energy	3325		
Net Energy	1859			Net Energy	2120		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.95	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	30.7	-	-
Macro Minerals (%)				Iron (Fe)	136.7	-	-
Potassium (K)	1.99	-	-	Copper (Cu)	15.3	-	-
Sodium (Na)	0.01	-	-	Zinc (Zn)	48.2	-	-
Chlorine (Cl)	0.05	-	-	Selenium (Se)	0.45	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.29	-	-				
Total Phosphorus (P)	0.59	-	-				
Phytate P	0.37	-	-				
Available P (Pav)	0.22						
Coef. Dig. P Poultry	42.3						
Std. Dig. P Poultry	0.25						
Coef. Dig. P Swine	46.1						
Std. Dig. P Swine	0.27						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 46.5% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	46.5	100	41.9	90.2	41.9	90.2
Lysine, %	2.93	6.31	2.68	91.4	2.66	90.8
Methionine, %	0.62	1.34	0.57	92.4	0.57	92.2
Met + Cys, %	1.28	2.76	1.15	89.3	1.17	91.2
Threonine, %	1.88	4.03	1.63	87.1	1.63	87.0
Tryptophan, %	0.65	1.40	0.59	90.0	0.59	89.9
Arginine, %	3.40	7.31	3.16	93.2	3.20	94.2
Gly + Ser, %	4.57	9.84	4.00	87.4		
Valine, %	2.25	4.84	2.00	88.7	2.00	88.7
Isoleucine, %	2.13	4.58	1.91	89.7	1.92	89.9
Leucine, %	3.58	7.70	3.22	89.9	3.20	89.5
Histidine, %	1.22	2.63	1.10	90.1	1.12	91.4
Phenylalanine, %	2.39	5.13	2.16	90.3	2.16	90.4
Phe + Tyr, %	4.13	8.88	3.71	89.9	3.73	90.4
Alanine, %	2.13	4.58	1.83	85.9	1.87	87.8
Cysteine, %	0.66	1.42	0.57	86.3	0.60	90.3
Tyrosine, %	1.74	3.74	1.56	89.4	1.58	90.5
Glycine, %	2.07	4.45	1.73	83.7	1.79	86.7
Serine, %	2.51	5.39	2.27	90.5	2.25	89.7
Proline, %	2.44	5.24	2.19	89.8	2.21	90.6
Glutamine[2], %	4.13	8.87	3.84	93.0	3.77	91.3
Glutamic Acid[2], %	4.61	9.91	4.28	93.0	4.20	91.3
Asparagine[2], %	2.32	4.98	2.08	90.0	2.08	89.7
Aspartic Acid[2], %	3.45	7.42	3.10	90.0	3.09	89.7
Total Nitrogen (PB/6.25), %	7.44	16.0	6.71	90.2	6.71	90.2
Essential Nitrogen Poultry, %	4.16	55.9*	3.73	89.8		
Essential Nitrogen Swine, %	3.44	46.2*			3.11	90.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	35	35		30	
Maximum	35	35		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	25	20	15	25
Maximum	30	25	20	15	25

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 48% CP

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.9	74	1.01	Organic Matter (OM)	82.8		
Crude Protein (CP)	48.2	54	0.72	Coef. Dig. OM Swine	84.5		
Starch	3.00	1	-	Digestible OM Swine	69.9		
Crude Fiber (CF)	4.55	41	0.54	Undig. OM Pigs	12.8		
Coef. Dig. CF Swine	68.6			Ether Extract (EE)	1.72	60	0.53
NDF	11.5	3	2.98	Coef. Dig. EE Poultry	50.0		
Coef. Dig. NDF Swine	82.6			Digestible EE Poultry	0.86		
ADF	8.60	3	3.47	Coef. Dig. EE Swine	60.0		
Coef. Dig. ADF Swine	77.7			Digestible EE Swine	1.03		
N-Free Extract (NFE)	28.3			Linoleic Acid	0.77	1	-
Coef. Dig. NFE Poultry	30.0			Linolenic Acid	0.10	1	-
Digestible NFE Poultry	8.50						
Undig. NFE + CF Poultry	24.4						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4187	4	28	***Swine***			
Poultry				Digestible Energy	3548		
Metabolizable Energy	2295			Metabolizable Energy	3306		
Std. Metab. Energy	2373			Net Energy	2080		
Net Energy	1769			***Sows***			
Hens				Digestible Energy	3801		
Metabolizable Energy	2371			Metabolizable Energy	3447		
Net Energy	1845			Net Energy	2183		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.10	81	0.36	***Trace Minerals, mg/kg***			
				Manganese (Mn)	30.7	2	1.41
Macro Minerals (%)				Iron (Fe)	159.5	2	12.1
Potassium (K)	2.13	2	0.03	Copper (Cu)	9.0	1	-
Sodium (Na)	0.02	2	0.00	Zinc (Zn)	47.7	2	4.03
Chlorine (Cl)	0.05	1	-	Selenium (Se)	0.34	1	-
Sulfur (S)	0.42	1	-				
Magnesium (Mg)	0.27	2	0.06				
Total Calcium (Ca)	0.34	10	0.03				
Total Phosphorus (P)	0.59	27	0.03				
Phytate P	0.36	25	0.03				
Available P (Pav)	0.23						
Coef. Dig. P Poultry	45.0						
Std. Dig. P Poultry	0.27						
Coef. Dig. P Swine	45.7						
Std. Dig. P Swine	0.27						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Meal 48% CP

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	48.2	100	43.3	89.9	44.0	91.3
Lysine, %	2.97	6.17	2.74	92.4	2.71	91.2
Methionine, %	0.63	1.31	0.59	93.6	0.58	92.5
Met + Cys, %	1.35	2.80	1.21	89.6	1.22	90.3
Threonine, %	1.87	3.88	1.64	87.6	1.64	87.5
Tryptophan, %	0.67	1.39	0.61	90.9	0.61	90.3
Arginine, %	3.49	7.25	3.23	92.5	3.31	94.7
Gly + Ser, %	4.65	9.65	4.01	86.2		
Valine, %	2.29	4.75	2.00	87.4	2.05	89.5
Isoleucine, %	2.23	4.63	1.99	89.1	2.01	90.2
Leucine, %	3.65	7.58	3.35	91.8	3.30	90.5
Histidine, %	1.25	2.59	1.14	91.0	1.14	91.2
Phenylalanine, %	2.48	5.15	2.34	94.2	2.24	90.5
Phe + Tyr, %	4.18	8.68	3.83	91.6	3.81	91.1
Alanine, %	2.00	4.15	1.74	86.9	1.78	89.2
Cysteine, %	0.72	1.49	0.62	86.1	0.64	88.4
Tyrosine, %	1.70	3.53	1.49	87.8	1.56	91.9
Glycine, %	2.10	4.36	1.73	82.4	1.89	90.0
Serine, %	2.55	5.29	2.28	89.4	2.32	91.0
Proline, %	2.36	4.90	2.12	90.0	2.17	92.0
Glutamine[2], %	4.88	10.1	4.41	90.5	4.54	93.0
Glutamic Acid[2], %	5.44	11.3	4.93	90.5	5.06	93.0
Asparagine[2], %	2.21	4.59	1.97	89.2	2.01	91.0
Aspartic Acid[2], %	3.29	6.83	2.93	89.2	2.99	91.0
Total Nitrogen (PB/6.25), %	7.71	16.0	6.93	89.9	7.04	91.3
Essential Nitrogen Poultry, %	4.24	55.1*	3.83	90.3		
Essential Nitrogen Swine, %	3.51	45.6*			3.20	91.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	35	35		30	
Maximum	35	35		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	30	25	20	15	25
Maximum	30	25	20	15	25

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Protein Concentrate

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.1	21	2.20	Organic Matter (OM)	85.2		
Crude Protein (CP)	62.4	33	2.42	Coef. Dig. OM Swine	89.4		
Starch	7.50	1	-	Digestible OM Swine	76.1		
Crude Fiber (CF)	3.36	9	0.92	Undig. OM Pigs	9.03		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.58	8	0.12
NDF	11.8	6	2.64	Coef. Dig. EE Poultry	50.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.29		
ADF	6.36	3	0.28	Coef. Dig. EE Swine	57.5		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.33		
N-Free Extract (NFE)	18.8			Linoleic Acid	0.27	1	-
Coef. Dig. NFE Poultry	17.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	3.19						
Undig. NFE + CF Poultry	19.0						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4471	5	99	***Swine***			
Poultry				Digestible Energy	4071		
Metabolizable Energy	2635			Metabolizable Energy	3638		
Std. Metab. Energy	2870			Net Energy	2240		
Net Energy	2010			***Sows***			
Hens				Digestible Energy	4131		
Metabolizable Energy	2699			Metabolizable Energy	3705		
Net Energy	2074			Net Energy	2289		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.90	15	0.49	***Trace Minerals, mg/kg***			
				Manganese (Mn)	38.3	1	-
Macro Minerals (%)				Iron (Fe)	92.3	1	-
Potassium (K)	2.18	1	-	Copper (Cu)	32.6	1	-
Sodium (Na)	0.05	1	-	Zinc (Zn)	24.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.29	1	-				
Total Calcium (Ca)	0.29	6	0.04				
Total Phosphorus (P)	0.73	13	0.14				
Phytate P	0.45	6	0.10				
Available P (Pav)	0.28						
Coef. Dig. P Poultry	40.0						
Std. Dig. P Poultry	0.29						
Coef. Dig. P Swine	40.0						
Std. Dig. P Swine	0.29						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Protein Concentrate

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	62.4	100	57.6	92.3	57.8	92.6
Lysine, %	3.84	6.15	3.61	93.9	3.56	92.6
Methionine, %	0.82	1.31	0.78	96.2	0.77	94.1
Met + Cys, %	1.60	2.56	1.43	89.5	1.47	92.1
Threonine, %	2.57	4.12	2.29	89.1	2.30	89.5
Tryptophan, %	0.72	1.16	0.69	95.9	0.66	90.7
Arginine, %	4.44	7.11	4.22	95.0	4.35	97.9
Gly + Ser, %	5.92	9.48	4.52	76.3		
Valine, %	3.18	5.09	2.89	90.9	2.90	91.1
Isoleucine, %	2.80	4.48	2.66	95.2	2.62	93.7
Leucine, %	4.77	7.64	4.45	93.2	4.50	94.2
Histidine, %	2.11	3.37	1.93	91.9	1.96	93.1
Phenylalanine, %	3.12	5.00	2.94	94.2	2.93	93.9
Phe + Tyr, %	5.26	8.43	4.82	91.7	4.87	92.6
Alanine, %	2.67	4.27	2.46	92.3	2.42	90.7
Cysteine, %	0.78	1.25	0.65	82.9	0.71	90.4
Tyrosine, %	2.14	3.43	1.88	87.8	1.94	90.5
Glycine, %	2.60	4.17	1.78	68.3	2.38	91.4
Serine, %	3.32	5.31	2.74	82.7	2.93	88.5
Proline, %	3.11	4.98	2.85	91.8	2.92	94.1
Glutamine[2], %	5.10	8.16	5.01	98.4	4.76	93.5
Glutamic Acid[2], %	6.15	9.86	6.06	98.4	5.75	93.5
Asparagine[2], %	2.88	4.62	2.71	94.1	2.62	90.8
Aspartic Acid[2], %	4.47	7.16	4.21	94.1	4.06	90.8
Total Nitrogen (PB/6.25), %	9.99	16.0	9.22	92.3	9.25	92.6
Essential Nitrogen Poultry, %	5.59	56.0*	5.05	90.4		
Essential Nitrogen Swine, %	4.66	46.7*			4.36	93.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Protein Isolate

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	94.6	7	4.22	Organic Matter (OM)	90.5		
Crude Protein (CP)	81.0	6	4.35	Coef. Dig. OM Swine	82.0		
Starch	1.89	1	-	Digestible OM Swine	74.2		
Crude Fiber (CF)	0.23	2	0.08	Undig. OM Pigs	16.3		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.11	3	0.36
NDF	0.19	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	8.11			Linoleic Acid	1.18	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.15	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5062	2	458	***Swine***			
Poultry				Digestible Energy	4150		
Metabolizable Energy	-			Metabolizable Energy	3573		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.08	2	0.13	***Trace Minerals, mg/kg***	-	-	-
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.16	1	-	Copper (Cu)	-	-	-
Sodium (Na)	1.14	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.02	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.17	2	0.00				
Total Phosphorus (P)	0.74	2	0.02				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Protein Isolate

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	81.0	100	76.2	94.0	73.6	90.9
Lysine, %	4.79	5.91	4.50	93.9	4.36	91.0
Methionine, %	1.05	1.30	0.99	94.4	0.91	86.0
Met + Cys, %	2.01	2.48	1.89	94.0	1.66	82.6
Threonine, %	2.80	3.46	2.67	95.4	2.32	83.0
Tryptophan, %	1.08	1.33	-	-	0.94	87.0
Arginine, %	5.76	7.11	5.61	97.4	5.41	94.0
Gly + Ser, %	7.43	9.17	6.94	93.4		
Valine, %	3.78	4.66	3.51	92.9	3.25	86.0
Isoleucine, %	3.62	4.47	3.36	92.7	3.19	88.0
Leucine, %	6.09	7.51	5.63	92.5	5.42	89.0
Histidine, %	1.99	2.46	1.85	93.2	1.75	88.0
Phenylalanine, %	4.15	5.12	3.90	94.1	3.65	88.0
Phe + Tyr, %	7.03	8.67	6.62	94.1	6.19	88.0
Alanine, %	3.15	3.88	-	-	2.83	90.0
Cysteine, %	0.96	1.18	0.90	93.8	0.75	79.0
Tyrosine, %	2.88	3.56	2.71	94.0	2.54	88.0
Glycine, %	3.16	3.90	-	-	2.81	89.0
Serine, %	3.70	4.57	-	-	3.44	93.0
Proline, %	3.93	4.85	-	-	3.89	99.0
Glutamine[2], %	6.51	8.03	-	-	6.12	94.0
Glutamic Acid[2], %	7.58	9.35	-	-	7.12	94.0
Asparagine[2], %	3.43	4.24	-	-	3.16	92.0
Aspartic Acid[2], %	5.32	6.57	-	-	4.90	92.0
Total Nitrogen (PB/6.25), %	13.0	16.0	12.2	94.0	11.8	90.9
Essential Nitrogen Poultry, %	6.81	52.5*	-	-		
Essential Nitrogen Swine, %	5.73	44.2*			5.09	88.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Semi-defatted Extruded

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.4	6	0.89	Organic Matter (OM)	86.0		
Crude Protein (CP)	40.2	16	1.56	Coef. Dig. OM Swine	78.5		
Starch	7.37	1	-	Digestible OM Swine	67.5		
Crude Fiber (CF)	6.63	1	-	Undig. OM Pigs	18.5		
Coef. Dig. CF Swine	76.6			Ether Extract (EE)	10.5	13	1.47
NDF	18.3	1	-	Coef. Dig. EE Poultry	79.0		
Coef. Dig. NDF Swine	76.7			Digestible EE Poultry	8.30		
ADF	13.6	1	-	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	85.1			Digestible EE Swine	8.40		
N-Free Extract (NFE)	28.6			Linoleic Acid	4.27	1	-
Coef. Dig. NFE Poultry	41.4			Linolenic Acid	0.60	1	-
Digestible NFE Poultry	11.9						
Undig. NFE + CF Poultry	23.4						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4456	1	-	***Swine***			
Poultry				Digestible Energy	3760		
Metabolizable Energy	2811			Metabolizable Energy	3530		
Std. Metab. Energy	-			Net Energy	2408		
Net Energy	2263			***Sows***			
Hens				Digestible Energy	3957		
Metabolizable Energy	2886			Metabolizable Energy	3665		
Net Energy	2338			Net Energy	2507		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.45	16	0.41	***Trace Minerals, mg/kg***			
				Manganese (Mn)	24.8	1	-
Macro Minerals (%)				Iron (Fe)	179.1	1	-
Potassium (K)	1.80	1	-	Copper (Cu)	13.7	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	41.6	1	-
Chlorine (Cl)	0.02	1	-	Selenium (Se)	0.21	1	-
Sulfur (S)	0.31	1	-				
Magnesium (Mg)	0.32	1	-				
Total Calcium (Ca)	0.25	1	-				
Total Phosphorus (P)	0.55	14	0.02				
Phytate P	0.36	13	0.02				
Available P (Pav)	0.19						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.21						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.21						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Semi-defatted Extruded

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	40.2	100	36.1	89.7	35.2	87.6
Lysine, %	2.48	6.17	2.22	89.5	2.16	87.1
Methionine, %	0.55	1.37	0.50	90.1	0.48	86.9
Met + Cys, %	1.14	2.84	1.01	88.2	0.98	85.9
Threonine, %	1.61	4.00	1.40	87.0	1.39	86.4
Tryptophan, %	0.56	1.39	0.50	89.9	0.51	91.2
Arginine, %	2.93	7.29	2.73	93.2	2.69	91.9
Gly + Ser, %	3.45	8.58	3.16	91.6		
Valine, %	1.94	4.83	1.65	84.8	1.67	85.9
Isoleucine, %	1.84	4.58	1.60	87.1	1.62	88.1
Leucine, %	3.09	7.69	2.70	87.4	2.73	88.2
Histidine, %	1.07	2.66	0.95	89.6	0.96	90.1
Phenylalanine, %	2.04	5.07	1.80	88.4	1.83	89.7
Phe + Tyr, %	3.48	8.66	3.09	88.8	3.11	89.5
Alanine, %	1.60	3.98	1.41	88.1	1.33	83.0
Cysteine, %	0.59	1.47	0.51	86.5	0.50	84.7
Tyrosine, %	1.44	3.58	1.29	89.3	1.29	89.3
Glycine, %	1.60	3.98	1.49	93.1	1.31	82.0
Serine, %	1.85	4.60	1.67	90.3	1.57	85.0
Proline, %	1.84	4.58	1.66	90.2	1.62	88.0
Glutamine[2], %	3.62	9.02	3.27	90.3	3.19	88.0
Glutamic Acid[2], %	4.05	10.1	3.65	90.3	3.56	88.0
Asparagine[2], %	1.67	4.15	1.55	92.8	1.45	87.0
Aspartic Acid[2], %	2.48	6.17	2.30	92.8	2.16	87.0
Total Nitrogen (PB/6.25), %	6.43	16.0	5.77	89.7	5.63	87.6
Essential Nitrogen Poultry, %	3.50	54.4*	3.12	89.1		
Essential Nitrogen Swine, %	2.96	46.0*			2.62	88.6

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	10	12		10	
Maximum	20	22		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	10	10	5	10
Maximum	25	25	25	25	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Semi-defatted Roasted

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.4	6	0.89	Organic Matter (OM)	86.0		
Crude Protein (CP)	40.2	16	1.56	Coef. Dig. OM Swine	73.8		
Starch	7.37	1	-	Digestible OM Swine	63.4		
Crude Fiber (CF)	6.63	1	-	Undig. OM Pigs	22.5		
Coef. Dig. CF Swine	76.6			Ether Extract (EE)	10.5	13	1.48
NDF	18.3	1	-	Coef. Dig. EE Poultry	74.0		
Coef. Dig. NDF Swine	76.7			Digestible EE Poultry	7.77		
ADF	13.6	1	-	Coef. Dig. EE Swine	78.0		
Coef. Dig. ADF Swine	85.1			Digestible EE Swine	8.19		
N-Free Extract (NFE)	28.6			Linoleic Acid	4.27	1	-
Coef. Dig. NFE Poultry	40.0			Linolenic Acid	0.60	1	-
Digestible NFE Poultry	11.5						
Undig. NFE + CF Poultry	23.8						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4456	1	-	***Swine***			
Poultry				Digestible Energy	3525		
Metabolizable Energy	2726			Metabolizable Energy	3315		
Std. Metab. Energy	-			Net Energy	2251		
Net Energy	2193			***Sows***			
Hens				Digestible Energy	3760		
Metabolizable Energy	2793			Metabolizable Energy	3484		
Net Energy	2260			Net Energy	2374		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	5.45	16	0.41	***Trace Minerals, mg/kg***			
				Manganese (Mn)	24.8	1	-
Macro Minerals (%)				Iron (Fe)	179.0	1	-
Potassium (K)	1.80	1	-	Copper (Cu)	13.7	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	41.6	1	-
Chlorine (Cl)	0.02	1	-	Selenium (Se)	0.21	1	-
Sulfur (S)	0.31	1	-				
Magnesium (Mg)	0.32	1	-				
Total Calcium (Ca)	0.25	1	-				
Total Phosphorus (P)	0.55	14	0.02				
Phytate P	0.36	13	0.02				
Available P (Pav)	0.19						
Coef. Dig. P Poultry	38.0						
Std. Dig. P Poultry	0.21						
Coef. Dig. P Swine	38.0						
Std. Dig. P Swine	0.21						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Soybean, Semi-defatted Roasted

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	40.2	100	35.4	88.1	31.5	78.3
Lysine, %	2.48	6.17	2.15	86.8	2.02	81.3
Methionine, %	0.55	1.37	0.48	86.8	0.44	79.8
Met + Cys, %	1.14	2.84	0.95	83.5	0.89	78.2
Threonine, %	1.61	4.00	1.35	83.6	1.26	78.2
Tryptophan, %	0.56	1.39	0.48	84.9	0.46	82.1
Arginine, %	2.93	7.29	2.68	91.4	2.49	85.1
Gly + Ser, %	3.45	8.58	3.04	88.2		
Valine, %	1.94	4.83	1.63	84.2	1.48	76.3
Isoleucine, %	1.84	4.58	1.60	86.8	1.42	77.0
Leucine, %	3.09	7.69	2.69	86.9	2.39	77.4
Histidine, %	1.07	2.66	0.96	89.7	0.88	82.6
Phenylalanine, %	2.04	5.07	1.79	87.7	1.61	78.9
Phe + Tyr, %	3.48	8.66	3.06	87.9	2.75	79.0
Alanine, %	1.60	3.98	1.32	82.8	1.18	74.0
Cysteine, %	0.59	1.47	0.47	80.4	0.45	76.8
Tyrosine, %	1.44	3.58	1.27	88.3	1.14	79.1
Glycine, %	1.60	3.98	1.52	95.0	1.18	74.0
Serine, %	1.85	4.60	1.52	82.3	1.44	78.0
Proline, %	1.84	4.58	1.56	85.0	1.34	73.0
Glutamine[2], %	3.62	9.02	3.32	91.6	2.83	78.0
Glutamic Acid[2], %	4.05	10.1	3.71	91.6	3.16	78.0
Asparagine[2], %	1.67	4.15	1.49	89.6	1.30	78.0
Aspartic Acid[2], %	2.48	6.17	2.22	89.6	1.94	78.0
Total Nitrogen (PB/6.25), %	6.43	16.0	5.66	88.1	5.04	78.3
Essential Nitrogen Poultry, %	3.50	54.4*	3.06	87.4		
Essential Nitrogen Swine, %	2.96	46.0*			2.36	79.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	7	10		10	
Maximum	12	20		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	7	10	10	5	10
Maximum	20	20	20	25	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Starch

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.6	9	2.21	Organic Matter (OM)	87.8		
Crude Protein (CP)	0.40	5	0.17	Coef. Dig. OM Swine	96.4		
Starch	87.7	4	0.11	Digestible OM Swine	84.8		
Crude Fiber (CF)	0.20	1	-	Undig. OM Pigs	2.98		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.50	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	86.6			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	97.1			Linolenic Acid	-	-	-
Digestible NFE Poultry	84.1						
Undig. NFE + CF Poultry	2.71						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3736	4	86	***Swine***			
Poultry				Digestible Energy	3594		
Metabolizable Energy	3528			Metabolizable Energy	3533		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	2823			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	3528			Metabolizable Energy	-		
Net Energy	2823			Net Energy	-		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.80	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	1.0	1	-
Macro Minerals (%)				Iron (Fe)	12.0	1	-
Potassium (K)	-	-	-	Copper (Cu)	1.0	1	-
Sodium (Na)	-	-	-	Zinc (Zn)	1.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	1.04	1	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Starch

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef	SID[1]	Coef
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
	-	-	-	-	-	
Alanine, %						-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugar

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.0	1	-	Organic Matter (OM)	98.9		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	91.2		
Starch	-	-	-	Digestible OM Swine	90.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	8.70		
Coef. Dig. CF Swine	-			Ether Extract (EE)	-	-	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	98.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	93.6			Linolenic Acid	-	-	-
Digestible NFE Poultry	92.5						
Undig. NFE + CF Poultry	6.33						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4008	1	-	***Swine***			
Poultry				Digestible Energy	3873		
Metabolizable Energy	3831			Metabolizable Energy	3737		
Std. Metab. Energy	3887			Net Energy	2728		
Net Energy	3065			***Sows***			
Hens				Digestible Energy	3873		
Metabolizable Energy	3831			Metabolizable Energy	3737		
Net Energy	3065			Net Energy	2728		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.14	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugar

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-			
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	5	10		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	-	-	-	3
Maximum	10	10	10	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Juice

Principais Componentes (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	19.7	2	1.53	Organic Matter (OM)	19.4		
Crude Protein (CP)	0.32	2	0.03	Coef. Dig. OM Swine	93.4		
Starch	-	-	-	Digestible OM Swine	18.1		
Crude Fiber (CF)	0.05	-	-	Undig. OM Pigs	1.28		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.15	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	18.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	757	1	-	***Swine***			
Poultry				Digestible Energy	707		
Metabolizable Energy	-			Metabolizable Energy	675		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.27	2	0.05	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.01	1	-				
Total Phosphorus (P)	0.02	1	-				
Phytate P	0.01	1	-				
Available P (Pav)	0.01						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	32.0						
Std. Dig. P Swine	0.01						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Juice

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	0.32	100.0	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	-	-	-	-	-
Maximum	-	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Molasses

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	73.9	1	-	Organic Matter (OM)	65.2		
Crude Protein (CP)	3.66	1	-	Coef. Dig. OM Swine	84.3		
Starch	-	-	-	Digestible OM Swine	54.9		
Crude Fiber (CF)	2.46	1	-	Undig. OM Pigs	10.2		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.10	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	58.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	2850	1	-	***Swine***			
Poultry				Digestible Energy	2403		
Metabolizable Energy	1880			Metabolizable Energy	2345		
Std. Metab. Energy	2230			Net Energy	1665		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	8.75	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	3.25	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.58	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	1.38	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.76	1	-				
Total Phosphorus (P)	0.06	1	-				
Phytate P	0.04	1	-				
Available P (Pav)	0.02						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	32.0						
Std. Dig. P Swine	0.02						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Molasses

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	3.66	100	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	1		1	
Maximum	1	3		3	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	2	2
Maximum	3	5	5	5	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Molasses Dried

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	93.3	1	-	Organic Matter (OM)	77.0		
Crude Protein (CP)	2.44	1	-	Coef. Dig. OM Swine	82.5		
Starch	-	-	-	Digestible OM Swine	63.5		
Crude Fiber (CF)	6.20	1	-	Undig. OM Pigs	13.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	-	-	-
NDF	-	-	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	68.4			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3170	1	-	***Swine***			
Poultry				Digestible Energy	2616		
Metabolizable Energy	2153			Metabolizable Energy	2495		
Std. Metab. Energy	2480			Net Energy	1745		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	16.3	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	2.19	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.15	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	6.21	1	-				
Total Phosphorus (P)	0.21	1	-				
Phytate P	0.14	1	-				
Available P (Pav)	0.07						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	32.0						
Std. Dig. P Swine	0.07						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sugarcane, Molasses Dried

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	2.44	100	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	1	1		1	
Maximum	2	3		3	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	1	2	2	2	2
Maximum	2	3	3	3	3

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sunflower Meal

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.8	24	0.89	Organic Matter (OM)	83.7		
Crude Protein (CP)	33.0	25	5.02	Coef. Dig. OM Swine	48.0		
Starch	4.38	2	0.88	Digestible OM Swine	40.2		
Crude Fiber (CF)	25.8	7	2.23	Undig. OM Pigs	43.5		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.98	13	0.53
NDF	40.7	7	3.56	Coef. Dig. EE Poultry	60.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.19		
ADF	26.3	7	4.37	Coef. Dig. EE Swine	65.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.29		
N-Free Extract (NFE)	23.0			Linoleic Acid	1.03	1	-
Coef. Dig. NFE Poultry	45.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	10.4						
Undig. NFE + CF Poultry	38.4						

Energy (kcal/kg)							
	Mean	**N**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4216	9	109	***Swine***			
Poultry				Digestible Energy	2159		
Metabolizable Energy	1795			Metabolizable Energy	1951		
Std. Metab. Energy	-			Net Energy	995		
Net Energy	1396			***Sows***			
Hens				Digestible Energy	2588		
Metabolizable Energy	1913			Metabolizable Energy	2285		
Net Energy	1514			Net Energy	1239		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	6.11	17	0.86	***Trace Minerals, mg/kg***			
				Manganese (Mn)	0.34	1	-
Macro Minerals (%)				Iron (Fe)	248.0	1	-
Potassium (K)	1.42	6	0.25	Copper (Cu)	26.0	1	-
Sodium (Na)	0.02	6	0.01	Zinc (Zn)	79.0	1	-
Chlorine (Cl)	0.15	3	0.05	Selenium (Se)	0.50	1	-
Sulfur (S)	0.32	2	0.02				
Magnesium (Mg)	0.65	3	0.09				
Total Calcium (Ca)	0.35	7	0.05				
Total Phosphorus (P)	0.98	6	0.10				
Phytate P	0.66	1	-				
Available P (Pav)	0.32						
Coef. Dig. P Poultry	39.0						
Std. Dig. P Poultry	0.38						
Coef. Dig. P Swine	25.0						
Std. Dig. P Swine	0.25						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sunflower, Meal

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	33.0	100	29.2	88.6	27.9	84.5
Lysine, %	1.14	3.46	0.94	82.8	0.90	79.2
Methionine, %	0.70	2.12	0.64	91.2	0.63	90.4
Met + Cys, %	1.26	3.82	1.08	86.0	1.08	85.4
Threonine, %	1.16	3.52	0.96	82.6	0.92	79.7
Tryptophan, %	0.43	1.30	0.37	86.0	0.36	83.5
Arginine, %	2.67	8.10	2.45	91.8	2.48	92.9
Gly + Ser, %	3.15	9.55	2.60	82.6		
Valine, %	1.53	4.64	1.35	88.3	1.24	81.1
Isoleucine, %	1.25	3.79	1.12	89.5	1.04	83.3
Leucine, %	1.98	6.00	1.76	89.0	1.66	83.6
Histidine, %	0.79	2.40	0.69	86.8	0.65	82.8
Phenylalanine, %	1.45	4.40	1.31	90.0	1.25	86.2
Phe + Tyr, %	2.25	6.82	2.00	89.0	1.95	86.8
Alanine, %	1.40	4.25	1.20	85.6	1.12	80.1
Cysteine, %	0.56	1.70	0.45	79.5	0.44	79.1
Tyrosine, %	0.80	2.43	0.70	87.2	0.70	87.8
Glycine, %	1.75	5.31	1.44	82.0	1.26	72.1
Serine, %	1.40	4.25	1.17	83.3	1.13	80.5
Proline, %	1.66	5.03	1.56	94.0	1.38	83.4
Glutamine[2], %	3.00	9.09	2.79	93.0	2.67	89.0
Glutamic Acid[2], %	2.34	10.1	3.11	93.0	2.98	89.0
Asparagine[2], %	1.16	3.52	1.01	86.7	0.98	84.0
Aspartic Acid[2], %	1.73	5.24	1.50	86.7	1.45	84.0
Total Nitrogen (PB/6.25), %	5.28	16.0	4.67	88.6	4.46	84.5
Essential Nitrogen Poultry, %	2.72	51.5*	2.37	87.3		
Essential Nitrogen Swine, %	2.20	41.8*			1.87	85.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	8		8	
Maximum	10	15		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	5	8	10	13	10
Maximum	10	15	18	20	20

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sweet Potato, Flour

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	89.2	2	0.68	Organic Matter (OM)	86.5		
Crude Protein (CP)	4.00	2	0.18	Coef. Dig. OM Swine	85.3		
Starch	62.9	1	-	Digestible OM Swine	73.8		
Crude Fiber (CF)	2.69	1	-	Undig. OM Pigs	12.7		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.03	2	0.17
NDF	8.80	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	3.60	1	-	Coef. Dig. EE Swine	70.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.72		
N-Free Extract (NFE)	78.8			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3875	1	-	***Swine***			
Poultry				Digestible Energy	3305		
Metabolizable Energy	2706			Metabolizable Energy	3284		
Std. Metab. Energy	2519			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.72	2	0.39	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	0.65	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.15	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	0.09	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.10	1	-				
Total Phosphorus (P)	0.16	1	-				
Phytate P	0.11	1	-				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Sweet Potato, Flour

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	4.00	100	-	-	2.14	53.6
Lysine, %	0.13	3.25	-	-	0.08	58.3
Methionine, %	0.05	1.25	-	-	0.03	60.0
Met + Cys, %	0.06	1.50	-	-	-	-
Threonine, %	0.16	4.00	-	-	0.07	45.5
Tryptophan, %	0.05	1.25	-	-	0.03	50.0
Arginine, %	0.13	3.25	-	-	-	-
Gly + Ser, %	0.36	9.00	-	-		
Valine, %	0.19	4.75	-	-	0.10	53.8
Isoleucine, %	0.15	3.75	-	-	0.08	53.8
Leucine, %	0.18	4.50	-	-	-	-
Histidine, %	0.11	2.75	-	-	-	-
Phenylalanine, %	0.18	4.50	-	-	-	-
Phe + Tyr, %	0.27	6.75	-	-	-	-
Alanine, %	0.21	5.25	-	-	-	-
Cysteine, %	0.01	0.25	-	-		-
Tyrosine, %	0.09	2.25	-	-	-	-
Glycine, %	0.17	4.25	-	-	-	-
Serine, %	0.19	4.75	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	0.64	16.00	-	-	-	-
Essential Nitrogen Poultry, %	0.26	40.2*	-	-		
Essential Nitrogen Swine, %	0.20	31.3*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	-	-		-	
Maximum	-	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	5	6	6	5
Maximum	5	10	12	12	8

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Tallow

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	99.4	1	-	Organic Matter (OM)	99.4		
Crude Protein (CP)	-	-	-	Coef. Dig. OM Swine	87.1		
Starch	-	-	-	Digestible OM Swine	86.6		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	12.8		
Coef. Dig. CF Swine	-			Ether Extract (EE)	99.4	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	80.2		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	79.7		
ADF	-	-	-	Coef. Dig. EE Swine	86.2		
Coef. Dig. ADF Swine	-			Digestible EE Swine	85.7		
N-Free Extract (NFE)	-			Linoleic Acid	3.10	1	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	0.60	1	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	9408	1	-	***Swine***			
Poultry				Digestible Energy	8193		
Metabolizable Energy	7401			Metabolizable Energy	7886		
Std. Metab. Energy	8116			Net Energy	7059		
Net Energy	6660			***Sows***			
Hens				Digestible Energy	8193		
Metabolizable Energy	7401			Metabolizable Energy	7886		
Net Energy	6660			Net Energy	7059		

Minerals							
	Mean	**n**	**SD**		**Means**	**n**	**SD**
Ash, %	-	-	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	-	-	-				
Total Phosphorus (P)	-	-	-				
Phytate P	-	-	-				
Available P (Pav)	-						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Tallow

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	-	-	-	-	-	-
Lysine, %	-	-	-	-	-	-
Methionine, %	-	-	-	-	-	-
Met + Cys, %	-	-	-	-	-	-
Threonine, %	-	-	-	-	-	-
Tryptophan, %	-	-	-	-	-	-
Arginine, %	-	-	-	-	-	-
Gly + Ser, %	-	-	-	-		
Valine, %	-	-	-	-	-	-
Isoleucine, %	-	-	-	-	-	-
Leucine, %	-	-	-	-	-	-
Histidine, %	-	-	-	-	-	-
Phenylalanine, %	-	-	-	-	-	-
Phe + Tyr, %	-	-	-	-	-	-
Alanine, %	-	-	-	-	-	-
Cysteine, %	-	-	-	-	-	-
Tyrosine, %	-	-	-	-	-	-
Glycine, %	-	-	-	-	-	-
Serine, %	-	-	-	-	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	-	-	-	-	-	-
Glutamic Acid[2], %	-	-	-	-	-	-
Asparagine[2], %	-	-	-	-	-	-
Aspartic Acid[2], %	-	-	-	-	-	-
Total Nitrogen (PB/6.25), %	-	-	-	-	-	-
Essential Nitrogen Poultry, %	-	-	-	-		
Essential Nitrogen Swine, %	-	-			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter		Grower		
Practical	2		3	3	
Maximum	4		6	6	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	2	2	0	2
Maximum	4	5	5	4	5

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Triticale, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.0	61	0.79	Organic Matter (OM)	86.3		
Crude Protein (CP)	13.6	62	1.30	Coef. Dig. OM Swine	85.0		
Starch	60.3	6	4.68	Digestible OM Swine	73.3		
Crude Fiber (CF)	2.13	58	0.26	Undig. OM Pigs	12.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.56	60	0.37
NDF	12.6	4	0.12	Coef. Dig. EE Poultry	67.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.05		
ADF	3.87	4	0.29	Coef. Dig. EE Swine	70.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.10		
N-Free Extract (NFE)	69.0			Linoleic Acid	0.50	3	0.07
Coef. Dig. NFE Poultry	83.0			Linolenic Acid	0.04	1	-
Digestible NFE Poultry	57.3						
Undig. NFE + CF Poultry	13.9						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3880	35	60	***Swine***			
Poultry				Digestible Energy	3268		
Metabolizable Energy	2968			Metabolizable Energy	3185		
Std. Metab. Energy	3165			Net Energy	2457		
Net Energy	2363			***Sows***			
Hens				Digestible Energy	3388		
Metabolizable Energy	3016			Metabolizable Energy	3279		
Net Energy	2411			Net Energy	2526		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.70	58	0.19	***Trace Minerals, mg/kg***			
				Manganese (Mn)	44.6	1	-
Macro Minerals (%)				Iron (Fe)	156.0	1	-
Potassium (K)	0.46	4	0.02	Copper (Cu)	21.8	1	-
Sodium (Na)	0.02	4	0.01	Zinc (Zn)	64.1	1	-
Chlorine (Cl)	0.05	4	0.03	Selenium (Se)	-	-	-
Sulfur (S)	0.14	2	0.01				
Magnesium (Mg)	0.10	1	-				
Total Calcium (Ca)	0.05	8	0.01				
Total Phosphorus (P)	0.31	9	0.05				
Phytate P	0.18	4	0.03				
Available P (Pav)	0.13						
Coef. Dig. P Poultry	50.0						
Std. Dig. P Poultry	0.15						
Coef. Dig. P Swine	50.0						
Std. Dig. P Swine	0.15						

Pav = Non Phytate P (Total P – Phytate P);

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Triticale, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	13.6	100	11.7	86.3	11.0	81.0
Lysine, %	0.41	3.02	0.34	82.7	0.34	82.1
Methionine, %	0.20	1.47	0.17	85.2	0.18	90.6
Met + Cys, %	0.48	3.54	0.39	81.1	0.41	86.2
Threonine, %	0.37	2.72	0.30	81.8	0.29	77.3
Tryptophan, %	0.14	1.03	0.12	88.1	0.12	83.8
Arginine, %	0.62	4.57	0.53	84.7	0.54	87.7
Gly + Ser, %	1.13	8.32	0.94	83.2		
Valine, %	0.52	3.83	0.42	80.7	0.41	79.8
Isoleucine, %	0.42	3.09	0.36	86.1	0.36	86.3
Leucine, %	0.79	5.82	0.67	84.2	0.67	85.1
Histidine, %	0.30	2.21	0.25	83.8	0.24	81.4
Phenylalanine, %	0.56	4.12	0.46	83.0	0.45	81.2
Phe + Tyr, %	0.88	6.48	0.73	83.2	0.71	81.2
Alanine, %	0.51	3.76	0.41	80.0	0.41	80.0
Cysteine, %	0.28	2.06	0.22	78.1	0.23	83.1
Tyrosine, %	0.32	2.36	0.27	83.5	0.26	81.3
Glycine, %	0.56	4.12	0.50	89.1	0.41	73.2
Serine, %	0.57	4.20	0.44	77.4	0.45	78.9
Proline, %	1.18	8.69	1.05	89.0	1.11	94.0
Glutamine[2], %	2.25	16.6	2.09	93.0	1.70	75.7
Glutamic Acid[2], %	1.41	10.4	1.31	93.0	1.07	75.7
Asparagine[2], %	0.33	2.45	0.26	77.0	0.27	80.0
Aspartic Acid[2], %	0.41	3.00	0.31	77.0	0.33	80.0
Total Nitrogen (PB/6.25), %	2.17	16.0	1.87	86.3	1.76	81.0
Essential Nitrogen Poultry, %	0.86	39.6*	0.72	83.6		
Essential Nitrogen Swine, %	0.68	31.3*			0.57	83.5

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	10	15		15	
Maximum	20	25		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	20	20	20	20
Maximum	25	35	35	35	35

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Bran

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.5	29	1.30	Organic Matter (OM)	84.1		
Crude Protein (CP)	15.2	29	1.18	Coef. Dig. OM Swine	62.0		
Starch	29.6	4	4.26	Digestible OM Swine	52.1		
Crude Fiber (CF)	9.07	6	0.59	Undig. OM Pigs	31.9		
Coef. Dig. CF Swine	36.1			Ether Extract (EE)	3.40	10	0.69
NDF	39.8	6	2.13	Coef. Dig. EE Poultry	56.0		
Coef. Dig. NDF Swine	50.4			Digestible EE Poultry	1.90		
ADF	13.1	5	0.77	Coef. Dig. EE Swine	63.0		
Coef. Dig. ADF Swine	52.4			Digestible EE Swine	2.14		
N-Free Extract (NFE)	56.5			Linoleic Acid	1.54	1	-
Coef. Dig. NFE Poultry	47.3			Linolenic Acid	0.12	1	-
Digestible NFE Poultry	23.7						
Undig. NFE + CF Poultry	38.8						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3922	6	45	***Swine***			
Poultry				Digestible Energy	2481		
Metabolizable Energy	1810			Metabolizable Energy	2370		
Std. Metab. Energy	2119			Net Energy	1694		
Net Energy	1444			***Sows***			
Hens				Digestible Energy	2767		
Metabolizable Energy	1927			Metabolizable Energy	2605		
Net Energy	1561			Net Energy	1866		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.43	9	0.97	***Trace Minerals, mg/kg***			
				Manganese (Mn)	102.7	1	-
Macro Minerals (%)				Iron (Fe)	205.3	1	-
Potassium (K)	1.10	6	0.11	Copper (Cu)	15.0	1	-
Sodium (Na)	0.02	5	0.01	Zinc (Zn)	134.5	1	-
Chlorine (Cl)	0.07	4	0.01	Selenium (Se)	0.31	1	-
Sulfur (S)	0.20	2	0.03				
Magnesium (Mg)	0.43	4	0.07				
Total Calcium (Ca)	0.14	12	0.03				
Total Phosphorus (P)	0.94	8	0.07				
Phytate P	0.45	9	0.22				
Available P (Pav)	0.49						
Coef. Dig. P Poultry	50.0						
Std. Dig. P Poultry	0.47						
Coef. Dig. P Swine	52.0						
Std. Dig. P Swine	0.49						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Bran

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	15.2	100	12.3	80.9	11.7	77.3
Lysine, %	0.60	3.96	0.44	74.1	0.43	72.0
Methionine, %	0.24	1.58	0.18	76.1	0.19	77.1
Met + Cys, %	0.55	3.63	0.42	75.6	0.41	74.9
Threonine, %	0.51	3.36	0.37	72.6	0.33	65.4
Tryptophan, %	0.22	1.45	0.17	75.0	0.16	70.9
Arginine, %	1.02	6.73	0.93	91.0	0.88	86.4
Gly + Ser, %	1.47	9.69	1.05	71.1		
Valine, %	0.70	4.62	0.50	71.4	0.53	75.4
Isoleucine, %	0.48	3.16	0.39	80.3	0.37	77.5
Leucine, %	0.92	6.07	0.74	80.6	0.72	78.6
Histidine, %	0.40	2.64	0.29	73.5	0.34	85.3
Phenylalanine, %	0.60	3.96	0.50	83.8	0.49	81.3
Phe + Tyr, %	1.04	6.86	0.86	82.9	0.83	80.2
Alanine, %	0.72	4.75	0.54	75.0	0.48	66.0
Cysteine, %	0.31	2.04	0.23	75.2	0.23	73.2
Tyrosine, %	0.44	2.90	0.36	81.7	0.35	78.7
Glycine, %	0.81	5.34	0.50	61.5	0.53	65.0
Serine, %	0.66	4.35	0.53	80.7	0.47	71.6
Proline, %	1.00	6.59	0.88	87.6	0.79	79.1
Glutamine[2], %	1.85	12.2	1.65	89.1	1.57	85.0
Glutamic Acid[2], %	1.16	7.65	1.03	89.1	0.99	85.0
Asparagine[2], %	0.48	3.17	0.38	79.9	0.34	71.0
Aspartic Acid[2], %	0.59	3.89	0.47	79.9	0.42	71.0
Total Nitrogen (PB/6.25), %	2.43	16.0	1.96	80.9	1.88	77.3
Essential Nitrogen Poultry, %	1.19	48.9*	0.92	77.4		
Essential Nitrogen Swine, %	0.95	39.1*			0.74	78.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	5		6	
Maximum	10	15		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	5	8	15	5
Maximum	5	12	15	35	15

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Dark Flour

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.2	2	0.00	Organic Matter (OM)	84.2		
Crude Protein (CP)	17.9	2	0.91	Coef. Dig. OM Swine	72.8		
Starch	27.7	1	-	Digestible OM Swine	61.3		
Crude Fiber (CF)	7.75	2	0.22	Undig. OM Pigs	22.9		
Coef. Dig. CF Swine	-			Ether Extract (EE)	2.07	2	0.79
NDF	31.7	2	0.29	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.80		
ADF	10.1	2	0.75	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.66		
N-Free Extract (NFE)	56.5			Linoleic Acid	1.46	1	-
Coef. Dig. NFE Poultry	64.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	36.2						
Undig. NFE + CF Poultry	28.1						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3773	2	35	***Swine***			
Poultry				Digestible Energy	2848		
Metabolizable Energy	2321			Metabolizable Energy	2740		
Std. Metab. Energy	-			Net Energy	1935		
Net Energy	1846			***Sows***			
Hens				Digestible Energy	3067		
Metabolizable Energy	2411			Metabolizable Energy	2910		
Net Energy	1936			Net Energy	2059		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	4.01	2	0.14	***Trace Minerals, mg/kg***			
				Manganese (Mn)	103.5	2	0.01
Macro Minerals (%)				Iron (Fe)	177.9	2	21.0
Potassium (K)	1.00	2	0.01	Copper (Cu)	14.94	2	1.18
Sodium (Na)	0.03	2	0.01	Zinc (Zn)	153.4	2	17.5
Chlorine (Cl)	0.04	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.34	2	0.04				
Total Calcium (Ca)	0.15	1	0.01				
Total Phosphorus (P)	0.90	1	-				
Phytate P	0.60	1	-				
Available P (Pav)	0.30						
Coef. Dig. P Poultry	28.0						
Std. Dig. P Poultry	0.25						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.25						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Dark Flour

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID¹	Coef.	SID¹	Coef.
Crude Protein, %	17.9	100	15.4	85.9	13.9	77.5
Lysine, %	0.74	4.13	0.61	81.8	0.54	73.6
Methionine, %	0.29	1.62	0.24	81.6	0.23	80.0
Met + Cys, %	0.64	3.58	0.53	82.3	0.47	73.5
Threonine, %	0.58	3.24	0.46	79.3	0.42	71.7
Tryptophan, %	0.20	1.12	0.17	85.0	0.15	75.0
Arginine, %	1.24	6.93	1.14	92.3	1.06	85.7
Gly + Ser, %	0.94	5.25	0.79	84.5		
Valine, %	0.82	4.58	0.67	82.0	0.63	77.2
Isoleucine, %	0.57	3.18	0.48	83.5	0.44	77.8
Leucine, %	1.10	6.15	0.94	85.2	0.88	80.0
Histidine, %	0.49	2.74	0.43	86.8	0.40	81.4
Phenylalanine, %	0.68	3.80	0.60	87.8	0.55	81.4
Phe + Tyr, %	1.09	6.09	0.96	87.7	0.87	80.0
Alanine, %	0.83	4.64	0.59	71.5	-	-
Cysteine, %	0.35	1.96	0.29	82.8	0.24	68.2
Tyrosine, %	0.41	2.29	0.36	87.6	0.32	77.8
Glycine, %	0.19	1.06	0.16	84.5	-	-
Serine, %	0.75	4.19	0.63	84.5	-	-
Proline, %	1.35	7.54	1.22	90.5	-	-
Glutamine², %	2.00	11.2	1.84	91.9	-	-
Glutamic Acid², %	1.26	7.02	1.16	91.9	-	-
Asparagine², %	0.57	3.18	0.46	80.1	-	-
Aspartic Acid², %	0.70	3.91	0.56	80.1	-	-
Total Nitrogen (PB/6.25), %	2.86	16.0	2.46	85.9	2.22	77.5
Essential Nitrogen Poultry, %	1.27	44.2*	1.08	85.2		
Essential Nitrogen Swine, %	1.13	39.5*			0.90	79.2

¹SID = Standardized Ileal Digestibility.
²Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	6	8		8	
Maximum	15	15		20	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	8	15	15	20	15
Maximum	15	30	30	40	35

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Flour

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	87.1	17	0.56	Organic Matter (OM)	86.4		
Crude Protein (CP)	11.7	18	0.93	Coef. Dig. OM Swine	90.8		
Starch	76.5	1	-	Digestible OM Swine	78.5		
Crude Fiber (CF)	0.11	4	0.13	Undig. OM Pigs	7.95		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.19	10	0.30
NDF	2.65	1	-	Coef. Dig. EE Poultry	87.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.04		
ADF	-	-	-	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.95		
N-Free Extract (NFE)	73.4			Linoleic Acid	0.54	1	-
Coef. Dig. NFE Poultry	96.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	70.5						
Undig. NFE + CF Poultry	3.05						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3775	1	-	***Swine***			
Poultry				Digestible Energy	3588		
Metabolizable Energy	3503			Metabolizable Energy	3388		
Std. Metab. Energy	3551			Net Energy	2692		
Net Energy	2794			***Sows***			
Hens				Digestible Energy	3549		
Metabolizable Energy	3504			Metabolizable Energy	3451		
Net Energy	2796			Net Energy	2738		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.71	10	0.23	***Trace Minerals, mg/kg***			
				Manganese (Mn)	6.80	1	-
Macro Minerals (%)				Iron (Fe)	29.3	1	-
Potassium (K)	0.11	1	-	Copper (Cu)	3.01	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	22.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.03	1	-				
Total Calcium (Ca)	0.04	4	0.05				
Total Phosphorus (P)	0.07	4	0.01				
Phytate P	0.05	1	-				
Available P (Pav)	0.02						
Coef. Dig. P Poultry	28.0						
Std. Dig. P Poultry	0.02						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.02						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Flour

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	11.7	100	11.2	95.3	11.2	95.6
Lysine, %	0.30	2.57	0.28	93.2	0.28	92.0
Methionine, %	0.20	1.71	0.19	95.2	0.19	95.0
Met + Cys, %	0.49	4.19	0.46	93.3	0.45	92.6
Threonine, %	0.35	3.00	0.30	87.1	0.32	90.0
Tryptophan, %	0.14	1.20	0.13	92.9	0.13	91.0
Arginine, %	0.52	4.45	0.50	96.4	0.50	96.0
Gly + Ser, %	1.04	8.90	0.97	93.3		
Valine, %	0.50	4.28	0.46	92.8	0.46	92.0
Isoleucine, %	0.48	4.11	0.46	95.0	0.45	94.0
Leucine, %	0.85	7.27	0.80	94.3	0.81	95.0
Histidine, %	0.28	2.40	0.26	94.2	0.27	96.0
Phenylalanine, %	0.60	5.14	0.56	93.3	0.58	96.0
Phe + Tyr, %	0.88	7.53	0.82	92.7	0.84	95.4
Alanine, %	0.34	2.91	0.29	84.5	0.31	90.3
Cysteine, %	0.29	2.48	0.27	92.0	0.26	91.0
Tyrosine, %	0.28	2.40	0.26	91.5	0.26	94.0
Glycine, %	0.48	4.11	0.43	89.4	0.45	94.2
Serine, %	0.56	4.79	0.54	96.6	0.53	93.9
Proline, %	1.48	12.7	1.45	98.0	1.45	97.9
Glutamine[2], %	2.80	21.4	2.47	98.9	2.46	98.4
Glutamic Acid[2], %	1.57	13.4	1.55	98.9	1.54	98.4
Asparagine[2], %	0.22	1.88	0.19	88.0	0.20	89.9
Aspartic Acid[2], %	0.27	2.31	0.24	88.0	0.24	89.9
Total Nitrogen (PB/6.25), %	1.87	16.0	1.78	95.3	1.79	95.6
Essential Nitrogen Poultry, %	0.80	46.2*	0.75	93.6		
Essential Nitrogen Swine, %	0.63	33.8*			0.60	94.1

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	20	20		20	
Maximum	40	40		40	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	20	20	20	20	20
Maximum	40	40	40	40	40

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Germ

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.9	3	0.83	Organic Matter (OM)	84.9		
Crude Protein (CP)	27.6	4	0.85	Coef. Dig. OM Swine	88.8		
Starch	15.5	1	-	Digestible OM Swine	75.4		
Crude Fiber (CF)	2.43	2	0.11	Undig. OM Pigs	9.51		
Coef. Dig. CF Swine	-			Ether Extract (EE)	8.33	3	0.75
NDF	11.5	3	3.87	Coef. Dig. EE Poultry	64.0		
Coef. Dig. NDF Swine	38.8			Digestible EE Poultry	5.33		
ADF	3.52	3	1.25	Coef. Dig. EE Swine	60.0		
Coef. Dig. ADF Swine	35.9			Digestible EE Swine	5.00		
N-Free Extract (NFE)	46.6			Linoleic Acid	3.43	1	-
Coef. Dig. NFE Poultry	49.5			Linolenic Acid	-	-	-
Digestible NFE Poultry	23.1						
Undig. NFE + CF Poultry	26.0						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4331	2	17	***Swine***			
Poultry				Digestible Energy	3700		
Metabolizable Energy	2536			Metabolizable Energy	3578		
Std. Metab. Energy	2718			Net Energy	2570		
Net Energy	2034			***Sows***			
Hens				Digestible Energy	3842		
Metabolizable Energy	2619			Metabolizable Energy	3652		
Net Energy	2117			Net Energy	2624		

Minerals							
	Means	**n**	**SD**		**Means**	**n**	**SD**
Ash, %	3.97	3	0.16	***Trace Minerals, mg/kg***			
				Manganese (Mn)	134.5	1	-
Macro Minerals (%)				Iron (Fe)	110.3	1	-
Potassium (K)	0.73	1	-	Copper (Cu)	4.80	1	-
Sodium (Na)	0.01	1	-	Zinc (Zn)	197.4	1	-
Chlorine (Cl)	0.07	1	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.25	1	-				
Total Calcium (Ca)	0.09	1	-				
Total Phosphorus (P)	0.88	1	-				
Phytate P	0.58	1	-				
Available P (Pav)	0.30						
Coef. Dig. P Poultry	28.0						
Std. Dig. P Poultry	0.25						
Coef. Dig. P Swine	28.0						
Std. Dig. P Swine	0.25						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Germ

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	27.6	100	25.3	91.8	23.8	86.4
Lysine, %	1.75	6.35	1.64	93.8	1.52	86.9
Methionine, %	0.49	1.78	0.46	94.4	0.44	89.8
Met + Cys, %	0.91	3.30	0.84	91.8	0.76	83.2
Threonine, %	1.04	3.77	0.92	88.3	0.81	77.5
Tryptophan, %	0.30	1.09	0.26	86.7	0.22	73.3
Arginine, %	2.07	7.51	1.96	94.6	1.93	93.1
Gly + Ser, %	2.39	8.67	2.17	90.7		
Valine, %	1.35	4.90	1.21	89.6	1.11	82.4
Isoleucine, %	0.92	3.34	0.84	91.5	0.76	82.4
Leucine, %	1.70	6.17	1.56	91.5	1.43	84.0
Histidine, %	0.67	2.43	0.63	93.7	0.62	92.2
Phenylalanine, %	0.99	3.59	0.90	91.1	0.85	86.0
Phe + Tyr, %	1.67	6.09	1.53	91.6	1.46	87.3
Alanine, %	1.55	5.62	1.40	90.5	1.24	80.0
Cysteine, %	0.42	1.52	0.37	88.8	0.32	75.4
Tyrosine, %	0.68	2.47	0.63	92.3	0.61	89.2
Glycine, %	1.28	4.64	1.16	90.7	1.08	84.0
Serine, %	1.11	4.03	1.01	90.7	0.99	89.0
Proline, %	1.45	5.26	1.24	85.7	1.35	93.0
Glutamine[2], %	2.29	8.32	2.18	95.3	2.13	93.0
Glutamic Acid[2], %	1.44	5.22	1.37	95.3	1.34	93.0
Asparagine[2], %	0.99	3.60	0.91	91.7	0.79	80.0
Aspartic Acid[2], %	1.22	4.42	1.12	91.7	0.97	80.0
Total Nitrogen (PB/6.25), %	4.41	16.0	4.05	91.8	3.81	86.4
Essential Nitrogen Poultry, %	2.30	52.2*	2.11	91.8		
Essential Nitrogen Swine, %	1.92	43.5*			1.65	85.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	5	8		8	
Maximum	15	15		15	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	20	25	25	20
Maximum	15	30	30	30	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Gluten

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.7	30	1.36	Organic Matter (OM)	90.9		
Crude Protein (CP)	74.4	26	1.61	Coef. Dig. OM Swine	-		
Starch	-	-	-	Digestible OM Swine	-		
Crude Fiber (CF)	1.13	1	-	Undig. OM Pigs	-		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.06	3	0.69
NDF	5.27	1	-	Coef. Dig. EE Poultry	-		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	-		
ADF	-	-	-	Coef. Dig. EE Swine	-		
Coef. Dig. ADF Swine	-			Digestible EE Swine	-		
N-Free Extract (NFE)	14.3			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	-			Linolenic Acid	-	-	-
Digestible NFE Poultry	-						
Undig. NFE + CF Poultry	-						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	5123	2	248	***Swine***			
Poultry				Digestible Energy	-		
Metabolizable Energy	3493			Metabolizable Energy	-		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	-			***Sows***			
Hens				Digestible Energy	-		
Metabolizable Energy	-			Metabolizable Energy	-		
Net Energy	-			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	0.78	4	0.28	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	-	-	-	Copper (Cu)	-	-	-
Sodium (Na)	-	-	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.12	2	0.03				
Total Phosphorus (P)	0.18	5	0.03				
Phytate P	0.13	3	0.01				
Available P (Pav)	0.05						
Coef. Dig. P Poultry	-						
Std. Dig. P Poultry	-						
Coef. Dig. P Swine	-						
Std. Dig. P Swine	-						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Gluten

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	74.4	100	65.2	88.2	66.0	88.6
Lysine, %	1.24	1.67	1.11	89.6	0.99	80.0
Methionine, %	1.20	1.61	1.15	95.7	1.02	85.0
Met + Cys, %	2.81	3.78	2.66	94.8	2.30	82.0
Threonine, %	1.95	2.62	1.83	93.6	1.40	72.0
Tryptophan, %	0.73	0.98	0.72	98.1	0.61	83.0
Arginine, %	2.59	3.48	2.14	82.5	2.20	85.0
Gly + Ser, %	6.09	8.19	5.54	90.9		
Valine, %	3.02	4.06	2.76	91.3	2.57	85.0
Isoleucine, %	2.70	3.63	2.47	91.4	2.35	87.0
Leucine, %	5.18	6.96	4.52	87.3	4.71	91.0
Histidine, %	1.59	2.14	1.50	94.6	1.38	87.0
Phenylalanine, %	3.76	5.05	3.47	92.3	3.35	89.0
Phe + Tyr, %	6.43	8.64	6.08	94.5	5.46	84.9
Alanine, %	2.01	2.70	1.81	90.2	1.57	78.0
Cysteine, %	1.61	2.16	1.52	94.1	1.37	85.0
Tyrosine, %	2.67	3.59	2.60	97.5	2.43	91.0
Glycine, %	2.56	3.44	2.29	89.6	2.23	87.0
Serine, %	3.53	4.74	3.24	91.9	3.07	87.0
Proline, %	9.67	13.0	8.18	84.6	8.90	92.0
Glutamine[2], %	16.2	21.8	13.9	85.7	15.1	93.0
Glutamic Acid[2], %	10.2	13.7	8.72	85.7	9.47	93.0
Asparagine[2], %	1.12	1.50	0.96	85.5	0.76	68.0
Aspartic Acid[2], %	1.37	1.85	1.17	85.5	0.93	68.0
Total Nitrogen (PB/6.25), %	11.9	16.0	10.5	88.2	10.6	88.6
Essential Nitrogen Poultry, %	4.41	37.1*	3.99	90.5		
Essential Nitrogen Swine, %	3.46	29.1*			2.98	85.9

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	3	-		-	
Maximum	6	-		-	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	3	-	-	-	-
Maximum	6	-	-	-	-

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Grain

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.0	54	0.64	Organic Matter (OM)	86.5		
Crude Protein (CP)	13.6	54	1.03	Coef. Dig. OM Swine	85.9		
Starch	56.7	4	3.10	Digestible OM Swine	74.3		
Crude Fiber (CF)	2.08	54	0.33	Undig. OM Pigs	12.2		
Coef. Dig. CF Swine	17.0			Ether Extract (EE)	1.80	51	0.37
NDF	11.3	5	1.39	Coef. Dig. EE Poult.	68.0		
Coef. Dig. NDF Swine	-			Digestible EE Poult.	1.23		
ADF	3.09	5	0.32	Coef. Dig. EE Swine	70.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.26		
N-Free Extract (NFE)	69.0			Linoleic Acid	0.68	1	-
Coef. Dig. NFE Poultry	83.8			Linolenic Acid	0.05	1	-
Digestible NFE Poultry	57.8						
Undig. NFE + CF Poultry	13.3						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3835	16	27	***Swine***			
Poultry				Digestible Energy	3340		
Metabolizable Energy	3039			Metabolizable Energy	3243		
Std. Metab. Energy	3124			Net Energy	2489		
Net Energy	2422			***Sows***			
Hens				Digestible Energy	3448		
Metabolizable Energy	3084			Metabolizable Energy	3332		
Net Energy	2462			Net Energy	2555		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	1.51	54	0.20	***Trace Minerals, mg/kg***			
				Manganese (Mn)	22.93	5	1.30
Macro Minerals (%)				Iron (Fe)	42.69	5	6.44
Potassium (K)	0.39	8	0.03	Copper (Cu)	3.36	5	0.42
Sodium (Na)	0.01	8	0.00	Zinc (Zn)	28.51	5	2.67
Chlorine (Cl)	0.08	4	0.01	Selenium (Se)	-	-	-
Sulfur (S)	0.15	3	0.01				
Magnesium (Mg)	0.11	7	0.01				
Total Calcium (Ca)	0.05	12	0.01				
Total Phosphorus (P)	0.30	12	0.03				
Phytate P	0.22	4	0.01				
Available P (Pav)	0.08						
Coef. Dig. P Poultry	50.0						
Std. Dig. P Poultry	0.15						
Coef. Dig. P Swine	49.0						
Std. Dig. P Swine	0.15						

Pav = Non Phytate P (Total P – Phytate P).

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Grain

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	13.6	100	12.3	90.5	12.3	90.5
Lysine, %	0.35	2.57	0.29	82.3	0.29	82.2
Methionine, %	0.20	1.47	0.18	89.5	0.18	89.8
Met + Cys, %	0.48	3.53	0.43	88.8	0.43	89.9
Threonine, %	0.36	2.65	0.29	81.6	0.30	82.6
Tryptophan, %	0.15	1.10	0.12	80.0	0.13	87.0
Arginine, %	0.59	4.34	0.53	90.2	0.52	87.6
Gly + Ser, %	1.09	8.01	0.93	85.7		
Valine, %	0.53	3.90	0.45	85.8	0.46	86.7
Isoleucine, %	0.44	3.23	0.39	89.0	0.39	88.8
Leucine, %	0.84	6.17	0.76	89.9	0.75	89.5
Histidine, %	0.30	2.21	0.27	86.9	0.27	89.3
Phenylalanine, %	0.57	4.19	0.52	90.7	0.52	91.4
Phe + Tyr, %	0.80	5.88	0.72	90.1	0.73	91.1
Alanine, %	0.43	3.16	0.34	78.6	0.35	81.6
Cysteine, %	0.28	2.06	0.25	88.3	0.25	90.0
Tyrosine, %	0.23	1.69	0.20	88.6	0.21	90.3
Glycine, %	0.54	3.97	0.44	82.0	0.46	84.7
Serine, %	0.55	4.04	0.49	89.4	0.48	87.3
Proline, %	1.29	9.48	1.24	96.0	1.27	98.5
Glutamine[2], %	2.14	15.8	2.06	96.0	2.04	94.9
Glutamic Acid[2], %	1.35	9.89	1.29	96.0	1.27	94.7
Asparagine[2], %	0.28	2.08	0.24	85.0	0.23	83.0
Aspartic Acid[2], %	0.35	2.55	0.30	85.0	0.29	83.0
Total Nitrogen (PB/6.25), %	2.18	16.0	1.97	90.5	1.97	90.5
Essential Nitrogen Poultry, %	0.84	38.7*	0.74	87.4		
Essential Nitrogen Swine, %	0.67	30.7*			0.59	87.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	12	20		20	
Maximum	20	30		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	20	20	20	20
Maximum	25	35	35	35	35

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Screenings

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	88.2	1	-	Organic Matter (OM)	85.4		
Crude Protein (CP)	13.6	1	-	Coef. Dig. OM Swine	81.1		
Starch	-	-	-	Digestible OM Swine	69.3		
Crude Fiber (CF)	6.55	1	-	Undig. OM Pigs	16.2		
Coef. Dig. CF Swine	60.0			Ether Extract (EE)	2.11	1	-
NDF	18.7	1	-	Coef. Dig. EE Poultry	60.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.27		
ADF	8.85	1	-	Coef. Dig. EE Swine	60.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.27		
N-Free Extract (NFE)	63.2			Linoleic Acid	0.79	1	-
Coef. Dig. NFE Poultry	81.5			Linolenic Acid	-	-	-
Digestible NFE Poultry	51.5						
Undig. NFE + CF Poultry	18.2						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	3875	1	-	***Swine***			
Poultry				Digestible Energy	3141		
Metabolizable Energy	2783			Metabolizable Energy	3027		
Std. Metab. Energy	-			Net Energy	-		
Net Energy	2217			***Sows***			
Hens				Digestible Energy	3268		
Metabolizable Energy	2837			Metabolizable Energy	3149		
Net Energy	2271			Net Energy	-		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	2.76	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	44.6	1	-
Macro Minerals (%)				Iron (Fe)	156	1	-
Potassium (K)	0.43	1	-	Copper (Cu)	21.8	1	-
Sodium (Na)	0.02	1	-	Zinc (Zn)	64.1	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	0.17	1	-				
Total Calcium (Ca)	0.12	1	-				
Total Phosphorus (P)	0.43	1	-				
Phytate P	0.29	1	-				
Available P (Pav)	0.14						
Coef. Dig. P Poultry	50.0						
Std. Dig. P Poultry	0.22						
Coef. Dig. P Swine	49.0						
Std. Dig. P Swine	0.21						

Pav = Non Phytate P (Total P – Phytate P);

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Wheat, Screenings

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	13.6	100	12.4	90.8	11.2	82.0
Lysine, %	0.46	3.38	0.38	83.5	-	-
Methionine, %	0.21	1.54	0.18	86.9	-	-
Met + Cys, %	0.50	3.68	0.45	90.3	-	-
Threonine, %	0.42	3.09	0.38	90.4	-	-
Tryptophan, %	0.17	1.25	0.15	90.5	-	-
Arginine, %	0.67	4.93	0.66	98.5	-	-
Gly + Ser, %	1.22	8.97	1.05	85.9		
Valine, %	0.60	4.41	0.52	87.3	-	-
Isoleucine, %	0.48	3.53	0.43	90.4	-	-
Leucine, %	0.89	6.54	0.81	91.2	-	-
Histidine, %	0.32	2.35	0.26	80.6	-	-
Phenylalanine, %	0.55	4.04	0.52	94.5	-	-
Phe + Tyr, %	0.89	6.54	0.84	94.6	-	-
Alanine, %	0.50	3.68	0.38	76.7	-	-
Cysteine, %	0.29	2.13	0.27	92.7	-	-
Tyrosine, %	0.34	2.50	0.32	94.7	-	-
Glycine, %	0.63	4.63	0.49	77.7	-	-
Serine, %	0.59	4.34	0.56	94.7	-	-
Proline, %	-	-	-	-	-	-
Glutamine[2], %	2.16	15.7	2.08	96.3	-	-
Glutamic Acid[2], %	1.35	10.1	1.30	96.3	-	-
Asparagine[2], %	0.34	2.50	0.28	83.8	-	-
Aspartic Acid[2], %	0.41	3.01	0.35	83.8	-	-
Total Nitrogen (PB/6.25), %	2.18	16.0	1.98	90.8	1.78	82.0
Essential Nitrogen Poultry, %	0.94	43.4*	0.84	89.4		
Essential Nitrogen Swine, %	0.75	34.3*			-	-

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	10	12		15	
Maximum	20	25		30	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	10	15	15	15	15
Maximum	20	30	30	30	30

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Yeast, Alcohol Distiller's

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	91.2	1	-	Organic Matter (OM)	87.8		
Crude Protein (CP)	37.2	1	-	Coef. Dig. OM Swine	80.0		
Starch	-	-	-	Digestible OM Swine	70.2		
Crude Fiber (CF)	-	-	-	Undig. OM Pigs	17.6		
Coef. Dig. CF Swine	-			Ether Extract (EE)	0.48	1	-
NDF	-	-	-	Coef. Dig. EE Poultry	70.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	0.34		
ADF	-	-	-	Coef. Dig. EE Swine	80.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	0.38		
N-Free Extract (NFE)	50.2			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	76.0			Linolenic Acid	-	-	-
Digestible NFE Poultry	38.1						
Undig. NFE + CF Poultry	12.0						

Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4157	1	-	***Swine***			
Poultry				Digestible Energy	3370		
Metabolizable Energy	2506			Metabolizable Energy	3164		
Std. Metab. Energy	2615			Net Energy	2067		
Net Energy	1974			***Sows***			
Hens				Digestible Energy	3538		
Metabolizable Energy	2535			Metabolizable Energy	3292		
Net Energy	2003			Net Energy	2161		

Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.36	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	14.0	1	-
Macro Minerals (%)				Iron (Fe)	191.0	1	-
Potassium (K)	1.13	1	-	Copper (Cu)	30.0	1	-
Sodium (Na)	0.20	1	-	Zinc (Zn)	108.0	1	-
Chlorine (Cl)	-	-	-	Selenium (Se)	0.55	1	-
Sulfur (S)	4.00	1	-				
Magnesium (Mg)	0.09	1	-				
Total Calcium (Ca)	0.29	1	-				
Total Phosphorus (P)	0.82	1	-				
Phytate P	-	-	-				
Available P (Pav)	0.27						
Coef. Dig. P Poultry	45.9						
Std. Dig. P Poultry	0.38						
Coef. Dig. P Swine	45.9						
Std. Dig. P Swine	0.38						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Yeast, Alcohol Distiller's

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	37.2	100	20.6	55.5	28.8	77.5
Lysine, %	2.99	8.0	2.11	70.6	2.48	83.0
Methionine, %	0.61	1.6	0.35	57.5	0.47	77.1
Met + Cys, %	0.89	2.4	0.46	52.2	0.66	74.2
Threonine, %	2.14	5.8	1.07	49.8	1.51	70.4
Tryptophan, %	0.48	1.3	0.26	53.6	0.38	78.4
Arginine, %	1.75	4.7	1.25	71.5	1.47	83.8
Gly + Ser, %	3.77	10.1	2.41	64.0		
Valine, %	2.24	6.0	1.26	56.3	1.63	72.7
Isoleucine, %	1.92	5.2	1.04	54.3	1.43	74.6
Leucine, %	2.69	7.2	1.53	57.0	2.04	75.7
Histidine, %	0.83	2.2	0.47	56.8	0.67	80.5
Phenylalanine, %	1.64	4.4	0.84	51.2	1.22	74.2
Phe + Tyr, %	2.53	6.8	1.29	51.1	1.95	77.1
Alanine, %	2.51	6.75	-	-	1.90	75.7
Cysteine, %	0.28	0.75	0.11	40.5	0.19	67.9
Tyrosine, %	0.89	2.39	0.45	51.0	0.73	82.4
Glycine, %	1.66	4.46	-	-	1.35	81.2
Serine, %	2.25	6.05	-	-	1.71	76.1
Proline, %	-	-	-	-	-	-
Glutamine[2], %	2.63	7.02	-	-	2.07	78.7
Glutamic Acid[2], %	1.65	4.49	-	-	1.30	78.7
Asparagine[2], %	1.91	5.16	-	-	1.50	78.7
Aspartic Acid[2], %	2.35	6.29	-	-	1.85	78.7
Total Nitrogen (PB/6.25), %	5.95	16.0			4.61	77.5
Essential Nitrogen Poultry, %	3.24	54.5*	1.79	55.5		
Essential Nitrogen Swine, %	2.63	44.3*			2.02	76.8

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	3		3	
Maximum	3	4		4	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	3	4	3	4
Maximum	6	8	12	10	10

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Yeast, Brewer's

Main Components (%)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Dry Matter	90.0	1	-	Organic Matter (OM)	86.4		
Crude Protein (CP)	41.8	1	-	Coef. Dig. OM Swine	81.2		
Starch	1.00	1	-	Digestible OM Swine	70.1		
Crude Fiber (CF)	1.33	1	-	Undig. OM Pigs	16.2		
Coef. Dig. CF Swine	-			Ether Extract (EE)	1.38	1	-
NDF	6.20	1	-	Coef. Dig. EE Poultry	75.0		
Coef. Dig. NDF Swine	-			Digestible EE Poultry	1.04		
ADF	1.80	1	-	Coef. Dig. EE Swine	82.0		
Coef. Dig. ADF Swine	-			Digestible EE Swine	1.13		
N-Free Extract (NFE)	41.9			Linoleic Acid	-	-	-
Coef. Dig. NFE Poultry	77.4			Linolenic Acid	-	-	-
Digestible NFE Poultry	32.4						
Undig. NFE + CF Poultry	10.8						
Energy (kcal/kg)							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Gross Energy	4339	1	-	***Swine***			
Poultry				Digestible Energy	3474		
Metabolizable Energy	2590			Metabolizable Energy	3240		
Std. Metab. Energy	-			Net Energy	2094		
Net Energy	2035			***Sows***			
Hens				Digestible Energy	3638		
Metabolizable Energy	2624			Metabolizable Energy	3360		
Net Energy	2069			Net Energy	2182		
Minerals							
	Mean	**n**	**SD**		**Mean**	**n**	**SD**
Ash, %	3.64	1	-	***Trace Minerals, mg/kg***			
				Manganese (Mn)	-	-	-
Macro Minerals (%)				Iron (Fe)	-	-	-
Potassium (K)	1.32	1	-	Copper (Cu)	-	-	-
Sodium (Na)	0.19	1	-	Zinc (Zn)	-	-	-
Chlorine (Cl)	-	-	-	Selenium (Se)	-	-	-
Sulfur (S)	-	-	-				
Magnesium (Mg)	-	-	-				
Total Calcium (Ca)	0.26	1	-				
Total Phosphorus (P)	0.77	1	-				
Phytate P	0.52	-	-				
Available P (Pav)	0.25						
Coef. Dig. P Poultry	45.9						
Std. Dig. P Poultry	0.35						
Coef. Dig. P Swine	45.9						
Std. Dig. P Swine	0.35						

Pav = Non Phytate P (Total P – Phytate P)

Table 1.01 - Chemical Composition, Digestibility, and Energy Values of Poultry and Swine Feedstuffs (as-fed) cont.

Yeast, Brewer's

Amino Acid Content and Digestibility						
	Total	% CP	Poultry		Swine	
			SID[1]	Coef.	SID[1]	Coef.
Crude Protein, %	41.8	100	26.8	64.0	34.0	81.4
Lysine, %	3.54	8.47	2.57	72.5	2.94	83.0
Methionine, %	0.69	1.65	0.42	60.7	0.53	77.1
Met + Cys, %	1.05	2.51	0.51	49.0	0.78	73.9
Threonine, %	2.31	5.53	1.23	53.4	1.63	70.4
Tryptophan, %	0.51	1.22	0.30	58.7	0.40	78.4
Arginine, %	2.14	5.12	1.59	74.5	1.79	83.8
Gly + Ser, %	4.20	10.1	2.70	64.4		
Valine, %	2.36	5.65	1.49	63.0	1.72	72.7
Isoleucine, %	2.45	5.86	1.59	65.0	1.83	74.6
Leucine, %	3.16	7.56	2.15	67.9	2.39	75.7
Histidine, %	0.96	2.30	0.65	67.8	0.77	80.5
Phenylalanine, %	1.84	4.40	1.29	70.3	1.37	74.2
Phe + Tyr, %	3.05	7.30	2.14	70.3	2.36	77.5
Alanine, %	2.69	6.44	-	-	2.27	84.3
Cysteine, %	0.36	0.86	-	-	0.24	67.9
Tyrosine, %	1.21	2.89	0.85	70.3	1.00	82.4
Glycine, %	1.98	4.74	-	-	1.76	88.9
Serine, %	2.22	5.31	-	-	1.81	81.4
Proline, %	3.93	9.40	-	-	3.30	84.1
Glutamine[2], %	2.96	7.07	-	-	2.63	88.9
Glutamic Acid[2], %	1.85	4.44	-	-	1.65	88.9
Asparagine[2], %	1.93	4.63	-	-	1.68	86.9
Aspartic Acid[2], %	2.38	5.68	-	-	2.06	86.9
Total Nitrogen (PB/6.25), %	6.69	16.0	-	-	5.45	81.4
Essential Nitrogen Poultry, %	3.74	55.9*	-	-		
Essential Nitrogen Swine, %	3.07	45.9*			2.36	77.0

[1]SID = Standardized Ileal Digestibility.
[2]Values estimated using data from Li et al. (2011) and Li e Wu (2020).
*Essential Nitrogen for Poultry and Swine calculated as a percentage of Total Nitrogen.

Recommended Inclusion Levels in Poultry and Swine Feeds (%)					
	Broilers			***Hens***	
	Starter	Grower			
Practical	2	3		3	
Maximum	3	4		4	
	Growing Pigs			***Sows***	
	Starter	Grower	Finisher	Gestation	Lactation
Practical	2	4	4	4	4
Maximum	8	10	15	15	10

Table 1.02 - Equations to Estimate the Metabolizable Energy Values of Feedstuffs for Young and Mature Poultry.

VEGETAL FEEDSTUFFS

Poultry: Broilers and Young Birds

$ME_{Poultry}$ = 4.31 CPd + 9.29 EEd + 4.14 NFEd

$NE_{Poultry}$ = $ME_{Poultry}$ - (4.31 CPd x 0.24) - (9.29 EEd x 0.10) - (4.14 NFEd x 0.20)

Hens and Mature Poultry

ME_{Hens} = 4.31 CPd + 9.29 EEd + 4.14 NFEd + 0.3 UDEF

NE_{Hens} = ME_{Hens} - (4.31 CPd x 0.24) - (9.29 EEd x 0.10) - (4.14 NFEd x 0.20)

ANIMAL BY-PRODUCTS AND FATS

Poultry: Young and Mature

$ME_{Poultry}$ = 4.31 CPd + 9.29 EEd

$NE_{Poultry}$ = $ME_{Poultry}$ - (4.31 CPd x 0.24) - (9.29 EEd x 0.10)

$ME_{Poultry}$ = Metabolizable Energy Poultry, kcal/kg.
ME_{Hens} = Metabolizable Energy Hens, kcal/kg.
$NE_{Poultry}$ = Net Energy Poultry, kcal/kg.
NE_{Hens} = Net Energy Hens, kcal/kg.
CPd = Digestible Crude Protein Poultry, g/kg
EEd = Digestible Ether Extract Poultry, g/kg
NFEd = Digestible N-Free Extract Poultry, g/kg
UDEF = Undigestible N-Free Extract + Crude Fiber Poultry, g/kg

Data from UFV Theses and Dissertations.
Carré, B; M. Lessire and H. Juin. Prediction of the net energy value of broiler diets. Animal. 8:9, pp 1395–1401. 2014.
De Groote, G. A comparison of a new net energy system with the metabolizable energy system in broiler diet formulation, performance and profitability. Br. Poultry Sci. 15:75-95. 1974.
Janssen, W. M. European Table of Energy Values for Poultry Feedstuffs. Wageningen, Holland. 1989, 104p.
Titus, H. W. Alimentación Científica de las Gallinas. Ed. Acribia, Espanha. 1960, 290p.

Table 1.03 - Equations to Estimate the Energy Values of Feedstuffs for Swine in General

DIGESTIBLE ENERGY - Swine

Vegetable Feedstuffs and Dairy Products

DE_{Swine} = 5.65 CPd + 9.45 EEd + 4.14 (OMd - CPd - EEd)

Animal By-Products and Fats

DE = 5.65 CPd + 9.45 EEd

METABOLIZABLE ENERGY - Swine

Vegetable Feedstuffs and Dairy Products

ME_{Swine} = 4.952 CPd + 9.45 EEd + 4.14 (OMd - CPd - EEd)

Animal By-Products

ME = 4.952 CPd + 9.45 EEd

Fat and Carbohydrate Feedstuffs

ME_{Swine} = 0.965 DE

NET ENERGY - Swine

NE_{Swine} = 0.73 ME_{Swine} + 13.1 EE + 3.7 S - 6.7 CP - 9.7 CF

DE_{Swine}	= Dig. Energy Swine, kcal/kg	NE_{Swine}	= Net Energy Swine, kcal/kg
ME_{Swine}	= Metab. Energy Swine, kcal/kg	EE	= Ether Extract, %
CPd	= Dig. Crude Protein Swine, g/kg	S	= Starch, %
EEd	= Dig. Ether Extract Swine, g/kg	CP	= Crude Protein, %
OMd	= Dig. Organic Matter Swine, g/kg	CF	= Crude Fiber, %

Data from UFV Theses and Dissertations.
Noblet, J. H. Fortune. X.S. Shi. S. Dubois. Prediction of net energy value of feeds for growing pigs. J. Anim.Sci. 72, 344-354. 1994.
Coutinho, R. Noções de Fisiologia da Nutrição. Ed. O Cruzeiro. Rio de Janeiro. 1966, 471p.
Sauvant, D., Perez, J. M. and Tran, G. (Editors). Tablas de Composición y de Valor Nutritivo de las Materias Primas Destinadas a los Animales de Interés Ganadero. Ed. Mundi-Prensa. Espanha. 2004, 310p.

Table 1.04 - Equations to Estimate the Energy Values of Feedstuffs for Sows and Mature Swine

DIGESTIBLE ENERGY - Sows

Vegetable Feedstuffs

DE_{Sows} = 5.65 CPd + 9.45 EEd + 4.14 (OMd - CPd - EEd) + 1 UDOM

METABOLIZABLE ENERGY - Sows

Vegetable Feedstuffs

ME_{Sows}= 4.952 CPd + 9.45 EEd + 4.14 (OMd - CPd - EEd) + 0.75 UDOM

NET ENERGY - Sows

Vegetable Feedstuffs

NE_{Sows}= 0.73 ME_{Sows} + 13.1 EE + 3.7 S - 6.7 CP - 9.7 CF

DE_{Sows}	= Dig. Energy Sows, kcal/kg	NE_{Sows}	= Net Energy Sows, kcal/kg
ME_{Sows}	= Metab. Energy Sows, kcal/kg	EE	= Ether Extract, %
CPd	= Dig. Crude Protein Swine, g/kg	S	= Starch, %
EEd	= Dig. Ether Extract Swine, g/kg	CP	= Crude Protein, %
OMd	= Dig. Organic Matter Swine, g/kg	CF	= Crude Fiber %
UDOM	= Undigestible Organic Matter Swine, g/kg		

Data from UFV Theses and Dissertations.

Coutinho, R. Noções de Fisiologia da Nutrição. Ed. O Cruzeiro. Rio de Janeiro. 1966, 471p.
Sauvant, D., Perez, J. M. and Tran, G. (Editors). Tablas de Composición y de Valor Nutritivo de las Materias Primas Destinadas a los Animales de Interés Ganadero. Ed. Mundi-Prensa. Espanha. 2004, 310p.

Table 1.05 - Equation to Estimate Metabolizable Energy Lost (ME_L) for Poultry as a Function of Corn Classification[1]

ME_L = -0.064 + 1.62 BRK + 6.98 FRIM + 10.06 MOLD + 12.28 INS + 5.87 ADC

ME_L = Metabolizable Energy Lost by Poultry, Kcal/kg.
BRK = Broken Grains, %
FRIM = Fragmented Grains and Impurities, %
MOLD = Grains Contamineds by Molds, %
INS = Grains Attacked by Insects, %
ADC = Granis Affected by Different Causes, %

Example:

Classification	"0"	I	II	III
BRK, %	0	0.16	1.32	5.88
FRIM, %	0	0	1.18	1.96
MOLD, %	0	2.60	3.64	6.32
INS, %	0	0.24	0.12	0.16
ADC, %	0	0	0	0
ME_L, Kcal/kg	0	- 29	- 48	- 89
ME Poultry, Kcal/kg	3412[2]	3383	3364[2]	3323

[1] Equation developed by Barbarino and Rostagno (Barbarino, 2001).
[2] Considering corn type II with 3364 Kcal/kg (Table 1.01), then corn with 0 % of BRK, FRIM, MOLD, INS, and ADC has ME_L = 0; then the ME Poultry value is 3364 + 48 = 3412 Kcal/kg.

Table 1.06 - Equation to Estimate Corn and Sorghum Amino Acid Content as a Function of Crude Protein (CP) Content

AAsum= Lys + Met + Met+Cys + Thr+ Trp + Arg + Gly+Ser + Val + Iso + Leu + His + Phe + Phe+Tyr

Eq. Corn: Y(AAsum, %) = 0.3468 + 0.5757 (%CP); R^2 = 0.71; n = 428
Eq. Sorghum: Y(AAsum, %) = 1.0723 + 0.4977 (%CP); R^2 = 0.75; n = 118

Procedure:
1 - Determine feedstuff crude protein. 2 - Use the equation to estimate the sum of amino acids (AAsum). 3 - Calculate the content (%) of each amino acid considering its percentage in the sum.

Amino Acids	Corn		Sorghum	
	% AA in the sum	E.g. Corn 7.1% CP	% AA in the sum	E.g. Sorghum 8.15% CP
Sum of AAs, %	100	4.434	100	5.129
Lysine, %	4.902	0.217	3.623	0.186
Methionine, %	3.137	0.139	2.717	0.139
Met+Cys, %	6.471	0.287	5.435	0.279
Threonine, %	5.882	0.261	5.072	0.260
Tryptophan, %	1.176	0.052	1.812	0.093
Arginine, %	7.647	0.339	6.341	0.325
Gly+Ser. %	14.118	0.626	12.681	0.650
Valine, %	7.843	0.348	7.971	0.409
Isoleucine, %	5.490	0.243	6.341	0.325
Leucine, %	18.824	0.835	21.196	1.087
Histidine, %	4.706	0.209	3.623	0.186
Phenylalanine, %	7.059	0.313	8.333	0.427
Phe+Tyr, %	12.745	0.565	14.855	0.762

Example for Lysine:

Corn Determined CP: 7.10%
Y(AAsum) = 0.3468 + 0.5757 (7.10) = 4.434%
Calculation: 4.902 x 4.434 / 100 = 0.217% Lysine

Sorghum Determined CP: 8.15%
Y (AAsum) = 1.0723 + 0.4977 (8.15) = 5.129%
Calculation: 3.623 x 5.129 / 100 = 0.186% Lysine

Table 1.07 - Equation to Estimate Soybean Amino Acid Content as a Function of Crude Protein Content

AAsum= Lys + Met + Met+Cys + Thr + Trp + Arg + Gly+Ser + Val + Iso + Leu + His + Phe + Phe+Tyr

Eq. Soybeans (full fat and meal): Y(AAsum %)= - 0.3850 + 0.6750 (%CP); R^2=0.93; n= 299

Procedure:
1 - Determine feedstuff crude protein. 2 - Use the equation to estimate the sum of amino acids (AAsum). 3 - Calculate the content (%) of each amino acid considering its percentage in the sum.

Amino Acids	% AA in the sum	Full-Fat Soybean (FFS)	Soybean Meal (SBM)	
		E.g. FFS 35.1%CP	E.g. SBM 43.7%CP	Ex. SBM 47.2%CP
Sum of AAs, %	100	23.308	29.113	31.475
Lysine, %	9.441	2.200	2.749	2.972
Methionine, %	2.011	0.469	0.586	0.633
Met+Cys. %	4.146	0.966	1.207	1.305
Threonine, %	6.042	1.408	1.759	1.902
Tryptophan, %	2.102	0.490	0.612	0.661
Arginine, %	10.943	2.551	3.186	3.444
Gly+Ser. %	14.761	3.440	4.297	4.646
Valine, %	7.257	1.692	2.113	2.284
Isoleucine, %	6.871	1.602	2.000	2.163
Leucine, %	11.510	2.683	3.351	3.623
Histidine, %	3.941	0.918	1.147	1.240
Phenylalanine, %	7.684	1.791	2.237	2.419
Phe+Tyr. %	13.291	3.098	3.869	4.183

Example for Lysine:

Full-Fat Soybean Determined CP: 35.1%
Y(AAsum) = -0.3850 + 0.6750 (35.1) = 23.308%%
Calculation: 9.441 x 23.308 / 100 = 2.200% Lysine

Soybean Meal Determined CP: 43.7%
Y (AAsum) = -0.3850 + 0.6750 (43.7) = 29.113%
Calculation: 9.441 x 29.113 / 100 = 2.749% Lysine

Table 1.08 - Composition, Digestibility, and Energy Values of Crystalline Amino Acids for Poultry (dry matter basis)

Amino Acid	N (%)	CP (N x 6.25) (%)	Standardized Digestibility[1] (%)	Gross Energy (kcal/kg)	Dig. Energy and Met. Standard. (kcal/kg)		Net Energy[3]
					DES	$MESn_{50}$[2]	
Alanine	15.72	98.26	99.7	4389	4376	3730	2890
Asparagine	21.20	132.52	100.0	3503	3503	2632	2039
Aspartic Ac.	10.52	65.77	99.7	2854	2845	2413	1870
Arginine	32.16	201.02	100.0	4492	4492	3616	2802
Cystine	11.56	72.26	97.2	4325	4204	3729	2890
Phenylalan.	8.48	53.00	98.1	6932	6800	6452	5000
Glycine	18.66	116.63	97.0	3163	3068	2301	1783
Glutamic Ac.	9.52	59.50	99.4	3686	3664	3273	2536
Glutamine	19.17	119.80	99.4	4206	4181	3393	2630
Histidine	27.08	169.27	99.0	4036	3996	2883	2234
Isoleucine	10.68	66.74	100.0	6605	6605	6166	4779
Leucine	10.68	66.74	99.5	6714	6680	6242	4837
Lysine	19.16	119.77	99.8	6204	6191	5404	4188
Lysine - HCl	13.73	85.81	99.8	4901	4891	4327	3353
Methionine	9.39	58.67	99.2	5684	5639	5253	4071
Proline	12.17	76.04	99.1	5065	5019	4519	3503
Tyrosine	7.73	48.32	99.6	5990	5966	5648	4377
Threonine	11.76	73.49	98.1	4173	4094	3610	2798
Tryptophan	13.72	85.73	99.3	6506	6460	5897	4570
Serine	13.33	83.30	100.0	3306	3306	2758	2138
Valine	11.96	74.73	100.0	6026	6026	5535	4289

[1] Determined with cecectomized cockerels and broiler chicks (standardized ileal digestibility).
[2] Considering 50% of nitrogen conversion to uric acid (except arginine into urea).
[3] Considering 70% the efficiency of amino acids utilization to protein deposition and 30% for deamination and catabolism. The utilization efficiency of standardized ME was considered 85% for deposition and 60% for amino acid deaminated and catabolized. NE = MESn x 0.595 + MESn x 0.18.

Table 1.09 - Composition, Digestibility, and Energy Values of Crystalline Amino Acids for Swine (dry matter basis)

Amino Acid	N (%)	CP (N x 6.25) (%)	Standardized Digestibility[1] (%)	Gross Energy (kcal/kg)	Dig. Energy and Met. Standard. (kcal/kg)		Net Energy[3]
					DES	$MESn_{35}$[2]	
Alanine	15.72	98.26	92.0	4389	4038	3738	2897
Asparagine	21.20	132.52	100.0	3503	3503	3099	2401
Aspartic Ac.	10.52	65.77	93.5	2854	2668	2468	1913
Arginine	32.16	201.02	95.5	4492	4290	3676	2849
Cystine	11.56	72.26	92.4	4325	3996	3776	2926
Phenylalan.	8.48	53.00	95.2	6932	6599	6438	4989
Glycine	18.66	116.63	97.0	3163	3068	2712	2102
Glutamic Ac.	9.52	59.50	99.2	3686	3657	3475	2693
Glutamine	19.17	119.80	100.0	4206	4206	3840	2976
Histidine	27.08	169.27	100.0	4036	4036	3519	2728
Isoleucine	10.68	66.74	97.1	6605	6413	6210	4813
Leucine	10.68	66.74	95.4	6714	6405	6201	4806
Lysine	19.16	119.77	98.1	6204	6086	5720	4433
Lysine - HCl	13.73	85.81	98.1	4901	4808	4546	3523
Methionine	9.39	58.67	99.5	5684	5656	5477	4244
Proline	12.17	76.04	99.0	5065	5014	4782	3706
Tyrosine	7.73	48.32	98.0	5990	5870	5723	4435
Threonine	11.76	73.49	96.8	4173	4039	3815	2957
Tryptophan	13.72	85.73	99.0	6506	6441	6179	4789
Serine	13.33	83.30	100.0	3306	3306	3052	2365
Valine	11.96	74.73	95.5	6026	5755	5527	4283

[1] Determined with cannulated pigs at the terminal ileum.
[2] Considering 35% of nitrogen conversion into ureia.
[3] Considering 70% the efficiency of amino acids utilization to protein deposition and 30% for deamination and catabolism. The utilization efficiency of the standardized ME was considered 85% for deposition and 60% for amino acid deaminated and catabolized. NE= MESn x 0.595 + MESn x 0.18.

Table 1.10 - Inorganic Mineral Sources for Poultry and Swine (as-fed)

Phosphorus Souces	Minerals (%)	Phosphorus (%)							Fluorine (%)
		Total (%)	Avail. (%)		Dig. Broilers (%)		Dig. Swine (%)		
			Value	Coef	Value	Coef	Value	Coef	
Phosphoric Acid		21.5	25.8	120			19.4	90.0	0.16
Bone Meal Steamed	25.0 Ca[1]	11.4	11.4	100	6.84	60.0	6.84	60.0	
Bone Flour Ash	33.8 Ca	16.2	14.9	92	9.72	60.0	9.72	60.0	
Monocalcium Phosph.	18.9 Ca	21.4	22.0	103	15.2	71.0	16.4	78.2	0.25
Dicalcium Phosph.	24.0 Ca	18.5	18.5	100	12.9	70.0	13.9	75.0	0.14
Monodical. Phosph.	20.3 Ca	18.6	19.6	105	13.8	74.0	15.9	85.3	0.19
Tricalcium Phosph.	35.2 Ca	17.9	17.9	100					
Monosodium Phosph.	20.0 Na[1]	24.0	25.9	108	17.8	74	23.6	98.2	
Disodium Phosph.	28.7 Na	21.3	21.3	100			18.7	88.0	
Monoammon. Phosph.	12.2 N[1]	24.0	25.9	108					0.22
Diammonium Phosph.	21.2 N	23.1	28.9	125					0.10
Potassium Phosph.	28.7 K[1]	21.0							
Araxá Rock Phosph.	26.0 Ca	12.1	6.20	51.0					1.59
Catalão Rock Phosph.	32.3 Ca	15.1	7.90	52.0			9.56	63.3	2.17
Jacupir. Rock Phosph.	34.8 Ca	13.2	4.10	31.0					1.65
Patos Rock Phosph.	20.8 Ca	10.6	6.10	58.0					1.50
Tapira Rock Phosph.	33.6 Ca	15.0	7.80	52.0					1.10
Semidefluor. Phosph.	30.3 Ca	16.7	10.2	61.0					0.88
Super Simple Phosph.	21.5 Ca	8.60	17.6	82.0					1.31
Super Triple Phosph.	17.9 Ca	20.4	20.4	100	18.9	92.8	15.7	76.9	0.74

Calcium Sources	Calcium (%)	Other MInerals (%)
Limestone	37.5	0.27 Mg[1]
Dolomitic Limestone	18.6	10.0 Mg
Calcium Carbonate	43.3	
Oyster Shell	36.4	

Magnesium Sources	Magnesium (%)	Other MInerals (%)
Magnesium Oxide	52.8	
Magnesium Sulfate	20.2	26.6 S[1]
Magnesium Chloride	25.5	74.5 Cl[1]
Magnesium Phosphate	9.27	51.5 P[1]

Sodium Sources	Sodium (%)	Other Minerals (%)
Salt	39.7	59.6 Cl
Sodium Bicarbonate	27.0	
Sodium Carbonate	43.0	
Sodium Sulfate	32.4	22.6 S

Potassium Sources	Potassium (%)	Other Minerals (%)
Potassium Carbonate	56.4	
Potassium Bicarbonate	38.9	
Potassium Sulfate	44.7	18.4 S
Potassium Chloride	52.3	47.6 Cl
Potassium Phosphate	28.7	22.8 P

[1]Ca = Calcium; Na = Sodium; N = Nitrogen; K = Potassium; Mg = Magnesium; S = Sulfur; Cl = Chlorine;P =Phosphorus.

Table 1.11 - Mineral Content of Brazilian Phosphates (as-fed)

Phosphates	Mg[1]	Mn[1]	Zn[1]	Fe[1]	Cu[1]	Cr[1]	Pb[1]	Ni[1]	Cd[1]	Va[1]
	%	mg/kg								
Phosphoric Acid P A	0.37	0.7	0.6	31.3	1.8	3.7	12.6	0.5	2.0	-
Phosphoric Acid	0.56	29.7	7.3	39.3	4.9	8.1	13.6	5.1	2.1	-
Monocalcium Phosph.										
Dicalcium Phosph.	0.91	284.2	40.3	4023	11.7	17.4	24.0	19.7	3.6	74.0
Monodical. Phosph.	0.81	36.3	4.6	1432	7.80	5.90	18.5	9.60	2.0	-
Monoamm. Phosph.	-	371	130	9000	79.0	50.0	10.0	27.0	4.60	54.0
Araxá Rock Phosph.	0.54	52.5	208.8	6464	11.1	13.5	39.1	40.6	3.70	-
Catalão Pock Phosph.	0.81	405.0	36.7	8486	14.9	9.10	37.1	37.2	2.90	-
Jacupir. Rock Phosph.		321	11.0	6000	27.0	3.00	12.0	10.0	1.00	17.0
Tapira Rock Phosph.	0.50	234	127	7520	9.80	5.40	28.7	16.3	3.50	70.0
Semidefluor. Phosph.	0.81	19.0	3.80	913	139.6	5.90	48.5	22.2	3.30	-
Super Simple Phosph.	0.46	36.1	142.4	7010	13.9	17.5	18.9	28.6	3.00	-
Super Triple Phosph.	0.71	36.2	154.6	3298	38.0	93.4	19.0	25.2	4.90	41.0

[1] Mg = Magnesium; Mn = Manganese; Zn = Zinc; Fe = Iron; Cu = Copper; Cr = Chromium; Pb = Lead; Ni = Nickel; Cd = Cadmium; Va = Vanadium.

Table 1.12 - Average Available and Standardized Digestible Phosphorus Equivalence Values as a Function of Dietary Phytase Inclusion Levels (Maximum 1500 FTU) in Broiler Diets[1]

	Inclusion level					
FTU/kg	**250**	**500**	**750**	**1000**	**1250**	**1500**
Fungal phytases[2]						
1 to 21 days-old						
Available P (%)	0.073	0.100	0.127	0.154	0.182	0.209
Digestible P (%)	0.048	0.067	0.086	0.106	0.125	0.144
22 to 42 days-old						
Available P (%)	0.067	0.098	0.130	0.161	0.192	0.224
Digestible P (%)	0.051	0.073	0.096	0.119	0.142	0.164
Available P Average ± σ (%)	0.070 ± 0.000	0.099 ± 0.001	0.129 ± 0.001	0.158 ± 0.002	0.187 ± 0.002	0.217 ± 0.003
Digestible P Average ± σ (%)	0.050 ± 0.009	0.070 ± 0.013	0.091 ± 0.016	0.113 ± 0.020	0.134 ± 0.024	0.154 ± 0.028
Bacterial Phytases[3]						
1 to 21 days-old						
Available P (%)	0.076	0.110	0.144	0.179	0.213	0.248
Digestible P (%)	0.050	0.074	0.099	0.123	0.147	0.172
22 to 42 days-old						
Available P (%)	0.047	0.090	0.133	0.176	0.219	0.261
Digestible P (%)	0.038	0.068	0.098	0.128	0.158	0.188
Available P Average ± σ (%)	0.062 ± 0.001	0.102 ± 0.002	0.139 ± 0.002	0.178 ± 0.003	0.216 ± 0.004	0.255 ± 0.005
Digestible P Average ± σ (%)	0.045 ± 0.008	0.071 ± 0.013	0.099 ± 0.019	0.126 ± 0.024	0.153 ± 0.029	0.180 ± 0.034

[1] Systematic review and meta-analysis of literature values (n = 106 articles).

[2] Linear equations for fungal phytases determined by bone ash percentage as response criterion:

$$\text{Pav}_{(1\text{ a }21\text{ days})} = \frac{0.0460 + (0.00011 \times \text{FTU})}{1.0098} \qquad \text{Pav}_{(22\text{ a }42\text{ days})} = \frac{0.0342 + (0.00012 \times \text{FTU})}{0.9571}$$

$$\text{Pdig}_{(1\text{ a }21\text{ days})} = \frac{0.0410 + (0.00011 \times \text{FTU})}{1.4279} \qquad \text{Pdig}_{(22\text{ a }42\text{ days})} = \frac{0.0370 + (0.00012 \times \text{FTU})}{1.3199}$$

[3] Linear equations for bacterial phytases determined by bone ash percentage as response criterion:

$$\text{Pav}_{(1\text{ a }21\text{ days})} = \frac{0.0418 + (0.00014 \times \text{FTU})}{1.0165} \qquad \text{Pav}_{(22\text{ a }42\text{ days})} = \frac{0.0044 + (0.00016 \times \text{FTU})}{0.9348}$$

$$\text{Pdig}_{(1\text{ a }21\text{ days})} = \frac{0.0367 + (0.00014 \times \text{FTU})}{1.4371} \qquad \text{Pdig}_{(22\text{ a }42\text{ days})} = \frac{0.0109 + (0.00016 \times \text{FTU})}{1.3370}$$

Table 1.13 - Average Available and Standardized Digestible Phosphorus Equivalence Values as a Function of Dietary Phytase Inclusion Levels (Maximum 1500 FTU) in Piglet Diets (9.92 ± 2.75 kg)[1]

	Inclusion level					
FTU/kg	**250**	**500**	**750**	**1000**	**1250**	**1500**
			Fungal phytases [2]			
Available P (%)	0.082	0.107	0.132	0.157	0.182	0.206
Digestible P (%)	0.068	0.089	0.110	0.131	0.152	0.173
			Bacterial Phytases [3]			
Available P (%)	0.099	0.127	0.155	0.183	0.211	0.239
Digestible P (%)	0.083	0.106	0.130	0.153	0.177	0.200

[1]Systematic review and meta-analysis of literature values (*n* = 12 articles).

[2]Linear equations for fungal phytases determined by bone ash percentage as response criterion:

$$\text{Pav} = \frac{0.0462 + (0.00008 \times \text{FTU})}{0{,}8050}$$

$$\text{Pdig} = \frac{0.0455 + (0.00008 \times \text{FTU})}{0.9581}$$

[3]Linear equations for bacterial phytases determined by bone ash percentage as response criterion:

$$\text{Pav} = \frac{0.0574 + (0.00009 \times \text{FTU})}{0.8050}$$

$$\text{Pdig} = \frac{0.0567 + (0.00009 \times \text{FTU})}{0.9581}$$

Table 1.14 - Feedstuff Non-Starch Polysaccharide Content (% on as-fed basis)[1]

Bakery By-products							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.20	0.13	0.33
Fucose	-	-	-	Galactose	0.14	0.24	0.38
Arabinose	0.31	0.71	1.02	Glucose	0.41	1.03	1.44
Xylose	0.41	1.13	1.54	Uronic Acids	0.03	-	0.03
Barley Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.20	0.10	0.30
Fucose	-	-	-	Galactose	0.20	0.40	0.60
Arabinose	0.30	1.80	2.10	Glucose	4.10	3.60	7.70
Xylose	0.40	3.80	4.20	Uronic Acids	0.20	-	0.20
Canola Meal							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.05	0.15	0.20	Manose	0.25	0.38	0.63
Fucose	0.08	-	0.08	Galactose	0.40	1.18	1.58
Arabinose	0.70	3.00	3.70	Glucose	0.25	6.63	6.88
Xylose	0.23	1.58	1.81	Uronic Acids	1.28	2.85	4.13
Corn Germ							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	-	0.30	0.30
Fucose	-	-	-	Galactose	0.20	1.70	1.90
Arabinose	0.60	6.70	7.30	Glucose	0.50	8.20	8.70
Xylose	0.40	9.70	10.10	Uronic Acids	0.80	-	0.80
Corn Gluten 21%							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.23	0.83	1.06
Fucose	-	-	-	Galactose	0.18	1.75	1.93
Arabinose	0.35	6.28	6.63	Glucose	0.35	9.38	9.73
Xylose	0.35	9.43	9.78	Uronic Acids	0.35	0.78	1.13
Corn Gluten 60%							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.15	0.25	0.40
Fucose	-	-	-	Galactose	0.15	0.23	0.38
Arabinose	0.28	0.40	0.68	Glucose	0.68	0.75	1.43
Xylose	0.38	0.45	0.83	Uronic Acids	0.05	0.03	0.08
Corn Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.11	0.13	0.24
Fucose	-	-	-	Galactose	0.08	0.46	0.54
Arabinose	0.08	1.47	1.55	Glucose	0.46	1.88	2.34
Xylose	0.05	2.02	2.07	Uronic Acids	0.07	0.02	0.09
Corn Pre-Cooked							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.30	0.07	0.37
Fucose	-	-	-	Galactose	0.13	0.23	0.36
Arabinose	0.07	0.80	0.87	Glucose	0.67	0.87	1.54
Xylose	0.07	0.97	1.04	Uronic Acids	-	-	-

[1] Feedstuffs analyzed by AB Vista and expressed according to the methodology described by Englyst, Quingley and Hudson (1994).

Table 1.14 - Feedstuff Non-Starch Polysaccharide Content (% on as-fed basis)[1]

Millet Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.01	-	0.01	Manose	0.16	0.06	0.22
Fucose	-	-	-	Galactose	0.08	0.27	0.35
Arabinose	0.05	1.25	1.30	Glucose	0.39	1.78	2.17
Xylose	0.08	1.66	1.74	Uronic Acids	0.01	-	0.01
Oats Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.20	0.10	0.30
Fucose	0.10	-	0.10	Galactose	0.10	0.40	0.50
Arabinose	0.20	1.40	1.60	Glucose	2.20	5.10	7.30
Xylose	-	4.80	4.80	Uronic Acids	0.10	0.10	0.20
Peanut Meal							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	0.20	0.20	Manose	0.20	0.50	0.70
Fucose	-	-	-	Galactose	0.30	0.60	0.90
Arabinose	0.70	0.70	3.00	Glucose	0.20	9.10	9.30
Xylose	0.10	2.90	3.00	Uronic Acids	1.50	1.50	3.00
Rice Bran							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.01	-	0.01	Manose	0.23	0.16	0.39
Fucose	-	-	-	Galactose	0.23	0.90	1.13
Arabinose	0.28	3.21	3.49	Glucose	0.47	5.93	6.40
Xylose	0.12	3.97	4.09	UronicAcids	0.22	0.08	0.30
Rice Bran Defatted							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.05	-	0.05	Manose	0.25	0.15	0.40
Fucose	-	-	-	Galactose	0.30	1.10	1.40
Arabinose	0.30	3.30	3.60	Glucose	0.80	6.00	6.80
Xylose	0.10	4.00	4.10	Uronic Acids	0.45	0.10	0.55
Rice Broken							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.05	0.05	0.10
Fucose	-	-	-	Galactose	-	0.10	0.10
Arabinose	-	0.05	0.05	Glucose	0.05	0.30	0.35
Xylose	-	0.10	0.10	Uronic Acids	-	-	-
Sorghum Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.02	0.01	0.03	Manose	0.13	0.13	0.26
Fucose	-	-	-	Galactose	0.07	0.25	0.32
Arabinose	0.05	1.27	1.32	Glucose	0.27	2.29	2.56
Xylose	0.04	1.19	1.23	Uronic Acids	0.04	0.01	0.05
Soybean Full-Fat							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.03	0.11	0.14	Manose	0.30	0.50	0.80
Fucose	0.03	0.17	0.20	Galactose	0.81	2.44	3.25
Arabinose	0.45	1.68	2.13	Glucose	0.25	3.82	4.07
Xylose	0.10	1.23	1.33	Uronic Acids	0.86	1.42	2.28

[1] Feedstuffs analyzed by AB Vista and expressed according to the methodology described by Englyst, Quingley and Hudson (1994).

Table 1.14 - Feedstuff Non-Starch Polysaccharide Content (% on as-fed basis)[1]

Soybean Hulls							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.23	0.28	0.51	Manose	1.03	3.28	4.31
Fucose	0.05	0.06	0.11	Galactose	0.84	1.43	2.27
Arabinose	0.75	3.24	3.99	Glucose	2.23	26.53	28.76
Xylose	0.28	7.40	7.68	Uronic Acids	4.53	2.80	7.33
Soybean Meal 45.6%							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.07	0.13	0.20	Manose	0.44	0.53	0.97
Fucose	0.07	0.10	0.17	Galactose	1.06	2.86	3.87
Arabinose	0.61	1.79	2.39	Glucose	0.33	4.51	4.84
Xylose	0.20	1.33	1.53	UronicAcids	1.07	1.37	2.44
Soybean Semi-defatted Roasted							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.10	0.10	0.20	Manose	0.40	0.45	0.85
Fucose	0.10	0.10	0.20	Galactose	0.85	2.50	3.35
Arabinose	0.45	1.75	2.20	Glucose	0.05	6.15	6.20
Xylose	0.05	2.15	2.20	Uronic Acids	0.70	1.35	2.05
Soybean Protein Concentrate							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.10	0.20	0.30	Manose	0.60	0.40	1.00
Fucose	0.10	0.20	0.30	Galactose	1.20	3.90	5.10
Arabinose	0.70	2.20	2.90	Glucose	0.20	4.10	4.30
Xylose	0.20	1.30	1.50	Uronic Acids	1.00	1.80	2.80
Sunflower Meal							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.10	0.20	0.30	Manose	-	1.30	1.30
Fucose	-	-	-	Galactose	0.30	0.70	1.00
Arabinose	0.50	2.10	2.60	Glucose	1.90	15.70	17.60
Xylose	0.20	8.10	8.30	Uronic Acids	2.20	1.30	3.50
Wheat Bran							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	0.01	0.02	0.03	Manose	0.31	0.19	0.50
Fucose	0.01	0.02	0.03	Galactose	0.22	0.63	0.85
Arabinose	0.61	5.88	6.49	Glucose	0.65	7.34	7.99
Xylose	1.04	9.72	10.76	Uronic Acids	0.19	0.20	0.39
Wheat Grain							
	Soluble	**Insoluble**	**Total**		**Soluble**	**Insoluble**	**Total**
Rhamnose	-	-	-	Manose	0.21	0.23	0.44
Fucose	-	-	-	Galactose	0.16	0.26	0.42
Arabinose	0.39	1.70	2.09	Glucose	0.56	2.39	2.95
Xylose	0.44	2.80	3.24	Uronic Acids	0.01	-	0.01

[1] Feedstuffs analyzed by AB Vista and expressed according to the methodology described by Englyst, Quingley and Hudson (1994).

Table 1.15 - Fatty Acid Content of Fats and Oils (% on as-fed basis)

	≤10	Lauric C12:0	Myristic C14:0	Palmitic C16:0	Palmitolei c C16:1	Stearic C18:0	Oleic C18:1	Linoleic C18:2	Linolenic C18:3 n6	Arachidonic C20:4 n6	≥20
Fats											
Coconut	14.10	44.60	16.80	8.20	-	2.80	5.80	1.80	-	-	-
Fish	-	0.20	6.11	14.34	10.00	3.04	15.08	1.36	0.74	0.73	56.52
Lard	0.10	0.15	1.35	24.05	2.80	13.95	41.84	9.70	0.95	1.70	1.30
Poultry	-	0.10	1.00	20.74	5.40	6.74	42.68	20.68	1.30	0.10	1.63
Tallow	0.20	0.15	3.00	23.90	4.43	19.05	38.20	3.10	0.60	0.20	1.80
Oils											
Canola	-	0.20	0.10	3.94	0.17	1.76	60.00	18.82	9.55	-	4.07
Corn	-	-	-	10.85	0.11	1.69	36.38	52.45	0.70	-	2.05
Cottonseed	-	-	0.80	20.72	0.80	2.45	17.56	54.08	0.20	-	0.91
Soybean	-	-	0.10	9.76	0.20	3.77	23.32	52.78	6.97	-	2.13
Sunflower	-	0.20	0.17	5.41	0.30	3.60	32.19	51.98	0.25	-	3.15
Palm	-	-	0.20	10.92	0.45	4.35	36.85	9.50	0.25	-	0.50

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CHAPTER 2

Nutritional Requirements of Broiler Chickens

Melissa I. Hannas[1], Horacio S. Rostagno[1],
Érica B. Schultz[1] and Gabriel da S. Viana[1]

[1] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

The continuous genetic improvement on performance of broiler chickens, obtained from better daily weight gain and feed conversion, makes it necessary to periodically update nutritional requirements to allow the expression of the animals' genetic potential.

The objective of this 5th edition is to update the nutritional requirements for broilers, taking into account the recent advances in genetics, production research, management practices, and nutrition in particular.

The broiler requirements presented in this chapter were established according to the systems and procedures of the 4th edition of the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017), using integrated factorial and empirical models. The changes to calculate estimates and indices of equation parameters relative to the 4th edition are described below.

Among the many factors that affect the nutritional requirements of broilers, breed, genetic strain, sex, feed intake, feed energy level, nutritional availability, ambient temperature, air humidity, and health status are the most relevant. However, it is not yet possible to include all factors in models to estimate nutritional needs.

The recommendations consider the genetic growth potential of standard and high performance broilers as a function of age and sex, raised as separate sex or as hatched production systems.

Metabolizable energy, crude and digestible protein, total and digestible amino acids, minerals, total calcium, available and digestible phosphorus, sodium, potassium, chlorine, and linoleic acid requirements are presented. The recommendations for trace minerals and vitamins are assumed to be adequately met, provided the levels supplied are equivalent to those described in Chapter 7.

Mathematical models considering performance parameters were developed to allow nutritionists to accurately determine the daily nutritional requirements of broilers on an ongoing basis. Data obtained in several

experiments and manuals of different genetic strains were applied to Gompertz equations to estimate average weight and daily weight gain.

Based on those results, growth curves were calculated for standard and high performance male and female broilers. Additional performance curves can be incorporated as needed, and the models can be applied to determine broilers' daily metabolizable energy (ME) and standardized digestible lysine requirements.

The recommended nutritional levels were based on data obtained in dose-response experiments at the Federal University of Viçosa (UFV) and in scientific studies published in Brazil and abroad. In this 5th edition, data published between 2016 and 2023 was included from scientific articles of the Web of Science database and graduate MS and Ph.D theses carried out with broilers of different ages and production stages. Furthermore, the performance responses of commercial flocks in different regions of Brazil were considered.

After the database was built, equations for daily ME requirements were developed, considering the sum of ME requirements for maintenance and gain, using as parameters body weight (W) and body weight gain (G) of broilers of different ages and growing phases.

In addition to the model used by Rostagno et al. (2017), the ME requirement equations for maintenance (MEm) utilized information from graduate theses from UNESP (Jaboticabal, SP) and UFV (Viçosa, MG) and by Sakomura & Rostagno (2016).

Daily ME requirement equations for production (MEp) were based on data obtained in UFV experiments, graduate theses published in Brazil, and articles published between 2018 and 2023 retrieved from the Web of Science database. Performance, feed intake, and ME intake of broilers of different ages and production stages were considered. The ME intake obtained in experiments was recalculated considering the same feedstuffs nutritional composition and energy content.

A 4% increase in daily ME requirements was estimated for standard performance male and female broilers, assuming the management, environmental, and health challenges they experience.

The same correction published in the 4th edition (Rostagno et al., 2017) was applied to estimate the effect of environmental temperature on ME requirements. However, it is suggested to apply that correction starting at 17 days of age, as a function of metabolic weight ($W^{0.75}$). Furthermore, the proposed correction should be applied within daily average temperature limits of approximately ± 6ºC above or below the thermoneutral range, because higher values may impair broiler performance by overestimating feed intake and nutritional level corrections.

The target feed intake can be estimated by the ratio between ME requirement and dietary ME content. It should be noted that feed intake and feed conversion ratio, in particular, of broilers fed *ad libitum* largely depend on dietary energy content.

The Tables include examples of nutritional requirements of broilers fed diets containing the energy levels commonly used in Brazil and recommended in the manuals of the main genetic strains. Feed intake and other dietary nutrients should be adjusted when different dietary energy levels are used.

Most experiments used to determine nutritional requirements were carried out with mash feeds. The feed conversion ratio of broilers fed mash feeds is approximately 2-4% higher than those fed pelleted or crumbled diets.

In addition to the ME levels, the corresponding net energy (NE) levels of practical broiler feeds are mentioned in this edition.

Standardized ileal digestible lysine (SID Lys) levels were determined based on the results of dose-response experiments carried out at UFV and data obtained in the systematic review of graduate students theses and articles indexed in the Web of Science database published between 2016 and 2023. In order to standardize the database used to develop the equations, SID Lys intake values were recalculated to reflect feedstuff

chemical composition, digestibility coefficients, and SID amino acid levels, according to the 4th edition of the Brazilian Tables (2017).

In the equations to determine daily SID Lys requirements, the SID Lys requirement for maintenance was defined as 0.045 mg of SID Lys per kg of metabolic weight ($W^{0.75}$), the average value obtained in experiments carried out at UNESP Jaboticabal (Siqueira et al., 2011; Dorigam et al., 2020).

The determination of SID Lys requirements for production was based on weekly and total period results of dose-response experiments to different levels of lysine carried out at UFV and published in graduate theses and articles indexed in the Web of Science database between 2016 and 2023. The results were compiled, and daily SID Lys intake was determined. Next, SID Lys requirements for maintenance and per kg weight gain were calculated for the different production phases and were used to estimate SID Lys requirements for male and female broilers according to their performance.

Total lysine requirements were calculated considering an average standardized ileal lysine digestibility of 90.7%.

According to Rostagno et al. (2017), using equations to estimate daily SID Lys requirements allows greater precision in feed formulation, because they can be calculated as a function of broiler performance and feed intake.

The nutritional requirements of the other essential amino acids were calculated by applying the ideal protein concept, i.e., by maintaining the ratio of each amino acid to lysine and expressed in standardized ileal digestibility (SID) and total content. The SID and total amino acid ratios in the ideal protein were updated considering three production phases as a function of age: from 1 to 17, from 17 to 35, and from 35 to 56 days of age, since genetic advances may change the essential amino acids requirements for maintenance and production.

The methionine + cysteine requirements were established to ensure at least 55% of methionine in total sulfur amino acids. Phenylalanine +

tyrosine requirements considered a minimum ratio of 55% phenylalanine. Glycine and serine requirements are presented together, as these two amino acids are interconvertible.

As mentioned in the 4th edition, when the crystalline amino acids lysine, methionine, threonine, and valine are included in broiler diets based on corn and soybean meal, the requirements for the essential amino acids arginine, glycine + serine, isoleucine, leucine, histidine, and phenylalanine + tyrosine are commonly met. However, new cost-effective crystalline amino acids allow the formulation of diets with lower crude protein content, reducing the environmental impact of excessive nutrient excretion. Such diets have shown promising results in experimental trials and commercial flocks. However, essential amino acid levels should be maintained, and adequate values of essential and nonessential digestible amino acids or the ratio between essential nitrogen and total nitrogen (Ne: Total N) are recommended to achieve greater formulation precision.

To ensure that nonessential amino acids are not limiting when crystalline amino acids are included in reduced-crude protein diets, the 50% Ne: Total N ratio established in research carried out at UFV by Maia (2014) and Maia et al. (2021) was considered. Nonessential nitrogen (Nne) can become limiting in low crude protein diets, and therefore, the Ne: Total N or Ne:Nne ratio should be maintained to optimize broiler performance and improve protein utilization efficiency.

The Ne: Total N ratios presented in the Tables, were determined by calculating the digestible essential nitrogen (dig. Ne) and total essential nitrogen (Net) levels, considering the essential nitrogen requirements and its content in the amino acids. The essential amino acids used to calculate those ratios were lysine, methionine, threonine, tryptophan, arginine, glycine + serine (proportional to molecular weight), valine, isoleucine, leucine, histidine, and phenylalanine. Subsequently, total digestible nitrogen (total dig. N) and total nitrogen (Total N) were calculated based on dig. Ne:Total dig. N and total Ne:Total N ratios. The recommended ratio for broilers is 50%.

Total protein and digestible protein dietary levels were calculated by multiplying the obtained total N and total digestible N values by 6.25, considering that protein contains 16% N, on average. Digestible protein requirements should be met to prevent broilers from using essential amino acid nitrogen to synthesize nonessential amino acids, impairing their performance.

The minimum levels of dietary crude and digestible protein may also be estimated by applying 5.5 and 6.0% proportions of digestible lysine in crude and digestible protein, respectively. For instance, for a 31-d-old broiler with a 1.202% digestible lysine requirement, crude protein requirement is calculated as (% SID lysine x 100)/5.5 = (1.202 x 100)/5.5 = 21.85%; and the digestible protein requirement as (% SID lysine x 100)/6.0 = (1.202 x 100)/6.0 = 20.03%. The 6.0% SID lysine content in dietary digestible protein is in agreement on the body composition of broiler chicks, which was determined by Wu (2014) as 6.15 g of lysine/100 g of protein.

Precision Nutrition recommends formulating diets based on the standardized ileal digestible amino acid, which allows for reducing dietary crude protein and crude amino acid content. Digestible protein requirements should be met to ensure the supply of nonessential amino acids when reduced-protein diets are formulated. According to Pesti (2009), although formulating diets based on crude protein requirements is controversial, most experiments demonstrate better broiler performance when high dietary crude protein levels are fed. When determining the nutritional levels of broiler diets, the nutritionist should consider the cost-benefit ratio and the production system sustainability.

Phosphorus (P) requirements for broilers were estimated according to the procedure applied in the 4th edition. However, literature data published between 2016 and 2023 and the results of Angel (2017, 2019) were added to calculate available P and dig. P intake. The phosphorus requirement for maintenance was established considering the endogenous P losses estimated by Bunzen (2009) as 0.026 per kg metabolic weight ($W^{0.75}$). Subsequently, the results of dose-response experiments were used

to calculate available and dig. P requirements per kg of weight gain for each broiler production phase. Finally, considering the high growth rate of modern broiler strains, requirement equations were developed for three production phases. Bioavailability differences among inorganic P sources should be considered to meet available P requirements.

Experiments with broilers, evaluating alternative feedstuffs fed diets based on digestible nutrients, such as digestible protein and amino acids, showed more consistent performance and lower production costs than when diets were formulated on a total nutrient basis (Rostagno et al., 1995). Therefore, the dig. P requirement should be used in feed formulation, as it represents the P content in the feedstuff that is truly utilized and meets the requirements more accurately. The equations obtained to estimate available P and digestible P requirements in g/bird/day are presented in the tables below. Dietary available P and digestible P content are expressed in % as a function of feed intake.

Including the enzyme phytase in broiler diets to meet available P and digestible P requirements and reduce phytic P excretion in the environment is emphasized. In Chapter 1, the average phosphorus equivalence values of phytases in broiler diets are described.

Total calcium (Ca) levels were defined based on research results carried out at UFV and the recommendations of Angel (2017, 2019). Considering that Ca levels may compromise the utilization of P and other nutrients, total Ca to available P and digestible P ratios should be maintained at 2.10 and 2.32, respectively. Total Ca requirements were calculated using available P and digestible P levels multiplied by the respective ratios.

Due to the lack of scientific updates, sodium, potassium, chlorine, essential fatty acids, and linoleic acid requirements were determined using the same equations as those published in the 4th edition (Rostagno et al., 2017). Sodium, potassium, chlorine, and linoleic acid requirements, in mg/bird/day, were calculated as a function of broiler age in each production

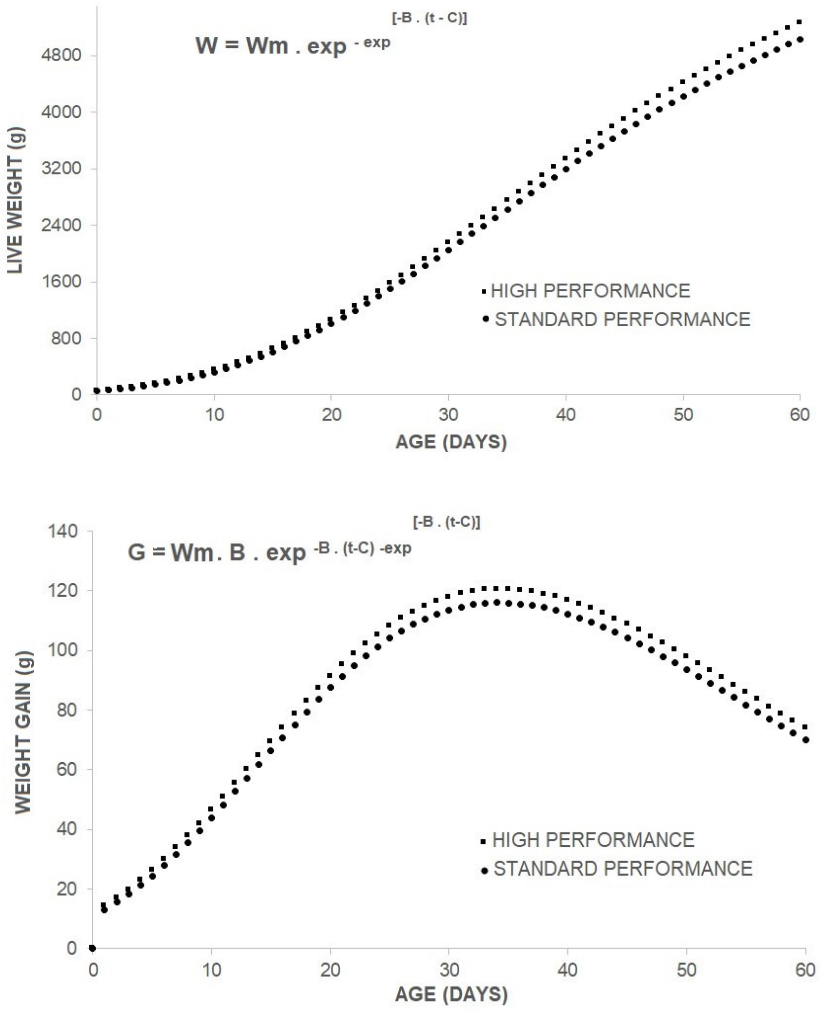
phase, and the value obtained was multiplied by dietary ME content expressed in Mcal.

Performance growth curves of male and female broilers with standard and high performance were used to estimate average weight and daily weight gain in each production phase. Based on these curves, equations to estimate ME and SID Lys requirements can be applied, and the requirements for other nutrients can be subsequently calculated. Similarly, considering the data of males and females of standard and high performance, respectively, response curves (weight, daily gain, and intake) were estimated for mixed-sex broilers, and ME and SID Lys requirements were estimated.

Such nutritional requirement calculations, allow nutritionists to apply the concept of precision nutrition, defined as supplying an animal's nutritional requirements under specific conditions, with no excesses or deficiencies of energy or any individual nutrients (Lee and Rochell, 2021). Precision nutrition aims to provide a specific diet as a function of animal growth and feed intake. It can be implemented using models and equations developed as a function of different production system characteristics. Examples of the nutritional requirements of standard and high performance male and female broilers and as hatched broiler flocks are provided to support the utilization of the Brazilian Tables.

Practical diets are those based on corn and soybean meal. Balanced diets formulated with other feedstuffs should contain adequate nutrients and pigments, such as xanthophyll, to obtain adequate carcass pigmentation. Crude fiber, neutral detergent fiber, and acid detergent fiber contents should be considered in diet formulation, as they may influence feed intake and nutrient utilization and promote gut health benefits. The inclusion of functional nutrients, such as fiber and amino acids, was not considered in these Tables and should be contemplated in specific feeding programs.

Table 2.01 - Live Weight and Daily Weight Gain Curves According to Gompertz Equation and the Derivative for Standard and High Performance Male Broilers



Equation parameters for high performance male broilers: Wm = 7104.878; B = 4.771161; C = 0.04613019; R^2 = 0.98; P<0.001. Standard performance male broilers: Wm = 6745.407; B = 4.845155; C = 0.04676116; R^2 = 0.99; P<0.001. W = weight (g); G = weight gain (g/day); t = age (days); Wm = mature weight (g); B = relative growth at the inflection point (g/day), C= age at the inflection point (days).

Table 2.02 - Equations Used to Estimate Metabolizable Energy (ME) Requirements of Male Broilers (kcal/bird/day)[1]

ME Requirements of High Performance Male Broilers[1]

$ME = (113\ W^{0.75}) + ((2098 + 961.31\ W - 167.87\ W^2)\ G);\ R^2 = 0.78$

[1] Considering the growth curve and ME of high performance male broilers

ME Requirements of Standard Performance Male Broilers[2]

$ME = ((113\ W^{0.75}) + ((2098 + 961.31\ W - 167.87\ W^2)\ G))\ 1.04$

[2] Considering the growth curve of standard performance male broilers and increasing ME requirement by 4%.

$\text{Correction for temperature}^3 = 2.6\ W^{0,75}\ (TN - T)$

W = Average Body Weight (kg); G = Weight Gain (kg/bird/day);
T = Average Temperature (°C); TN = Thermoneutral Temperature (°C)

[3] The equation was obtained based on data from MS and Ph.D. theses carried out at UNESP (Jaboticabal) and from Sakomura and Rostagno (2016)

Suggested temperatures for the correction of ME requirements

Age (days)	TN (°C)	Temperature Range (°C)
17 – 33	23	18 to 28
34 – 56	20	16 to 27

Higher temperature values may negatively influence broiler performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Male Broilers (31 days)
W = 2.268 kg; $W^{0,75}$ = 1.848 kg; G= 0.119 kg/bird/day; Dietary ME = 3100 kcal/kg

ME Req. = (113 x 1.848) + ((2098 + 961.31 x 2.268 – 167.87 x 2.268^2) 0.119)

ME Req. = 615.3 kcal/day; Estimated Feed Intake = 198.5 g/day
Correction for the average temperature of 26°C (TN = 23°C)
Correction for T° = 2.6 x 1.848 (23 – 26) = -14.4 kcal/day
ME Req. for 26 °C = 615.3 – 14.4 = 600.9 kcal/day; Estimated FI = 193.8 g/day

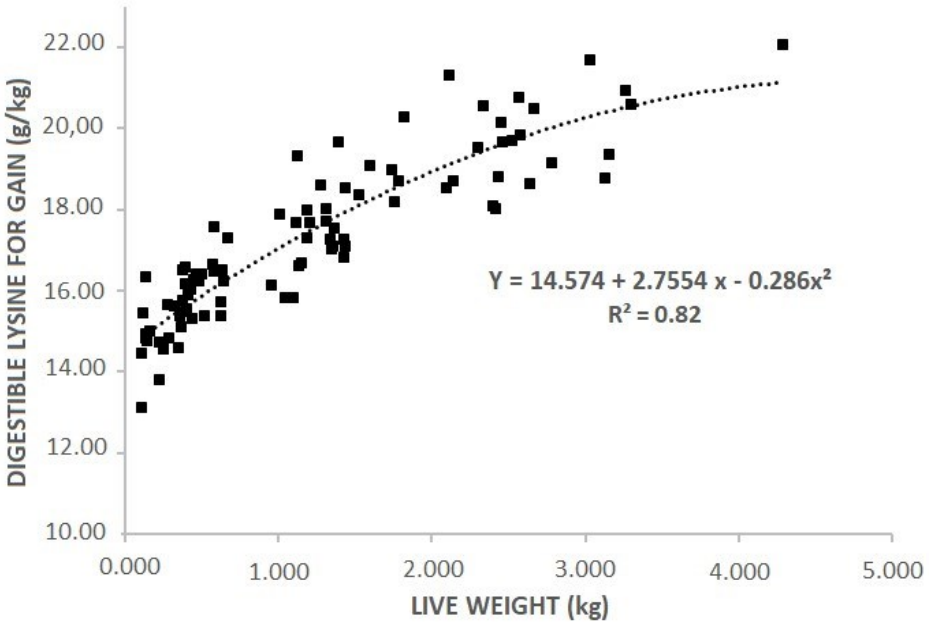
Table 2.03 - Methodology Applied to Obtain the Equation to Calculate the Standardized Digestible Lysine Requirements/kg Weight Gain of Male Broilers

Weight Range, kg	0.04–0.40	0.40–0.70	0.70–1.40	1.40 – 2.20	2.20-3.00	3.00-4.30
Experimental Data[1]	24	18	19	14	13	6
Avg. Weight in Period, kg	0.249	0.525	1.208	1.717	2.507	3.366
Feed Intake, g/day	38.161	74.93	130.50	171.14	197.79	229.97
SID Lys Intake, g/day	0.452	0.871	1.418	1.716	2.013	2.180
Maint. SID Lys g/day[2]	0.0156	0.0277	0.0518	0.0673	0.0971	0.1117
SID Lys for G, g/day	0.437	0.844	1.366	1.649	1.923	2.068
Mean G, kg/day	0.0288	0.0522	0.0784	0.0888	0.0989	0.1009
g SID Lys/ kg G	15.17	16.11	17.35	18.59	19.47	20.55
Equation, g Lys/ kg G	15.24	15.94	17.49	18.46	19.68	20.61

Eq: Y (g SID Lys/kg G) = 14.574 +2.7554 (Average Weight, kg) – 0.286 (Av. Weight, kg)^2 R^2 = 0.82

[1] Total of 94 experimental data (week and total period) obtained in dose-response trials with different lysine levels.

[2] Daily requirements of digestible lysine for maintenance = 0.045 x (Average Weight)$^{0.75}$. Estimated according to the values of Siqueira, 2009 (Ph.D. thesis) and Dorigam et al. (2020).



Equation to estimate SID lysine values, in grams of SID Lys / kg of weight gain of male broilers as a function of body weight (0.040 to 4.300 kg).

Table 2.04 - Equation Used to Estimate the Standardized Digestible Lysine (SID Lys) Requirements of Male Broilers

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.045\ W^{0.75}) + ((14.574 + 2.7554\ W - 0.286\ W^2)\ G)$

W = Average Body Weight (kg); G = Weight Gain (kg/bird/day)

Example:
High Performance Male Broilers (31 days)
Average Weight = 2.268 kg, $W^{0.75}$ = 1.848 kg
G = 0.119 kg/bird/day

SID Lys Req. = $(0.045 \times 1.848) + ((14.574 + 2.7554 \times 2.268 - 0.286 \times 2.268^2) \times 0.119)$
SID Lys Req. = (0.083) + (19.436 x 0.119) = 2.387 g/day

Estimated Feed Intake = 198.5 g/day (Table 2.02)

% Dietary SID Lys = 1.202%

Correction for average temperature of 26°C (TN = 23°C)
Weight = 2.268 kg; Gain = 0.119 kg/day
SID Lysine Req. = 2.387 g/day
Estimated Feed Intake = 193.8 g/day (Table 2.02)
% Dietary SID Lys = 1.231%

Table 2.05 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Male Broilers Using the Equations in Tables 2.01, 2.02, and 2.04

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.066	13.1	0.200	44.9	15.3	15	0.445	1.305
2	0.082	15.6	0.237	53.2	18.2	33	0.446	1.307
3	0.100	18.3	0.279	62.6	21.3	55	0.446	1.308
4	0.121	21.2	0.326	73.0	24.9	80	0.446	1.307
5	0.146	24.4	0.376	84.5	28.8	109	0.445	1.305
6	0.174	27.9	0.432	97.2	33.2	142	0.444	1.302
7	0.205	31.6	0.492	111.0	37.9	180	0.443	1.298
8	0.241	35.5	0.556	126.0	42.4	222	0.441	1.310
9	0.280	39.6	0.624	142.2	47.9	270	0.439	1.303
10	0.324	43.8	0.696	159.5	53.7	324	0.436	1.296
11	0.372	48.2	0.772	178.0	59.9	384	0.434	1.288
12	0.425	52.7	0.850	197.5	66.5	450	0.431	1.279
13	0.482	57.2	0.932	218.1	73.4	524	0.427	1.269
14	0.544	61.8	1.016	239.6	80.7	604	0.424	1.259
15	0.610	66.3	1.102	262.0	88.2	692	0.421	1.249
16	0.681	70.8	1.189	285.1	96.0	788	0.417	1.239
17	0.756	75.2	1.277	308.8	102.3	891	0.414	1.249
18	0.836	79.5	1.365	333.0	110.3	1001	0.410	1.238
19	0.920	83.7	1.453	357.5	118.4	1119	0.407	1.228
20	1.007	87.6	1.540	382.1	126.5	1246	0.403	1.217
21	1.099	91.4	1.626	406.7	134.7	1380	0.400	1.207
22	1.194	95.0	1.709	431.1	142.8	1523	0.396	1.197
23	1.292	98.3	1.790	455.1	150.7	1674	0.393	1.188
24	1.393	101.3	1.867	478.6	158.5	1832	0.390	1.178
25	1.497	104.1	1.941	501.3	166.0	1998	0.387	1.169
26	1.604	106.6	2.010	523.1	173.2	2172	0.384	1.161
27	1.713	108.8	2.075	543.8	177.1	2349	0.382	1.171
28	1.823	110.7	2.135	563.4	183.5	2532	0.379	1.163
29	1.936	112.3	2.189	581.7	189.5	2722	0.376	1.155
30	2.049	113.6	2.238	598.6	195.0	2917	0.374	1.148
31	2.164	114.6	2.281	614.0	200.0	3117	0.371	1.140
32	2.279	115.4	2.318	628.0	204.5	3321	0.369	1.133
33	2.395	115.8	2.349	640.3	208.6	3530	0.367	1.126
34	2.511	116.0	2.374	651.1	212.1	3742	0.365	1.119
35	2.627	116.0	2.393	660.3	211.6	3954	0.362	1.131
36	2.743	115.6	2.407	668.0	214.1	4168	0.360	1.124
37	2.858	115.1	2.414	674.2	216.1	4384	0.358	1.117
38	2.972	114.4	2.416	679.0	217.6	4601	0.356	1.110
39	3.085	113.4	2.413	682.3	218.7	4820	0.354	1.103
40	3.198	112.2	2.404	684.4	219.4	5039	0.351	1.096
41	3.309	110.9	2.391	685.3	219.6	5259	0.349	1.089
42	3.418	109.4	2.373	685.0	219.5	5479	0.346	1.081
43	3.526	107.8	2.351	683.7	213.7	5692	0.344	1.100
44	3.632	106.1	2.325	681.5	213.0	5905	0.341	1.092
45	3.736	104.2	2.296	678.4	212.0	6117	0.338	1.083
46	3.838	102.2	2.263	674.6	210.8	6328	0.336	1.074
47	3.939	100.2	2.228	670.2	209.4	6538	0.332	1.064
48	4.037	98.0	2.190	665.3	207.9	6745	0.329	1.053
49	4.132	95.8	2.150	659.8	206.2	6952	0.326	1.043
50	4.226	93.6	2.108	654.1	204.4	7156	0.322	1.031
51	4.317	91.3	2.064	648.0	202.5	7359	0.318	1.019
52	4.406	88.9	2.019	641.7	200.5	7559	0.315	1.007
53	4.493	86.6	1.972	635.3	198.5	7758	0.310	0.993
54	4.577	84.2	1.925	628.8	196.5	7954	0.306	0.980
55	4.659	81.8	1.878	622.2	194.5	8149	0.302	0.966
56	4.738	79.4	1.829	615.7	192.4	8341	0.297	0.951

[1] Diets containing 2930, 2970, 3020, 3070, 3120, and 3200 kcal ME/kg for the phases 0-7, 8-16, 17-26, 27-34, 35-42, and 43-56 days of age.

Table 2.06 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Male Broilers Using the Equations in Tables 2.01, 2.02, and 2.04

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.075	14.4	0.220	47.5	16.1	16	0.463	1.367
2	0.092	17.0	0.260	56.0	19.0	35	0.464	1.368
3	0.111	19.9	0.304	65.6	22.2	57	0.464	1.369
4	0.134	23.0	0.353	76.2	25.8	83	0.464	1.367
5	0.161	26.3	0.407	87.9	29.8	113	0.463	1.365
6	0.191	29.9	0.465	100.8	34.2	147	0.461	1.361
7	0.225	33.8	0.528	114.8	38.9	186	0.460	1.356
8	0.262	37.8	0.595	129.9	43.3	229	0.458	1.373
9	0.304	42.1	0.666	146.2	48.7	278	0.455	1.366
10	0.351	46.5	0.741	163.7	54.6	333	0.453	1.358
11	0.402	51.0	0.820	182.3	60.8	393	0.450	1.349
12	0.457	55.6	0.901	201.9	67.3	461	0.446	1.339
13	0.518	60.2	0.986	222.5	74.2	535	0.443	1.330
14	0.583	64.9	1.073	244.1	81.4	616	0.440	1.319
15	0.652	69.5	1.162	266.5	88.8	705	0.436	1.309
16	0.726	74.1	1.253	289.6	96.5	802	0.433	1.298
17	0.805	78.6	1.344	313.3	102.7	904	0.429	1.309
18	0.888	83.0	1.436	337.4	110.6	1015	0.425	1.298
19	0.975	87.3	1.527	361.9	118.6	1134	0.422	1.287
20	1.066	91.3	1.617	386.4	126.7	1260	0.418	1.276
21	1.162	95.2	1.706	410.9	134.7	1395	0.415	1.266
22	1.260	98.8	1.792	435.1	142.7	1538	0.412	1.256
23	1.363	102.2	1.876	458.9	150.5	1688	0.409	1.246
24	1.468	105.3	1.956	482.2	158.1	1846	0.406	1.237
25	1.576	108.2	2.032	504.6	165.5	2012	0.403	1.228
26	1.687	110.7	2.105	526.2	172.5	2184	0.400	1.220
27	1.800	113.0	2.172	546.6	176.3	2360	0.397	1.232
28	1.915	114.9	2.234	565.9	182.5	2543	0.395	1.224
29	2.031	116.6	2.291	583.8	188.3	2731	0.392	1.216
30	2.149	118.0	2.342	600.3	193.7	2925	0.390	1.209
31	2.268	119.0	2.387	615.3	198.5	3123	0.388	1.202
32	2.388	119.8	2.426	628.8	202.8	3326	0.386	1.196
33	2.508	120.3	2.458	640.7	206.7	3533	0.384	1.189
34	2.629	120.5	2.485	651.0	210.0	3743	0.382	1.183
35	2.750	120.5	2.505	659.7	209.4	3952	0.380	1.196
36	2.870	120.2	2.519	666.9	211.7	4164	0.378	1.190
37	2.989	119.7	2.527	672.5	213.5	4378	0.376	1.184
38	3.108	119.0	2.530	676.7	214.8	4592	0.374	1.178
39	3.226	118.0	2.526	679.5	215.7	4808	0.372	1.171
40	3.343	116.9	2.518	681.0	216.2	5024	0.370	1.165
41	3.459	115.6	2.504	681.2	216.3	5241	0.368	1.158
42	3.573	114.1	2.486	680.4	216.0	5457	0.365	1.151
43	3.685	112.5	2.464	678.5	212.0	5669	0.363	1.162
44	3.796	110.7	2.437	675.7	211.2	5880	0.361	1.154
45	3.905	108.8	2.407	672.1	210.0	6090	0.358	1.146
46	4.012	106.8	2.373	667.7	208.7	6298	0.355	1.137
47	4.116	104.7	2.336	662.8	207.1	6506	0.353	1.128
48	4.219	102.5	2.297	657.3	205.4	6711	0.349	1.118
49	4.319	100.3	2.255	651.3	203.5	6915	0.346	1.108
50	4.417	98.0	2.211	645.1	201.6	7116	0.343	1.097
51	4.513	95.7	2.166	638.5	199.5	7316	0.339	1.085
52	4.606	93.3	2.119	631.8	197.4	7513	0.335	1.073
53	4.697	90.9	2.071	625.0	195.3	7708	0.331	1.060
54	4.786	88.5	2.022	618.1	193.1	7902	0.327	1.047
55	4.872	86.0	1.972	611.1	191.0	8093	0.323	1.033
56	4.955	83.6	1.922	604.3	188.8	8281	0.318	1.018

[1] Diets containing 2950, 3000, 3050, 3100, 3150, and 3200 kcal ME/kg for the phases 0-7, 8-16, 17-26, 27-34, 35-42, and 43-56 days of age.

Table 2.07 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium-to-Phosphorus Ratio Requirements of Male Broilers[1]

Available Phosphorus Requirement

Pav Req. (g/day) = (Pav for Maintenance) + (Pav for Gain)

Equation 01 to 21 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 6.0 G
Equation 22 to 42 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 5.0 G
Equation 43 to 56 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 4.0 G

W = Average Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

Example: High Performance Male Broilers with 31 days
Average Weight: 2.268 kg; Daily Gain: 0.119 kg/day; Feed Intake: 198.5 g/day

Pav (g/day) = (0.026 x $2.268^{0.75}$) + 5.0 x 0.119 = 0.643 g
% Pav = (0.643 x 100) / 198.5 = 0.324%;
% Ca in diet = 0.324 x 2.10= 0.680%

Standardized Digestible Phosphorus Requirement

Dig. P Req. (g/day) = (Dig. P for Maintenance) + (Dig. P for Gain)

Equation 01 to 21 days: Y (g Dig. P/day) = (0.026 $W^{0.75}$) + 5.4 G
Equation 22 to 42 days: Y (g Dig. P/day) = (0.026 $W^{0.75}$) + 4.5 G
Equation 43 to 56 days: Y (g Dig. P/day) = (0.026 $W^{0.75}$) + 3.7 G

W = Average Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.32

Example: High Performance Male Broilers (31 days)
Average Weight: 2.268 kg; Daily Gain: 0.119 kg/day; Feed Intake: 198.5 g/day

Dig. P (g/day) = (0.026 x $2.268^{0.75}$) + 4.5 x 0.119 = 0.584 g.
% Dig. P = (0.584 x 100)/198.5 = 0.294%;
% Ca in diet = 0.294 x 2.32 = 0.682%

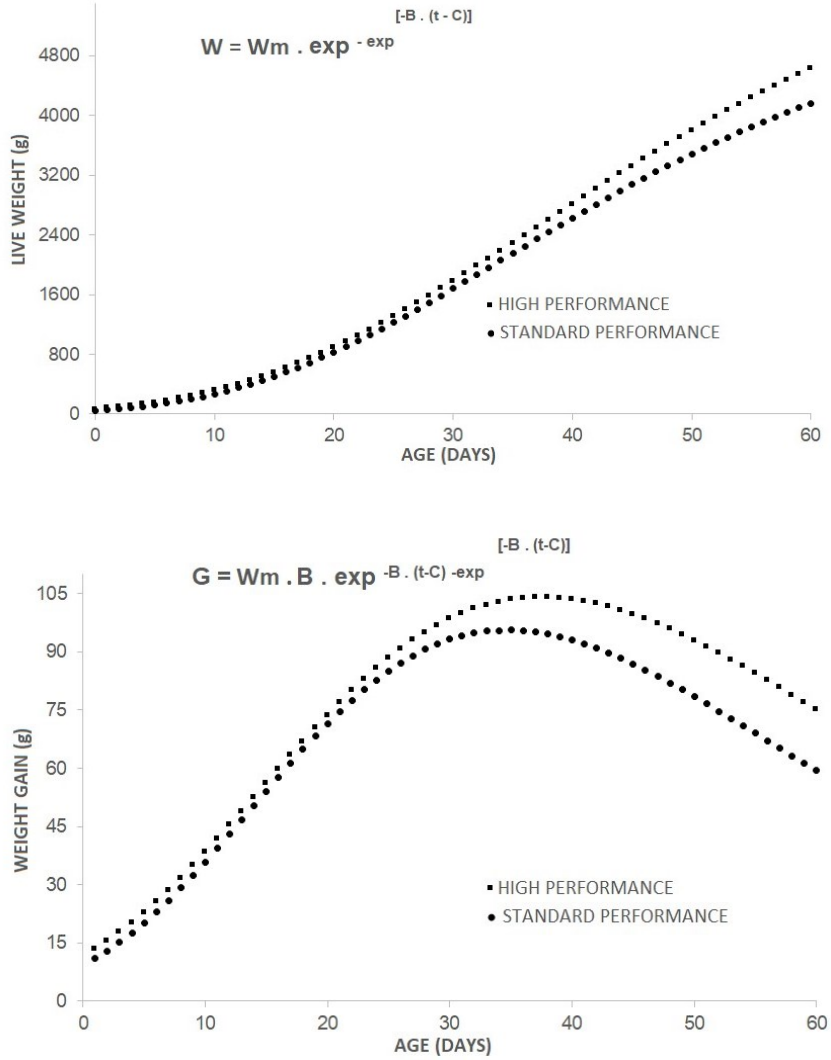
[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen 2009 (UFV Ph.D. Thesis), data from experiments carried out at UFV, and from Angel (2017) and Angel (2019).

Table 2.08 - Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Male Broilers Using the Equations in Table 2.07

Age, Days	Weight, Kg	Gain, g/day	Intake, g/day	Pav, g/day	Pav, %	Dig P, g/day	Dig P, %	Calcium[1], %
Standard Performance Male Broilers								
0-8	0.121	21.2	24.9	0.133	0.533	0.120	0.482	1.118
8	0.241	35.5	42.4	0.222	0.523	0.201	0.473	1.098
14	0.544	61.8	80.7	0.387	0.480	0.350	0.434	1.007
21	1.099	91.4	134.7	0.576	0.428	0.522	0.387	0.899
28	1.823	110.7	183.5	0.594	0.324	0.539	0.294	0.681
35	2.627	116.0	211.6	0.633	0.299	0.575	0.272	0.630
42	3.418	109.4	219.5	0.613	0.279	0.558	0.254	0.588
49	4.132	95.8	206.2	0.459	0.222	0.430	0.208	0.475
56	4.738	79.4	192.4	0.401	0.209	0.377	0.196	0.447
High Performance Male Broilers								
0-8	0.134	23.0	25.8	0.144	0.556	0.130	0.503	1.167
8	0.262	37.8	43.3	0.237	0.546	0.214	0.494	1.146
14	0.583	64.9	81.4	0.407	0.500	0.368	0.452	1.049
21	1.162	95.2	134.7	0.600	0.446	0.543	0.403	0.935
28	1.915	114.9	182.5	0.617	0.338	0.560	0.307	0.710
35	2.750	120.5	209.4	0.658	0.314	0.598	0.285	0.661
42	3.573	114.1	216.0	0.638	0.295	0.581	0.269	0.622
49	4.319	100.3	203.5	0.479	0.235	0.449	0.221	0.503
56	4.955	83.6	188.8	0.421	0.223	0.396	0.209	0.477

[1] Mean % Ca was calculated multiplying % Pav by the factor of 2.10 and % Dig. P by a factor of 2.32.

Table 2.09 - Live Weight and Daily Weight Gain Curves According to Gompertz Equation and the Derivative for Standard and High Performance Female Broilers



Equation parameters for high performance female broilers: Wm = 6806.051; B = 4.667622; C = 0.04156387; R^2=0.99; P<0.001. Standard performance female broilers: Wm = 5652.758; B = 4.82316; C = 0.0459867; R^2=0.99; P<0.001. W = weight (g); G= weight gain (g/day); t = age (days); Wm = mature weight (g); B = relative growth at the inflection point (g/day); C = age at the inflection point (days).

Table 2.10 - Equations Used to Estimate Metabolizable Energy (ME) Requirements of Female Broilers (kcal/bird/day)

ME Requirements of High Performance Female Broilers

$ME = (113\ W^{0.75}) + ((2158.2 + 1154.4\ W - 227.78\ W^2)\ G);\ R^2 = 0.83$

ME Requirements of Standard Performance Female Broilers[1]

$ME = ((113\ W^{0.75}) + ((2158.2 + 1154.4\ W - 227.78\ W^2)\ G))\ 1.04$

[1] Considering the growth curve of high performance female broilers and increasing ME requirement by 4%.

Correction for temperature[2] $= 2.6\ W^{0.75}\ (TN - T)$

W = Average Body Weight (kg); G = Weight Gain (kg/bird/day);
T= Average Temperature (°C); TN = Thermoneutral Temperature (°C)

[2] The equation was obtained based on data from MS and Ph.D. theses carried out at UNESP (Jaboticabal) and on Sakomura and Rostagno (2016)

Suggested temperatures for the correction of ME requirements

Age (days)	TN (°C)	Temperature Range (°C)
17 – 33	23	18 to 28
34 – 56	20	16 to 27

Higher temperature values may negatively influence broiler performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Female Broilers (31 days)
W = 1.880 kg; $W^{0.75}$ = 1.605 kg; G=0.0999 kg/bird/day; Dietary ME= 3100 kcal/kg

ME Req. = $(113 \times 1.605) + ((2158.2 + 1154.4 \times 1.880 - 227.78 \times 1.880^2) \times 0.0999)$

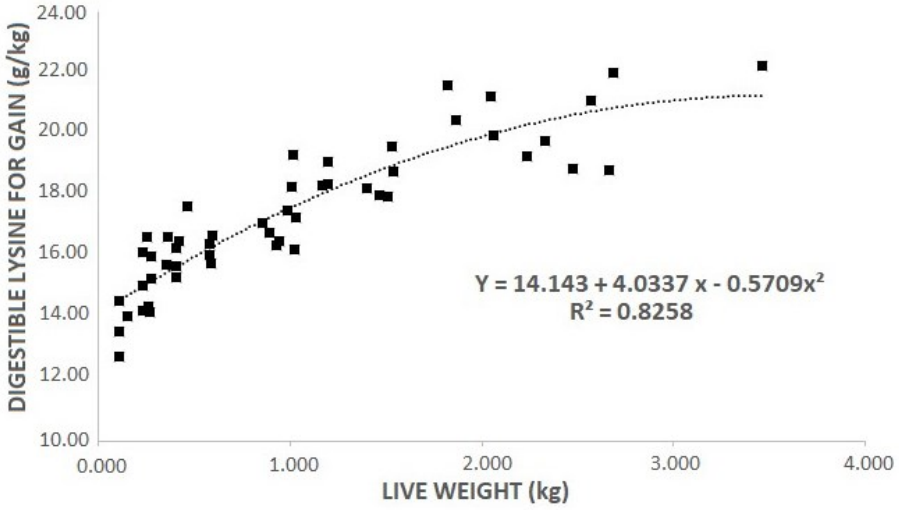
ME Req. = 533.3 kcal/bird/day; Estimated Feed Intake = 172.04 g/day
Correction for the average temperature of 26°C (TN=23°C)
Correction for T° = 2.6 x 1.606 (23 – 26) = -12.52 kcal/day
ME Req. for 26°C = 533.3 – 12.5 = 520.8 kcal/day; Estimated FI = 168.0 g/day

Table 2.11 - Methodology Applied to Obtain the Equation to Calculate Standardized Digestible Lysine Requirements / kg Weight Gain of Female Broilers

Weight Range, kg	0.04–0.30	0.30–0.60	0.60–1.30	1.30 – 2.00	2.00 – 2.50	2.50-4.00
Experimental Data[1]	12	11	12	7	5	4
Avg. Weight in Period, kg	0.207	0.468	1.020	1.591	2.230	2.846
Feed Intake, g/day	34.08	65.35	111.20	151.06	162.64	206.38
SID Lys Intake, g/day	0.421	0.729	1.196	1.404	1.697	1.720
Maint. SID Lys g/day[2]	0.0137	0.0254	0.0456	0.0637	0.0821	0.0985
SID Lys for G, g/day	0.407	0.703	1.150	1.341	1.615	1.621
Mean G, kg/day	0.0274	0.0431	0.0653	0.0700	0.0816	0.0773
g SID Lys/ kg G	14.75	16.26	17.60	19.24	19.84	21.04
Equation, g Lys/ kg G	14.95	15.91	17.66	19.12	20.30	21.00
Eq: Y (g SID Lys/kg G) = 14.143 + 4.0337 (Average Weight, kg) – 0.5709 (Average Weight, kg)^2 R^2 = 0.83						

[1] Total of 51 experimental data (week and total period) obtained in dose-response trials with different lysine levels.

[2] Daily requirements of digestible lysine for maintenance = 0.045 x (Average Weight)$^{0.75}$. Estimated according to the values of Siqueira, 2009 (Ph.D. thesis) and Dorigam et al. (2020).



Equation to estimate SID lysine values, in grams of SID Lys / kg of weight gain of female broilers as a function of body weight (0.040 to 4.000 kg).

Table 2.12 - Equation Used to Estimate the Standardized Digestible Lysine (SID Lys) Requirements of Female Broilers

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.045\ W^{0.75}) + ((14.143 + 4.0337\ W - 0.5709\ W^2)\ G)$

W = Average Body Weight (kg); G = Weight Gain (kg/bird/day)

Example:
High Performance Female Broilers (31 days)
Average Weight = 1.880 kg, with $W^{0.75}$ = 1.606 kg
G = 0.0999 kg/bird/day

SID Lys Req. = $(0.045 \times 1.606) + ((14.143 + 4.0337 \times 1.880 - 0.5709 \times 1.880^2) \times 0.0999)$

SID Lys Req. = (0.072) + (19.708 x 0.0999) = 2.041 g/day

Estimated Feed Intake = 172.04 g/day (Table 2.10)

% Dietary SID Lys = 1.186%

Correction for average temperature of 26°C (TN=23°C)
Weight = 1.880 kg; Gain = 0.099 kg/day
SID Lys Req. = 2.041 g/day
Estimated Feed Intake = 168.0 g/day (Table 2.10)
% Dietary SID Lys = 1.215%

Table 2.13 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Female Broilers Using the Equations in Tables 2.09, 2.10, and 2.12

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.057	11.0	0.163	39.0	13.3	13	0.418	1.226
2	0.069	13.0	0.193	46.1	15.7	29	0.419	1.229
3	0.085	15.2	0.227	54.0	18.4	48	0.420	1.230
4	0.102	17.6	0.264	62.8	21.4	69	0.420	1.231
5	0.122	20.2	0.305	72.6	24.8	94	0.420	1.231
6	0.145	23.0	0.349	83.2	28.4	122	0.420	1.230
7	0.171	26.0	0.397	94.9	32.4	155	0.419	1.227
8	0.201	29.2	0.449	107.4	36.2	191	0.418	1.241
9	0.233	32.5	0.504	121.0	40.7	231	0.417	1.237
10	0.269	35.9	0.562	135.5	45.6	277	0.415	1.232
11	0.309	39.5	0.624	150.9	50.8	328	0.413	1.227
12	0.352	43.1	0.688	167.3	56.3	384	0.411	1.221
13	0.398	46.7	0.754	184.4	62.1	446	0.409	1.215
14	0.449	50.4	0.823	202.4	68.1	514	0.407	1.208
15	0.503	54.1	0.894	221.1	74.4	589	0.404	1.201
16	0.561	57.8	0.966	240.4	80.9	670	0.402	1.194
17	0.622	61.4	1.040	260.2	86.2	756	0.400	1.207
18	0.687	64.9	1.113	280.5	92.9	849	0.397	1.199
19	0.755	68.2	1.187	301.0	99.7	948	0.394	1.191
20	0.827	71.5	1.261	321.7	106.5	1055	0.392	1.183
21	0.901	74.6	1.333	342.5	113.4	1168	0.389	1.176
22	0.979	77.5	1.404	363.2	120.2	1289	0.387	1.168
23	1.059	80.3	1.474	383.5	127.0	1416	0.384	1.160
24	1.142	82.8	1.540	403.6	133.6	1549	0.382	1.153
25	1.227	85.1	1.604	423.0	140.1	1689	0.379	1.145
26	1.314	87.2	1.665	441.9	146.3	1836	0.377	1.138
27	1.403	89.1	1.722	459.9	149.8	1986	0.374	1.149
28	1.494	90.7	1.774	477.0	155.4	2141	0.372	1.142
29	1.586	92.1	1.823	493.2	160.7	2302	0.370	1.135
30	1.679	93.2	1.866	508.3	165.6	2467	0.367	1.127
31	1.773	94.2	1.905	522.2	170.1	2637	0.365	1.120
32	1.868	94.8	1.939	535.0	174.3	2811	0.362	1.113
33	1.963	95.3	1.968	546.5	178.0	2989	0.360	1.105
34	2.059	95.6	1.991	556.8	181.4	3171	0.358	1.098
35	2.155	95.6	2.010	565.8	181.3	3352	0.355	1.108
36	2.250	95.5	2.023	573.5	183.8	3536	0.353	1.101
37	2.345	95.1	2.032	580.1	185.9	3722	0.350	1.093
38	2.440	94.6	2.035	585.4	187.6	3910	0.348	1.085
39	2.534	93.9	2.034	589.6	189.0	4099	0.345	1.076
40	2.627	93.1	2.028	592.7	190.0	4289	0.342	1.068
41	2.719	92.1	2.018	594.7	190.6	4479	0.339	1.059
42	2.810	90.9	2.004	595.8	191.0	4670	0.336	1.050
43	2.899	89.7	1.987	596.0	186.2	4856	0.333	1.067
44	2.988	88.3	1.966	595.3	186.0	5042	0.330	1.057
45	3.075	86.9	1.941	594.0	185.6	5228	0.327	1.046
46	3.160	85.3	1.914	591.9	185.0	5413	0.323	1.035
47	3.244	83.7	1.885	589.2	184.1	5597	0.320	1.024
48	3.326	82.0	1.853	586.0	183.1	5780	0.316	1.012
49	3.406	80.2	1.819	582.4	182.0	5962	0.312	0.999
50	3.484	78.4	1.783	578.3	180.7	6143	0.308	0.987
51	3.561	76.6	1.746	574.0	179.4	6322	0.304	0.973
52	3.636	74.7	1.708	569.4	177.9	6500	0.300	0.960
53	3.709	72.8	1.668	564.6	176.4	6677	0.295	0.946
54	3.779	70.9	1.628	559.6	174.9	6852	0.291	0.931
55	3.848	69.0	1.587	554.5	173.3	7025	0.286	0.916
56	3.916	67.1	1.546	549.4	171.7	7197	0.281	0.901

[1] Diets containing 2930, 2970, 3020, 3070, 3120, and 3200 kcal ME/kg for the phases 0-8, 8-17, 17-27, 27-35, 35-43, and 43-56 days of age.

Table 2.14 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Female Broilers Using the Equations in Tables 2.09, 2.10, and 2.12

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.077	13.4	0.200	46.6	15.8	16	0.429	1.265
2	0.093	15.5	0.232	54.0	18.3	34	0.430	1.267
3	0.111	17.7	0.267	62.1	21.1	55	0.430	1.268
4	0.131	20.2	0.306	71.1	24.1	79	0.430	1.268
5	0.154	22.8	0.348	80.9	27.4	107	0.430	1.268
6	0.179	25.6	0.393	91.5	31.0	138	0.429	1.266
7	0.208	28.6	0.441	103.1	34.9	173	0.428	1.264
8	0.239	31.7	0.493	115.5	38.5	211	0.427	1.282
9	0.274	35.0	0.549	128.8	42.9	254	0.426	1.278
10	0.313	38.3	0.607	142.9	47.6	302	0.425	1.274
11	0.355	41.8	0.668	158.0	52.7	354	0.423	1.269
12	0.400	45.3	0.732	173.9	58.0	412	0.421	1.264
13	0.449	48.9	0.799	190.6	63.5	476	0.419	1.258
14	0.501	52.5	0.868	208.1	69.4	545	0.417	1.252
15	0.557	56.2	0.940	226.3	75.4	621	0.415	1.246
16	0.617	59.8	1.013	245.1	81.7	702	0.413	1.239
17	0.681	63.4	1.087	264.5	86.7	789	0.411	1.253
18	0.747	66.9	1.162	284.4	93.2	882	0.409	1.247
19	0.818	70.3	1.239	304.6	99.9	982	0.407	1.240
20	0.892	73.7	1.315	325.2	106.6	1089	0.404	1.233
21	0.968	76.9	1.391	345.8	113.4	1202	0.402	1.227
22	1.048	80.0	1.466	366.6	120.2	1322	0.400	1.220
23	1.131	83.0	1.541	387.2	126.9	1449	0.398	1.214
24	1.217	85.7	1.613	407.5	133.6	1583	0.396	1.207
25	1.305	88.4	1.684	427.5	140.2	1723	0.394	1.201
26	1.396	90.8	1.752	447.1	146.6	1870	0.392	1.195
27	1.489	93.0	1.817	466.0	150.3	2020	0.390	1.209
28	1.584	95.0	1.879	484.2	156.2	2176	0.388	1.203
29	1.681	96.9	1.937	501.5	161.8	2338	0.386	1.197
30	1.780	98.5	1.991	517.9	167.1	2505	0.384	1.192
31	1.880	99.9	2.041	533.3	172.0	2677	0.383	1.186
32	1.981	101.1	2.086	547.6	176.7	2854	0.381	1.181
33	2.083	102.1	2.126	560.8	180.9	3035	0.379	1.176
34	2.186	102.9	2.162	572.7	184.7	3219	0.377	1.170
35	2.289	103.4	2.193	583.4	185.2	3405	0.376	1.184
36	2.393	103.8	2.218	592.9	188.2	3593	0.374	1.178
37	2.497	104.0	2.238	601.1	190.8	3784	0.372	1.173
38	2.601	104.0	2.253	608.0	193.0	3977	0.371	1.167
39	2.705	103.9	2.264	613.8	194.8	4172	0.369	1.162
40	2.808	103.5	2.269	618.3	196.3	4368	0.367	1.156
41	2.911	103.1	2.269	621.7	197.4	4565	0.365	1.150
42	3.014	102.4	2.265	623.9	198.1	4763	0.363	1.144
43	3.115	101.6	2.257	625.1	195.4	4959	0.361	1.155
44	3.216	100.7	2.244	625.4	195.4	5154	0.359	1.148
45	3.316	99.7	2.228	624.7	195.2	5349	0.357	1.141
46	3.414	98.5	2.207	623.1	194.7	5544	0.354	1.134
47	3.512	97.2	2.184	620.8	194.0	5738	0.352	1.126
48	3.607	95.9	2.157	617.8	193.1	5931	0.349	1.117
49	3.702	94.4	2.127	614.2	191.9	6123	0.346	1.108
50	3.795	92.9	2.095	610.1	190.6	6314	0.343	1.099
51	3.886	91.3	2.061	605.4	189.2	6503	0.340	1.089
52	3.976	89.7	2.024	600.4	187.6	6690	0.337	1.079
53	4.064	88.0	1.986	595.1	186.0	6876	0.334	1.068
54	4.150	86.2	1.946	589.5	184.2	7061	0.330	1.056
55	4.234	84.4	1.905	583.7	182.4	7243	0.326	1.044
56	4.317	82.6	1.863	577.7	180.5	7424	0.322	1.032

[1]Diets containing 2950, 3000, 3050, 3100, 3150, and 3200 kcal ME/kg for the phases 0-8, 8-17, 17-27, 27-35, 35-43, and 43-56 days of age

Table 2.15 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium-to-Phosphorus Ratio Requirements of Female Broilers[1]

Available Phosphorus Requirement

Pav Req. (g/day) = (Pav for Maintenance) + (Pav for Gain)

Equation 01 to 21 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 6.0 G
Equation 22 to 42 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 5.0 G
Equation 43 to 56 days: Y (g Pav /day) = (0.026 $W^{0.75}$) + 4.0 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

Example: High Performance Female Broilers (31 days)
Average Weight: 1.880 kg; Daily Gain: 0.0999 kg/day; Feed Intake:172.0 g/day

Pav (g/day) = (0.026 x $1.880^{0.75}$) + 5.0 x 0.0999 = 0.541 g
% Pav = (0.541 x 100) / 172.0 = 0.315%;
% Ca in diet = 0.315 x 2.10= 0.661%

Standardized Digestible Phosphorus Requirement

Dig. P Req. (g/day) = (Dig. P for Maintenance) + (Dig. P for Gain)

Equation 01 to 21 days: Y (g Dig. P/day) = (0.026 $P^{0.75}$) + 5.4 G
Equation 22 to 42 days: Y (g Dig. P/day) = (0.026 $P^{0.75}$) + 4.5 G
Equation 43 to 56 days: Y (g Dig. P/day) = (0.026 $P^{0.75}$) + 3.7 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2,32

Example: High Performance Female Broilers (31 days)
Average Weight: 1.880 kg; Daily Gain: 0.099 kg/day; Feed Intake: 172.0 g/day

Dig. P (g/day) = (0.026 x $1.880^{0.75}$) + 4.5 x 0.0999 = 0.491 g
% Dig. P = (0.491 x 100) /172.0 = 0.286 %
% Ca in diet = 0.286 x 2.32 = 0.662 %

[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen 2009 (UFV Ph.D. Thesis), data from experiments carried out at UFV, and from Angel (2017) and Angel (2019).

Table 2.16 - Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Female Broilers Using the Equations in Table 2.15

Age, Days	Weight, Kg	Gain, g/day	Intake, g/day	Pav, g/day	Pav, %	Dig P, g/day	Dig P, %	Calcium[1], %
Standard Performance Female Broilers								
1 – 8	0.102	17.6	21.4	0.110	0.514	0.100	0.465	1.079
8	0.201	29.2	36.2	0.183	0.505	0.165	0.457	1.061
14	0.449	50.4	68.1	0.317	0.465	0.287	0.421	0.976
21	0.901	74.6	113.4	0.472	0.416	0.427	0.376	0.873
28	1.494	90.7	155.4	0.489	0.314	0.443	0.285	0.661
35	2.155	95.6	181.3	0.524	0.289	0.477	0.263	0.608
42	2.810	90.9	191.0	0.511	0.268	0.466	0.244	0.564
49	3.406	80.2	182.0	0.386	0.212	0.362	0.199	0.454
56	3.915	67.1	171.7	0.341	0.198	0.321	0.187	0.425
High Performance Female Broilers								
1 - 8	0.131	20.2	24.1	0.127	0.526	0.115	0.476	1.104
8	0.239	31.7	38.5	0.199	0.517	0.180	0.468	1.086
14	0.501	52.5	69.4	0.331	0.477	0.299	0.431	1.001
21	0.968	76.9	113.4	0.487	0.429	0.441	0.389	0.902
28	1.584	95.0	156.2	0.512	0.328	0.464	0.297	0.689
35	2.289	103.4	185.2	0.566	0.305	0.514	0.277	0.642
42	3.014	102.4	198.1	0.572	0.289	0.520	0.263	0.608
49	3.702	94.4	191.9	0.447	0.233	0.419	0.218	0.498
56	4.317	82.6	180.5	0.408	0.226	0.384	0.212	0.484

[1] Mean % Ca was calculated multiplying % Pav by the factor 2.10 and % Dig. P by the factor 2.32.

Table 2.17 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance As Hatched Broilers Using the Equations in Tables 2.01, 2.02, 2.04, and 2.09

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.062	12.1	0.182	42.0	14.3	14	0.432	1.266
2	0.076	14.3	0.215	49.7	17.0	31	0.433	1.268
3	0.093	16.8	0.253	58.3	19.9	52	0.433	1.269
4	0.112	19.4	0.295	67.9	23.2	75	0.433	1.269
5	0.134	22.3	0.341	78.6	26.8	102	0.433	1.268
6	0.160	25.5	0.391	90.2	30.8	132	0.432	1.266
7	0.188	28.8	0.445	103.0	35.2	168	0.431	1.263
8	0.221	32.4	0.503	116.7	39.3	207	0.430	1.276
9	0.257	36.1	0.564	131.6	44.3	251	0.428	1.270
10	0.297	39.9	0.629	147.5	49.7	301	0.426	1.264
11	0.341	43.9	0.698	164.5	55.4	356	0.424	1.258
12	0.389	47.9	0.769	182.4	61.4	417	0.421	1.250
13	0.440	52.0	0.843	201.3	67.8	485	0.418	1.242
14	0.497	56.1	0.920	221.0	74.4	559	0.416	1.234
15	0.557	60.2	0.998	241.6	81.3	641	0.413	1.225
16	0.621	64.3	1.078	262.8	88.5	729	0.410	1.217
17	0.689	68.3	1.159	284.5	94.3	824	0.407	1.228
18	0.762	72.2	1.239	306.8	101.6	925	0.404	1.219
19	0.838	76.0	1.320	329.3	109.1	1034	0.401	1.210
20	0.917	79.6	1.401	351.9	116.5	1151	0.398	1.200
21	1.000	83.0	1.480	374.6	124.1	1274	0.395	1.192
22	1.087	86.3	1.557	397.2	131.5	1406	0.392	1.183
23	1.176	89.3	1.632	419.3	138.9	1545	0.389	1.174
24	1.268	92.1	1.704	441.1	146.1	1691	0.386	1.166
25	1.362	94.6	1.773	462.2	153.1	1844	0.383	1.157
26	1.459	96.9	1.838	482.5	159.8	2004	0.381	1.150
27	1.558	99.0	1.899	501.9	163.5	2168	0.378	1.160
28	1.659	100.7	1.955	520.2	169.5	2337	0.376	1.153
29	1.761	102.2	2.006	537.5	175.1	2512	0.373	1.145
30	1.864	103.4	2.052	553.5	180.3	2692	0.371	1.138
31	1.969	104.4	2.093	568.1	185.1	2877	0.368	1.130
32	2.074	105.1	2.129	581.5	189.4	3066	0.366	1.123
33	2.179	105.6	2.159	593.4	193.3	3260	0.364	1.116
34	2.285	105.8	2.183	604.0	196.8	3457	0.362	1.109
35	2.391	105.8	2.202	613.1	196.5	3653	0.359	1.120
36	2.497	105.6	2.215	620.8	199.0	3852	0.357	1.113
37	2.602	105.1	2.223	627.2	201.0	4053	0.354	1.105
38	2.706	104.5	2.226	632.2	202.6	4256	0.352	1.098
39	2.810	103.7	2.224	636.0	203.9	4460	0.350	1.090
40	2.913	102.7	2.216	638.6	204.7	4664	0.347	1.082
41	3.014	101.5	2.205	640.0	205.1	4869	0.344	1.074
42	3.114	100.2	2.189	640.4	205.3	5075	0.341	1.066
43	3.213	98.8	2.169	639.9	200.0	5274	0.339	1.084
44	3.310	97.2	2.146	638.4	199.5	5474	0.336	1.075
45	3.406	95.6	2.119	636.2	198.8	5673	0.333	1.065
46	3.499	93.8	2.089	633.3	197.9	5871	0.330	1.055
47	3.592	92.0	2.057	629.7	196.8	6068	0.326	1.044
48	3.682	90.0	2.022	625.7	195.5	6263	0.323	1.033
49	3.769	88.0	1.985	621.1	194.1	6457	0.319	1.021
50	3.855	86.0	1.946	616.2	192.6	6650	0.315	1.009
51	3.939	84.0	1.905	611.0	191.0	6841	0.311	0.996
52	4.021	81.8	1.864	605.6	189.2	7030	0.3075	0.984
53	4.101	79.7	1.820	600.0	187.5	7218	0.3025	0.970
54	4.178	77.6	1.777	594.2	185.7	7403	0.2985	0.956
55	4.254	75.4	1.733	588.4	183.9	7587	0.294	0.941
56	4.327	73.3	1.688	582.6	182.1	7769	0.289	0.926

[1] Diets containing 2930, 2970, 3020, 3070, 3120, and 3200 kcal ME/kg for the phases 0-8, 8-17, 17-27, 27-35, 35-43, and 43-56 days of age.

Table 2.18 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance As Hatched Broilers Using the Equations in Tables 2.01, 2.02, 2.04, and 2.09

Age, Days	Weight, Kg	Gain, g/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Intake, g/day	Cumulative Intake, g	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
1	0.076	13.9	0.210	47.1	16.0	16	0.446	1.316
2	0.093	16.3	0.246	55.0	18.7	35	0.447	1.318
3	0.111	18.8	0.286	63.9	21.7	56	0.447	1.319
4	0.133	21.6	0.330	73.7	25.0	81	0.447	1.318
5	0.158	24.6	0.378	84.4	28.6	110	0.447	1.317
6	0.185	27.8	0.429	96.2	32.6	143	0.445	1.314
7	0.217	31.2	0.485	109.0	36.9	180	0.444	1.310
8	0.251	34.8	0.544	122.7	40.9	220	0.443	1.328
9	0.289	38.6	0.608	137.5	45.8	266	0.441	1.322
10	0.332	42.4	0.674	153.3	51.1	318	0.439	1.316
11	0.379	46.4	0.744	170.2	56.8	374	0.437	1.309
12	0.429	50.5	0.817	187.9	62.7	437	0.434	1.302
13	0.484	54.6	0.893	206.6	68.9	506	0.431	1.294
14	0.542	58.7	0.971	226.1	75.4	581	0.429	1.286
15	0.605	62.9	1.051	246.4	82.1	663	0.426	1.278
16	0.672	67.0	1.133	267.4	89.1	752	0.423	1.269
17	0.743	71.0	1.216	288.9	94.7	847	0.420	1.281
18	0.818	75.0	1.299	310.9	101.9	949	0.417	1.273
19	0.897	78.8	1.383	333.3	109.3	1058	0.415	1.264
20	0.979	82.5	1.466	355.8	116.7	1175	0.411	1.255
21	1.065	86.1	1.549	378.4	124.1	1299	0.409	1.247
22	1.154	89.4	1.629	400.9	131.5	1430	0.406	1.238
23	1.247	92.6	1.709	423.1	138.7	1569	0.404	1.230
24	1.343	95.5	1.785	444.9	145.9	1715	0.401	1.222
25	1.441	98.3	1.858	466.1	152.9	1868	0.399	1.215
26	1.542	100.8	1.929	486.7	159.6	2027	0.396	1.208
27	1.645	103.0	1.995	506.3	163.3	2190	0.394	1.221
28	1.750	105.0	2.057	525.1	169.4	2360	0.392	1.214
29	1.856	106.8	2.114	542.7	175.1	2535	0.389	1.207
30	1.965	108.3	2.167	559.1	180.4	2715	0.387	1.201
31	2.074	109.5	2.214	574.3	185.3	2900	0.386	1.194
32	2.185	110.5	2.256	588.2	189.8	3090	0.384	1.189
33	2.296	111.2	2.292	600.8	193.8	3284	0.382	1.183
34	2.408	111.7	2.324	611.9	197.4	3481	0.380	1.177
35	2.520	112.0	2.349	621.6	197.3	3679	0.378	1.190
36	2.632	112.0	2.369	629.9	200.0	3879	0.376	1.184
37	2.743	111.9	2.383	636.8	202.2	4081	0.374	1.179
38	2.855	111.5	2.392	642.4	203.9	4285	0.373	1.173
39	2.966	111.0	2.395	646.7	205.3	4490	0.371	1.167
40	3.076	110.2	2.394	649.7	206.3	4696	0.369	1.161
41	3.185	109.4	2.387	651.5	206.9	4903	0.367	1.154
42	3.294	108.3	2.376	652.2	207.1	5110	0.364	1.148
43	3.400	107.1	2.361	651.8	203.7	5314	0.362	1.159
44	3.506	105.7	2.341	650.6	203.3	5517	0.360	1.151
45	3.611	104.3	2.318	648.4	202.6	5720	0.358	1.144
46	3.713	102.7	2.290	645.4	201.7	5921	0.355	1.136
47	3.814	101.0	2.260	641.8	200.6	6122	0.353	1.127
48	3.913	99.2	2.227	637.6	199.3	6321	0.349	1.118
49	4.011	97.4	2.191	632.8	197.7	6519	0.346	1.108
50	4.106	95.5	2.153	627.6	196.1	6715	0.343	1.098
51	4.200	93.5	2.114	622.0	194.4	6910	0.340	1.087
52	4.291	91.5	2.072	616.1	192.5	7102	0.336	1.076
53	4.381	89.5	2.029	610.1	190.7	7292	0.333	1.064
54	4.468	87.4	1.984	603.8	188.7	7482	0.329	1.052
55	4.553	85.2	1.939	597.4	186.7	7668	0.325	1.039
56	4.636	83.1	1.893	591.0	184.7	7853	0.320	1.025

[1] Diets containing 2950, 3000, 3050, 3100, 3150, and 3200 kcal ME/kg for the phases 0-8, 8-17, 17-27, 27-35, 35-43, and 43-56 days of age.

Table 2.19 - Equations Used to Estimate the Nutritional Requirements (Y) of Broilers in % per Mcal ME as a Function of Average Age (X)[1]

Male	Female[2]
Potassium	
Y=0.2027 – 0.000454X	Y=0.1932 – 0.000454X
Sodium	
Y=0.0773 – 0.00041X	Y=0.0732 – 0.00038X
Chlorine	
Y=0.0694 – 0.00041X	Y=0.0665 – 0.00040X
Linoleic Acid	
Y=0.3720 – 0.00134X	Y=0.3530 – 0.00128X

[1] In order to determine the nutrient percentage in the diet of a nutritional program, use the equations above. Y = nutrient % per 1.0 Mcal of ME/kg and X = bird average age (days). The obtained value must be multiplied by dietary ME in Mcal; e.g.: sodium requirement of high performance male broilers in the period of 27 to 35 days (average age of 31 days) is: Y = 0.0773 – 0.00041 (31) = 0.065 % Mcal x 3.100 Mcal ME/kg diet = 0.200% of sodium.

[2] Nutrient level suggested for females corresponds approximately to 95% of male requirements.

Table 2.20 - Amino Acid / Lysine Ratio (%) Used to Estimate Broiler Amino Acid Requirements

Amino Acid		Phase / Age					
		Pre Starter and Starter		Grower I and II		Finisher I and II	
		0 - 8 - 17 days		17 - 27 - 35 days		35 - 43 - 56 days	
		SID	Total	SID	Total	SID	Total
Lysine	%	100	100	100	100	100	100
Methionine	%	40	40	42	42	43	43
Methionine + Cysteine	%	73	73	77	77	78	78
Threonine	%	66	69	66	69	66	69
Tryptophan	%	18	18	18	18	18	18
Arginine	%	108	106	107	105	105	103
Glycine + Serine	%	147	150	140	143	135	138
Valine	%	77	79	77	79	77	79
Isoleucine	%	67	67	67	68	68	68
Leucine	%	107	107	107	107	107	107
Histidine	%	37	37	37	37	35	35
Phenylalanine	%	63	63	63	63	63	63
Phenylalanine + Tyrosine	%	115	115	115	115	115	115

SID.: Standardized Ileal Digestibility

Table 2.21 - Example to Calculate the Digestible Essential Nitrogen (Dig. Ne) Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of Broilers[1]

Amino Acid	N (%)	SID AA Req. (%)	Dig. Ne (%)	Total AA Req. (%)	Net (%)
Lysine	19.16	1.202	0.230	1.326	0.254
Methionine	9.39	0.509	0.048	0.557	0.052
Threonine	11.76	0.794	0.093	0.915	0.108
Tryptophan	13.72	0.216	0.030	0.239	0.033
Arginine	32.16	1.287	0.414	1.392	0.448
Glycine + Serine[2]	15.56	1.683	0.262	1.896	0.295
Valine	11.96	0.926	0.111	1.047	0.125
Isoleucine	10.68	0.806	0.086	0.901	0.096
Leucine	10.68	1.287	0.137	1.419	0.151
Histidine	27.08	0.445	0.120	0.491	0.133
Phenylalanine	8.48	0.761	0.064	0.835	0.071
Ne Req.		1.596		1.766	
Total N Req.[3]		3.192		3.532	
Protein Req.[4]		19.95		22.07	
SID Lys: Protein		6.03		5.45	

[1] Example for high performance male broilers (27 to 35 days of age).
[2] N from Glycine + Serine according to molecular weight (Gly, 41.67%; Ser, 58.33%).
[3] Ne:Nt Ratio of 50%.
[4] Conversion Factor of N to Protein: 6.25.

- Total lysine requirement was calculated considering 90.7% of dietary ileal digestibility which was used to determine the total amino acid to total lysine ratio (Table 2.20) to estimate each total amino acid requirement.
- Minimum levels of Crude Protein and Digestible Protein can be estimated in a simplified way using the average value of % SID Lys in the protein of 5.5% (5.40 - 5.53) and 6.0% (5.97 - 6.11), respectively.

Example:
Simplified calculation of Crude Protein and Digestible Protein Requirements using the % Dietary SID Lys.
High Performance Male Broilers (31 days)
Weight = 2.268 kg, Gain = 0.119 kg/bird/day, % Dietary SID Lys = 1.202%

% Crude Protein = (% SID Lys x 100) / 5.5 = (1.202 x 100) / 5.5 = 21.9%
% Digestible Protein = (% SID Lys x 100) / 6.0 = (1.202 x 100) / 6.0 = 20.0%

Table 2.22 - Nutritional Requirements of High Performance Male Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.05-0.26	0.26-0.80	0.80-1.80	1.80-2.75	2.75-3.68	3.68-4.32
Average Weight	kg	0.134	0.488	1.260	2.268	3.226	4.012
Gain	g/day	23.0	57.9	98.8	119.0	118.0	106.8
SID Lysine	g/day	0.353	0.944	1.792	2.387	2.526	2.373
Available Phosphorus	g/day	0.144	0.362	0.525	0.643	0.653	0.501
Digestible Phosphorus	g/day	0.130	0.328	0.476	0.584	0.594	0.469
Metabolizable Energy	kcal/day	76.2	212.2	435.1	615.3	679.5	667.7
Diet Metabolizable Energy	kcal/kg	2950	3000	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	25.8	70.7	142.7	198.5	215.7	208.7
				Nutrients			
Calcium	%	1.167	1.076	0.773	0.681	0.637	0.513
Available Phosphorus	%	0.556	0.513	0.368	0.324	0.303	0.240
Digestible Phosphorus	%	0.503	0.464	0.333	0.294	0.275	0.225
Potassium	%	0.593	0.591	0.588	0.585	0.583	0.582
Sodium	%	0.223	0.217	0.208	0.200	0.193	0.187
Chlorine	%	0.200	0.193	0.184	0.176	0.168	0.162
Linoleic Acid	%	1.082	1.066	1.045	1.024	1.007	0.993
				Digestible Protein and Amino Acid			
Digestible Protein	%	22.89	22.34	20.84	19.95	19.17	18.61
Lysine	%	1.367	1.335	1.256	1.202	1.171	1.137
Methionine	%	0.549	0.536	0.532	0.509	0.502	0.488
Methionine + Cysteine	%	0.998	0.974	0.967	0.926	0.914	0.887
Threonine	%	0.903	0.881	0.829	0.794	0.773	0.751
Tryptophan	%	0.246	0.240	0.226	0.216	0.211	0.205
Arginine	%	1.477	1.441	1.344	1.287	1.230	1.194
Glycine + Serine	%	2.010	1.962	1.759	1.683	1.581	1.535
Valine	%	1.053	1.028	0.967	0.926	0.902	0.876
Isoleucine	%	0.916	0.894	0.842	0.806	0.796	0.773
Leucine	%	1.463	1.428	1.344	1.287	1.253	1.217
Histidine	%	0.506	0.494	0.465	0.445	0.410	0.398
Phenylalanine	%	0.865	0.844	0.794	0.761	0.741	0.719
Phenylalanine + Tyrosine	%	1.573	1.535	1.445	1.383	1.347	1.308
Digestible Essential Nitrogen	%	1.832	1.787	1.667	1.596	1.534	1.489
				Total Protein and Amino Acid			
Crude Protein	%	25.31	24.70	23.06	22.07	21.20	20.59
Lysine	%	1.508	1.471	1.385	1.326	1.291	1.254
Methionine	%	0.603	0.588	0.582	0.557	0.555	0.539
Methionine + Cysteine	%	1.101	1.074	1.066	1.021	1.007	0.978
Threonine	%	1.040	1.015	0.956	0.915	0.891	0.865
Tryptophan	%	0.271	0.265	0.249	0.239	0.232	0.226
Arginine	%	1.598	1.560	1.454	1.392	1.330	1.292
Glycine + Serine	%	2.261	2.207	1.980	1.896	1.782	1.730
Valine	%	1.191	1.162	1.094	1.047	1.020	0.991
Isoleucine	%	1.010	0.986	0.942	0.901	0.878	0.853
Leucine	%	1.613	1.574	1.482	1.419	1.382	1.342
Histidine	%	0.558	0.544	0.512	0.491	0.452	0.439
Phenylalanine	%	0.950	0.926	0.872	0.835	0.814	0.790
Phenylalanine + Tyrosine	%	1.734	1.692	1.593	1.525	1.485	1.442
Total Essential Nitrogen	%	2.025	1.976	1.845	1.766	1.696	1.647

Table 2.23 - Nutritional Requirements of High Performance Male Broilers Grown at 26 ºC (21-31 ºC) Average Temperature

Age	Days	17-27	27-35	35-43	43-49
Weight Range	kg	0.80-1.80	1.80-2.75	2.75-3.68	3.68-4.32
Average Weight	kg	1.260	2.268	3.226	4.012
Gain	g/day	98.8	119.0	118.0	106.8
SID Lysine	g/day	1.792	2.387	2.526	2.373
Available Phosphorus	g/day	0.525	0.643	0.653	0.501
Digestible Phosphorus	g/day	0.476	0.584	0.594	0.469
Metabolizable Energy	kcal/day	425.8	600.9	641.9	623.5
Diet Metabolizable Energy	kcal/kg	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2400	2450	2470	2530
Intake	g/day	139.6	193.8	203.8	194.8
			Nutrients		
Calcium	%	0.790	0.698	0.674	0.549
Available Phosphorus	%	0.376	0.332	0.320	0.257
Digestible Phosphorus	%	0.341	0.301	0.291	0.241
Potassium	%	0.588	0.585	0.583	0.582
Sodium	%	0.208	0.200	0.193	0.187
Chlorine	%	0.184	0.176	0.168	0.162
Linoleic Acid	%	1.045	1.024	1.007	0.993
			Digestible Protein and Amino Acid		
Digestible Protein	%	21.30	20.43	20.29	19.93
Lysine	%	1.283	1.231	1.240	1.218
Methionine	%	0.544	0.521	0.532	0.522
Methionine + Cysteine	%	0.988	0.948	0.967	0.950
Threonine	%	0.847	0.813	0.818	0.804
Tryptophan	%	0.231	0.222	0.223	0.219
Arginine	%	1.373	1.317	1.302	1.279
Glycine + Serine	%	1.797	1.724	1.674	1.644
Valine	%	0.988	0.948	0.955	0.938
Isoleucine	%	0.860	0.825	0.843	0.828
Leucine	%	1.373	1.317	1.327	1.303
Histidine	%	0.475	0.456	0.434	0.426
Phenylalanine	%	0.812	0.779	0.784	0.770
Phenylalanine + Tyrosine	%	1.476	1.416	1.426	1.401
Digestible Essential Nitrogen	%	1.704	1.634	1.623	1.595
			Total Protein and Amino Acid		
Crude Protein	%	23.56	22.60	22.44	22.04
Lysine	%	1.415	1.358	1.367	1.343
Methionine	%	0.594	0.570	0.588	0.577
Methionine + Cysteine	%	1.090	1.045	1.066	1.047
Threonine	%	0.976	0.937	0.943	0.927
Tryptophan	%	0.255	0.244	0.246	0.242
Arginine	%	1.486	1.425	1.408	1.383
Glycine + Serine	%	2.024	1.941	1.886	1.853
Valine	%	1.118	1.072	1.080	1.061
Isoleucine	%	0.962	0.923	0.929	0.913
Leucine	%	1.514	1.453	1.463	1.437
Histidine	%	0.524	0.502	0.478	0.470
Phenylalanine	%	0.891	0.855	0.861	0.846
Phenylalanine + Tyrosine	%	1.627	1.561	1.572	1.544
Total Essential Nitrogen	%	1.885	1.808	1.795	1.764

Table 2.24 - Nutritional Requirements of Standard Performance Male Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.05-0.24	0.24-0.76	0.76-1.71	1.71-2.63	2.63-3.53	3.53-4.13
Average Weight	kg	0.121	0.454	1.194	2.164	3.085	3.838
Gain	g/day	21.2	55.0	95.0	114.6	113.4	102.2
SID Lysine	g/day	0.326	0.891	1.709	2.281	2.413	2.263
Available Phosphorus	g/day	0.133	0.344	0.505	0.620	0.627	0.480
Digestible Phosphorus	g/day	0.120	0.311	0.457	0.562	0.571	0.449
Metabolizable Energy	kcal/day	73.0	207.8	431.1	614.0	682.3	674.6
Diet Metabolizable Energy	kcal/kg	2930	2970	3020	3070	3120	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	24.9	70.0	142.8	200.0	218.7	210.8
				Nutrients			
Calcium	%	1.118	1.032	0.742	0.651	0.604	0.486
Available Phosphorus	%	0.533	0.492	0.353	0.310	0.287	0.228
Digestible Phosphorus	%	0.482	0.445	0.320	0.281	0.261	0.213
Potassium	%	0.589	0.585	0.582	0.579	0.577	0.582
Sodium	%	0.222	0.214	0.206	0.198	0.191	0.187
Chlorine	%	0.199	0.191	0.182	0.174	0.167	0.162
Linoleic Acid	%	1.074	1.055	1.034	1.015	0.998	0.993
				Digestible Protein and Amino Acid			
Digestible Protein	%	21.88	21.33	19.86	18.92	18.06	17.57
Lysine	%	1.307	1.274	1.197	1.140	1.103	1.074
Methionine	%	0.525	0.512	0.507	0.483	0.473	0.461
Methionine + Cysteine	%	0.954	0.930	0.922	0.878	0.860	0.837
Threonine	%	0.863	0.841	0.790	0.753	0.728	0.709
Tryptophan	%	0.235	0.229	0.216	0.205	0.199	0.193
Arginine	%	1.412	1.376	1.281	1.220	1.158	1.127
Glycine + Serine	%	1.921	1.873	1.676	1.596	1.489	1.449
Valine	%	1.006	0.981	0.922	0.878	0.849	0.827
Isoleucine	%	0.876	0.854	0.802	0.764	0.750	0.730
Leucine	%	1.399	1.363	1.281	1.220	1.180	1.149
Histidine	%	0.484	0.471	0.443	0.422	0.386	0.376
Phenylalanine	%	0.827	0.806	0.757	0.721	0.698	0.679
Phenylalanine + Tyrosine	%	1.503	1.465	1.377	1.311	1.269	1.235
Digestible Essential Nitrogen	%	1.751	1.706	1.589	1.514	1.444	1.406
				Total Protein and Amino Acid			
Crude Protein	%	24.20	23.58	21.98	20.93	19.97	19.43
Lysine	%	1.441	1.405	1.320	1.257	1.216	1.184
Methionine	%	0.576	0.562	0.554	0.528	0.523	0.509
Methionine + Cysteine	%	1.052	1.025	1.016	0.968	0.949	0.923
Threonine	%	0.994	0.969	0.911	0.867	0.839	0.817
Tryptophan	%	0.259	0.253	0.238	0.226	0.219	0.213
Arginine	%	1.528	1.489	1.386	1.320	1.253	1.219
Glycine + Serine	%	2.162	2.107	1.888	1.798	1.679	1.634
Valine	%	1.138	1.110	1.043	0.993	0.961	0.935
Isoleucine	%	0.966	0.941	0.898	0.855	0.827	0.805
Leucine	%	1.542	1.503	1.412	1.345	1.301	1.267
Histidine	%	0.533	0.520	0.488	0.465	0.426	0.414
Phenylalanine	%	0.908	0.885	0.832	0.792	0.766	0.746
Phenylalanine + Tyrosine	%	1.657	1.615	1.518	1.446	1.399	1.361
Total Essential Nitrogen	%	1.936	1.887	1.758	1.675	1.597	1.555

Table 2.25 - Nutritional Requirements of High Performance Female Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.05-0.24	0.24-0.68	0.68-1.49	1.49-2.29	2.29-3.11	3.11-3.70
Average Weight	kg	0.131	0.424	1.048	1.879	2.705	3.414
Gain	g/day	20.18	47.11	80.01	99.89	103.88	98.51
SID Lysine	g/day	0.306	0.766	1.466	2.041	2.264	2.207
Available Phosphorus	g/day	0.127	0.296	0.427	0.541	0.574	0.459
Digestible Phosphorus	g/day	0.115	0.268	0.387	0.491	0.522	0.430
Metabolizable Energy	kcal/day	71.1	182.2	366.6	533.3	613.8	623.1
Diet Metabolizable Energy	kcal/kg	2950	3000	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	24.10	60.75	120.18	172.04	194.85	194.73
				Nutrients			
Calcium	%	1.104	1.024	0.747	0.662	0.620	0.504
Available Phosphorus	%	0.526	0.488	0.355	0.315	0.295	0.236
Digestible Phosphorus	%	0.476	0.441	0.322	0.286	0.268	0.221
Potassium	%	0.565	0.563	0.559	0.555	0.553	0.551
Sodium	%	0.211	0.205	0.198	0.190	0.184	0.178
Chlorine	%	0.191	0.185	0.176	0.168	0.160	0.154
Linoleic Acid	%	1.026	1.011	0.991	0.971	0.955	0.941
				Digestible Protein and Amino Acid			
Digestible Protein	%	21.24	21.11	20.24	19.68	19.01	18.55
Lysine	%	1.268	1.261	1.220	1.186	1.162	1.134
Methionine	%	0.509	0.506	0.517	0.502	0.498	0.486
Methionine + Cysteine	%	0.926	0.920	0.939	0.913	0.906	0.884
Threonine	%	0.837	0.832	0.805	0.783	0.767	0.748
Tryptophan	%	0.228	0.227	0.220	0.214	0.209	0.204
Arginine	%	1.370	1.362	1.306	1.269	1.220	1.190
Glycine + Serine	%	1.865	1.854	1.708	1.661	1.568	1.530
Valine	%	0.977	0.971	0.939	0.913	0.895	0.873
Isoleucine	%	0.850	0.845	0.817	0.795	0.790	0.771
Leucine	%	1.357	1.349	1.306	1.269	1.243	1.213
Histidine	%	0.469	0.467	0.451	0.439	0.407	0.397
Phenylalanine	%	0.802	0.798	0.772	0.750	0.735	0.717
Phenylalanine + Tyrosine	%	1.459	1.450	1.403	1.364	1.336	1.304
Digestible Essential Nitrogen	%	1.699	1.689	1.620	1.575	1.521	1.484
				Total Protein and Amino Acid			
Crude Protein	%	23.48	23.34	22.40	21.78	21.03	20.52
Lysine	%	1.399	1.390	1.345	1.308	1.281	1.250
Methionine	%	0.559	0.556	0.565	0.549	0.551	0.537
Methionine + Cysteine	%	1.021	1.015	1.036	1.007	0.999	0.975
Threonine	%	0.965	0.959	0.928	0.902	0.884	0.862
Tryptophan	%	0.252	0.250	0.242	0.235	0.231	0.225
Arginine	%	1.482	1.474	1.412	1.373	1.319	1.287
Glycine + Serine	%	2.098	2.085	1.924	1.870	1.768	1.725
Valine	%	1.105	1.098	1.063	1.033	1.012	0.987
Isoleucine	%	0.937	0.931	0.915	0.889	0.871	0.850
Leucine	%	1.496	1.488	1.439	1.399	1.370	1.337
Histidine	%	0.517	0.514	0.498	0.484	0.448	0.437
Phenylalanine	%	0.881	0.876	0.847	0.824	0.807	0.787
Phenylalanine + Tyrosine	%	1.608	1.599	1.547	1.504	1.473	1.437
Total Essential Nitrogen	%	1.879	1.867	1.792	1.742	1.682	1.641

Table 2.26 - Nutritional Requirements of High Performance Female Broilers Grown at 26 ºC (21-31 ºC) Average Temperature

Age	Days	17-27	27-35	35-43	43-49
Weight Range	kg	0.80-1.80	1.80-2.75	2.75-3.68	3.68-4.32
Average Weight	kg	1.048	1.879	2.705	3.414
Gain	g/day	80.0	99.9	103.9	98.5
SID Lysine	g/day	1.466	2.041	2.264	2.207
Available Phosphorus	g/day	0.427	0.541	0.574	0.459
Digestible Phosphorus	g/day	0.387	0.491	0.522	0.430
Metabolizable Energy	kcal/day	358.5	520.8	580.9	583.9
Diet Metabolizable Energy	kcal/kg	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2400	2450	2470	2530
Intake	g/day	117.5	168.0	184.4	182.5
			Nutrients		
Calcium	%	0.763	0.677	0.656	0.538
Available Phosphorus	%	0.363	0.322	0.311	0.252
Digestible Phosphorus	%	0.329	0.292	0.283	0.236
Potassium	%	0.559	0.555	0.553	0.551
Sodium	%	0.198	0.190	0.184	0.178
Chlorine	%	0.176	0.168	0.160	0.154
Linoleic Acid	%	0.991	0.971	0.955	0.941
			Digestible Protein and Amino Acid		
Digestible Protein	%	20.70	20.16	20.09	19.80
Lysine	%	1.248	1.215	1.228	1.210
Methionine	%	0.528	0.514	0.527	0.519
Methionine + Cysteine	%	0.961	0.935	0.957	0.944
Threonine	%	0.823	0.802	0.810	0.798
Tryptophan	%	0.225	0.219	0.221	0.218
Arginine	%	1.335	1.300	1.289	1.270
Glycine + Serine	%	1.747	1.701	1.657	1.633
Valine	%	0.961	0.935	0.945	0.931
Isoleucine	%	0.836	0.814	0.835	0.823
Leucine	%	1.335	1.300	1.313	1.294
Histidine	%	0.462	0.449	0.430	0.423
Phenylalanine	%	0.789	0.768	0.776	0.765
Phenylalanine + Tyrosine	%	1.435	1.397	1.412	1.391
Digestible Essential Nitrogen	%	1.656	1.612	1.607	1.584
			Total Protein and Amino Acid		
Crude Protein	%	22.90	22.30	22.22	21.89
Lysine	%	1.376	1.339	1.353	1.334
Methionine	%	0.578	0.563	0.582	0.573
Methionine + Cysteine	%	1.059	1.031	1.056	1.040
Threonine	%	0.949	0.924	0.934	0.920
Tryptophan	%	0.248	0.241	0.244	0.240
Arginine	%	1.444	1.406	1.394	1.374
Glycine + Serine	%	1.967	1.915	1.868	1.840
Valine	%	1.087	1.058	1.069	1.054
Isoleucine	%	0.935	0.911	0.920	0.907
Leucine	%	1.472	1.433	1.448	1.427
Histidine	%	0.509	0.496	0.474	0.467
Phenylalanine	%	0.867	0.844	0.853	0.840
Phenylalanine + Tyrosine	%	1.582	1.540	1.556	1.534
Total Essential Nitrogen	%	1.832	1.784	1.778	1.752

Table 2.27 - Nutritional Requirements of Standard Performance Female Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.04-0.20	0.20-0.62	0.62-1.40	1.40-2.15	2.15-2.90	2.90-3.41
Average Weight	kg	0.102	0.375	0.979	1.773	2.534	3.160
Gain	g/day	17.59	44.91	77.53	94.15	93.90	85.32
SID Lysine	g/day	0.264	0.721	1.404	1.905	2.034	1.914
Available Phosphorus	g/day	0.110	0.282	0.413	0.511	0.522	0.403
Digestible Phosphorus	g/day	0.100	0.255	0.374	0.464	0.475	0.377
Metabolizable Energy	kcal/day	62.8	175.8	363.2	522.2	589.6	591.9
Diet Metabolizable Energy	kcal/kg	2930	2970	3020	3070	3120	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	21.4	59.2	120.2	170.1	189.0	185.0
				Nutrients			
Calcium	%	1.079	1.000	0.722	0.631	0.581	0.465
Available Phosphorus	%	0.514	0.476	0.344	0.300	0.276	0.218
Digestible Phosphorus	%	0.465	0.431	0.311	0.273	0.251	0.204
Potassium	%	0.561	0.557	0.553	0.550	0.548	0.551
Sodium	%	0.210	0.203	0.196	0.189	0.182	0.178
Chlorine	%	0.190	0.183	0.174	0.166	0.159	0.154
Linoleic Acid	%	1.019	1.001	0.981	0.962	0.946	0.941
				Digestible Protein and Amino Acid			
Digestible Protein	%	20.61	20.40	19.38	18.58	17.62	16.94
Lysine	%	1.231	1.218	1.168	1.120	1.076	1.035
Methionine	%	0.494	0.489	0.495	0.474	0.462	0.444
Methionine + Cysteine	%	0.899	0.889	0.899	0.862	0.840	0.807
Threonine	%	0.813	0.804	0.771	0.739	0.710	0.683
Tryptophan	%	0.222	0.219	0.210	0.202	0.194	0.186
Arginine	%	1.330	1.316	1.250	1.198	1.130	1.087
Glycine + Serine	%	1.810	1.791	1.635	1.568	1.453	1.397
Valine	%	0.948	0.938	0.899	0.862	0.829	0.797
Isoleucine	%	0.825	0.816	0.783	0.750	0.732	0.704
Leucine	%	1.317	1.303	1.250	1.198	1.152	1.107
Histidine	%	0.456	0.451	0.432	0.414	0.377	0.362
Phenylalanine	%	0.779	0.771	0.739	0.708	0.681	0.655
Phenylalanine + Tyrosine	%	1.416	1.401	1.343	1.288	1.238	1.190
Digestible Essential Nitrogen	%	1.649	1.632	1.550	1.487	1.409	1.355
				Total Protein and Amino Acid			
Crude Protein	%	22.79	22.55	21.44	20.56	19.48	18.73
Lysine	%	1.357	1.343	1.288	1.235	1.187	1.141
Methionine	%	0.543	0.537	0.541	0.519	0.510	0.491
Methionine + Cysteine	%	0.991	0.980	0.992	0.951	0.926	0.890
Threonine	%	0.937	0.927	0.888	0.852	0.819	0.787
Tryptophan	%	0.244	0.242	0.232	0.222	0.214	0.205
Arginine	%	1.439	1.424	1.352	1.297	1.222	1.175
Glycine + Serine	%	2.036	2.015	1.841	1.766	1.638	1.575
Valine	%	1.072	1.061	1.017	0.976	0.937	0.901
Isoleucine	%	0.909	0.900	0.876	0.840	0.807	0.776
Leucine	%	1.452	1.437	1.378	1.321	1.270	1.221
Histidine	%	0.502	0.497	0.476	0.457	0.415	0.399
Phenylalanine	%	0.855	0.846	0.811	0.778	0.748	0.719
Phenylalanine + Tyrosine	%	1.561	1.545	1.481	1.420	1.365	1.312
Total Essential Nitrogen	%	1.823	1.804	1.715	1.645	1.559	1.499

Table 2.28 - Nutritional Requirements of High Performance As Hatched Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.05-0.24	0.24-0.68	0.68-1.49	1.49-2.29	2.29-3.11	3.11-3.70
Average Weight	kg	0.133	0.456	1.154	2.074	2.966	3.713
Gain	g/day	21.6	52.5	89.4	109.4	110.9	102.7
SID Lysine	g/day	0.330	0.855	1.629	2.214	2.395	2.290
Available Phosphorus	g/day	0.136	0.329	0.476	0.592	0.614	0.480
Digestible Phosphorus	g/day	0.123	0.298	0.432	0.538	0.558	0.450
Metabolizable Energy	kcal/day	73.7	197.2	400.9	574.3	646.7	645.4
Diet Metabolizable Energy	kcal/kg	2950	3000	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	25.0	65.7	131.4	185.3	205.3	201.7
				Nutrients			
Calcium	%	1.136	1.050	0.760	0.672	0.629	0.509
Available Phosphorus	%	0.541	0.501	0.362	0.320	0.299	0.238
Digestible Phosphorus	%	0.490	0.453	0.328	0.290	0.272	0.223
Potassium	%	0.579	0.577	0.574	0.570	0.568	0.567
Sodium	%	0.217	0.211	0.203	0.195	0.189	0.183
Chlorine	%	0.196	0.189	0.180	0.172	0.164	0.158
Linoleic Acid	%	1.054	1.039	1.018	0.998	0.981	0.967
				Digestible Protein and Amino Acid			
Digestible Protein	%	22.07	21.73	20.54	19.82	19.09	18.58
Lysine	%	1.318	1.298	1.238	1.194	1.167	1.136
Methionine	%	0.529	0.521	0.525	0.506	0.500	0.487
Methionine + Cysteine	%	0.962	0.947	0.953	0.920	0.910	0.886
Threonine	%	0.870	0.857	0.817	0.789	0.770	0.750
Tryptophan	%	0.237	0.234	0.223	0.215	0.210	0.205
Arginine	%	1.424	1.402	1.325	1.278	1.225	1.192
Glycine + Serine	%	1.938	1.908	1.734	1.672	1.575	1.533
Valine	%	1.015	1.000	0.953	0.920	0.899	0.875
Isoleucine	%	0.883	0.870	0.830	0.801	0.793	0.772
Leucine	%	1.410	1.389	1.325	1.278	1.248	1.215
Histidine	%	0.488	0.481	0.458	0.442	0.409	0.398
Phenylalanine	%	0.834	0.821	0.783	0.756	0.738	0.718
Phenylalanine + Tyrosine	%	1.516	1.493	1.424	1.374	1.342	1.306
Digestible Essential Nitrogen	%	1.766	1.738	1.644	1.586	1.528	1.487
				Total Protein and Amino Acid			
Crude Protein	%	24.40	24.02	22.73	21.93	21.12	20.56
Lysine	%	1.454	1.431	1.365	1.317	1.286	1.252
Methionine	%	0.581	0.572	0.574	0.553	0.553	0.538
Methionine + Cysteine	%	1.061	1.045	1.051	1.014	1.003	0.977
Threonine	%	1.003	0.987	0.942	0.909	0.888	0.864
Tryptophan	%	0.262	0.258	0.246	0.237	0.232	0.226
Arginine	%	1.540	1.517	1.433	1.383	1.325	1.290
Glycine + Serine	%	2.180	2.146	1.952	1.883	1.775	1.728
Valine	%	1.148	1.130	1.079	1.040	1.016	0.989
Isoleucine	%	0.974	0.959	0.929	0.895	0.875	0.852
Leucine	%	1.555	1.531	1.461	1.409	1.376	1.340
Histidine	%	0.538	0.529	0.505	0.488	0.450	0.438
Phenylalanine	%	0.916	0.901	0.860	0.830	0.811	0.789
Phenylalanine + Tyrosine	%	1.671	1.646	1.570	1.515	1.479	1.440
Total Essential Nitrogen	%	1.952	1.922	1.819	1.754	1.689	1.644

Table 2.29 - Nutritional Requirements of High Performance As Hatched Broilers Grown at 26 °C (21-31 °C) Average Temperature

Age	Days	17-27	27-35	35-43	43-49
Weight Range	kg	0.80-1.80	1.80-2.75	2.75-3.68	3.68-4.32
Average Weight	kg	1.154	2.074	2.966	3.713
Gain	g/day	89.4	109.5	111.0	102.7
SID Lysine	g/day	1.629	2.214	2.395	2.290
Available Phosphorus	g/day	0.476	0.592	0.614	0.480
Digestible Phosphorus	g/day	0.432	0.538	0.558	0.450
Metabolizable Energy	kcal/day	392.2	560.9	611.4	603.7
Diet Metabolizable Energy	kcal/kg	3050	3100	3150	3200
Diet Net Energy	kcal/kg	2400	2450	2470	2530
Intake	g/day	128.6	180.9	194.1	188.7
			Nutrients		
Calcium	%	0.777	0.688	0.665	0.544
Available Phosphorus	%	0.370	0.327	0.316	0.255
Digestible Phosphorus	%	0.335	0.297	0.287	0.239
Potassium	%	0.574	0.570	0.568	0.567
Sodium	%	0.203	0.195	0.189	0.183
Chlorine	%	0.180	0.172	0.164	0.158
Linoleic Acid	%	1.018	0.998	0.981	0.967
			Digestible Protein and Amino Acid		
Digestible Protein	%	21.00	20.30	20.19	19.87
Lysine	%	1.266	1.223	1.234	1.214
Methionine	%	0.536	0.518	0.530	0.521
Methionine + Cysteine	%	0.975	0.942	0.962	0.947
Threonine	%	0.835	0.808	0.814	0.801
Tryptophan	%	0.228	0.221	0.222	0.219
Arginine	%	1.354	1.309	1.296	1.275
Glycine + Serine	%	1.772	1.713	1.666	1.639
Valine	%	0.975	0.942	0.950	0.935
Isoleucine	%	0.848	0.820	0.839	0.826
Leucine	%	1.354	1.309	1.320	1.299
Histidine	%	0.469	0.453	0.432	0.425
Phenylalanine	%	0.801	0.774	0.780	0.768
Phenylalanine + Tyrosine	%	1.456	1.407	1.419	1.396
Digestible Essential Nitrogen	%	1.680	1.623	1.615	1.590
			Total Protein and Amino Acid		
Crude Protein	%	23.23	22.45	22.33	21.97
Lysine	%	1.396	1.349	1.360	1.339
Methionine	%	0.586	0.567	0.585	0.575
Methionine + Cysteine	%	1.075	1.038	1.061	1.044
Threonine	%	0.963	0.931	0.939	0.924
Tryptophan	%	0.252	0.243	0.245	0.241
Arginine	%	1.465	1.416	1.401	1.379
Glycine + Serine	%	1.996	1.928	1.877	1.847
Valine	%	1.103	1.065	1.075	1.058
Isoleucine	%	0.949	0.917	0.925	0.910
Leucine	%	1.493	1.443	1.456	1.432
Histidine	%	0.517	0.499	0.476	0.469
Phenylalanine	%	0.879	0.850	0.857	0.843
Phenylalanine + Tyrosine	%	1.605	1.551	1.564	1.539
Total Essential Nitrogen	%	1.859	1.796	1.787	1.758

Table 2.30 - Nutritional Requirements of Standard Performance As Hatched Broilers

Age	Days	0-8	8-17	17-27	27-35	35-43	43-49
Weight Range	kg	0.05-0.24	0.24-0.68	0.68-1.49	1.49-2.29	2.29-3.11	3.11-3.70
Average Weight	kg	0.112	0.415	1.087	1.969	2.810	3.499
Gain	g/day	19.4	50.0	86.3	104.4	103.7	93.8
SID Lysine	g/day	0.295	0.806	1.557	2.093	2.224	2.089
Available Phosphorus	g/day	0.122	0.313	0.459	0.566	0.575	0.442
Digestible Phosphorus	g/day	0.110	0.283	0.416	0.513	0.523	0.413
Metabolizable Energy	kcal/day	67.9	191.8	397.2	568.1	636.0	633.3
Diet Metabolizable Energy	kcal/kg	2930	2970	3020	3070	3120	3200
Diet Net Energy	kcal/kg	2331	2375	2400	2450	2470	2530
Intake	g/day	23.2	64.6	131.5	185.1	203.9	197.9
				Nutrients			
Calcium	%	1.099	1.016	0.732	0.641	0.593	0.476
Available Phosphorus	%	0.524	0.484	0.349	0.305	0.282	0.223
Digestible Phosphorus	%	0.474	0.438	0.316	0.277	0.256	0.209
Potassium	%	0.575	0.571	0.568	0.565	0.563	0.567
Sodium	%	0.216	0.209	0.201	0.194	0.187	0.183
Chlorine	%	0.195	0.187	0.178	0.170	0.163	0.158
Linoleic Acid	%	1.047	1.028	1.008	0.989	0.972	0.967
				Digestible Protein and Amino Acid			
Digestible Protein	%	21.25	20.87	19.62	18.75	17.84	17.26
Lysine	%	1.269	1.246	1.183	1.130	1.090	1.055
Methionine	%	0.510	0.501	0.501	0.479	0.468	0.453
Methionine + Cysteine	%	0.927	0.910	0.911	0.870	0.850	0.822
Threonine	%	0.838	0.823	0.781	0.746	0.719	0.696
Tryptophan	%	0.229	0.224	0.213	0.204	0.197	0.190
Arginine	%	1.371	1.346	1.266	1.209	1.144	1.107
Glycine + Serine	%	1.866	1.832	1.656	1.582	1.471	1.423
Valine	%	0.977	0.960	0.911	0.870	0.839	0.812
Isoleucine	%	0.851	0.835	0.793	0.757	0.741	0.717
Leucine	%	1.358	1.333	1.266	1.209	1.166	1.128
Histidine	%	0.470	0.461	0.438	0.418	0.382	0.369
Phenylalanine	%	0.803	0.789	0.748	0.715	0.690	0.667
Phenylalanine + Tyrosine	%	1.460	1.433	1.360	1.300	1.254	1.213
Digestible Essential Nitrogen	%	1.700	1.669	1.570	1.501	1.427	1.381
				Total Protein and Amino Acid			
Crude Protein	%	23.50	23.07	21.71	20.75	19.73	19.08
Lysine	%	1.399	1.374	1.304	1.246	1.202	1.163
Methionine	%	0.560	0.550	0.548	0.524	0.517	0.500
Methionine + Cysteine	%	1.022	1.003	1.004	0.960	0.938	0.907
Threonine	%	0.966	0.948	0.900	0.860	0.829	0.802
Tryptophan	%	0.252	0.248	0.235	0.224	0.217	0.209
Arginine	%	1.484	1.457	1.369	1.309	1.238	1.197
Glycine + Serine	%	2.099	2.061	1.865	1.782	1.659	1.605
Valine	%	1.105	1.086	1.030	0.985	0.949	0.918
Isoleucine	%	0.938	0.921	0.887	0.848	0.817	0.791
Leucine	%	1.497	1.470	1.395	1.333	1.286	1.244
Histidine	%	0.518	0.509	0.482	0.461	0.421	0.407
Phenylalanine	%	0.882	0.866	0.822	0.785	0.757	0.733
Phenylalanine + Tyrosine	%	1.609	1.580	1.500	1.433	1.382	1.337
Total Essential Nitrogen	%	1.880	1.846	1.737	1.660	1.578	1.527

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CHAPTER 3

Nutritional Requirement of Replacement Pullets, Layers, and Broiler Breeders

Nilva Kazue Sakomura[1], Matheus de Paula Reis[2], Marie-Pierre Létourneau Montminy[3] and Horacio Santiago Rostagno[4]

[1] Department of Animal Science, FCAV- UNESP- Jaboticabal, Brazil
[2] Trow Nutrition, Community of Madrid, Spain.
[3] Laval University, Quebec, Canadá.
[4] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

The main objective of nutritionists is to formulate balanced diets to meet animals' energy and nutrient requirements as accurately as possible. Considering the advances in animal performance promoted by recent genetic improvements, such requirements must be regularly updated to allow animals to express their full genetic potential.

The nutritional requirements of replacement pullets presented in this 5th edition were calculated considering the genetic growth potential estimated in studies developed at UNESP-Jaboticabal (Alves et al., 2019). Live weight was estimated using the Gompertz equation, and weight gain was obtained from the first derivative of this equation. For layers and breeders, the production potential recommended in the manuals of the main genetic strains published in 2022 was considered.

Feed intake is influenced by several factors, particularly by providing an adequate dietary energy level to supply the bird's energy requirements. Daily feed intake was calculated as the ratio between daily metabolizable energy (ME) requirement and dietary ME content.

Metabolizable energy (ME) requirements were calculated by applying the factorial model proposed by Sakomura et al. (2005) and net energy (NE) requirements based on a thesis carried out at UNESP-Jaboticabal. In the current edition, maintenance requirement values of 113 kcal/kg$^{0.75}$ ME and 92.3 kcal NE were applied, independently of the bird category. Energy requirements for weight gain are corrected as a function of body weight using a quadratic equation. However, different coefficients were applied for each bird category to minimize body composition differences, as mentioned for standardized digestible lysine. Energy requirements for egg production were 2.4 kcal/g egg mass for white and brown layers and 1.54 kcal/g egg mass for broiler breeders.

Digestible amino acid requirements in standardized ileal digestibility (SID) and lysine requirements of growing pullets and laying hens were determined in studies conducted at UNESP-Jaboticabal. Lysine

requirements were used as a reference to estimate the requirements for the other amino acids, as the ideal protein concept. The ideal essential amino acid profile of pullets and layers was defined in studies carried out at UNESP-Jaboticabal.

The factorial model to determine SID Lys requirements of white and brown replacement pullets and broiler breeders was adjusted as a function of live weight and weight gain. The SID Lys requirement of growing pullets was divided into requirements for maintenance and weight gain (growth), in addition to the requirement for egg mass during the pre-laying phase, considering a 5 to 15% laying rate. The same factors were considered for layers and broiler breeders. The SID Lys requirement for maintenance of replacement pullets and layers was estimated as 45.1 mg per kg of metabolic weight ($kg^{0.75}$). The SID Lys requirement for growth was estimated per g of weight gain using a quadratic equation as a function of body weight. The parameters of that equation vary according to bird category to account for the body composition differences between growing pullets, white or brown layers and laying broiler breeders. The SID Lys requirements for egg production were calculated as 11.5 mg/g of egg mass for white or brown layers and 14.5 mg for broiler breeders.

Due to the increasing availability and inclusion of crystalline amino acids in poultry diets, to reduce dietary crude protein content, the essential nitrogen (Ne) to total nitrogen (Total N) ratio must be considered in feed formulation. When dietary crude protein levels are reduced, non-essential nitrogen (Nne) may become limiting. Therefore, the ideal Ne:Total N or Ne:Nne ratios in reduced-protein diets should be determined to maximize bird performance and nitrogen utilization efficiency. Digestible essential nitrogen (dig. Ne) to total essential nitrogen (Net) ratios were calculated as a function of the requirements and the N content of essential amino acids for each bird category. The ratios of the essential amino acids methionine, threonine, tryptophan arginine, glycine + serine, valine, isoleucine, leucine, histidine, and phenylalanine to lysine were calculated. Next, the obtained dig. Ne:Total N and Net:Total N ratios were used to calculate total

digestible nitrogen (total dig. N) and total N values. The recommended ratios are 50% for growing pullets and 44% for white and brown layers. The value of 44% reported in the 4th edition of the Brazilian Tables was applied for broiler breeders during the growing and laying phases. Based on the dig. N and total N values obtained, for each phase and bird category, the total and digestible protein requirements were estimated by multiplying the dig. N and total N by 6.25, considering a 16% N content in the dietary protein.

In the current edition, factorial models to estimate calcium (Ca) and phosphorus (P) requirements were developed, considering the requirements for maintenance, growth (replacement layer and broiler breeder pullets), and egg production (layers and broiler breeders). The coefficients of the factorial models were estimated based on data produced at the University of Laval (Canada) and published in the literature. The Ca and P requirements for maintenance were calculated as 70 mg/kg$^{0.75}$ metabolic weight (WPSA, 1984; Gopi et al., 2021). The Ca and P requirements for growth were adjusted for their deposition as a function of weight gain, using coefficients of 8.29 mg of Ca and 6.64 mg of P per gram of weight gain. Egg production requirement was calculated as a function of Ca and P deposition per gram of egg mass, using coefficients of 40 mg of Ca and 1.8 mg of P per gram of egg mass.

The proposed equations estimate Ca and P requirements (mg/bird/day) on a digestible basis. However, as feed formulation software programs use total Ca and available P values, Ca digestibility must be considered to estimate total Ca values. A 0.37 digestibility coefficient was applied for growing birds to calculate total Ca based on digestible Ca values. Ca digestibility was corrected as a function of age to contemplate the physiological changes experienced as birds age. The ratios presented in the 2017 edition were used to convert digestible P into available P, i.e., 1.18 for growing pullets, 1.11 for layers, and 1.05 for broiler breeders.

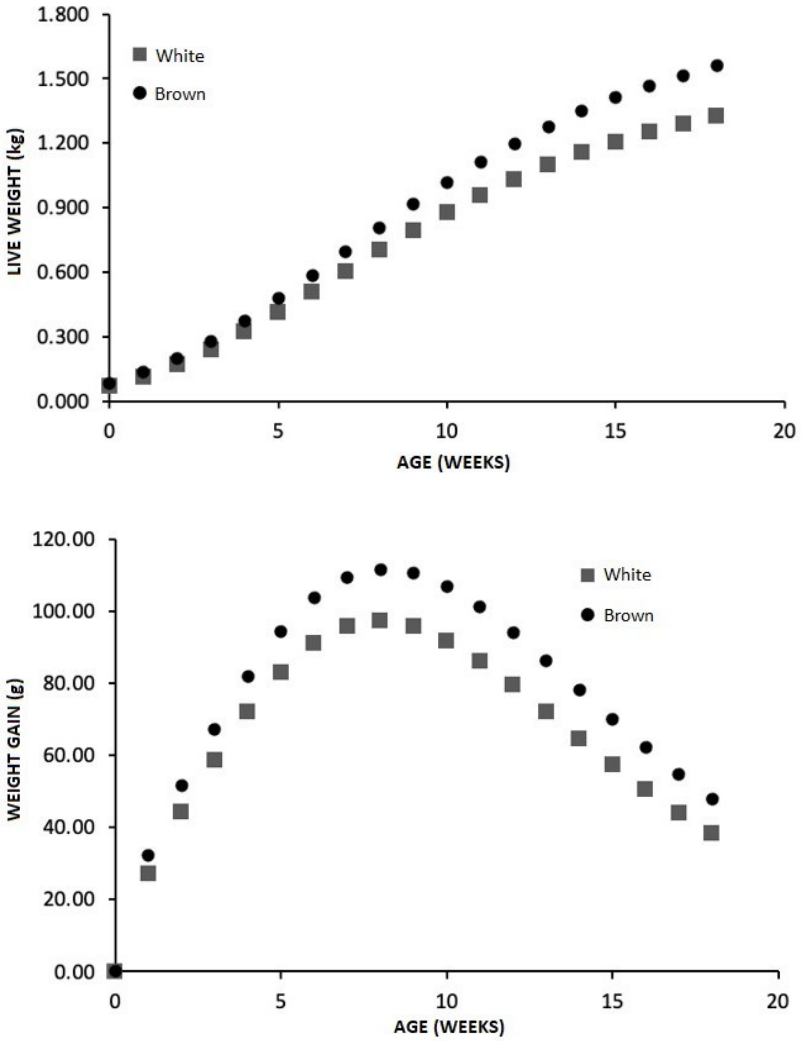
In this 5th edition, the sodium, potassium, chlorine, and linoleic acid requirements published in the 4th edition were updated based on the estimated feed intake of each bird category and production phase.

Factorial models allow for the adjustment of nutritional requirements as a function of the evolution of genetic potential for growth and production, as well as management and climate conditions, enabling the development of dynamic nutritional programs. To illustrate the application of factorial models for developing nutritional programs, Figure 1 shows an example of calculating the average lysine requirement for this production phase based on daily lysine requirements.

The nutritional programs for replacement pullets, layers, and broiler breeders during growing and laying phases were based on factorial models as a function of age and egg production. Nutritional programs were based on the genetic potential reported in the genetic strain manuals for high performance layers. Nutritional programs for standard performance layers assumed 5% lower performance than their genetic potential.

Nutritional Requirements of White and Brown Replacement Pullets

Table 3.01 - Live Weight and Daily Weight Gain Curves According to Gompertz Equation and the Derivative for White and Brown Replacement Pullets



Equation parameters for white replacement pullets: Wm = 1.511; b = 0.025; t* = 52.5; Brown replacement pullets: Wm = 1.808; b = 0.024; t* = 54.0; where, W = weight (kg); G = weight gain (g/day); t = age (days); Wm = mature body weight (kg), b = maturity rate (g/day), t* = age at maximum growth rate (weeks). The parameters were obtained from Alves et al. (2019) for Lohmann LsL and Dekalb Brown lineages.

Table 3.02 - Equations Used to Estimate Apparent Metabolizable Energy (ME) Requirements of White and Brown Replacement Pullets (kcal/bird/day)[1]

1 to 15 weeks:
$ME\ (kcal/day) = 113 \times W^{0.75} + (3.77 + 1.65 \times W - 0.923 \times W^2) \times G$

16 to 18 weeks:
$ME\ (kcal/day) = 113 \times W^{0.75} + (3.77+1.65 \times W - 0.923 \times W^2) \times G + (2.4 \times Egg)$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day); Egg = Egg Mass (g/bird/day)
Temperature: Thermoneutral temperature (TN) and temperature range (TR) were considered according to the bird's age: 8 to 14 days, TN = 29ºC, TR = 26 – 32ºC; 15 to 21 days, TN = 26ºC, TR = 23 – 29ºC; 22 to 28 days, TN = 23ºC, TR = 18 – 28ºC; 29 to 126 days, TN = 20ºC, TR = 16 – 27ºC.

Example: White Replacement Pullets
Age: 13 weeks (91 days); W = 1.025 kg, $W^{0.75} = 1.019$; G = 9.78 g/day
ME Req. = $113 \times 1.019 + (3.77 + 1.65 \times 1.025 - 0.923 \times 1.025^2) \times 9.78$.
ME Req. = 115 + 4.49 × 9.78 = 159 kcal/bird/day
Dietary ME[2] = 2.900 kcal/g
Estimated Feed Intake =159/2.9 = 54.9 g/day

Effect of temperature (TºC) of 26ºC on maintenance ME requirement (MEm):
TºC> TN
MEm = 113 + 0.88 × (Tº C – TN)
MEm = 113 + 0.88 × (26 – 23) = 113 + 0.88 × 3 = 115.64 kcal/bird/day

Effect of temperature (TºC) of 17ºC on maintenance ME requirement (MEm):
Tº C < TN
MEm = 113 + 6.73 × (TN – Tº C)
MEm = 113 + 6.73 × (23 - 17)
MEm = 113 + 6.73 × 6 = 153.88 kcal/bird/day

[1] Equations were adapted from Sakomura & Rostagno (2016), Neme et al. (2005), and Sakomura et al. (2004).
[2] Considering dietary ME in the whole growing period: White Pullet= 2.9 kcal/g and Brown Pullet = 2.85 kcal/g.

Table 3.03 - Equations Used to Estimate Net Energy (NE) Requirements of White and Brown Replacement Pullets (kcal/bird/day)[1]

1 to 15 weeks:
NE (kcal/bird/day) = $92.3 \times W^{0.75} + (2.40 + 1.36 \times W - 0.706 \times W^2) \times G$

16 to 18 weeks:
(NE kcal/bird/day) = $92.3 \times W^{0.75} + (2.40 + 1{,}36 \times W - 0.706 \times W^2) \times G +$ $(1.54 \times Egg)$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example: White Replacement Pullets

Age: 13 weeks (91 days); W = 1.025 kg, $W^{0.75}$ = 1.019,
G = 9.78 g/bird/day
NE Req. = $92.3 \times 1.019 + (2.40 + 1.36 \times 1.025 - 0.7058 \times 1.025^2) \times 9.78$.
NE Req. = 94.05 + 3.07 × 9.78 = 124 kcal/bird/day

Estimated Feed Intake = 54.9 g/day (Table 3.02)
Dietary NE[2] = 2.259 kcal/g

[1] Equations were adapted from Horna (2022) (Doctoral Thesis, UNESP – Jaboticabal).
[2] Considering feed intake determined according to the ME of 2.9 kcal/g, the dietary NE was calculated (124/54.9 = 2.259 kcal/g).

Table 3.04 - Equations Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of White and Brown Replacement Pullets (g/bird/day and %)[1,2]

SID Lys (g/bird/day) = Maintenance Req.[1] + Weight Gain Req.[2]

1 to 15 weeks:
SID Lys (g/bird/day) = [45.1 × $W^{0.75}$ + (24.13 –14.60 × W + 17.44 × W^2) × G] / 1000

16 to 18 weeks:
SID Lys (g/bird/day) = [45.1 × $W^{0.75}$ + (24.13 – 14.60 × W + 17.44 × W^2) × G + 9.46 × Egg] / 1000.
W = Average Body Weight (kg); G = Weight Gain (g/bird/day); Egg = Egg Mass (g/bird/day)

Example:

Parameters	Replacement Pullets	
	White	Brown
Age (weeks/days)	13(91)	18(126)[3]
W (kg)	1.025	1.519
$W^{0.75}$	1.019	1.368
G (g/bird/day)	9.78	6.42
Feed Intake (g)	54.9	69
Egg Mass (g/bird/day)	-	6.6
SID Lys Maintenance (g/bird/day)	0.046	0.062
SID Lys Weight Gain (g/bird/day)	0.269	0.271
SID Lys Egg Mass (g/bird/day)	-	0.062
SID Lys Requirement (g/day)	0.315	0.595[3]
SID Lys Requirement (%)	0.57	0.86

[1] Daily requirements of digestible lysine for maintenance were estimated according to the values reported by Siqueira et al. (2011).
[2] Daily requirements of digestible lysine for growing White and Brown Pullets were estimated from research carried out at UNESP – Jaboticabal.
[3] According to the reproductive organ development in the 18th week, 0.20 g/day of SID Lys was added.

Table 3.05 - Performance and Standardized Digestible Lysine (SID Lys), Metabolizable Energy (ME), and Net Energy (NE) Requirements of White[1] and Brown[2] Replacement Pullets Using the Equations in Tables 3.01, 3.02, 3.03 e 3.04

Age	Weight	Gain	SID Lys	ME	NE	Intake	Cumulative Intake	Lys/ME Ratio	SID Lys
Week (Days)	kg	g/day	g/day	kcal/day	kcal/day	g/day	g	%/Mcal	%
White Replacement Pullets[1]									
1 (7)	0.067	5.2	0.127	35	25	12	71	0.362	1.051
2 (14)	0.110	7.2	0.173	50	36	17	176	0.345	1.000
3 (21)	0.168	9.2	0.216	67	48	23	319	0.324	0.940
4 (28)	0.239	11.0	0.254	84	61	29	504	0.302	0.877
5 (35)	0.321	12.4	0.283	100	74	35	730	0.282	0.818
6 (42)	0.412	13.4	0.305	116	85	40	993	0.264	0.766
7 (49)	0.507	13.8	0.321	128	96	44	1291	0.250	0.724
8 (56)	0.604	13.8	0.331	139	104	48	1615	0.239	0.692
9 (63)	0.700	13.5	0.337	147	111	51	1962	0.230	0.666
10 (70)	0.792	12.8	0.339	152	116	53	2324	0.222	0.644
11 (77)	0.879	11.9	0.336	156	120	54	2698	0.215	0.623
12 (84)	0.959	10.9	0.329	159	123	55	3078	0.207	0.602
13 (91)	1.031	9.8	0.318	160	125	55	3463	0.199	0.577
14 (98)	1.097	8.8	0.304	160	126	55	3850	0.190	0.550
15 (105)	1.154	7.8	0.287	160	126	55	4237	0.179	0.519
16 (112)	1.205	6.8	0.400	168	132	58	4639	0.238	0.691
17 (119)	1.250	5.9	0.446	171	134	59	5049	0.260	0.755
18 (126)	1.289	5.1	0.493	175	137	60	5467	0.282	0.817
Brown Replacement Pullets[2]									
1 (7)	0.082	6.1	0.148	41	29	14	86	0.358	1.022
2 (14)	0.133	8.3	0.197	58	42	20	210	0.340	0.970
3 (21)	0.199	10.5	0.244	76	55	27	378	0.320	0.911
4 (28)	0.280	12.5	0.285	96	70	34	592	0.299	0.851
5 (35)	0.373	14.1	0.320	114	84	40	853	0.280	0.799
6 (42)	0.476	15.2	0.348	131	97	46	1158	0.265	0.757
7 (49)	0.586	15.8	0.372	146	109	51	1501	0.255	0.727
8 (56)	0.697	15.9	0.392	158	118	55	1876	0.249	0.709
9 (63)	0.808	15.6	0.409	167	126	58	2276	0.245	0.699
10 (70)	0.915	15.0	0.421	173	132	61	2695	0.243	0.694
11 (77)	1.017	14.0	0.429	178	136	62	3126	0.242	0.689
12 (84)	1.111	13.0	0.431	180	139	63	3567	0.239	0.681
13 (91)	1.198	11.8	0.426	182	141	64	4012	0.235	0.668
14 (98)	1.277	10.7	0.416	182	143	64	4459	0.228	0.650
15 (105)	1.347	9.5	0.400	182	143	64	4907	0.219	0.625
16 (112)	1.410	8.4	0.511	190	149	67	5370	0.269	0.766
17 (119)	1.465	7.4	0.553	193	152	68	5841	0.286	0.816
18 (126)	1.514	6.5	0.595	197	154	69	6321	0.302	0.861

[1] Dietary ME 2.900; [2]Dietary ME 2.850. White and Brown Pullets (16 to 18 weeks), extra requirements of + 0.10, 0.15 e 0.20 g SID Lys/ day, respectively, for reproductive tract development.

Table 3.06 - Amino Acid to Lysine Ratios Used to Estimate the Amino Acid Requirements of White and Brown Replacement Pullets[1]

Phase	Starter		Grower		Pre Lay	
Age (Weeks)	1-4		5-15		16-18	
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine	100	100	100	100	100	100
Methionine	41	41	44	44	46	46
Methionine + Cysteine	73	74	79	79	83	84
Threonine	68	71	67	70	70	73
Tryptophan	18	18	21	21	21	21
Arginine	108	106	109	109	109	109
Glycine + Serine	125	130	115	120	111	115
Valine	77	79	79	80	83	83
Isoleucine	70	71	74	75	76	78
Leucine	113	112	119	118	130	129
Histidine	37	37	37	37	39	39
Phenylalanine	67	66	69	69	71	71
Phenylalanine + Tyrosine	122	121	126	126	129	129

[1]The amino acids to lysine ratios were obtained from information reported by Soares et al. (2021).

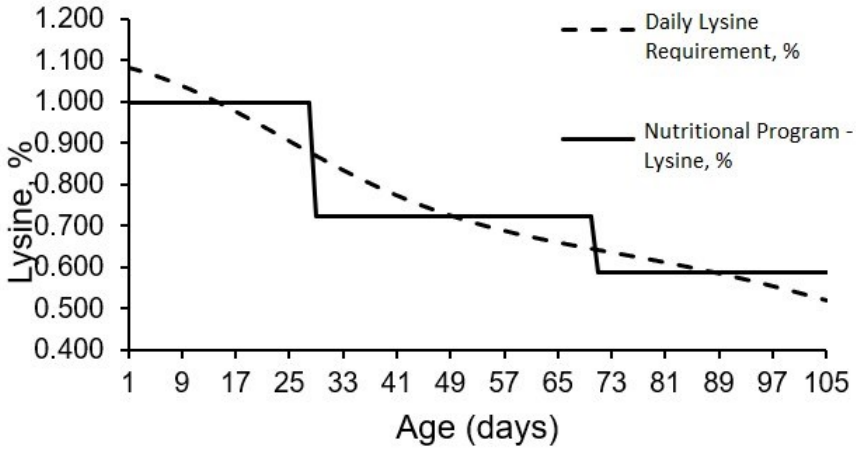


Figure 1 - Daily lysine requirements calculated using the factorial model (---) and a three-phase nutritional program (—) developed considering the midpoint requirement for each phase for white egg replacement pullets.

Table 3.07 - Example to Calculate Digestible Essential N (Dig. Ne), Total Essential N (Net), and Digestible and Total Crude Protein Requirements of White and Brown Replacement Pullets[1]

Amino Acids	N (%)	SID AA Req. g/day)	Dig. Ne (g/day)	Total AA Req. (g/day)	Net (g/day)
Lysine	19.16	0.322	0.062	0.358	0.069
Methionine	9.39	0.141	0.013	0.147	0.014
Threonine	11.76	0.215	0.025	0.254	0.030
Tryptophan	13.72	0.068	0.009	0.064	0.009
Arginine	32.16	0.351	0.113	0.379	0.122
Glycine + Serine	15.99	0.370	0.059	0.465	0.074
Valine	11.96	0.254	0.030	0.283	0.034
Isoleucine	10.68	0.238	0.025	0.254	0.027
Leucine	10.68	0.383	0.041	0.401	0.043
Histidine	27.08	0.119	0.032	0.132	0.036
Phenylalanine	8.48	0.222	0.019	0.247	0.021
Ne Req.			0.425		0.475
Total N Req.[2]			0.850		0.950
Protein Req., g/d[3]			5.31		5.94

[1] Example for white replacement pullets (5 to 10 weeks of age and 0.515 kg of weight).
[2] Ne: Total N ratio of 50%.
[3] Conversion factor of N to protein: 6.25.

The total lysine requirement was calculated considering 90.0% the ileal digestibility of lysine in the diet. Total amino acid to total lysine ratios was used (Table 3.06) to estimate total amino acid requirements.

- Dig. Lys(g/day) to Dig. Protein (g/day) ratio referring to the phases of 1 to 4, 5 to 10, 11 to 15, and 16 to 18 weeks are, respectively, 6.03, 6.00, 6.03, and 5.88%.
- Example: Dig. Protein (g/day) calculation considering Dig. Lys intake of 0.322: Dig. Protein = (0.322 × 100)/6.00 = 5.36 g/day. Considering feed intake of 44.2 g/day: 5.36 × 100/44.2 = 12.0 % of Dig. Protein.

- Dig. Lys(g/day) to Total Protein (g/day) ratio referring to the phases of 1 to 4, 5 to 10, 11 to 15, and 16 to 18 weeks are, respectively, 5.42, 5.38, 5.38, and 5.30%.
- Example: Total Protein (g/day) calculation considering Dig. Lys intake of 0.322: Dig. Protein = (0.322 × 100)/5.40 = 5.96 g/day. Considering feed intake of 44.2 g/day: 5.96 × 100/44.2 = 13.5 % of Total Protein.

Table 3.08 - Equations Used to Estimate Total Calcium, Standardized Digestible Phosphorus (Dig. P), and Available Phosphorus (Pav) of White and Brown Replacement Pullets[1]

Calcium (g/bird/day) = Maintenance Req. + Weight Gain Req. + Egg Req.

1 to 15 weeks:
Total Calcium (g/bird/day) = [(70 × $W^{0.75}$ + 8.29 × G)/0.37] / 1000
16 to 18 weeks:
Total Calcium (g/bird/day)=[(70×$W^{0.75}$ + 8.29 × G + 40 × Egg)/0.37] / 1000

W = Average Body Weight (kg); G = Weight Gain (g/bird/day); Egg = Egg Mass (g/bird/day)

Example for Calcium: White Replacement Pullets
Age: 13 weeks; W = 1.025 kg; $W^{0.75}$ = 1.019; G = 9.78 g/bird/day
Estimated Feed Intake = 54.9 g/day
Calcium Req. = [(70 × 1.019 + 8.29 × 9.78)/0.37]/1000 = 0.412 g/bird/day
% Calcium = (0.412 × 100)/54.9 = 0.75 %

Dig. Phosphorus (g/bird/d) = Maintenance Req + Wt Gain Req + Egg Req
1 to 15 weeks:
Dig. P (g/bird/day) = [70 × $W^{0.75}$ + 6.64 × G] / 1000
15 to 18 weeks:
Dig. P (g/bird/day) = [70 × $W^{0.75}$ + 6.64 × G + 1.8 Egg] / 1000

Example for Phosphorus: White Replacement Pullets
Age: 13 weeks (91 days); W = 1.025 kg; G = 9.78 g/bird/day
Estimated Feed Intake = 54.9 g/day

Dig. P (g/bird/day) = 70 × 1.019 + 6.64 × 9.78 = 0.136 g/bird/day
Pav = 0.136 × 1.18 = 0.161 g/bird/day
Dig. P = 0.136 x 100/54.9 = 0.248 %
Pav (%) = 0.161 × 100/54.9 = 0.293 %

[1] The maintenance requirements for calcium and phosphorus of 70 mg/kg ^{0,75} were adapted from WPSA (1984) and Gopi et al. (2021). Weight gain requirements for calcium and phosphorus (8.29 and 6.64 mg/g, respectively), and egg requirements for calcium and phosphorus (40 and 1.8 mg/g) were obtained from research carried out at Laval University. A calcium digestibility coefficient of 0.37 was obtained from the information reported by Mutucumarana et al. (2014). To convert Dig. P in Pav the value of 1.18 was used according to the Brazilian Tables (2017).

Table 3.09 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of White and Brown Replacement Pullets, Using the Equations in Table 3.08

Age	Weight	Gain	Intake	Calcium	Dig. P	Pav	Calcium	Dig. P	Pav
Week (Days)	Kg	g/day	g/day	g/day	g/day	g/day	%	%	%
White Replacement Pullets									
1 (7)	0.071	5.3	12	0.142	0.044	0.052	1.17	0.363	0.428
2 (14)	0.115	7.3	17	0.198	0.061	0.072	1.15	0.356	0.420
3 (21)	0.172	9.2	23	0.256	0.080	0.094	1.11	0.347	0.409
4 (28)	0.243	10.9	29	0.311	0.097	0.115	1.08	0.336	0.397
5 (35)	0.325	12.3	35	0.359	0.113	0.133	1.04	0.325	0.384
6 (42)	0.414	13.2	40	0.397	0.125	0.148	1.00	0.314	0.371
7 (49)	0.508	13.6	44	0.424	0.134	0.159	0.96	0.304	0.358
8 (56)	0.604	13.6	48	0.440	0.140	0.166	0.92	0.293	0.346
9 (63)	0.698	13.3	51	0.446	0.144	0.169	0.88	0.284	0.335
10 (70)	0.789	12.6	53	0.445	0.144	0.170	0.85	0.275	0.324
11 (77)	0.874	11.8	54	0.439	0.143	0.169	0.81	0.266	0.314
12 (84)	0.953	10.8	55	0.428	0.141	0.166	0.78	0.258	0.304
13 (91)	1.025	9.8	55	0.412	0.136	0.161	0.75	0.248	0.293
14 (98)	1.090	8.8	55	0.400	0.134	0.159	0.72	0.243	0.287
15 (105)	1.148	7.8	55	0.385	0.131	0.154	0.70	0.236	0.279
16 (112)	1.199	6.8	58	0.727	0.133	0.157	1.25	0.229	0.270
17 (119)	1.243	6.0	59	0.886	0.132	0.156	1.50	0.223	0.264
18 (126)	1.282	5.2	60	1.057	0.132	0.155	1.75	0.218	0.258
Brown Replacement Pullets									
1 (7)	0.079	6.1	14	0.166	0.051	0.061	1.15	0.355	0.419
2 (14)	0.129	8.3	20	0.228	0.071	0.083	1.12	0.348	0.410
3 (21)	0.194	10.5	27	0.292	0.091	0.107	1.09	0.339	0.399
4 (28)	0.276	12.5	34	0.353	0.110	0.130	1.05	0.328	0.387
5 (35)	0.370	14.1	40	0.407	0.127	0.150	1.02	0.318	0.375
6 (42)	0.474	15.2	46	0.450	0.141	0.167	0.98	0.307	0.363
7 (49)	0.585	15.8	51	0.482	0.152	0.179	0.94	0.298	0.351
8 (56)	0.697	15.9	55	0.502	0.159	0.188	0.91	0.288	0.340
9 (63)	0.809	15.6	58	0.511	0.163	0.193	0.87	0.279	0.330
10 (70)	0.918	15.0	61	0.512	0.165	0.194	0.84	0.271	0.320
11 (77)	1.021	14.0	62	0.506	0.164	0.194	0.81	0.264	0.311
12 (84)	1.116	13.0	63	0.496	0.162	0.191	0.78	0.256	0.302
13 (91)	1.204	11.8	64	0.482	0.159	0.187	0.76	0.249	0.294
14 (98)	1.283	10.7	64	0.466	0.155	0.183	0.73	0.242	0.286
15 (105)	1.353	9.5	64	0.450	0.151	0.178	0.70	0.235	0.278
16 (112)	1.416	8.4	67	0.790	0.152	0.180	1.18	0.229	0.270
17 (119)	1.471	7.4	68	0.947	0.151	0.178	1.40	0.223	0.263
18 (126)	1.519	6.5	69	1.116	0.150	0.177	1.62	0.218	0.257

Table 3.10 - Nutritional Requirements of White Replacement Pullets, According to Growing Phase (g/day)

Phase		Starter		Grower/ Developer				Pre Lay	
Age (Week)		1-4		5-10		11-15		16-18	
Average Weight	kg	0.114		0.514		1.001		1.232	
Gain	g/day	7.4		13.4		10.3		6.3	
SID Lysine	g/day	0.176		0.322		0.323		0.448	
Metabolizable Energy	kcal/day	59		129		159		170	
Net Energy	kcal/day	43		96		124		133	
Diet Metab Energy	kcal/kg	2.900		2.900		2.900		2.900	
Diet Net Energy	kcal/kg	2086		2163		2253		2275	
Intake	g/day	20.3		44.6		55.0		58.6	
Nutrients									
Total Crude Protein	g/day	3.25		5.99		6.00		8.46	
Digestible Protein	g/day	2.91		5.36		5.36		7.61	
Calcium	g/day	0.202		0.425		0.420		0.816	
Available Phosphorus	g/day	0.074		0.159		0.164		0.156	
Digestible Phosphorus	g/day	0.063		0.135		0.139		0.132	
Potassium	g/day	0.107		0.232		0.281		0.299	
Sodium	g/day	0.037		0.075		0.088		0.094	
Chlorine	g/day	0.032		0.067		0.083		0.087	
Linoleic Acid	g/day	0.209		0.446		0.550		0.586	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	g/day	0.176	0.196	0.322	0.358	0.323	0.359	0.448	0.498
Methionine	g/day	0.071	0.080	0.141	0.158	0.142	0.158	0.206	0.229
Met + Cys	g/day	0.128	0.145	0.254	0.283	0.255	0.284	0.372	0.418
Threonine	g/day	0.120	0.139	0.215	0.251	0.217	0.251	0.313	0.364
Tryptophan	g/day	0.032	0.035	0.068	0.075	0.068	0.075	0.094	0.105
Arginine	g/day	0.190	0.208	0.351	0.390	0.352	0.391	0.488	0.543
Gly + Ser	g/day	0.220	0.255	0.370	0.430	0.372	0.431	0.497	0.573
Valine	g/day	0.135	0.155	0.254	0.286	0.255	0.287	0.372	0.413
Isoleucine	g/day	0.123	0.139	0.238	0.269	0.239	0.269	0.340	0.388
Leucine	g/day	0.199	0.220	0.383	0.422	0.385	0.424	0.582	0.642
Histidine	g/day	0.065	0.073	0.119	0.132	0.120	0.133	0.175	0.194
Phenylalanine	g/day	0.118	0.129	0.222	0.247	0.223	0.248	0.318	0.354
Phe + Tyr	g/day	0.215	0.237	0.405	0.452	0.407	0.452	0.578	0.642
Essential Nitrogen	g/day	0.233	0.260	0.429	0.479	0.429	0.480	0.609	0.677

Table 3.11 - Nutritional Requirements of White Replacement Pullets, According to Growing Phase (%)

Phase		Starter		Grower/ Developer				Pre Lay	
Age (Weeks)		1-4		5-10		11-15		16-18	
Average Weight	kg	0.114		0.514		1.001		1.232	
Gain	g/day	7.4		13.4		10.3		6.3	
SID Lysine	g/day	0.176		0.322		0.323		0.448	
Metabolizable Energy	kcal/day	59		129		159		170	
Net Energy	kcal/day	43		96		124		133	
Diet Metab Energy	kcal/kg	2.900		2.900		2.900		2.900	
Diet Net Energy	kcal/kg	2.086		2.163		2.253		2.275	
Intake	g/day	20.3		44.6		55.0		58.6	
		Nutrients							
Total Crude Protein	%	15.95		13.41		10.91		14.43	
Digestible Protein	%	14.36		12.04		9.76		12.99	
Calcium	%	1.144		0.954		0.764		1.393	
Available Phosphorus	%	0.419		0.357		0.299		0.266	
Digestible Phosphorus	%	0.355		0.303		0.253		0.226	
Potassium	%	0.528		0.521		0.511		0.510	
Sodium	%	0.182		0.169		0.160		0.161	
Chlorine	%	0.159		0.151		0.150		0.149	
Linoleic Acid	%	1.028		1.000		1.000		1.000	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	%	0.866	0.962	0.722	0.802	0.588	0.653	0.764	0.849
Methionine	%	0.355	0.394	0.317	0.353	0.258	0.287	0.352	0.391
Met + Cys	%	0.641	0.712	0.570	0.634	0.465	0.516	0.634	0.713
Threonine	%	0.615	0.683	0.484	0.561	0.394	0.457	0.535	0.620
Tryptophan	%	0.156	0.173	0.152	0.168	0.123	0.137	0.160	0.178
Arginine	%	0.918	1.020	0.787	0.874	0.641	0.712	0.833	0.925
Gly + Ser	%	1.126	1.251	0.830	0.962	0.676	0.784	0.848	0.976
Valine	%	0.684	0.760	0.570	0.642	0.465	0.522	0.634	0.705
Isoleucine	%	0.615	0.684	0.534	0.602	0.435	0.490	0.581	0.662
Leucine	%	0.970	1.077	0.859	0.946	0.700	0.771	0.993	1.095
Histidine	%	0.320	0.356	0.267	0.297	0.218	0.242	0.298	0.331
Phenylalanine	%	0.580	0.635	0.498	0.553	0.406	0.451	0.542	0.603
Phe + Tyr	%	1.048	1.164	0.909	1.011	0.741	0.823	0.986	1.095
Essential Nitrogen	%	1.149	1.276	0.963	1.073	0.781	0.873	1.039	1.154

Table 3.12 - Nutritional Requirements of Brown Replacement Pullets, According to Growing Phase (g/day)

Phase		Starter		Grower/ Developer				Pre Lay	
Age (Weeks)		1-4		5-10		11-15		16-18	
Average Weight	kg	0.137		0.593		1.162		1.443	
Gain	g/day	8.5		15.5		12.3		7.8	
SID Lysine	g/day	0.201		0.373		0.426		0.557	
Metabolizable Energy	kcal/day	59		147		181		192	
Net Energy	kcal/day	43		109		141		151	
Diet Metab Energy	kcal/kg	2.850		2.850		2.850		2.850	
Diet Net Energy	kcal/kg	2052		2126		2211		2236	
Intake	g/day	20.8		51.4		63.6		67.3	
		Nutrients							
Total Crude Protein	g/day	3.70		6.93		7.91		10.51	
Digestible Protein	g/day	3.32		6.38		7.28		9.47	
Calcium	g/day	0.233		0.483		0.488		0.878	
Available Phosphorus	g/day	0.085		0.180		0.189		0.179	
Digestible Phosphorus	g/day	0.072		0.153		0.160		0.152	
Potassium	g/day	0.110		0.267		0.324		0.343	
Sodium	g/day	0.037		0.087		0.102		0.108	
Chlorine	g/day	0.034		0.080		0.096		0.101	
Linoleic Acid	g/day	0.217		0.535		0.655		0.687	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	g/day	0.201	0.223	0.373	0.414	0.426	0.473	0.557	0.619
Methionine	g/day	0.081	0.091	0.164	0.182	0.187	0.208	0.257	0.285
Met + Cys	g/day	0.146	0.165	0.295	0.327	0.337	0.374	0.462	0.520
Threonine	g/day	0.136	0.158	0.250	0.290	0.286	0.331	0.390	0.452
Tryptophan	g/day	0.036	0.040	0.078	0.087	0.090	0.099	0.117	0.130
Arginine	g/day	0.217	0.236	0.407	0.451	0.465	0.516	0.607	0.675
Gly + Ser	g/day	0.251	0.290	0.429	0.497	0.490	0.568	0.618	0.712
Valine	g/day	0.154	0.176	0.295	0.331	0.337	0.378	0.462	0.514
Isoleucine	g/day	0.140	0.158	0.276	0.311	0.316	0.355	0.423	0.483
Leucine	g/day	0.227	0.250	0.444	0.489	0.507	0.558	0.724	0.799
Histidine	g/day	0.074	0.083	0.138	0.153	0.158	0.175	0.217	0.241
Phenylalanine	g/day	0.135	0.147	0.257	0.286	0.294	0.326	0.395	0.439
Phe + Tyr	g/day	0.245	0.270	0.470	0.522	0.537	0.596	0.718	0.799
Essential Nitrogen	g/day	0.266	0.296	0.510	0.554	0.583	0.633	0.757	0.841

Table 3.13 - Nutritional Requirements of Brown Replacement Pullets, According to Growing Phase (%)

Phase		Starter		Grower/ Development				Pre Lay	
Age (Week)		1-4		5-10		11-15		16-18	
Average Weight	kg	0.137		0.593		1.162		1.443	
Gain	g/day	8.5		15.5		12.3		7.8	
SID Lysine	g/day	0.201		0.373		0.426		0.557	
Metabolizable Energy	kcal/day	59		147		181		192	
Net Energy	kcal/day	43		109		141		151	
Diet Metab Energy	kcal/kg	2.850		2.850		2.850		2.850	
Diet Net Energy	kcal/kg	2.052		2.126		2.211		2.236	
Intake	g/day	20.8		51.4		63.6		67.3	
		Nutrients							
Total Crude Protein	%	17.79		13.49		12.44		15.61	
Digestible Protein	%	16.01		12.39		11.20		14.06	
Calcium	%	1.120		0.940		0.767		1.304	
Available Phosphorus	%	0.409		0.350		0.297		0.266	
Digestible Phosphorus	%	0.346		0.297		0.252		0.225	
Potassium	%	0.531		0.520		0.509		0.509	
Sodium	%	0.179		0.169		0.161		0.160	
Chlorine	%	0.163		0.155		0.151		0.150	
Linoleic Acid	%	1.046		1.040		1.030		1.020	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	%	0.966	1.073	0.726	0.807	0.670	0.744	0.827	0.919
Methionine	%	0.392	0.440	0.319	0.355	0.295	0.327	0.381	0.423
Met + Cys	%	0.705	0.794	0.573	0.638	0.529	0.588	0.686	0.772
Threonine	%	0.657	0.762	0.486	0.565	0.469	0.521	0.579	0.671
Tryptophan	%	0.174	0.193	0.152	0.169	0.141	0.156	0.174	0.193
Arginine	%	1.043	1.137	0.791	0.880	0.730	0.811	0.901	1.002
Gly + Ser	%	1.208	1.395	0.835	0.968	0.804	0.893	0.918	1.057
Valine	%	0.744	0.848	0.573	0.646	0.536	0.595	0.686	0.763
Isoleucine	%	0.676	0.762	0.537	0.605	0.503	0.558	0.629	0.717
Leucine	%	1.092	1.202	0.864	0.952	0.791	0.878	1.075	1.186
Histidine	%	0.357	0.397	0.269	0.299	0.248	0.275	0.323	0.358
Phenylalanine	%	0.647	0.708	0.501	0.557	0.462	0.513	0.587	0.652
Phe + Tyr	%	1.179	1.298	0.915	1.017	0.844	0.937	1.067	1.186
Essential Nitrogen	%	1.281	1.423	0.992	1.079	0.896	0.995	1.125	1.249

Nutritional Requirements of White and Brown Layers

Table 3.14 - Equations Used to Estimate Metabolizable Energy (ME) Requirements of White and Brown Layers (kcal/bird/day)[1,2]

ME (kcal/bird/day) = $113 \times W^{0.75} + 6.68 \times G + 2.4 \times Egg$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day) = % Lay ÷ 100 × Egg Weight

Temperature: Thermoneutral temperature (TN) and temperature range (TR) were considered according to the bird's age: TN = 24º C,
TR = 16 to 27º C.
Effect of temperature (TºC) of 27ºC on maintenance ME requirement (MEm):
Tº C > TN
MEm = 113 + 0.88 × (Tº C – TN)
MEm = 113 + 0.88 × (27 – 24) = 13 + 0.88 × 3 = 115.6 kcal/bird/day

Effect of temperature (TºC) of 16ºC on maintenance ME requirement (MEm):
TºC < TN
MEm = 113 + 6.73 × (TN – Tº C)
MEm = 113 + 6.73 × (23 - 17) = 113 + 6.73 × 6 = 153 kcal/bird/day

Example: High Performance White and Brown Layers

Parameters	Layer	
	White	Brown
Age (weeks/days)	33(231)	40(280)
W (kg)	1.537	1.858
$W^{0.75}$	1.380	1.591
G (g/bird/day)	0.4	0.1
Egg Mass (g/bird/day)	60.2	61.3
ME Req. Maintenance (kcal/day)	156	180
ME Req. Gain (kcal/day)	2.86	0.668
ME Req. Egg Mass (kcal/day)	144	147.1
ME Req. Total (kcal/day)	303	327
Estimated Feed Intake (g/day)	105	115

[1] Equations were adapted from Sakomura & Rostagno (2016), Neme et al. (2005), Sakomura et al. (2004), and Sakomura et al. (2005).
[2] Considering dietary ME of 2.9 kcal/g for white layers and 2.85 kcal/g for brown layers.

Table 3.15 - Equations Used to Estimate Net Energy (NE) Requirements of White and Brown Layers (kcal/bird/day)[1]

NE (kcal/bird/day) = $92.3 \times W^{0.75} + 4.34 \times G + 1.54 \times Egg$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day); Egg = Egg Mass (g/bird/day)

Example: High Performance White and Brown Layers

Parameters	Layers	
	White	Brown
Age (weeks/days)	33(231)	40(280)
W (kg)	1.537	1.858
$W^{0.75}$	1.380	1.591
G (g/bird/day)	0.4	0.1
Egg Mass (g/bird/day)	60.2	61.3
NE Req. Maintenance (kcal/day)	127	146.9
NE Req. Gain (kcal/day)	1.86	0.3
NE Req. Egg Mass (kcal/day)	92.7	94.36
NE Req. Total (kcal/day)	222	242
Estimated Feed Intake (g/day)	105	115
Dietary NE (kcal/kg)	2122	2103

[1] Equations were adapted from Horna (2022) (Doctoral Thesis, UNESP – Jaboticabal).
[2] Considering dietary ME of 2.9 kcal/g for white layers and 2.85 kcal/g for brown layers, dietary NE was calculated for white layers (222 x 1000/105 = 2122 kcal/kg) and brown layers (242 x 1000/115) = 2103 kcal/kg).

Table 3.16 - Equations Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of White and Brown Layers (g/bird/day and %)[1, 2, 3]

SID Lys (g/bird/day) = Maintenance Req. + Wt Gain Req. + Egg Req.

SID Lys Req. (g/bird/day) = [45.1 × $W^{0.75}$ + (55 + 12 × G) / 0.80 + 11.5 × Egg] / 1000
W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example: High Performance White and Brown Layers

Parameters	Layers	
	White	Brown
Age (weeks/days)	33(231)	40(280)
W (kg)	1.537	1.858
$W^{0.75}$	1.380	1.591
G (g/bird/day)	0.4	0.1
Intake (g)	105	115
Egg Mass (g/bird/day)	60.2	61.3
SID Lys Maintenance (g/bird/day)	0.065	0.072
SID Lys Gain (g/bird/day)	0.075	0.070
SID Lys Egg Mass (g/bird/day)	0.692	0.705
SID Lys Req. (g/day)	0.829	0.847
SID Lys Req. (%)	0.79	0.74

[1] Daily maintenance SID Lys requirement (Siqueira et al., 2011) and for gain were estimated at UNESP – Jaboticabal.
[2] Equations were adapted from Sakomura & Rostagno (2016).
[3] Utilization efficiency of SID Lysine = 0.80.

Table 3.17 - Standardized Digestible Lysine (SID Lys), ME, and NE Requirements of High Performance White Layers

Age Weeks	Weight kg	Gain g/day	Production %	Egg Weight g	Egg Mass g/bird/day	SID Lys g/day	ME kcal/day	NE kcal/day	Intake g/day	Dietary SID Lys %
19-24	1.23-1.44	-	-	-	-	0.761	295	216	-	0.747
25	1.47	4	95.1	55.4	52.7	0.791	302	220	104	0.760
26	1.49	3	97.1	56.7	55.0	0.814	307	224	106	0.768
27	1.51	3	98.4	57.5	56.6	0.824	309	225	106	0.774
28	1.52	1	99.1	58.2	57.7	0.811	301	220	104	0.783
29	1.52	1.0	99.4	58.9	58.5	0.819	302	221	104	0.786
30	1.53	0.6	99.6	59.4	59.1	0.819	301	220	104	0.789
31	1.53	0.4	99.5	59.8	59.5	0.822	301	221	104	0.791
32	1.53	0.4	99.4	60.2	59.9	0.826	302	221	104	0.792
33	1.54	0.4	99.2	60.7	60.2	0.830	303	222	105	0.793
34	1.54	0.4	98.9	61.0	60.4	0.832	304	222	105	0.794
35	1.54	0.4	98.7	61.4	60.6	0.834	305	223	105	0.794
36	1.55	0.4	98.4	61.7	60.7	0.836	305	223	105	0.794
37	1.55	0.4	98.1	62.0	60.8	0.837	306	224	105	0.794
38	1.55	0.4	97.8	62.2	60.8	0.837	306	224	105	0.793
39	1.56	0.4	97.4	62.4	60.8	0.837	306	224	106	0.793
40	1.56	0.4	97.1	62.5	60.7	0.836	306	224	106	0.792
41	1.56	0.4	96.8	62.7	60.7	0.836	306	224	106	0.791
42	1.56	0.4	96.5	62.8	60.6	0.835	306	224	106	0.791
43	1.57	0.4	96.2	63.0	60.6	0.835	306	224	106	0.790
44	1.57	0.4	95.8	63.1	60.5	0.833	306	224	105	0.789
45	1.57	0.4	95.5	63.2	60.4	0.832	306	224	106	0.789
46	1.57	0.3	95.2	63.3	60.3	0.830	305	224	105	0.788
47	1.58	0.3	94.9	63.4	60.2	0.829	305	224	105	0.787
48	1.58	0.3	94.5	63.5	60.1	0.827	305	224	105	0.786
49	1.58	0.3	94.2	63.6	60.0	0.826	305	224	105	0.785
50	1.58	0.3	93.9	63.8	59.9	0.825	305	224	105	0.785
51	1.58	0.3	93.6	63.9	59.7	0.824	305	224	105	0.784
52	1.59	0.1	93.2	64.0	59.6	0.820	304	223	105	0.783
53	1.59	0.1	92.9	64.0	59.5	0.818	303	223	105	0.782
54	1.59	0.1	92.6	64.1	59.4	0.817	303	223	105	0.782
55	1.59	0.1	92.3	64.2	59.2	0.816	303	222	104	0.781
56	1.59	0.1	91.9	64.3	59.1	0.814	303	222	104	0.780
57	1.59	0.1	91.6	64.4	59.0	0.813	302	222	104	0.779
58	1.59	0.1	91.3	64.5	58.8	0.811	302	222	104	0.779
59	1.59	0.1	91.0	64.5	58.6	0.809	302	222	104	0.777
60	1.59	0.1	90.6	64.6	58.5	0.808	302	222	104	0.777
61	1.59	0.1	90.3	64.6	58.3	0.805	301	221	104	0.775
62	1.60	0.1	90.0	64.6	58.1	0.803	301	221	104	0.774
63	1.60	0.1	89.7	64.7	58.0	0.802	301	221	104	0.774
64	1.60	0.1	89.3	64.7	57.8	0.799	300	221	103	0.772
65	1.60	0.1	89.0	64.8	57.6	0.798	300	221	103	0.772
66	1.60	0.1	88.7	64.8	57.4	0.796	299	220	103	0.770
67	1.60	0.1	88.4	64.8	57.3	0.794	299	220	103	0.769
68	1.60	0.1	88.0	64.9	57.1	0.792	299	220	103	0.769
69	1.60	0.1	87.7	64.9	56.9	0.790	299	220	103	0.767
70	1.60	0.1	87.4	65.0	56.8	0.788	298	220	103	0.766
71	1.60	0.1	87.1	65.0	56.6	0.786	298	219	103	0.765
72	1.61	0.1	86.7	65.1	56.4	0.784	298	219	103	0.764
73	1.61	0.1	86.4	65.1	56.2	0.782	297	219	102	0.763
74	1.61	0.1	86.1	65.1	56.1	0.780	297	219	102	0.762
75	1.61	0.1	85.7	65.2	55.9	0.778	296	218	102	0.761
76	1.61	0.1	85.4	65.2	55.7	0.776	296	218	102	0.760
77	1.61	0.1	85.1	65.2	55.5	0.774	296	218	102	0.759
78	1.61	0.1	84.8	65.3	55.3	0.772	295	218	102	0.758
79	1.61	0.1	84.4	65.3	55.2	0.770	295	218	102	0.757
80	1.61	0.1	84.1	65.3	55.0	0.767	295	217	102	0.756

Table 3.18 - Standardized Digestible Lysine (SID Lys), ME, and NE Requirements of Standard Performance White Layers

Age	Weight	Gain	Production	Egg Weight	Egg Mass	SID Lys	ME	NE	Intake	Dietary SID Lys
Weeks	Kg	g/day	%	g	g/bird/day	g/day	kcal/day	kcal/day	g/day	%
19 -24	1.23-1.44	-	-	-	-	0.705	284	208	-	0.721
25	1.47	3.7	74.2	48.1	35.7	0.731	289	212	100	0.733
26	1.49	3.4	82.1	50.0	41.0	0.752	294	216	102	0.741
27	1.51	2.9	87.1	51.4	44.8	0.761	296	217	102	0.746
28	1.52	1.1	90.3	52.7	47.6	0.747	287	211	99	0.754
29	1.52	1.0	92.3	53.8	49.7	0.753	288	212	99	0.757
30	1.53	0.6	93.5	54.7	51.1	0.753	287	211	99	0.760
31	1.53	0.4	94.1	55.3	52.1	0.755	287	212	99	0.762
32	1.53	0.4	94.5	55.9	52.8	0.759	288	212	99	0.763
33	1.54	0.4	94.6	56.4	53.3	0.762	289	213	100	0.764
34	1.54	0.4	94.5	56.8	53.7	0.764	290	213	100	0.765
35	1.54	0.4	94.4	57.2	54.0	0.766	291	214	100	0.765
36	1.55	0.4	94.2	57.7	54.3	0.768	291	214	100	0.765
37	1.55	0.4	94.0	58.0	54.5	0.769	292	215	101	0.765
38	1.55	0.4	93.7	58.3	54.7	0.769	292	215	101	0.764
39	1.56	0.4	93.5	58.6	54.8	0.769	292	215	101	0.764
40	1.56	0.4	93.2	58.9	54.9	0.768	292	215	101	0.763
41	1.56	0.4	92.9	59.1	54.9	0.768	292	215	101	0.762
42	1.56	0.4	92.6	59.3	54.9	0.767	292	215	101	0.762
43	1.57	0.4	92.3	59.4	54.8	0.767	292	215	101	0.761
44	1.57	0.4	92.0	59.5	54.8	0.765	292	215	101	0.760
45	1.57	0.4	91.7	59.7	54.7	0.764	292	215	101	0.759
46	1.57	0.3	91.4	59.8	54.7	0.762	291	215	100	0.759
47	1.58	0.3	91.0	59.9	54.6	0.761	291	215	100	0.758
48	1.58	0.3	90.7	60.1	54.5	0.760	291	215	100	0.757
49	1.58	0.3	90.4	60.2	54.4	0.759	291	215	100	0.756
50	1.58	0.3	90.1	60.3	54.3	0.758	291	215	100	0.755
51	1.58	0.3	89.8	60.4	54.2	0.757	291	215	100	0.755
52	1.59	0.1	89.5	60.5	54.1	0.753	290	214	100	0.754
53	1.59	0.1	89.2	60.6	54.0	0.752	289	214	100	0.753
54	1.59	0.1	88.9	60.7	53.9	0.751	289	214	100	0.753
55	1.59	0.1	88.6	60.8	53.8	0.750	289	214	100	0.752
56	1.59	0.1	88.3	60.8	53.7	0.748	289	213	100	0.751
57	1.59	0.1	88.0	60.9	53.6	0.747	289	213	100	0.750
58	1.59	0.1	87.6	61.0	53.5	0.746	288	213	99	0.749
59	1.59	0.1	87.3	61.0	53.3	0.743	288	213	99	0.748
60	1.59	0.1	87.0	61.1	53.2	0.742	288	213	99	0.748
61	1.59	0.1	86.7	61.2	53.1	0.740	288	213	99	0.746
62	1.60	0.1	86.4	61.2	52.9	0.738	287	212	99	0.745
63	1.60	0.1	86.1	61.3	52.8	0.737	287	212	99	0.744
64	1.60	0.1	85.8	61.3	52.6	0.735	287	212	99	0.743
65	1.60	0.1	85.5	61.3	52.4	0.733	286	212	99	0.742
66	1.60	0.1	85.2	61.4	52.3	0.731	286	212	99	0.741
67	1.60	0.1	84.9	61.4	52.1	0.729	286	212	99	0.740
68	1.60	0.1	84.6	61.5	52.0	0.728	286	211	98	0.740
69	1.60	0.1	84.2	61.5	51.8	0.726	285	211	98	0.738
70	1.60	0.1	83.9	61.6	51.7	0.724	285	211	98	0.737
71	1.60	0.1	83.6	61.7	51.6	0.723	285	211	98	0.736
72	1.61	0.1	83.3	61.7	51.4	0.721	284	211	98	0.735
73	1.61	0.1	83.0	61.7	51.2	0.719	284	210	98	0.734
74	1.61	0.1	82.7	61.8	51.1	0.717	284	210	98	0.733
75	1.61	0.1	82.4	61.8	50.9	0.715	283	210	98	0.732
76	1.61	0.1	82.1	61.8	50.7	0.714	283	210	98	0.731
77	1.61	0.1	81.8	61.9	50.6	0.711	283	210	97	0.730
78	1.61	0.1	81.5	61.9	50.4	0.710	282	210	97	0.729
79	1.61	0.1	81.2	62.0	50.3	0.708	282	209	97	0.728
80	1.61	0.1	80.8	62.0	50.1	0.706	282	209	97	0.727

Table 3.19 - Standardized Digestible Lysine (SID Lys), ME, and NE Requirements of High Performance Brown Layers

Age	Weight	Gain	Production	Egg Weight	Egg Mass	SID Lys	ME	NE	Intake	Dietary SID Lys
Weeks	kg	g/day	%	g	g/day	g/day	kcal/day	kcal/day	g/day	%
19-24	1.47-1.77	-	-	-	-	0.828	335	246	-	0.704
25	1.80	4.7	96.4	58.3	56.2	0.856	342	251	120	0.713
26	1.82	1.5	97.9	59.5	58.2	0.831	326	240	115	0.726
27	1.82	1.3	98.6	60.2	59.4	0.842	328	242	115	0.730
28	1.83	1.1	98.9	61.1	60.4	0.852	331	243	116	0.734
29	1.84	1.1	98.9	61.7	61.0	0.859	333	245	117	0.736
30	1.85	1.1	98.8	62.1	61.3	0.862	334	246	117	0.736
31	1.85	0.8	98.5	62.4	61.5	0.860	332	245	117	0.737
32	1.85	0.1	98.3	62.7	61.6	0.850	328	242	115	0.739
33	1.85	0.1	97.9	62.9	61.6	0.850	328	242	115	0.739
34	1.86	0.1	97.6	63.2	61.7	0.851	328	242	115	0.739
35	1.86	0.1	97.2	63.4	61.7	0.851	328	242	115	0.739
36	1.86	0.1	96.9	63.7	61.7	0.850	328	242	115	0.739
37	1.86	0.1	96.5	63.8	61.6	0.849	328	242	115	0.738
38	1.86	0.1	96.1	63.9	61.5	0.848	328	242	115	0.738
39	1.86	0.1	95.7	64.1	61.4	0.847	328	242	115	0.737
40	1.86	0.1	95.4	64.3	61.3	0.846	327	242	115	0.737
41	1.86	0.1	95.0	64.4	61.2	0.845	327	241	115	0.736
42	1.86	0.1	94.6	64.6	61.1	0.844	327	241	115	0.736
43	1.86	0.1	94.2	64.8	61.1	0.844	327	241	115	0.736
44	1.86	0.1	93.8	65.0	61.0	0.843	327	241	115	0.735
45	1.86	0.1	93.5	65.2	60.9	0.842	327	241	115	0.735
46	1.86	0.1	93.1	65.3	60.8	0.840	326	241	115	0.734
47	1.86	0.1	92.7	65.3	60.7	0.839	326	241	114	0.733
48	1.86	0.1	92.3	65.6	60.5	0.838	326	241	114	0.733
49	1.86	0.1	91.9	65.7	60.4	0.837	326	241	114	0.732
50	1.86	0.1	91.6	65.8	60.3	0.835	325	240	114	0.731
51	1.86	0.1	91.2	65.9	60.1	0.833	325	240	114	0.731
52	1.86	0.1	90.8	66.0	59.9	0.831	325	240	114	0.730
53	1.86	0.1	90.4	66.1	59.8	0.829	324	240	114	0.729
54	1.87	0.1	90.0	66.2	59.6	0.827	324	239	114	0.728
55	1.87	0.1	89.7	66.2	59.4	0.824	323	239	113	0.727
56	1.87	0.1	89.3	66.3	59.1	0.822	323	239	113	0.726
57	1.87	0.1	88.9	66.4	59.0	0.820	322	239	113	0.725
58	1.87	0.1	88.5	66.4	58.8	0.818	322	238	113	0.724
59	1.87	0.1	88.1	66.5	58.6	0.815	322	238	113	0.723
60	1.87	0.1	87.8	66.6	58.4	0.813	321	238	113	0.722
61	1.87	0.1	87.4	66.6	58.2	0.811	321	237	113	0.721
62	1.87	0.1	87.0	66.7	58.0	0.809	320	237	112	0.720
63	1.87	0.1	86.6	66.7	57.8	0.806	320	237	112	0.719
64	1.87	0.1	86.2	66.8	57.6	0.804	319	237	112	0.718
65	1.87	0.1	85.8	66.7	57.4	0.802	319	236	112	0.717
66	1.87	0.1	85.5	66.9	57.2	0.800	318	236	112	0.716
67	1.87	0.1	85.1	66.9	57.0	0.797	318	236	112	0.714
68	1.87	0.1	84.7	67.0	56.8	0.795	318	235	111	0.713
69	1.87	0.1	84.3	67.1	56.6	0.792	317	235	111	0.712
70	1.87	0.1	83.9	67.1	56.3	0.790	317	235	111	0.711
71	1.87	0.1	83.6	67.2	56.1	0.787	316	235	111	0.710
72	1.87	0.1	83.2	67.3	56.0	0.786	316	234	111	0.709
73	1.87	0.1	82.8	67.3	55.7	0.783	315	234	111	0.708
74	1.88	0.1	82.4	67.4	55.6	0.781	315	234	110	0.707
75	1.88	0.1	82.0	67.5	55.4	0.779	314	233	110	0.706
76	1.88	0.1	81.7	67.6	55.2	0.777	314	233	110	0.705
77	1.88	0.1	81.3	67.6	55.0	0.774	314	233	110	0.704
78	1.88	0.1	80.9	67.7	54.8	0.772	313	233	110	0.703
79	1.88	0.1	80.5	67.8	54.6	0.770	313	232	110	0.702
80	1.88	0.1	80.1	67.9	54.4	0.768	312	232	110	0.701

Table 3.20 - Standardized Digestible Lysine (SID Lys), ME, and NE Requirements of Standard Performance Brown Layers

Age	Weight	Gain	Production	Egg Weight	Egg Mass	SID Lys	ME	NE	Intake	Dietary SID Lys
Weeks	Kg	g/day	%	g	g/day	g/day	kcal/day	kcal/day	g/day	%
19-24	1.47-1.77	-	-	-	-	0.768	323	238	-	0.666
25	1.80	4.7	91.6	55.4	50.7	0.793	329	242	118	0.675
26	1.82	1.5	93.0	56.5	52.5	0.766	313	232	112	0.686
27	1.82	1.3	93.7	57.2	53.6	0.775	315	233	112	0.690
28	1.83	1.1	93.9	58.0	54.5	0.784	316	234	113	0.694
29	1.84	1.1	94.0	58.6	55.1	0.791	318	236	114	0.695
30	1.85	1.1	93.8	59.0	55.3	0.794	320	236	114	0.695
31	1.85	0.8	93.6	59.3	55.5	0.791	318	236	114	0.696
32	1.85	0.1	93.3	59.6	55.6	0.781	313	233	112	0.697
33	1.85	0.1	93.0	59.8	55.6	0.781	314	233	112	0.698
34	1.86	0.1	92.7	60.0	55.7	0.781	314	233	112	0.698
35	1.86	0.1	92.4	60.3	55.7	0.782	314	233	112	0.698
36	1.86	0.1	92.0	60.5	55.6	0.781	314	233	112	0.697
37	1.86	0.1	91.7	60.6	55.6	0.780	314	233	112	0.697
38	1.86	0.1	91.3	60.8	55.5	0.779	313	233	112	0.696
39	1.86	0.1	90.9	60.9	55.4	0.779	313	232	112	0.696
40	1.86	0.1	90.6	61.1	55.3	0.778	313	232	112	0.695
41	1.86	0.1	90.2	61.2	55.2	0.777	313	232	112	0.695
42	1.86	0.1	89.9	61.3	55.1	0.775	313	232	112	0.694
43	1.86	0.1	89.5	61.6	55.1	0.775	313	232	112	0.694
44	1.86	0.1	89.1	61.8	55.1	0.775	313	232	112	0.694
45	1.86	0.1	88.8	61.9	55.0	0.774	312	232	112	0.694
46	1.86	0.1	88.4	62.0	54.8	0.772	312	232	111	0.693
47	1.86	0.1	88.1	62.2	54.7	0.771	312	232	111	0.692
48	1.86	0.1	87.7	62.3	54.6	0.770	312	232	111	0.692
49	1.86	0.1	87.3	62.5	54.5	0.769	312	231	111	0.691
50	1.86	0.1	87.0	62.6	54.4	0.767	311	231	111	0.690
51	1.86	0.1	86.6	62.7	54.3	0.766	311	231	111	0.690
52	1.86	0.1	86.3	62.7	54.1	0.764	311	231	111	0.689
53	1.86	0.1	85.9	62.8	53.9	0.762	310	231	111	0.688
54	1.87	0.1	85.5	62.8	53.8	0.760	310	230	111	0.687
55	1.87	0.1	85.2	62.9	53.6	0.758	309	230	110	0.686
56	1.87	0.1	84.8	62.9	53.4	0.756	309	230	110	0.685
57	1.87	0.1	84.4	63.0	53.2	0.754	309	230	110	0.684
58	1.87	0.1	84.1	63.1	53.0	0.752	308	229	110	0.683
59	1.87	0.1	83.7	63.1	52.9	0.750	308	229	110	0.682
60	1.87	0.1	83.4	63.2	52.7	0.748	308	229	110	0.681
61	1.87	0.1	83.0	63.3	52.5	0.746	307	229	110	0.680
62	1.87	0.1	82.6	63.4	52.4	0.744	307	228	110	0.679
63	1.87	0.1	82.3	63.4	52.1	0.742	306	228	109	0.678
64	1.87	0.1	81.9	63.5	52.0	0.740	306	228	109	0.677
65	1.87	0.1	81.6	63.5	51.8	0.738	306	228	109	0.676
66	1.87	0.1	81.2	63.6	51.6	0.735	305	227	109	0.675
67	1.87	0.1	80.8	63.6	51.4	0.733	305	227	109	0.674
68	1.87	0.1	80.5	63.7	51.2	0.731	304	227	109	0.673
69	1.87	0.1	80.1	63.7	51.0	0.729	304	227	109	0.672
70	1.87	0.1	79.8	63.8	50.9	0.727	303	226	108	0.671
71	1.87	0.1	79.4	63.8	50.7	0.725	303	226	108	0.670
72	1.87	0.1	79.0	63.9	50.5	0.723	303	226	108	0.669
73	1.87	0.1	78.7	64.0	50.3	0.721	302	226	108	0.668
74	1.88	0.1	78.3	64.1	50.2	0.719	302	225	108	0.667
75	1.88	0.1	77.9	64.1	50.0	0.717	301	225	108	0.666
76	1.88	0.1	77.6	64.2	49.8	0.715	301	225	108	0.665
77	1.88	0.1	77.2	64.2	49.6	0.713	301	225	107	0.664
78	1.88	0.1	76.9	64.3	49.5	0.711	300	224	107	0.663
79	1.88	0.1	76.5	64.4	49.3	0.709	300	224	107	0.661
80	1.88	0.1	76.1	64.5	49.1	0.707	300	224	107	0.661

Table 3.21 - Equations Used to Estimate Total Calcium, Standardized Digestible Phosphorus (Dig. P), and Available Phosphorus (Pav) Requirements of White and Brown Layers[1,2]

Calcium (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.

$$\text{Calcium (g/bird/day)} = [(70 \times W^{0.75} + 8.29 \times G + 40 \times Egg) / (0.57\text{-}9.5 \times 10^{-6} \times t^2)] / 1000$$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day); t = age in weeks.

Example for calcium: White Layers

W = 1.537 kg; $W^{0.75}$ = 1.380; G = 0.4 g/bird/day; Egg = 60.2;
t = age 33 weeks; Estimated Feed Intake = 105 g/day
Calcium Req. = $[(70 \times 1.380 + 8.29 \times 0.4 + 40 \times 60.2) / (0.57\text{-}9.5 \times 10^{-6} \times 33^2)] / 1000$ = 4.484 g/bird/day
% Calcium = (4.484 × 100) / 105 = 4.270 %

Dig. P (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.

$$\text{Dig. P (g/bird/day)} = (70 \times W^{0.75} + 4.0 \times G + 1.8\ Egg) / 1000$$

Example for phosphorus: White layers
W = 1.537 kg; $W^{0.75}$ = 1.380; G = 0.4 g/bird/day; Egg = 60.2; t = age 33 weeks (231 days); Estimated Feed Intake = 105 g/day
Dig. P = (70 × 1.380 + 4 × 0.4 + 1.8 × 60.2) / 1000 = 0.207 g/bird/day
Dig. P (%) = 0.207 x 100/105 = 0.197 %
Pav = 0.207 × 1.11 = 0.229 g/bird/day
Pav (%) = 0.229 × 100/105 = 0.218 %

[1] The maintenance requirements for calcium and phosphorus were adapted from WPSA (1984) and Gopi et al. (2021). Weight gain and egg mass requirements for calcium and phosphorus were obtained from research carried out at Laval University (Canada). The calcium digestibility coefficient was adjusted according to the bird's age.
[2] Equation was adjusted according to the layer's age (19 to 80 weeks).

Table 3.22 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of High Performance White Layers, Using Equations in Table 3.21

Age Weeks	Weight kg	Gain g/day	Egg Mass g/bird/day	Intake g/day	Calcium g/day	Dig. P g/day	Pav g/day	Calcium %	Dig. P %	Pav %
19-24	1.23-1.44	-	-	-	3.73	0.197	0.218	3.67	0.193	0.214
25	1.51	3.7	52.7	104	3.95	0.202	0.224	3.80	0.194	0.215
26	1.52	3.4	55.0	106	4.12	0.206	0.228	3.89	0.194	0.216
27	1.53	2.9	56.6	106	4.23	0.207	0.230	3.97	0.195	0.216
28	1.54	1.1	57.7	104	4.28	0.203	0.225	4.13	0.196	0.217
29	1.55	1.0	58.5	104	4.35	0.204	0.226	4.17	0.196	0.217
30	1.55	0.6	59.1	104	4.38	0.204	0.226	4.22	0.196	0.218
31	1.56	0.4	59.5	104	4.42	0.204	0.226	4.25	0.196	0.218
32	1.56	0.4	59.9	104	4.45	0.205	0.229	4.26	0.196	0.218
33	1.57	0.4	60.2	105	4.48	0.207	0.228	4.27	0.197	0.218
34	1.57	0.4	60.4	105	4.49	0.206	0.229	4.29	0.196	0.218
35	1.58	0.4	60.6	105	4.51	0.206	0.229	4.30	0.196	0.218
36	1.58	0.4	60.7	105	4.53	0.207	0.229	4.30	0.196	0.218
37	1.59	0.4	60.8	105	4.54	0.207	0.230	4.31	0.196	0.218
38	1.59	0.4	60.8	105	4.55	0.207	0.230	4.31	0.196	0.218
39	1.59	0.4	60.8	106	4.55	0.207	0.230	4.31	0.196	0.218
40	1.60	0.4	60.7	106	4.55	0.207	0.230	4.31	0.196	0.218
41	1.60	0.4	60.7	106	4.58	0.207	0.230	4.31	0.196	0.218
42	1.60	0.4	60.6	106	4.56	0.207	0.230	4.32	0.196	0.218
43	1.60	0.4	60.6	106	4.56	0.207	0.230	4.32	0.196	0.218
44	1.60	0.4	60.5	105	4.56	0.207	0.230	4.32	0.196	0.218
45	1.60	0.4	60.4	106	4.56	0.207	0.230	4.33	0.196	0.218
46	1.60	0.3	60.3	105	4.56	0.207	0.229	4.33	0.196	0.218
47	1.60	0.3	60.2	105	4.56	0.207	0.229	4.33	0.196	0.218
48	1.60	0.3	60.1	105	4.56	0.206	0.229	4.33	0.196	0.218
49	1.60	0.3	60.0	105	4.56	0.206	0.229	4.34	0.196	0.218
50	1.60	0.3	59.9	105	4.56	0.206	0.229	4.34	0.196	0.218
51	1.60	0.3	59.7	105	4.56	0.206	0.229	4.34	0.196	0.218
52	1.60	0.1	59.6	105	4.56	0.205	0.228	4.35	0.196	0.218
53	1.60	0.1	59.5	105	4.56	0.205	0.228	4.35	0.196	0.218
54	1.60	0.1	59.4	105	4.56	0.205	0.228	4.36	0.196	0.218
55	1.60	0.1	59.2	104	4.56	0.205	0.227	4.36	0.196	0.218
56	1.60	0.1	59.1	104	4.55	0.205	0.227	4.36	0.196	0.218
57	1.60	0.1	59.0	104	4.55	0.204	0.227	4.37	0.196	0.218
58	1.60	0.1	58.8	104	4.55	0.204	0.227	4.37	0.196	0.218
59	1.60	0.1	58.6	104	4.55	0.204	0.226	4.37	0.196	0.217
60	1.60	0.1	58.5	104	4.55	0.204	0.226	4.37	0.196	0.217
61	1.60	0.1	58.3	104	4.54	0.203	0.226	4.37	0.196	0.217
62	1.60	0.1	58.1	104	4.54	0.203	0.225	4.37	0.196	0.217
63	1.60	0.1	58.0	104	4.54	0.203	0.225	4.38	0.196	0.217
64	1.60	0.1	57.8	103	4.53	0.203	0.225	4.38	0.196	0.217
65	1.60	0.1	57.6	103	4.54	0.202	0.225	4.38	0.196	0.217
66	1.60	0.1	57.4	103	4.53	0.202	0.224	4.39	0.196	0.217
67	1.60	0.1	57.3	103	4.53	0.202	0.224	4.39	0.196	0.217
68	1.60	0.1	57.1	103	4.53	0.202	0.224	4.39	0.196	0.217
69	1.60	0.1	56.9	103	4.53	0.201	0.223	4.40	0.196	0.217
70	1.60	0.1	56.8	103	4.52	0.201	0.223	4.40	0.196	0.217
71	1.60	0.1	56.6	103	4.52	0.201	0.223	4.40	0.196	0.217
72	1.60	0.1	56.4	103	4.52	0.201	0.223	4.41	0.195	0.217
73	1.60	0.1	56.2	102	4.52	0.200	0.222	4.41	0.195	0.217
74	1.60	0.1	56.1	102	4.52	0.200	0.222	4.41	0.195	0.217
75	1.60	0.1	55.9	102	4.52	0.200	0.222	4.42	0.195	0.217
76	1.60	0.1	55.7	102	4.52	0.199	0.221	4.42	0.195	0.217
77	1.60	0.1	55.5	102	4.51	0.199	0.221	4.43	0.195	0.217
78	1.60	0.1	55.3	102	4.51	0.199	0.221	4.43	0.195	0.217
79	1.60	0.1	55.2	102	4.51	0.199	0.220	4.44	0.195	0.217
80	1.60	0.1	55.0	102	4.51	0.198	0.220	4.44	0.195	0.217

Table 3.23 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of Standard Performance White Layers, Using the Equations in Table 3.21

Age Weeks	Weight Kg	Gain g/day	Egg Mass g/bird/day	Intake g/day	Calcium g/day	Dig. P g/day	Pav g/day	Calcium %	Dig. P %	Pav %
19-24	1.23-1.44	-	-	-	3.39	0.166	0.184	3.47	0.171	0.190
25	1.47	3.7	35.7	100	3.59	0.173	0.191	3.59	0.173	0.191
26	1.49	3.4	41.0	102	3.74	0.182	0.202	3.68	0.178	0.198
27	1.51	2.9	44.8	102	3.83	0.188	0.208	3.76	0.184	0.204
28	1.52	1.1	47.6	99	3.88	0.186	0.206	3.92	0.188	0.208
29	1.52	1.0	49.7	99	3.94	0.189	0.210	3.96	0.191	0.212
30	1.53	0.6	51.1	99	3.97	0.191	0.212	4.01	0.193	0.214
31	1.53	0.4	52.1	99	4.00	0.192	0.213	4.04	0.194	0.215
32	1.53	0.4	52.8	99	4.03	0.193	0.214	4.05	0.195	0.216
33	1.54	0.4	53.3	100	4.06	0.194	0.216	4.07	0.194	0.216
34	1.54	0.4	53.7	100	4.07	0.195	0.216	4.08	0.195	0.216
35	1.54	0.4	54.0	100	4.09	0.196	0.217	4.08	0.196	0.217
36	1.55	0.4	54.3	100	4.10	0.197	0.218	4.09	0.197	0.218
37	1.55	0.4	54.5	101	4.12	0.197	0.219	4.10	0.195	0.216
38	1.55	0.4	54.7	101	4.12	0.197	0.219	4.10	0.195	0.217
39	1.56	0.4	54.8	101	4.13	0.198	0.220	4.10	0.196	0.218
40	1.56	0.4	54.9	101	4.13	0.198	0.220	4.10	0.196	0.218
41	1.56	0.4	54.9	101	4.13	0.198	0.220	4.10	0.196	0.218
42	1.56	0.4	54.9	101	4.13	0.198	0.220	4.10	0.196	0.218
43	1.57	0.4	54.8	101	4.14	0.198	0.220	4.10	0.196	0.218
44	1.57	0.4	54.8	101	4.13	0.198	0.220	4.11	0.196	0.218
45	1.57	0.4	54.7	101	4.14	0.198	0.220	4.11	0.196	0.218
46	1.57	0.3	54.7	100	4.13	0.198	0.220	4.12	0.198	0.220
47	1.58	0.3	54.6	100	4.13	0.198	0.220	4.12	0.198	0.220
48	1.58	0.3	54.5	100	4.13	0.198	0.220	4.12	0.198	0.220
49	1.58	0.3	54.4	100	4.13	0.198	0.220	4.12	0.198	0.220
50	1.58	0.3	54.3	100	4.13	0.198	0.219	4.12	0.198	0.219
51	1.58	0.3	54.2	100	4.13	0.197	0.219	4.12	0.197	0.219
52	1.59	0.1	54.1	100	4.13	0.197	0.219	4.14	0.197	0.219
53	1.59	0.1	54.0	100	4.13	0.197	0.218	4.14	0.197	0.218
54	1.59	0.1	53.9	100	4.13	0.197	0.218	4.14	0.197	0.218
55	1.59	0.1	53.8	100	4.13	0.196	0.218	4.14	0.196	0.218
56	1.59	0.1	53.7	100	4.13	0.196	0.218	4.14	0.196	0.218
57	1.59	0.1	53.6	100	4.13	0.196	0.218	4.15	0.196	0.218
58	1.59	0.1	53.5	99	4.13	0.196	0.217	4.15	0.198	0.220
59	1.59	0.1	53.3	99	4.12	0.195	0.217	4.15	0.197	0.219
60	1.59	0.1	53.2	99	4.12	0.195	0.217	4.15	0.197	0.219
61	1.59	0.1	53.1	99	4.12	0.195	0.217	4.15	0.197	0.219
62	1.60	0.1	52.9	99	4.11	0.195	0.217	4.15	0.197	0.219
63	1.60	0.1	52.8	99	4.11	0.195	0.216	4.16	0.197	0.219
64	1.60	0.1	52.6	99	4.11	0.195	0.216	4.16	0.197	0.218
65	1.60	0.1	52.4	99	4.11	0.194	0.216	4.16	0.196	0.218
66	1.60	0.1	52.3	99	4.11	0.194	0.215	4.16	0.196	0.218
67	1.60	0.1	52.1	99	4.10	0.194	0.215	4.17	0.196	0.217
68	1.60	0.1	52.0	98	4.11	0.194	0.215	4.17	0.198	0.219
69	1.60	0.1	51.8	98	4.10	0.193	0.214	4.17	0.197	0.219
70	1.60	0.1	51.7	98	4.10	0.193	0.214	4.17	0.197	0.219
71	1.60	0.1	51.6	98	4.10	0.193	0.214	4.18	0.197	0.218
72	1.61	0.1	51.4	98	4.10	0.193	0.214	4.18	0.197	0.219
73	1.61	0.1	51.2	98	4.10	0.193	0.214	4.18	0.197	0.218
74	1.61	0.1	51.1	98	4.10	0.192	0.214	4.19	0.196	0.218
75	1.61	0.1	50.9	98	4.09	0.192	0.213	4.19	0.196	0.218
76	1.61	0.1	50.7	98	4.09	0.192	0.213	4.19	0.196	0.217
77	1.61	0.1	50.6	97	4.09	0.192	0.213	4.20	0.197	0.219
78	1.61	0.1	50.4	97	4.09	0.191	0.212	4.20	0.197	0.219
79	1.61	0.1	50.3	97	4.09	0.191	0.212	4.21	0.197	0.219
80	1.61	0.1	50.1	97	4.09	0.191	0.212	4.21	0.197	0.218

Table 3.24 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of High Performance Brown Layers, Using the Equations in Table 3.21

Age Weeks	Weight kg	Gain g/day	Egg Mass g/day	Intake g/day	Calcium g/day	Dig. P g/day	Pav g/day	Calcium %	Dig. P %	Pav %
19-25	1.47-1.77	-	-	-	4.05	0.222	0.247	3.44	0.189	0.210
25	1.80	4.7	56.2	120	4.24	0.227	0.252	3.53	0.189	0.210
26	1.82	1.5	58.2	115	4.34	0.219	0.243	3.79	0.191	0.212
27	1.82	1.3	59.4	115	4.43	0.220	0.245	3.84	0.191	0.212
28	1.83	1.1	60.4	116	4.50	0.222	0.246	3.88	0.191	0.212
29	1.84	1.1	61.0	117	4.55	0.223	0.248	3.90	0.191	0.212
30	1.85	1.1	61.3	117	4.57	0.224	0.249	3.91	0.191	0.212
31	1.85	0.8	61.5	117	4.59	0.223	0.248	3.94	0.192	0.213
32	1.85	0.1	61.6	115	4.59	0.221	0.245	3.99	0.192	0.213
33	1.85	0.1	61.6	115	4.60	0.221	0.245	4.00	0.192	0.213
34	1.86	0.1	61.7	115	4.61	0.221	0.245	4.00	0.192	0.213
35	1.86	0.1	61.7	115	4.61	0.221	0.245	4.01	0.192	0.213
36	1.86	0.1	61.7	115	4.62	0.221	0.245	4.01	0.192	0.213
37	1.86	0.1	61.6	115	4.61	0.221	0.245	4.01	0.192	0.213
38	1.86	0.1	61.5	115	4.61	0.221	0.245	4.01	0.192	0.213
39	1.86	0.1	61.4	115	4.61	0.221	0.245	4.01	0.192	0.213
40	1.86	0.1	61.3	115	4.61	0.220	0.245	4.02	0.192	0.213
41	1.86	0.1	61.2	115	4.61	0.220	0.244	4.02	0.192	0.213
42	1.86	0.1	61.1	115	4.61	0.220	0.244	4.02	0.192	0.213
43	1.86	0.1	61.1	115	4.62	0.220	0.244	4.02	0.192	0.213
44	1.86	0.1	61.0	115	4.62	0.220	0.244	4.03	0.192	0.213
45	1.86	0.1	60.9	115	4.62	0.220	0.244	4.03	0.192	0.213
46	1.86	0.1	60.8	115	4.62	0.220	0.244	4.03	0.192	0.213
47	1.86	0.1	60.7	114	4.62	0.219	0.244	4.03	0.192	0.213
48	1.86	0.1	60.5	114	4.62	0.219	0.243	4.04	0.192	0.213
49	1.86	0.1	60.4	114	4.62	0.219	0.243	4.04	0.192	0.213
50	1.86	0.1	60.3	114	4.61	0.219	0.243	4.04	0.192	0.213
51	1.86	0.1	60.1	114	4.61	0.219	0.243	4.04	0.192	0.213
52	1.86	0.1	59.9	114	4.60	0.218	0.242	4.04	0.192	0.213
53	1.86	0.1	59.8	114	4.60	0.218	0.242	4.04	0.192	0.213
54	1.87	0.1	59.6	114	4.59	0.218	0.241	4.04	0.192	0.213
55	1.87	0.1	59.4	113	4.59	0.217	0.241	4.04	0.191	0.213
56	1.87	0.1	59.1	113	4.58	0.217	0.241	4.04	0.191	0.213
57	1.87	0.1	59.0	113	4.58	0.217	0.240	4.05	0.191	0.212
58	1.87	0.1	58.8	113	4.57	0.216	0.240	4.05	0.191	0.212
59	1.87	0.1	58.6	113	4.56	0.216	0.240	4.05	0.191	0.212
60	1.87	0.1	58.4	113	4.56	0.216	0.239	4.05	0.191	0.212
61	1.87	0.1	58.2	113	4.56	0.215	0.239	4.05	0.191	0.212
62	1.87	0.1	58.0	112	4.55	0.215	0.239	4.05	0.191	0.212
63	1.87	0.1	57.8	112	4.55	0.215	0.238	4.05	0.191	0.212
64	1.87	0.1	57.6	112	4.54	0.214	0.238	4.05	0.191	0.212
65	1.87	0.1	57.4	112	4.54	0.214	0.237	4.05	0.191	0.212
66	1.87	0.1	57.2	112	4.53	0.214	0.237	4.06	0.191	0.212
67	1.87	0.1	57.0	112	4.53	0.213	0.237	4.06	0.191	0.212
68	1.87	0.1	56.8	111	4.52	0.213	0.236	4.06	0.191	0.212
69	1.87	0.1	56.6	111	4.52	0.212	0.236	4.06	0.191	0.212
70	1.87	0.1	56.3	111	4.51	0.212	0.235	4.06	0.191	0.212
71	1.87	0.1	56.1	111	4.51	0.212	0.235	4.06	0.191	0.212
72	1.87	0.1	56.0	111	4.51	0.211	0.235	4.07	0.191	0.212
73	1.87	0.1	55.7	111	4.50	0.211	0.234	4.07	0.191	0.212
74	1.88	0.1	55.6	110	4.50	0.211	0.234	4.07	0.191	0.212
75	1.88	0.1	55.4	110	4.50	0.210	0.234	4.08	0.191	0.212
76	1.88	0.1	55.2	110	4.50	0.210	0.233	4.08	0.191	0.212
77	1.88	0.1	55.0	110	4.49	0.210	0.233	4.08	0.191	0.212
78	1.88	0.1	54.8	110	4.49	0.210	0.233	4.09	0.191	0.212
79	1.88	0.1	54.6	110	4.49	0.209	0.232	4.09	0.191	0.212
80	1.88	0.1	54.4	110	4.49	0.209	0.232	4.10	0.191	0.212

Table 3.25 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of Standard Performance Brown Layers, Using Equations in Table 3.21

Age Weeks	Weight kg	Gain g/day	Egg Mass g/bird/day	Intake g/day	Calcium g/day	Dig. P g/day	Pav g/day	Calcium %	Dig. P %	Pav %
19-24	1.47-1.77	-	-	-	3.45	0.205	0.225	2.92	0.174	0.191
25	1.80	4.7	51	118	3.88	0.219	0.241	3.29	0.186	0.205
26	1.82	1.5	53	112	3.98	0.211	0.232	3.55	0.188	0.207
27	1.82	1.3	54	112	4.05	0.212	0.233	3.62	0.189	0.208
28	1.83	1.1	55	113	4.12	0.214	0.235	3.65	0.189	0.208
29	1.84	1.1	55	114	4.13	0.214	0.235	3.62	0.188	0.206
30	1.85	1.1	55	114	4.13	0.214	0.236	3.62	0.188	0.207
31	1.85	0.8	56	114	4.20	0.215	0.237	3.69	0.189	0.207
32	1.85	0.1	56	112	4.20	0.212	0.233	3.75	0.189	0.208
33	1.85	0.1	56	112	4.20	0.212	0.233	3.75	0.189	0.208
34	1.86	0.1	56	112	4.21	0.213	0.234	3.76	0.190	0.209
35	1.86	0.1	56	112	4.21	0.213	0.234	3.76	0.190	0.209
36	1.86	0.1	56	112	4.22	0.213	0.234	3.77	0.190	0.209
37	1.86	0.1	56	112	4.22	0.213	0.234	3.77	0.190	0.209
38	1.86	0.1	55	112	4.16	0.211	0.232	3.71	0.188	0.207
39	1.86	0.1	55	112	4.16	0.211	0.232	3.72	0.188	0.207
40	1.86	0.1	55	112	4.17	0.211	0.232	3.72	0.188	0.207
41	1.86	0.1	55	112	4.17	0.211	0.232	3.73	0.188	0.207
42	1.86	0.1	55	112	4.18	0.211	0.232	3.73	0.188	0.207
43	1.86	0.1	55	112	4.19	0.211	0.232	3.74	0.188	0.207
44	1.86	0.1	55	112	4.19	0.211	0.232	3.74	0.188	0.207
45	1.86	0.1	55	112	4.20	0.211	0.232	3.75	0.188	0.207
46	1.86	0.1	55	111	4.20	0.211	0.232	3.79	0.190	0.209
47	1.86	0.1	55	111	4.21	0.211	0.232	3.79	0.190	0.209
48	1.86	0.1	55	111	4.22	0.211	0.232	3.80	0.190	0.209
49	1.86	0.1	55	111	4.23	0.211	0.232	3.81	0.190	0.209
50	1.86	0.1	54	111	4.16	0.209	0.230	3.75	0.188	0.207
51	1.86	0.1	54	111	4.17	0.209	0.230	3.75	0.188	0.207
52	1.86	0.1	54	111	4.17	0.209	0.230	3.76	0.188	0.207
53	1.86	0.1	54	111	4.18	0.209	0.230	3.77	0.188	0.207
54	1.87	0.1	54	111	4.19	0.210	0.230	3.78	0.189	0.208
55	1.87	0.1	54	110	4.20	0.210	0.230	3.82	0.190	0.210
56	1.87	0.1	53	110	4.13	0.208	0.229	3.76	0.189	0.208
57	1.87	0.1	53	110	4.14	0.208	0.229	3.76	0.189	0.208
58	1.87	0.1	53	110	4.15	0.208	0.229	3.77	0.189	0.208
59	1.87	0.1	53	110	4.16	0.208	0.229	3.78	0.189	0.208
60	1.87	0.1	53	110	4.17	0.208	0.229	3.79	0.189	0.208
61	1.87	0.1	53	110	4.18	0.208	0.229	3.80	0.189	0.208
62	1.87	0.1	52	110	4.11	0.206	0.227	3.74	0.187	0.206
63	1.87	0.1	52	109	4.12	0.206	0.227	3.78	0.189	0.208
64	1.87	0.1	52	109	4.13	0.206	0.227	3.79	0.189	0.208
65	1.87	0.1	52	109	4.14	0.206	0.227	3.80	0.189	0.208
66	1.87	0.1	52	109	4.15	0.206	0.227	3.81	0.189	0.208
67	1.87	0.1	51	109	4.08	0.204	0.225	3.75	0.187	0.206
68	1.87	0.1	51	109	4.09	0.204	0.225	3.75	0.187	0.206
69	1.87	0.1	51	109	4.10	0.204	0.225	3.76	0.187	0.206
70	1.87	0.1	51	108	4.11	0.204	0.225	3.81	0.189	0.208
71	1.87	0.1	51	108	4.12	0.204	0.225	3.82	0.189	0.208
72	1.87	0.1	51	108	4.13	0.204	0.225	3.83	0.189	0.208
73	1.87	0.1	50	108	4.07	0.202	0.223	3.77	0.187	0.206
74	1.88	0.1	50	108	4.08	0.203	0.223	3.78	0.188	0.207
75	1.88	0.1	50	108	4.09	0.203	0.223	3.79	0.188	0.207
76	1.88	0.1	50	108	4.10	0.203	0.223	3.80	0.188	0.207
77	1.88	0.1	50	107	4.11	0.203	0.223	3.84	0.190	0.208
78	1.88	0.1	49	107	4.05	0.201	0.221	3.78	0.188	0.207
79	1.88	0.1	49	107	4.06	0.201	0.221	3.79	0.188	0.207
80	1.88	0.1	49	107	4.07	0.201	0.221	3.81	0.188	0.207

Table 3.26 - Amino Acids to Lysine Ratios Used to Determine the Amino Acid Requirements of White and Brown Layers[1]

Amino Acids	Digestible	Total
Lysine	100	100
Methionine	46	45
Met + Cys	92	91
Threonine	77	80
Tryptophan	23	23
Arginine	105	101
Gly + Ser	79	82
Valine	90	90
Isoleucine	80	80
Leucine	122	119
Histidine	28	27
Phenylalanine	64	62
Phe + Tyr	116	113

[1] The amino acids to lysine ratios were obtained from Soares et al. (2019).

Table 3.27 - Example to Calculate the Digestible Essential Nitrogen (Dig. Ne), Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of High Performance White Layers[1]

	N (%)	SID AA Req. (g/day)	Dig. Ne (g/day)	Total AA Req. (g/day)	Net (g/day)
Lysine	19.16	0.803	0.154	0.892	0,171
Methionine	9.39	0.369	0.035	0.410	0,038
Threonine	11.76	0.618	0.073	0.714	0,084
Tryptophan	13.72	0.185	0.025	0.205	0,028
Arginine	32.16	0.843	0.271	0.901	0,290
Gly + Ser	15.99	0.618	0.099	0.731	0,117
Valine	11.96	0.747	0.089	0.803	0,096
Isoleucine	10.68	0.642	0.069	0.714	0,076
Leucine	10.68	0.980	0.105	1.061	0,113
Histidine	27.08	0.225	0.061	0.241	0,065
Phenylalanine	8.48	0.515	0.044	0.553	0,047
Ne Req.			1.024		1.122
Total N Req.[2]			2.328		2.550
Protein Req., g/d[3]			14.55		15.94

[1]Example for white layers (1.550 kg of weight, gain of 0.4 g, and 62 g of egg mass).
[2]Ne: Total N ratio of 44%.
[3]Conversion factor of N to protein: 6.25.

- Total lysine requirement was calculated considering 90.0% the ileal digestibility of lysine in the diet. Total amino acid to total lysine ratios were used (table 3.26) to estimate total amino acid requirements.

- SID Lys: Digestible Protein ratio = 5.52%
- SID Lys: Total Protein ratio = 5.04%

- Example: SID Lys = (0.803 × 100)/5.52 = 14.6 Digestible Protein Requirement (g/day). Considering feed intake of 105 g/day: (14.55 × 100)/105 = 13.9 % Digestible Protein.

- Example: SID Lys = (0.803 × 100)/5.04 = 15.93 Total Protein Requirement (g/day). Considering feed intake of 105 g/day: 15.93 × 100/105 = 15,2% Total Protein.

Table 3.28 - Nutritional Requirements of High Performance White Layers (g/day)

Nutrients		White Layers					
Average Weight	kg	1.500		1.550		1.600	
Gain,	g/day	0.4		0.3		0.1	
Egg Mass	g/day	62		58		54	
Metabolizable Energy	kcal/day	305		298		291	
Net Energy	kcal/day	222		219		215	
Diet Metab Energy	kcal/kg	2.900		2.900		2.900	
Diet Net Energy	kcal/kg	2116		2128		2141	
Intake	g/day	105.0		102.8		100.4	
Total Crude Protein	g/day	16.85		15.94		14.99	
Digestible Protein	g/day	15.38		14.55		13.69	
Calcium	g/day	4.52		4.25		3.97	
Available Phosphorus	g/day	0.230		0.224		0.217	
Digestible Phosphorus	g/day	0.207		0.201		0.196	
Potassium	g/day	0.560		0.548		0.535	
Sodium	g/day	0.223		0.218		0.213	
Chlorine	g/day	0.204		0.200		0.195	
Linoleic Acid	g/day	1.335		1.306		1.275	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	g/day	0.849	0.943	0.803	0.892	0.755	0.839
Methionine	g/day	0.390	0.424	0.369	0.401	0.347	0.378
Met + Cys	g/day	0.781	0.858	0.739	0.812	0.695	0.763
Threonine	g/day	0.654	0.754	0.618	0.714	0.582	0.671
Tryptophan	g/day	0.195	0.217	0.185	0.205	0.174	0.193
Arginine	g/day	0.891	0.952	0.843	0.901	0.793	0.847
Gly + Ser	g/day	0.671	0.773	0.634	0.731	0.597	0.688
Valine	g/day	0.764	0.849	0.723	0.803	0.680	0.755
Isoleucine	g/day	0.679	0.754	0.642	0.714	0.604	0.671
Leucine	g/day	1.036	1.122	0.980	1.061	0.922	0.998
Histidine	g/day	0.238	0.255	0.225	0.241	0.212	0.227
Phenylalanine	g/day	0.543	0.585	0.514	0.553	0.483	0.520
Phe + Tyr	g/day	0.985	1.066	0.931	1.008	0.876	0.948
Essential Nitrogen	g/day	1.083	1.186	1.024	1.122	0.964	1.055

Table 3.29 - Nutritional Requirements of High Performance White Layers (%)

Nutrients		White Layers					
Average Weight	kg	1.500		1.550		1.600	
Gain,	g/day	0.4		0.3		0.1	
Egg Mass	g/day	62		58		54	
Metabolizable Energy	kcal/day	305		298		291	
Net Energy	kcal/day	222		219		215	
Diet Metab Energy	kcal/kg	2.900		2.900		2.900	
Diet Net Energy	kcal/kg	2116		2128		2141	
Intake	g/day	105.0		102.8		100.4	
Total Crude Protein	%	16.05		15.51		14.96	
Digestible Protein	%	14.64		14.15		13.64	
Calcium	%	4.31		4.13		3.95	
Available Phosphorus	%	0.218		0.218		0.217	
Digestible Phosphorus	%	0.197		0.195		0.195	
Potassium	%	0.533		0.533		0.533	
Sodium	%	0.212		0.212		0.212	
Chlorine	%	0.195		0.195		0.195	
Linoleic Acid	%	1.270		1.270		1.270	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	%	0.808	0.898	0.781	0.868	0.753	0.837
Methionine	%	0.372	0.404	0.359	0.391	0.346	0.377
Met + Cys	%	0.743	0.817	0.718	0.790	0.693	0.762
Threonine	%	0.622	0.718	0.601	0.694	0.580	0.670
Tryptophan	%	0.186	0.207	0.180	0.200	0.173	0.193
Arginine	%	0.849	0.907	0.820	0.877	0.790	0.845
Gly + Ser	%	0.638	0.736	0.617	0.712	0.595	0.686
Valine	%	0.727	0.808	0.703	0.781	0.677	0.753
Isoleucine	%	0.646	0.718	0.625	0.694	0.602	0.670
Leucine	%	0.986	1.069	0.953	1.033	0.918	0.996
Histidine	%	0.226	0.242	0.219	0.234	0.211	0.226
Phenylalanine	%	0.517	0.557	0.500	0.538	0.482	0.519
Phe + Tyr	%	0.937	1.015	0.906	0.981	0.873	0.946
Essential Nitrogen	%	1.031	1.130	0.996	1.092	0.960	1.053

Table 3.30 - Nutritional Requirements of Standard Performance White Layers (g/bird/day)

Nutrients		White Layers					
Average Weight	kg	1.500		1.550		1.600	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	58		54		50	
Metabolizable Energy	kcal/day	295		289		281	
Net Energy	kcal/day	216		213		209	
Diet Metab Energy	kcal/kg	2.900		2.900		2.900	
Diet Net Energy	kcal/kg	2125		2137		2151	
Intake	g/day	101.7		99.5		97.0	
Total Crude Protein	g/day	15.94		15.03		14.08	
Digestible Protein	g/day	14.53		14.53		12.84	
Calcium	g/day	4.32		4.04		3.75	
Available Phosphorus	g/day	0.223		0.217		0.211	
Digestible Phosphorus	g/day	0.201		0.196		0.190	
Potassium	g/day	0.530		0.519		0.506	
Sodium	g/day	0.212		0.208		0.202	
Chlorine	g/day	0.191		0.187		0.182	
Linoleic Acid	g/day	1.273		1.245		1.214	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	g/day	0.803	0.892	0.757	0.841	0.709	0.788
Methionine	g/day	0.369	0.401	0.348	0.378	0.326	0.355
Met + Cys	g/day	0.739	0.812	0.696	0.765	0.653	0.717
Threonine	g/day	0.618	0.714	0.583	0.673	0.546	0.630
Tryptophan	g/day	0.185	0.205	0.174	0.193	0.163	0.181
Arginine	g/day	0.843	0.901	0.795	0.849	0.745	0.796
Gly + Ser	g/day	0.634	0.731	0.598	0.690	0.560	0.646
Valine	g/day	0.723	0.803	0.681	0.757	0.638	0.709
Isoleucine	g/day	0.642	0.714	0.606	0.673	0.568	0.630
Leucine	g/day	0.980	1.061	0.923	1.001	0.865	0.938
Histidine	g/day	0.225	0.241	0.212	0.227	0.199	0.213
Phenylalanine	g/day	0.514	0.553	0.484	0.521	0.454	0.489
Phe + Tyr	g/day	0.931	1.008	0.878	0.950	0.823	0.890
Essential Nitrogen	g/day	1.023	1.122	0.964	1.058	0.904	0.991

Table 3.31 - Nutritional Requirements of Standard Performance White Layers (%)

Nutrients		White Layers					
Average Weight	kg	1.500		1.550		1.600	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	58		54		50	
Metabolizable Energy	kcal/day	295		289		281	
Net Energy	kcal/day	216		213		209	
Diet Metab Energy	kcal/kg	2800		2800		2800	
Diet Net Energy	kcal/kg	2125		2137		2151	
Intake	g/day	101.7		99.5		97.0	
Total Crude Protein	%	15.67		15.11		14.50	
Digestible Protein	%	14.28		13.76		13.23	
Calcium	%	4.24		4.06		3.87	
Available Phosphorus	%	0.219		0.218		0.217	
Digestible Phosphorus	%	0.198		0.197		0.211	
Potassium	%	0.510		0.521		0.535	
Sodium	%	0.204		0.209		0.214	
Chlorine	%	0.184		0.188		0.192	
Linoleic Acid	%	1.224		1.251		1.283	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	%	0.789	0.877	0.761	0.846	0.731	0.812
Methionine	%	0.363	0.395	0.350	0.381	0.336	0.365
Met + Cys	%	0.726	0.798	0.700	0.770	0.673	0.739
Threonine	%	0.608	0.702	0.586	0.677	0.563	0.650
Tryptophan	%	0.182	0.202	0.175	0.195	0.168	0.187
Arginine	%	0.829	0.886	0.799	0.854	0.768	0.820
Gly + Ser	%	0.623	0.719	0.601	0.694	0.578	0.666
Valine	%	0.710	0.789	0.685	0.761	0.658	0.731
Isoleucine	%	0.631	0.702	0.609	0.677	0.585	0.650
Leucine	%	0.963	1.044	0.928	1.007	0.892	0.966
Histidine	%	0.221	0.237	0.213	0.228	0.205	0.219
Phenylalanine	%	0.505	0.544	0.487	0.525	0.468	0.503
Phe + Tyr	%	0.915	0.991	0.882	0.956	0.848	0.918
Essential Nitrogen	%	1.005	1.103	0.969	1.064	0.931	1.021

Table 3.32 - Nutritional Program Developed as a Function of Laying Rate of High Performance White Layers (g/bird/day)

	Nutritional Program		
Laying Rate, %	99 to 90	90 - 85	< 85
Average Weight, kg	1.561	1.597	1.609
Metabolizable Energy, kcal/day	305	300	296
Net Energy, kcal/day	224	221	218
Diet Metab Energy	2900	2900	2900
Diet Net Energy	2123	2132	2138
Intake, g/bird/day	104.5	102.7	101.6
Crude Protein, g/day	16.46	15.88	15.40
Digestible Protein, g/day	14.99	14.49	14.04
Calcium, g/day	4.56	4.54	4.52
Available Phosphorus, g/day	0.229	0.225	0.221
Digestible Phosphorus, g/day	0.206	0.203	0.199
Potassium, g/day	0.513	0.512	0.502
Sodium, g/day	0.204	0.204	0.200
Chlorine, g/day	0.188	0.187	0.183
Linoleic Acid, g/day	1.224	1.220	1.196

Amino Acids	SID	Total	SID	Total	SID	Total
Lysine, g/day	0.829	0.921	0.800	0.889	0.776	0.862
Methionine	0.381	0.414	0.368	0.400	0.357	0.388
Met + Cys, g/day	0.762	0.838	0.736	0.809	0.714	0.784
Threonine, g/day	0.638	0.737	0.616	0.711	0.598	0.690
Tryptophan, g/day	0.191	0.212	0.184	0.204	0.179	0.198
Arginine, g/day	0.870	0.930	0.841	0.898	0.815	0.871
Gly + Ser, g/day	0.655	0.755	0.632	0.729	0.613	0.707
Valine, g/day	0.746	0.829	0.720	0.800	0.699	0.776
Isoleucine, g/day	0.663	0.737	0.640	0.711	0.621	0.690
Leucine, g/day	1.011	1.096	0.977	1.058	0.947	1.026
Histidine, g/day	0.232	0.249	0.224	0.240	0.217	0.233
Phenylalanine	0.531	0.571	0.512	0.551	0.497	0.534
Phe + Tyr, g/day	0.961	1.041	0.929	1.005	0.900	0.974
Essential Nitrogen, g/day	1.056	1.159	1.020	1.118	0.989	1.084

Table 3.33 - Nutritional Program Developed as a Function of Laying Rate of High Performance White Layers (%)

	Nutritional Program		
Laying Rate, %	99 to 90	90 - 85	< 85
Average Weight, kg	1.561	1.597	1.609
Metabolizable Energy, kcal/day	305	300	296
Net Energy, kcal/day	224	221	218
Diet Metab Energy	2900	2900	2900
Diet Net Energy	2123	2132	2138
Intake, g/bird/day	104.5	102.7	101.6
Crude Protein, %	15.67	15.36	15.09
Digestible Protein, %	14.35	14.10	13.83
Calcium, %	4.36	4.40	4.44
Available Phosphorus, %	0.218	0.217	0.217
Digestible Phosphorus, %	0.196	0.196	0.195
Potassium, %	0.492	0.498	0.494
Sodium, %	0.196	0.198	0.197
Chlorine, %	0.180	0.182	0.180
Linoleic Acid, %	1.172	1.188	1.177

Amino Acids	SID	Total	SID	Total	SID	Total
Lysine, %	0.789	0.877	0.773	0.859	0.760	0.844
Methionine, %	0.363	0.395	0.356	0.387	0.350	0.380
Met + Cys, %	0.726	0.798	0.711	0.782	0.699	0.768
Threonine, %	0.608	0.702	0.595	0.687	0.585	0.675
Tryptophan, %	0.182	0.202	0.178	0.198	0.175	0.194
Arginine, %	0.829	0.886	0.812	0.868	0.798	0.852
Gly + Ser, %	0.623	0.719	0.611	0.704	0.600	0.692
Valine, %	0.710	0.789	0.696	0.773	0.684	0.760
Isoleucine, %	0.631	0.702	0.618	0.687	0.608	0.675
Leucine, %	0.963	1.044	0.943	1.022	0.927	1.004
Histidine, %	0.221	0.237	0.216	0.232	0.213	0.228
Phenylalanine, %	0.505	0.544	0.495	0.533	0.486	0.523
Phe + Tyr, %	0.915	0.991	0.897	0.971	0.882	0.954
Essential Nitrogen, %	1.010	1.103	0.993	1.081	0.973	1.062

Table 3.34 - Nutritional Requirements of High Performance Brown Layers (g/bird/day)

Nutrients		Brown Layers					
Average Weight	kg	1.800		1.850		1.900	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	62		58		54	
Metabolizable Energy	kcal/day	327		320		313	
Net Energy	kcal/day	241		237		233	
Diet Metab Energy	kcal/kg	2850		2850		2850	
Diet Net Energy	kcal/kg	2097		2108		2120	
Intake	g/day	114.8		112.4		109.9	
Total Crude Protein	g/day	17.03		16.12		15.17	
Digestible Protein	g/day	15.52		14.69		13.83	
Calcium	g/day	4.63		4.35		4.06	
Available Phosphorus	g/day	0.245		0.239		0.232	
Digestible Phosphorus	g/day	0.220		0.215		0.209	
Potassium	g/day	0.516		0.506		0.494	
Sodium	g/day	0.206		0.201		0.197	
Chlorine	g/day	0.189		0.185		0.181	
Linoleic Acid	g/day	1.231		1.206		1.179	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	g/day	0.858	0.953	0.812	0.902	0.764	0.849
Methionine	g/day	0.395	0.429	0.373	0.406	0.352	0.382
Met + Cys	g/day	0.789	0.867	0.747	0.821	0.703	0.773
Threonine	g/day	0.661	0.762	0.625	0.722	0.588	0.679
Tryptophan	g/day	0.197	0.219	0.187	0.207	0.176	0.195
Arginine	g/day	0.901	0.963	0.852	0.911	0.802	0.857
Gly + Ser	g/day	0.678	0.781	0.641	0.740	0.604	0.696
Valine	g/day	0.772	0.858	0.731	0.812	0.688	0.764
Isoleucine	g/day	0.686	0.762	0.649	0.722	0.611	0.679
Leucine	g/day	1.047	1.134	0.990	1.073	0.932	1.010
Histidine	g/day	0.240	0.257	0.227	0.244	0.214	0.229
Phenylalanine	g/day	0.549	0.591	0.520	0.559	0.489	0.526
Phe + Tyr	g/day	0.995	1.077	0.942	1.019	0.887	0.959
Essential Nitrogen	g/day	1.093	1.199	1.034	1.135	0.974	1.068

Table 3.35 - Nutritional Requirements of High Performance Brown Layers (%)

Nutrients		Brown Layers					
Average Weight	kg	1.800		1.850		1.900	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	62		58		54	
Metabolizable Energy	kcal/day	327		320		313	
Net Energy	kcal/day	241		237		233	
Diet Metab Energy	kcal/kg	2850		2850		2850	
Diet Net Energy	kcal/kg	2097		2108		2120	
Intake	g/day	114.8		112.4		109.9	
Total Crude Protein	%	14.83		14.33		13.81	
Digestible Protein	%	13.53		13.06		12.59	
Calcium	%	4.10		4.03		3.86	
Available Phosphorus	%	0.213		0.212		0.211	
Digestible Phosphorus	%	0.192		0.191		0.191	
Potassium	%	0.441		0.450		0.460	
Sodium	%	0.175		0.179		0.183	
Chlorine	%	0.161		0.164		0.168	
Linoleic Acid	%	1.051		1.073		1.098	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	%	0.747	0.830	0.722	0.802	0.696	0.773
Methionine	%	0.344	0.374	0.332	0.361	0.320	0.348
Met + Cys	%	0.688	0.755	0.664	0.730	0.640	0.703
Threonine	%	0.576	0.664	0.556	0.642	0.536	0.618
Tryptophan	%	0.172	0.191	0.166	0.184	0.160	0.178
Arginine	%	0.785	0.838	0.758	0.810	0.730	0.781
Gly + Ser	%	0.591	0.681	0.570	0.658	0.549	0.634
Valine	%	0.673	0.747	0.650	0.722	0.626	0.696
Isoleucine	%	0.598	0.664	0.578	0.642	0.556	0.618
Leucine	%	0.912	0.988	0.881	0.954	0.849	0.920
Histidine	%	0.209	0.224	0.202	0.217	0.195	0.209
Phenylalanine	%	0.478	0.515	0.462	0.497	0.445	0.479
Phe + Tyr	%	0.867	0.938	0.837	0.906	0.807	0.873
Essential Nitrogen	%	0.952	1.044	0.920	1.009	0.886	0.972

Table 3.36 - Nutritional Requirements of Standard Performance Brown Layers (g/bird/day)

Nutrients		Brown Layers					
Average Weight	kg	1.800		1.850		1.900	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	58		54		50	
Metabolizable Energy	kcal/day	317		311		304	
Net Energy	kcal/day	234		231		227	
Diet Metab Energy	kcal/kg	2850		2850		2850	
Diet Net Energy	kcal/kg	2068		2080		2092	
Intake	g/day	113.4		111.0		108.4	
Total Crude Protein	g/day	16.12		15.20		14.26	
Digestible Protein	g/day	14.69		13.86		13.00	
Calcium	g/day	4.34		4.06		3.78	
Available Phosphorus	g/day	0.238		0.232		0.226	
Digestible Phosphorus	g/day	0.215		0.209		0.204	
Potassium	g/day	0.499		0.489		0.478	
Sodium	g/day	0.200		0.196		0.191	
Chlorine	g/day	0.180		0.176		0.172	
Linoleic Acid	g/day	1.199		1.174		1.146	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	g/day	0.812	0.902	0.766	0.851	0.718	0.798
Methionine	g/day	0.373	0.406	0.352	0.383	0.330	0.359
Met + Cys	g/day	0.747	0.821	0.705	0.774	0.661	0.726
Threonine	g/day	0.625	0.722	0.590	0.681	0.553	0.638
Tryptophan	g/day	0.187	0.207	0.176	0.196	0.165	0.184
Arginine	g/day	0.852	0.911	0.804	0.860	0.754	0.806
Gly + Ser	g/day	0.641	0.740	0.605	0.698	0.567	0.654
Valine	g/day	0.731	0.812	0.689	0.766	0.646	0.718
Isoleucine	g/day	0.649	0.722	0.613	0.681	0.575	0.638
Leucine	g/day	0.990	1.073	0.934	1.013	0.876	0.950
Histidine	g/day	0.227	0.244	0.214	0.230	0.201	0.215
Phenylalanine	g/day	0.520	0.559	0.490	0.528	0.460	0.495
Phe + Tyr	g/day	0.942	1.019	0.888	0.962	0.833	0.902
Essential Nitrogen	g/day	1.034	1.135	0.976	1.070	0.915	1.004

Table 3.37 - Nutritional Requirements of Standard Performance Brown Layers (%)

Nutrients		Brown Layers					
Average Weight	kg	1.800		1.850		1.900	
Gain	g/day	0.4		0.3		0.1	
Egg Mass	g/day	58		54		50	
Metabolizable Energy	kcal/day	317		311		304	
Net Energy	kcal/day	234		231		227	
Diet Metab Energy	kcal/kg	2.850		2.850		2.850	
Diet Net Energy	kcal/kg	2068		2080		2092	
Intake	g/day	113.4		111.0		108.4	
Total Crude Protein	%	14.22		13.71		13.17	
Digestible Protein	%	12.96		12.48		11.99	
Cálcio	%	3.83		3.66		3.48	
Available Phosphorus	%	0.227		0.209		0.202	
Digestible Phosphorus	%	0.205		0.189		0.182	
Potassium	%	0.441		0.441		0.441	
Sodium	%	0.176		0.176		0.176	
Chlorine	%	0.159		0.159		0.159	
Linoleic Acid	%	1.057		1.057		1.057	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	%	0.716	0.796	0.690	0.767	0.663	0.737
Methionine	%	0.329	0.358	0.317	0.345	0.305	0.332
Met + Cys	%	0.659	0.724	0.635	0.698	0.610	0.671
Threonine	%	0.551	0.637	0.531	0.614	0.510	0.590
Tryptophan	%	0.165	0.183	0.159	0.176	0.152	0.170
Arginine	%	0.752	0.804	0.724	0.775	0.696	0.744
Gly + Ser	%	0.566	0.635	0.545	0.629	0.523	0.604
Valine	%	0.644	0.716	0.621	0.690	0.596	0.663
Isoleucine	%	0.573	0.637	0.552	0.614	0.530	0.590
Leucine	%	0.874	0.947	0.842	0.913	0.808	0.877
Histidine	%	0.200	0.215	0.193	0.207	0.186	0.199
Phenylalanine	%	0.458	0.494	0.442	0.476	0.424	0.457
Phe + Tyr	%	0.831	0.899	0.800	0.867	0.769	0.833
Essential Nitrogen	%	0.912	1.001	0.879	0.965	0.844	0.927

Table 3.38 - Nutritional Program Developed as a Function of Laying Rate of High Performance Brown Layers (g/bird/day)

	Nutritional Program		
Laying Rate, %	99 to 90	90 - 85	< 85
Average Weight, kg	1.857	1.866	1.874
Metabolizable Energy, kcal/day	328	323	316
Net Energy, kcal/day	242	239	234
Diet Metab Energy	2850	2850	2850
Diet Net Energy	2102	2108	2115
Intake, g/bird/day	115	113	111
Crude Protein, g/day	16.83	16.34	15.61
Digestible Protein, g/day	15.96	15.50	14.81
Calcium, g/day	4.61	4.58	4.51
Available Phosphorus, g/day	0.245	0.241	0.235
Digestible Phosphorus, g/day	0.221	0.217	0.212
Potassium, g/day	0.579	0.585	0.573
Sodium, g/day	0.230	0.233	0.228
Chlorine, g/day	0.212	0.214	0.209
Linoleic Acid, g/day	1.381	1.394	1.367

Amino Acids	SID	Total	SID	Total	SID	Total
Lysine, g/day	0.848	0.942	0.823	0.914	0.787	0.874
Methionine, g/day	0.390	0.424	0.379	0.411	0.362	0.393
Met + Cys, g/day	0.780	0.857	0.757	0.832	0.724	0.795
Threonine, g/day	0.653	0.754	0.634	0.731	0.606	0.699
Tryptophan, g/day	0.195	0.217	0.189	0.210	0.181	0.201
Arginine, g/day	0.890	0.951	0.864	0.923	0.826	0.883
Gly + Ser, g/day	0.670	0.772	0.650	0.749	0.621	0.717
Valine, g/day	0.763	0.848	0.741	0.823	0.708	0.787
Isoleucine, g/day	0.678	0.754	0.658	0.731	0.629	0.699
Leucine, g/day	1.034	1.121	1.004	1.088	0.960	1.040
Histidine, g/day	0.237	0.254	0.230	0.247	0.220	0.236
Phenylalanine, g/day	0.543	0.584	0.527	0.567	0.504	0.542
Phe + Tyr, g/day	0.984	1.064	0.955	1.033	0.912	0.988
Essential Nitrogen, g/day	1.124	1.185	1.091	1.150	1.043	1.099

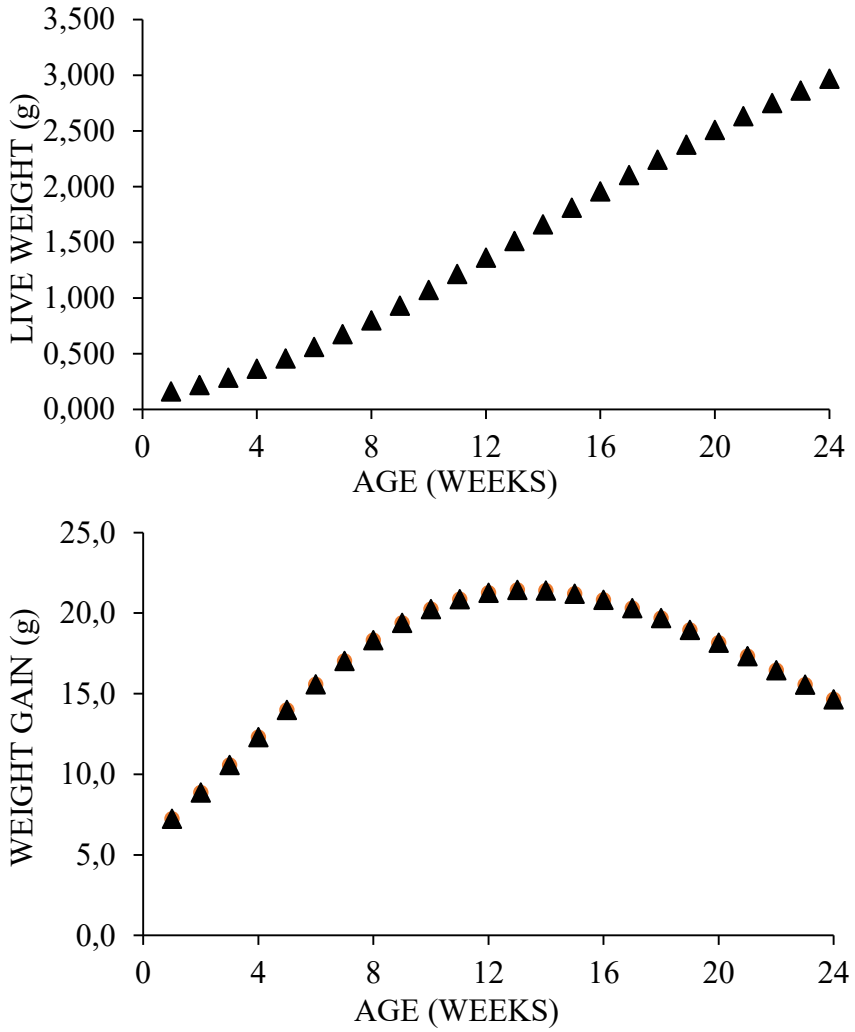
Table 3.39 - Nutritional Program Developed as a Function of Laying Rate of High Performance Brown Layers (%)

	Nutritional Program		
Laying Rate, %	99 to 90	90 - 85	< 85
Average Weight, kg	1.857	1.866	1.874
Metabolizable Energy, kcal/day	328	323	316
Net Energy, kcal/day	242	239	234
Diet Metab Energy	2850	2850	2850
Diet Net Energy	2102	2108	2115
Intake, g/bird/day	115	113	111
Crude Protein, %	14.62	14.42	14.08
Digestible Protein, %	13.88	13.67	13.36
Calcium, %	4.01	4.04	4.07
Available Phosphorus, %	0.213	0.213	0.212
Digestible Phosphorus, %	0.192	0.191	0.191
Potassium, %	0.503	0.516	0.517
Sodium, %	0.200	0.205	0.206
Chlorine, %	0.184	0.188	0.189
Linoleic Acid, %	1.201	1.230	1.233

Amino Acids	SID	Total	SID	Total	SID	Total
Lysine, %	0.736	0.818	0.726	0.807	0.709	0.788
Methionine, %	0.339	0.368	0.334	0.363	0.326	0.355
Met + Cys, %	0.677	0.744	0.668	0.734	0.653	0.717
Threonine, %	0.567	0.654	0.559	0.646	0.546	0.630
Tryptophan, %	0.169	0.188	0.167	0.186	0.163	0.181
Arginine, %	0.773	0.826	0.762	0.815	0.745	0.796
Gly + Ser, %	0.582	0.671	0.574	0.662	0.560	0.646
Valine, %	0.663	0.736	0.654	0.726	0.639	0.709
Isoleucine, %	0.589	0.654	0.581	0.646	0.568	0.630
Leucine, %	0.898	0.973	0.886	0.960	0.866	0.938
Histidine	0.206	0.221	0.203	0.218	0.199	0.213
Phenylalanine, %	0.471	0.507	0.465	0.500	0.454	0.489
Phe + Tyr, %	0.854	0.924	0.842	0.912	0.823	0.890
Essential Nitrogen, %	0.977	1.029	0.962	1.015	0.940	0.991

Nutritional Requirements of Broiler Breeder Pullets

Table 3.40 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Broiler Breeder Pullets



Equation parameters for broiler breeder pullets: Wm = 4.255; b = 0.014; t* = 93.5; where W = weight (kg); G = weight gain (g/day); t = age (days); Wm = mature body weight (kg); b = maturity rate (g/day per g); t* = age at maximum growth rate (days). The parameters were obtained by adjusting the Gompertz equation according to the weights presented in the lineage guidelines (Cobb, 2020; Ross, 2021).

Table 3.41 - Equations Used to Estimate Metabolizable Energy (ME) Requirements of Broiler Breeder Pullets (kcal/bird/day)[1,2]

1 to 15 weeks:
ME (kcal/bird/day) = $113 \times W^{0.75} + (4.0 + 0.56 \times W) \times G$

16 to 18 weeks:
ME (kcal/bird/day) = $113 \times W^{0.75} + (4.0 + 0.56 \times W) \times G + 2.4 \times Egg$
W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Thermoneutral temperature (TN) and temperature range (TR) were considered according to the bird's age: 8 to 14 days, TN = 29º C, TR = 26 – 32º C; 15 to 21 days, TN = 26º C, TR = 23 – 29º C; 22 to 28 days, TN = 23º C, TR = 18 – 28º C; 29 to 126 days, TN = 20º C, TR = 16 – 27º C.

Example: Broiler Breeder Pullets
Age: 12 weeks (84 days)
W = 1.362 kg, where $W^{0.75} = 1.261$, G = 21.25 g/bird/day
ME Req. = $(113 \times 1.261) + (4.0 + 0.559 \times 1.362) \times 21.25$
ME Req. = $142.47 + 4.76 \times 21.25 = 244$ kcal/bird/day
Dietary ME[2] = 2.800 Kcal/g; Estimated Feed Intake = 87 g/day

Effect of temperature (TºC) of 27ºC on maintenance ME requirement (MEm):
Tº C > TN
MEm = 113+ 0.88 × (Tº C – TN)
MEm = 113 + 0.88 × (27 – 20)
MEm = 113 + 0.88 × 7 = 119.16 kcal/bird/day

Effect of temperature (TºC) of 16ºC on maintenance ME requirement (MEm):
Tº C < TN
MEm = 113 + 6.73 × (TN – Tº C) = 113 + 6.73 × (20 - 16)
MEm = 113 + 6.73 × 4 = 139.92 kcal/bird/day

[1] Equations adapted from Sakomura & Rostagno (2016), Sakomura et al. (2003), Sakomura et al. (2004), and Neme et al. (2005).
[2] Considering dietary ME during the grower phase of broiler breeder pullets: 1 to 4 weeks = 2.900 kcal/g and 5 to 24 weeks = 2.800 kcal/g.

Table 3.42 - Equations Used to Estimate Net Energy (NE) Requirements of Broiler Breeder Pullets (kcal/ave/dia)[1,2]

1 to 15 weeks:
NE (kcal/bird/day) = $92.3 \times W^{0.75} + (2.24 + 0.486 \times W) \times G$

16 to 18 weeks:
NE (kcal/bird/d)= $92.23 \times W^{0.75} + (2.24 + 0.486 \times W) \times G + 1.54 \times Egg$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example: Broiler Breeder Pullets
Age: 12 weeks (84 days)
W = 1.362 kg, where: $W^{0.75}$ = 1.261, G = 21.25 g/bird/day

NE Req. = $(92.3 \times 1.261) + (2.24 + 0.486 \times 1.362) \times 21.25$
NE Req. = $116.34 + 2.90 \times 21.25 = 177.91$ kcal/bird/day
Estimated Feed Intake = 87 g/day
Dietary NE^2 = 2.045 kcal/g

[1] Equations developed at UNESP – Jaboticabal, Horna (2022) (Doctoral Thesis, UNESP – Jaboticabal).
[2] Feed intake determined considering 2.8 kcal/g ME, and dietary NE calculated (177.91/79.4 = 2.045 kcal/g).

Table 3.43 - Equations Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Broiler Breeder Pullets (g/bird/day and %)[1,2]

1 to 15 weeks:
SID Lys (g/bird/day) = Maintenance Req. + Gain Req.

$$\text{SID Lys (g/bird/day)} = [45.1 \times W^{0.75} + (14.7 + 5.3 \times W - 0.444 \times W^2) \times G] / 1000$$

16 to 18 weeks:
SID Lys (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.

$$\text{SID Lys (g/bird/day)} = [45.1 \times W^{0.75} + (14.7 + 5.2 \times W - 0.444 \times W^2) \times G + 9.46 \times Egg] / 100$$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example:

Parameters	Broiler Breeder Pullets
Age (weeks/days)	12(84)
W (kg)	1.362
$W^{0.75}$	1.261
G (g/bird/day)	21.25
Intake (g)	87
Egg Mass (g/bird/day)	-
SID Lys Maintenance (g/bird/day)	0.057
SID Lys Gain (g/bird/day)	0.446
SID Lys Egg Mass (g/bird/day)	-
SID Lys Req. (g/day)	0.502
SID Lys Req. (%)	0.58

[1] Daily maintenance requirement of SID Lys was reported by Siqueira et al. (2011) and gain requirement were estimated at UNESP – Jaboticabal.
[2] Equations adapted from Sakomura & Rostagno (2016).

Table 3.44 - Performance and Standardized Digestible Lysine (SID Lys) [1] and Metabolizable Energy (ME) Requirements of Broiler Breeder Pullets Using the Equations in Tables 3.40, 3.41, 3.42, and 3.43

Age	Weight	Gain	SID Lys	ME	NE	Intake	Cumulative Intake	Lys/ME	SID Lys
Week (Days)	kg	g/day	g/day	kcal/day	kcal/day	g/day	g	%/Mcal	%
1 (7)	0.161	7.2	0.124	58	40	20	128	0.212	0.615
2 (14)	0.218	8.9	0.155	73	50	25	288	0.213	0.618
3 (21)	0.286	10.6	0.188	88	61	30	484	0.214	0.620
4 (28)	0.366	12.3	0.225	105	73	36	720	0.214	0.621
5 (35)	0.458	14.0	0.263	122	86	44	1007	0.215	0.601
6 (42)	0.561	15.6	0.302	140	99	50	1339	0.215	0.601
7 (49)	0.676	17.0	0.340	159	113	57	1716	0.214	0.600
8 (56)	0.799	18.3	0.378	177	126	63	2139	0.214	0.598
9 (63)	0.931	19.4	0.414	195	140	70	2607	0.213	0.595
10 (70)	1.070	20.2	0.447	212	153	76	3119	0.211	0.591
11 (77)	1.214	20.9	0.477	228	166	82	3672	0.209	0.585
12 (84)	1.362	21.3	0.502	244	178	87	4265	0.206	0.577
13 (91)	1.511	21.4	0.523	258	190	92	4895	0.203	0.568
14 (98)	1.661	21.4	0.539	271	200	97	5558	0.199	0.557
15 (105)	1.811	21.2	0.551	283	210	101	6253	0.195	0.545
16 (112)	1.958	20.8	0.557	293	219	105	6975	0.190	0.532
17 (119)	2.102	20.3	0.559	302	227	108	7721	0.185	0.518
18 (126)	2.242	19.7	0.557	310	235	111	8489	0.180	0.503
19 (133)	2.377	19.0	0.565	321	243	115	9280	0.176	0.493
20 (140)	2.507	18.2	0.669	330	251	118	10095	0.203	0.568
21 (147)	2.631	17.3	0.721	338	258	121	10932	0.213	0.597
22 (154)	2.749	16.4	0.770	346	264	123	11788	0.223	0.624
23 (161)	2.862	15.6	0.818	352	270	126	12661	0.232	0.650
24 (168)	2.967	14.7	0.864	358	275	128	13551	0.241	0.675

[1] Broiler breeder pullets (19, 20, 21, 22, 23 to 24 weeks): extra requirement of +0.100, 0.150, 0.200, 0.250, and 0.300 g SID Lys /day, respectively, for reproductive tract development.

Table 3.45 - Amino Acid to Lysine Ratio (%) Used to Estimate Amino Acid Requirement of Broiler Breeder Pullets[1]

Phase	Starter		Grower		Developer/Pre Lay	
Weeks	1 to 4		5 to 12		13 to 24	
Days	1 - 42 days		43-84 days		44-126 days	
Amino Acids	SID	Total	SID	Total	SID	Total
Lysine	100	100	100	100	100	100
Methionine	41	41	44	45	46	46
Met, + Cys	73	73	79	80	83	83
Threonine	68	71	67	70	70	73
Tryptophan	18	18	21	21	21	21
Arginine	108	106	109	107	109	107
Gly + Ser	138	142	135	139	111	109
Valine	77	79	79	80	83	85
Isoleucine	70	71	74	75	76	76
Leucine	113	112	119	118	130	130
Histidine	37	37	37	37	39	39
Phenylalanine	67	67	69	69	71	71
Phe + Tyr	122	122	126	126	129	129

[1] Determined in research carried out at UNESP – Jaboticabal, Dorigam (2016) (Doctoral Thesis).
[2] Ne: Total N ratio of 50 %.

-Total lysine requirement was calculated considering 90.0% the ileal digestibility of lysine in the diet. The total amino acid to total lysine ratios were used (Table 3.45) to estimate total amino acid requirements.

- To calculate dietary digestible and total proteins, the Ne: Total N ratio was 50%.
- SID Lys to digestible protein average ratio was 5.87+-0.1 %.
- SID Lys to total protein average ratio was 5.41+-0.2%.

Table 3.46 - Equations Used to Estimate Total Calcium, Standardized Digestible Phosphorus (Dig. P), and Available Phosphorus (Pav) Requirements of Broiler Breeder Pullets[1]

Total calcium (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.
1 to 15 weeks:
Total calcium (g/bird/day) = [(70 × $W^{0.75}$ + 8.29 × G)/0.37] / 1000

16 to 18 weeks:
Total calcium (g/bird/d) = [(70 × $W^{0.75}$ + 8.29 × G + 40 × Egg)/0.37] / 1000

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example for calcium: Broiler Breeder Pullets
Age: 13 weeks (91 days)
W = 1.511 kg; $W^{0.75}$ = 1.363; G = 21.43 g/bird/day
Estimated Feed Intake = 92.1 g/day

Calcium Req. = [(70 × 1.363 + 8.29 × 21.43)/0.37] / 1000 = 0.721 g/bird/day
% Calcium = (0.721 × 100)/92.1 = 0.783 %

Dig. P (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.
1 to 15 weeks: Dig. P (g/bird/day) = [70 × $W^{0.75}$ + 6.64 × G] / 1000
15 to 18 weeks: Dig. P (g/bird/day) = [70 × $W^{0.75}$ + 6.64 × G + 1.8 Egg] / 1000
Example for phosphorus: Broiler Breeder Pullets
Age: 13 weeks (91 d), W = 1.511 kg; $W^{0.75}$ = 1.363 kg; G = 21.43 g/bird/d

Estimated Feed Intake = 92.1 g/day

Dig. P (g/bird/day) = [70 × 1.363 + 6.64 × 21.43] / 1000 = 0.238 g/bird/day
Pav = 0.238 × 1.18 = 0.280 g/bird/day
Pav (%) = 0.280 × 100/92.1 = 0.305 %

[1]The maintenance requirements for calcium and phosphorus of 70 mg/kg ^{0,75} were adapted from WPSA (1984) and Gopi et al. (2021). Weight gain requirements for calcium and phosphorus (8.29 and 6.64 mg/g, respectively), and calcium and phosphorus requirements for egg mass (40 and 1.8 mg/g) were obtained from research carried out at Laval University. A calcium digestibility coefficient of 0.37 was obtained from the information reported by Mutucumarana et al. (2014).

Table 3.47 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of Broiler Breeder Pullets, Using the Equations in Table 3.46

Age Weeks (days)	Weight Kg	Gain g/day	Intake g/day	Calcium g/day	Dig. P g/day	Pav g/day	Calcium %	Dig P. %	Pav %
1 (7)	0.161	7.2	20	0.210	0.066	0.078	1.045	0.327	0.386
2 (14)	0.218	8.9	25	0.259	0.081	0.096	1.035	0.324	0.383
3 (21)	0.286	10.6	30	0.311	0.098	0.115	1.023	0.321	0.379
4 (28)	0.366	12.3	36	0.365	0.115	0.135	1.008	0.317	0.374
5 (35)	0.458	14.0	44	0.419	0.132	0.156	0.957	0.301	0.356
6 (42)	0.561	15.6	50	0.472	0.149	0.176	0.940	0.297	0.350
7 (49)	0.676	17.0	57	0.523	0.165	0.195	0.922	0.291	0.344
8 (56)	0.799	18.3	63	0.570	0.181	0.213	0.902	0.286	0.337
9 (63)	0.931	19.4	70	0.614	0.195	0.230	0.882	0.280	0.331
10 (70)	1.070	20.2	76	0.652	0.208	0.245	0.862	0.275	0.324
11 (77)	1.214	20.9	82	0.686	0.219	0.259	0.841	0.269	0.318
12 (84)	1.362	21.3	87	0.715	0.229	0.271	0.821	0.264	0.311
13 (91)	1.511	21.4	92	0.738	0.238	0.281	0.801	0.258	0.305
14 (98)	1.661	21.4	97	0.756	0.245	0.289	0.782	0.253	0.298
15 (105)	1.811	21.2	101	0.770	0.250	0.295	0.763	0.248	0.292
16 (112)	1.958	20.8	105	0.780	0.254	0.300	0.745	0.243	0.286
17 (119)	2.102	20.3	108	0.785	0.257	0.303	0.727	0.238	0.281
18 (126)	2.242	19.7	111	0.788	0.259	0.306	0.710	0.234	0.276
19 (133)	2.377	19.0	115	0.936	0.262	0.310	0.817	0.229	0.270
20 (140)	2.507	18.2	118	1.081	0.265	0.313	0.918	0.225	0.265
21 (147)	2.631	17.3	121	1.225	0.267	0.315	1.014	0.221	0.261
22 (154)	2.749	16.4	123	1.367	0.269	0.317	1.108	0.218	0.257
23 (161)	2.862	15.6	126	1.508	0.270	0.318	1.199	0.214	0.253
24 (168)	2.967	14.7	128	1.648	0.270	0.319	1.288	0.211	0.249

Table 3.48 - Nutritional Requirements of Broiler Breeder Pullets, According to Growing Phase (g/day)

Phase		Starter		Grower/ Developer				Pre Lay	
Age (Week)		1-4		5-12		13-18		19-24	
Average Weight	kg	0.222		0.809		1.821		2.640	
Gain	g/day	9.0		18.4		21.2		17.3	
SID Lysine	g/day	0.225		0.381		0.551		0.745	
Metabolizable Energy	kcal/day	74		178		283		339	
Net Energy	kcal/day	51		127		211		258	
Diet Metab Energy	kcal/kg	2.900		2.800		2.800		2.800	
Diet Net Energy	kcal/kg	2007		1997		2083		2137	
Intake	g/day	25.4		63.7		101.2		121.0	
		Nutrients							
Total Crude Protein	g/day	4.20		7.20		10.37		13.91	
Digestible Protein	g/day	3.78		6.49		9.36		12.85	
Calcium	g/day	0.263		0.573		0.771		1.235	
Available Phosphorus	g/day	0.097		0.215		0.295		0.315	
Digestible Phosphorus	g/day	0.082		0.182		0.250		0.267	
Potassium	g/day	0.134		0.332		0.517		0.617	
Sodium	g/day	0.046		0.108		0.162		0.194	
Chlorine	g/day	0.040		0.096		0.152		0.181	
Linoleic Acid	g/day	0.261		0.637		1.012		1.210	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	g/day	0.225	0.250	0.381	0.423	0.551	0.612	0.745	0.828
Methionine	g/day	0.091	0.103	0.167	0.190	0.253	0.282	0.344	0.381
Met. + Cys	g/day	0.164	0.183	0.301	0.338	0.457	0.508	0.619	0.687
Threonine	g/day	0.153	0.178	0.255	0.296	0.386	0.447	0.522	0.604
Tryptophan	g/day	0.040	0.045	0.080	0.089	0.116	0.129	0.157	0.174
Arginine	g/day	0.243	0.265	0.415	0.453	0.601	0.655	0.812	0.886
Gly + Ser	g/day	0.310	0.355	0.514	0.588	0.612	0.667	0.932	0.903
Valine	g/day	0.173	0.198	0.301	0.338	0.457	0.520	0.619	0.704
Isoleucine	g/day	0.157	0.178	0.282	0.317	0.419	0.465	0.566	0.629
Leucine	g/day	0.254	0.280	0.453	0.499	0.716	0.796	0.969	1.076
Histidine	g/day	0.083	0.093	0.141	0.157	0.215	0.239	0.291	0.323
Phenylalanine	g/day	0.151	0.168	0.263	0.292	0.391	0.435	0.529	0.588
Phe + Tyr	g/day	0.274	0.305	0.480	0.533	0.711	0.789	0.962	1.068
Essential Nitrogen	g/day	0.302	0.336	0.519	0.576	0.749	0.829	1.028	1.113

Table 3.49 - Nutritional Requirements of Broiler Breeder Pullets, According to the Growing Phase (%)

Phase		Starter		Grower/Developer				Pre Lay	
Age (week)		1-4		5-12		13-18		19-24	
Average Weight	kg	0.222		0.809		1.821		2.640	
Gain	g/day	9.0		18.4		21.2		17.3	
SID Lysine	g/day	0.225		0.381		0.551		0.745	
Metabolizable Energy	kcal/day	74		178		283		339	
Net Energy	kcal/day	51		127		211		258	
Diet Metab Energy	kcal/kg	2.900		2.800		2.800		2.800	
Diet Net Energy	kcal/kg	2.007		1.997		2.083		2.137	
Intake	g/day	25.4		63.7		101.2		121.0	
		Nutrients							
Total Crude Protein	%	16.55		11.33		10.33		11.50	
Digestible Protein	%	14.84		10.18		9.26		10.63	
Calcium	%	1.034		0.901		0.762		1.021	
Available Phosphorus	%	0.383		0.337		0.292		0.261	
Digestible Phosphorus	%	0.324		0.286		0.247		0.221	
Potassium	%	0.528		0.521		0.511		0.510	
Sodium	%	0.182		0.169		0.160		0.161	
Chlorine	%	0.159		0.151		0.150		0.149	
Linoleic Acid	%	1.028		1.000		1.000		1.000	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	%	0.886	0.984	0.598	0.665	0.545	0.605	0.616	0.684
Methionine	%	0.363	0.403	0.263	0.299	0.251	0.278	0.284	0.315
Met. + Cys	%	0.647	0.718	0.473	0.532	0.452	0.502	0.511	0.568
Threonine	%	0.602	0.699	0.401	0.466	0.382	0.442	0.431	0.499
Tryptophan	%	0.159	0.177	0.126	0.140	0.114	0.127	0.129	0.144
Arginine	%	0.957	1.043	0.652	0.712	0.594	0.647	0.672	0.732
Gly + Ser	%	1.223	1.397	0.808	0.924	0.605	0.659	0.770	0.746
Valine	%	0.682	0.777	0.473	0.532	0.452	0.514	0.511	0.581
Isoleucine	%	0.620	0.699	0.443	0.499	0.414	0.460	0.468	0.520
Leucine	%	1.001	1.102	0.712	0.785	0.709	0.787	0.801	0.889
Histidine	%	0.328	0.364	0.221	0.246	0.213	0.236	0.240	0.267
Phenylalanine	%	0.594	0.659	0.413	0.459	0.387	0.430	0.437	0.486
Phe + Tyr	%	1.081	1.200	0.754	0.838	0.703	0.780	0.795	0.882
Essential Nitrogen	%	1.187	1.324	0.814	0.906	0.741	0.826	0.850	0.920

Nutritional Requirements of Broiler Breeders

Table 3.50 - Equations Used to Estimate Metabolizable Energy (ME) Requirements of Broiler Breeders (kcal/bird/day)[1,2]

ME (kcal/bird/day) = 113 × $W^{0.75}$ + 7.62 × G + 2.4 × Egg

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)
Thermoneutral temperature (TN) and temperature range (TR) were considered as TN = 20º C, TR = 16 – 27º C.

Example: Broiler Breeders
Age: 34 weeks; W = 3.768 kg, $W^{0.75}$ = 2.705, G = 3.6 g/day

ME Req. = 113 × $W^{0.75}$ + 7.62 × G + 2.4 × Egg
ME Req. = 305.6 + 27.21 + 125.5 = 458.3 kcal/bird/day
Dietary ME[2] = 2.750 kcal/g; Estimated Feed Intake = 166.7 g/day

Effect of temperature (TºC) of 25ºC on maintenance ME requirement (MEm):
Tº C > TN
MEm = 113 + 0.88 × (Tº C – TN)
MEm = 113 + 0.88 × (25 – 20) = 113 + 0.88 × 5 = 117.4 kcal/day

Effect of temperature (TºC) of 17ºC on maintenance ME requirement (MEm):
Tº C < TN
MEm = 113 + 6.73 × (TN – Tº C)
MEm = 113 + 6.73 × (20 - 17) = 113 + 6.73 × 3 = 133.2 kcal/bird/day

[1] Equations estimated at UNESP – Jaboticabal; Information from Sakomura & Rostagno (2016), Rabello et al. (2006), Sakomura et al. (2004), and Neme et al. (2005).
[2] Considering dietary ME of 2.750 kcal/g diet for broiler breeders.

Table 3.51 - Equations Used to Estimate Net Energy (NE) Requirements of Broiler Breeders (kcal/bird/day)[1,2]

NE kcal/bird/day = $92.3 \times W^{0.75} + 3.58 \times G + 1.54 \times Egg$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example: Broiler Breeders
Age: 34 weeks; W = 3.768 kg, where: $W^{0.75} = 2.705$
G = 3.6 g/bird/day; Egg = 52.3

NE Req. = $92.3 \times 2.705 + 3.58 \times 3.6 + 1.54 \times 52.3$
NE Req. = 249.6 + 12.88 + 80.54 = 343.05 kcal/bird/day
Estimated Feed Intake = 166.7 g/day
Dietary NE² = 2.058 kcal/g

[1] Equations estimated at UNESP – Jaboticabal; Horna (2022) (Doctoral Thesis, UNESP-Jaboticabal),
[2] Considering the feed intake determined with ME of 2.900 kcal/g, diet NE was calculated (343.05/166.7 = 2.058 kcal/g).

Table 3.52 - Equations Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Broiler Breeders (g/bird/day and %)[1,2]

Sid Lys (g/bird/day) = Maintenance Req. + Gain Req. + Egg

Maintenance Req. (mg/bird/day) = $45.1 \times W^{0.75}$
Gain Req. (mg/bird/day) = $(55 + 12 \times G)/0.80$
Egg Req. (mg/bird/day) = $14.5 \times Egg$

SID Lys (g/bird/d)= $[45.1 \times W^{0.75} + (55 + 12 \times G)/ 0.80 + 14.5 \times Egg] / 1000$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day);
Egg = Egg Mass (g/bird/day)

Example:

Parameters	Broiler Breeders
Age (weeks/days)	34 (238)
W (kg)	3.768
$W^{0.75}$	2.705
G (g/bird/day)	3.6
Intake (g)	166.7
Egg Mass (g/bird/day)	52.3
SID Lys Maintenance (g/bird/day)	0.122
SID Lys Gain (g/bird/day)	0.123
SID Lys Egg Mass (g/bird/day)	0.758
SID Lys Req. (g/day)	1.002
SID Lys Req. (%)	0.60

[1] Equations estimated at UNESP – Jaboticabal; Daily maintenance requirement of SID Lys estimated from the information reported by Siqueira et al. (2011). Daily gain requirement of SID Lys estimated from Sakomura & Rostagno (2016).
[2] Utilization Efficiency of SID Lysine for Broiler Breeders = 0.80 during the production phase.

Table 3.53 - Standardized Digestible Lysine (SID Lys), ME, and NE Requirements of Broiler Breeders as a Function of Productivity

Age	Weight	Gain	Production	Egg	Egg Mass	SID Lys	ME	NE	Intake	SID Lys
Weeks	kg	g/day	%	Wt (g)	(g)	Req. (g/day)	(kcal/day)	kcal/day	(g/day)	%
25-28	3.2 - 3.5	-	-	-	-	0.980	487	346	-	0.553
29	3.58	11	83.0	57.7	47.8	1.051	496	355	180	0.583
30	3.64	9	85.8	58.9	50.5	1.048	484	352	176	0.595
31	3.68	6	86.5	59.9	51.7	1.025	468	346	170	0.602
32	3.72	5	86.0	60.7	52.2	1.016	463	344	168	0.603
33	3.74	4	85.1	61.4	52.3	1.007	459	343	167	0.603
34	3.77	4	84.2	62.1	52.3	1.002	458	343	167	0.602
35	3.79	4	83.2	62.8	52.2	1.002	460	344	167	0.599
36	3.82	3	82.2	63.3	52.0	0.994	458	344	166	0.597
37	3.84	3	81.2	63.7	51.7	0.991	458	344	167	0.594
38	3.86	3	80.1	64.2	51.4	0.980	456	343	166	0.591
39	3.88	3	79.0	64.6	51.0	0.976	456	344	166	0.588
40	3.90	2	78.0	65.0	50.7	0.966	454	343	165	0.585
41	3.91	3	76.9	65.3	50.2	0.959	454	343	165	0.581
42	3.93	2	75.8	65.7	49.8	0.954	454	343	165	0.578
43	3.95	3	74.7	66.0	49.3	0.947	454	343	165	0.574
44	3.97	2	73.6	66.4	48.8	0.941	454	344	165	0.570
45	3.98	3	72.6	66.7	48.4	0.935	454	344	165	0.566
46	4.00	3	71.5	67.0	47.9	0.928	454	344	165	0.563
47	4.02	3	70.5	67.3	47.4	0.921	453	344	165	0.559
48	4.04	3	69.4	67.6	46.9	0.914	453	344	165	0.555
49	4.05	3	68.4	67.8	46.4	0.908	453	344	165	0.551
50	4.07	2	67.4	68.1	45.8	0.895	450	343	164	0.547
51	4.08	2	66.3	68.3	45.3	0.887	450	342	163	0.543
52	4.10	2	65.3	68.6	44.8	0.880	449	342	163	0.539
53	4.11	2	64.2	68.9	44.2	0.872	449	342	163	0.534
54	4.13	2	63.2	69.1	43.6	0.864	448	342	163	0.530
55	4.14	2	62.1	69.3	43.0	0.855	448	342	163	0.525
56	4.16	2	61.1	69.5	42.4	0.847	447	342	163	0.521
57	4.17	2	60.0	69.7	41.8	0.839	447	341	162	0.516
58	4.19	2	59.0	69.9	41.2	0.830	446	341	162	0.512
59	4.20	2	57.9	70.0	40.5	0.821	445	341	162	0.507
60	4.22	2	56.8	70.2	39.8	0.811	445	341	162	0.502
61	4.23	2	55.8	70.3	39.2	0.802	444	340	161	0.497
62	4.25	2	54.7	70.4	38.5	0.793	443	340	161	0.492
63	4.26	2	53.5	70.5	37.7	0.782	442	340	161	0.486
64	4.28	2	52.5	70.6	37.0	0.772	441	339	160	0.481
65	4.29	2	51.0	70.9	36.2	0.760	440	339	160	0.475

Table 3.54 - Amino Acid to Lysine Ratio (%) Used to Estimate Amino Acid Requirements of Broiler Breeders[1]

Amino Acid	SID	Total
Lysine	100	100
Methionine	45	45
Met + Cys	89	89
Threonine	80	83
Tryptophan	23	23
Arginine	112	109
Gly + Ser	95	98
Valine	90	90
Isoleucine	92	81
Leucine	125	123
Histidine	36	35
Phenylalanine	66	65
Phe + Tyr	113	111

[1]The amino acids to lysine ratios utilized were proposed by Dorigam et al. (2017).

- The total lysine requirement was calculated considering 90.0% the ileal digestibility of lysine in the diet. Total amino acid to total lysine ratios were used (table 3.54) to estimate total amino acid requirements.

- To calculate dietary digestible and total proteins the Ne: Total N ratio was 40%.
- SID Lys to Digestible Protein ratio = 4.69%.
- SID Lys to Total Protein = 4.28%.

- Example: SID Lys, g/day = (0.939 × 100)/4.69 = 20.0 g/day of Digestible Protein. Considering a feed intake of 167.5 g/day; (20.0 × 100)/167.5 = 11.9% Digestible Protein.

- Example: SID Lys = (0.939 × 100)/4.28 = 21.93 g/day of Total Protein. Considering a feed intake of 167.5 g/day; (21.93 × 100)/167.5 = 13,1% Total Protein.

Table 3.55 - Equations Used to Estimate Total Calcium, Standardized Digestible Phosphorus (Dig. P), and Available Phosphorus (Pav) Requirements of Broiler Breeders[1,2]

Total Calcium (g/bird/d) = Maintenance Req + Gain Req + Egg Req

Total Calcium (g/bird/day) = $[(70 \times W^{0.75} + 8.29 \times G + 40 \times Egg)/(0.517 + 0.0043 \times t - 0{,}0001 \times t^2)] / 1000$

W = Average Body Weight (kg); G = Weight Gain (g/bird/day); Egg = Egg Mass (g/bird/day); t = bird's age in weeks

Example for calcium: Broiler Breeders
W = 3.743 kg; $W^{0.75}$ = 2.689 kg; G = 3.9 g/bird/day; Egg = 52.3 g/bird/day; t = 33 weeks; Estimated Feed Intake = 167 g/day
Calcium Req. = $[(70 \times 2.689 + 8.29 \times 3.9 + 40 \times 52{,}3)/(0.517+0.0043 \times 33 - 0.0001 \times 1089)] / 1000$ = 4.20 g/bird/day
% Calcium = (4.220 × 100)/167 = 2.52 %

Dig. P (g/bird/day) = Maintenance Req. + Gain Req. + Egg Req.

Dig. P (g/bird/day) = $(101 \times W^{0.75} + 4.0 \times G + 1.8\ Egg) / 1000$

Example for phosphorus: Broiler Breeders
W = 3.74 kg; $W^{0.75}$ = 2.689 kg; G = 3.9 g/bird/day; Egg = 52.3 g/bird/day; t = 33 weeks; Estimated Feed Intake = 167 g/day
Dig. P = (101 × 2.689 + 4.0 × 3.9 + 1.8 × 52.3) / 1000 = 0.381 g/day
Pav = 0.381 × 1.05 = 0.400 g/bird/day
Dig. P (%) = 0.381 x 100/167 = 0.228%
Pav (%) = 0.400 × 100/167 = 0.240 %

[1] The maintenance requirements for calcium of 70 and phosphorus of 101 mg/$kg^{0.75}$ were adapted from WPSA (1984) and Gopi et al. (2021). Weight gain requirements for calcium and phosphorus (8.29 and 4.0 mg/g, respectively), and egg mass requirements for calcium and phosphorus (40 and 1.8 mg/g) were obtained from research carried out at Laval University. The calcium digestibility coefficient was adjusted according to the bird's age.

[2] The calcium equation was adjusted according to the broiler breeders' age (24 to 65 weeks).

Table 3.56 - Total Calcium, Digestible Phosphorus, and Available Phosphorus Requirements of Broiler Breeders as a Function of Productivity, Using the Equations in Table 3.55

Age	Weight	Gain	Egg Mass	Intake	Calcium	Dig. P	Pav	Calcium	Dig. P	Pav
Weeks	kg	g/day	g/day	g/day	g/day	g/day	g/day	%	%	%
25-28	3.20-3.50	-	-	-	3.49	0.382	0.401	1.97	0.216	0.226
29	3.58	11.4	47.8	180	3.93	0.395	0.414	2.18	0.219	0.230
30	3.64	8.6	50.5	176	4.09	0.391	0.411	2.32	0.222	0.234
31	3.68	5.7	51.7	170	4.16	0.384	0.403	2.44	0.226	0.237
32	3.72	4.6	52.2	168	4.19	0.383	0.402	2.49	0.228	0.239
33	3.74	3.9	52.3	167	4.20	0.381	0.400	2.52	0.228	0.240
34	3.77	3.6	52.3	167	4.22	0.382	0.401	2.53	0.229	0.240
35	3.79	3.6	52.2	167	4.24	0.383	0.402	2.53	0.229	0.241
36	3.82	3.2	52.0	166	4.24	0.382	0.401	2.55	0.230	0.242
37	3.84	3.2	51.7	167	4.24	0.383	0.402	2.55	0.229	0.241
38	3.86	2.9	51.4	166	4.24	0.382	0.401	2.56	0.230	0.242
39	3.88	2.9	51.0	166	4.24	0.383	0.402	2.55	0.230	0.242
40	3.90	2.5	50.7	165	4.24	0.382	0.401	2.57	0.231	0.243
41	3.91	2.5	50.2	165	4.23	0.381	0.400	2.57	0.231	0.243
42	3.93	2.5	49.8	165	4.24	0.382	0.401	2.57	0.231	0.243
43	3.95	2.5	49.3	165	4.23	0.382	0.401	2.57	0.231	0.243
44	3.97	2.5	48.8	165	4.24	0.382	0.401	2.57	0.231	0.243
45	3.98	2.5	48.4	165	4.24	0.382	0.401	2.57	0.231	0.243
46	4.00	2.5	47.9	165	4.24	0.382	0.401	2.57	0.231	0.243
47	4.02	2.5	47.4	165	4.25	0.382	0.401	2.58	0.232	0.243
48	4.04	2.5	46.9	165	4.25	0.382	0.401	2.58	0.232	0.243
49	4.05	2.5	46.4	165	4.26	0.382	0.401	2.58	0.231	0.243
50	4.07	2.1	45.8	164	4.26	0.380	0.399	2.60	0.232	0.243
51	4.08	2.1	45.3	163	4.26	0.380	0.399	2.61	0.233	0.245
52	4.10	2.1	44.8	163	4.28	0.380	0.399	2.62	0.233	0.245
53	4.11	2.1	44.2	163	4.29	0.380	0.398	2.63	0.233	0.244
54	4.13	2.1	43.6	163	4.30	0.379	0.398	2.64	0.233	0.244
55	4.14	2.1	43.0	163	4.31	0.379	0.398	2.65	0.232	0.244
56	4.16	2.1	42.4	163	4.32	0.379	0.398	2.66	0.232	0.244
57	4.17	2.1	41.8	162	4.33	0.378	0.397	2.67	0.234	0.245
58	4.19	2.1	41.2	162	4.35	0.378	0.397	2.68	0.234	0.245
59	4.20	2.1	40.5	162	4.37	0.378	0.396	2.70	0.233	0.245
60	4.22	2.1	39.8	162	4.38	0.377	0.396	2.71	0.233	0.245
61	4.23	2.1	39.2	161	4.40	0.377	0.396	2.73	0.234	0.246
62	4.25	2.1	38.5	161	4.42	0.377	0.395	2.75	0.234	0.246
63	4.26	2.1	37.7	161	4.44	0.376	0.395	2.76	0.233	0.245
64	4.28	2.1	37.0	160	4.46	0.376	0.394	2.78	0.235	0.246
65	4.29	2.1	36.2	160	4.48	0.395	0.414	2.80	0.219	0.230

Table 3.57 - Nutritional Requirements of Broiler Breeders (g/bird/day)

Nutrients		Broiler Breeders					
Average Weight	kg	3.800		4.050		4.200	
Gain	g/day	4		3		2	
Egg Mass	g/day	52		48		46	
Metabolizable Energy	kcal/day	463		461		457	
Net Energy	kcal/day	346		348		349	
Diet Metab Energy	kcal/kg	2750		2750		2750	
Diet Net Energy	kcal/Kg	2054		2078		2098	
Intake	g/day	168.3		167.5		166.2	
Total Crude Protein	g/day	23.46		21.91		20.96	
Digestible Protein	g/day	21.42		20.00		19.15	
Calcium	g/day	4.23		4.45		4.97	
Available Phosphorus	g/day	0.404		0.406		0.406	
Digestible Phosphorus	g/day	0.384		0.387		0.387	
Potassium	g/day	0.752		0.748		0.743	
Sodium	g/day	0.269		0.267		0.265	
Chlorine	g/day	0.236		0.235		0.233	
Linoleic Acid	g/day	2.15		2.14		2.12	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	g/day	1.005	1.117	0.939	1.043	0.898	0.998
Methionine	g/day	0.452	0.503	0.422	0.469	0.404	0.449
Met + Cys	g/day	0.895	0.994	0.835	0.928	0.799	0.888
Threonine	g/day	0.804	0.927	0.751	0.866	0.718	0.828
Tryptophan	g/day	0.231	0.257	0.216	0.240	0.207	0.230
Arginine	g/day	1.126	1.218	1.051	1.137	1.006	1.088
Gly + Ser	g/day	0.955	1.095	0.892	1.022	0.853	0.978
Valine	g/day	0.905	1.005	0.845	0.939	0.808	0.898
Isoleucine	g/day	0.925	0.905	0.863	0.845	0.826	0.808
Leucine	g/day	1.257	1.374	1.173	1.283	1.123	1.228
Histidine	g/day	0.362	0.391	0.338	0.365	0.323	0.349
Phenylalanine	g/day	0.664	0.726	0.619	0.678	0.593	0.649
Phe + Tyr	g/day	1.136	1.240	1.061	1.158	1.015	1.108
Essential Nitrogen	g/day	1.371	1.503	1.281	1.404	1.225	1.343

Table 3.58 - Nutritional Requirements of Broiler Breeders (%)

Nutrients		Broiler Breeders					
Average Weight	kg	3.800		4.050		4.200	
Gain	g/day	4		3		2	
Egg Mass	g/day	52		48		46	
Metabolizable Energy	kcal/day	463		461		457	
Net Energy	kcal/day	346		348		349	
Diet Metab Energy	kcal/kg	2750		2750		2750	
Diet Net Energy	kcal/Kg	2054		2078		2098	
Intake	g/day	168.3		167.5		166.2	
Crude Protein	%	13.94		13.08		12.61	
Digestible Protein	%	12.73		11.94		11.52	
Calcium	%	2.51		2.66		2.99	
Available Phosphorus	%	0.240		0.242		0.245	
Digestible Phosphorus	%	0.228		0.231		0.233	
Potassium	%	0.447		0.447		0.447	
Sodium	%	0.160		0.160		0.160	
Chlorine	%	0.140		0.1404		0.140	
Linoleic Acid	%	1.276		1.276		1.276	
Amino Acids		SID	Total	SID	Total	SID	Total
Lysine	%	0.589	0.663	0.560	0.622	0.540	0.600
Methionine	%	0.265	0.298	0.252	0.280	0.243	0.270
Met + Cys	%	0.524	0.590	0.499	0.554	0.481	0.534
Threonine	%	0.471	0.550	0.448	0.516	0.432	0.498
Tryptophan	%	0.135	0.152	0.129	0.143	0.124	0.138
Arginine	%	0.660	0.723	0.627	0.678	0.605	0.654
Gly + Ser	%	0.560	0.650	0.532	0.610	0.513	0.588
Valine	%	0.530	0.597	0.504	0.560	0.486	0.540
Isoleucine	%	0.542	0.537	0.515	0.504	0.497	0.586
Leucine	%	0.736	0.815	0.700	0.765	0.675	0.738
Histidine	%	0.212	0.232	0.202	0.218	0.194	0.210
Phenylalanine	%	0.389	0.431	0.370	0.404	0.357	0.390
Phe + Tyr	%	0.666	0.736	0.633	0.690	0.610	0.666
Essential Nitrogen	%	0.589	0.892	0.764	0.837	0.737	0.807

Table 3.59 - Nutritional Program Developed Based on the Laying Rate of Broiler Breeders (g/bird/day)

	Nutritional Program					
Laying Rate, %	87 to 75		75 to 65		< 65	
Average Weight, kg	3.83		4.03		4.20	
	Recommended Concentrations					
Metabolizable Energy, kcal/day	458		453		445	
Net Energy, kcal/day	343		344		341	
Diet Metab Energy, kcal/kg	2750		2750		2750	
Diet Net Energy , kcal/kg	2064		2086		2106	
Intake, g/bird/day	167		165		162	
Crude Protein, g/day	22.97		21.30		19.07	
Digestible Protein, g/day	20.96		19.45		17.41	
Calcium, g/day	4.24		4.25		4.37	
Available Phosphorus, g/day	0.398		0.397		0.393	
Digestible Phosphorus, g/day	0.379		0.378		0.374	
Potassium, g/day	0.794		0.735		0.701	
Sodium, g/day	0.284		0.263		0.250	
Chlorine, g/day	0.250		0.231		0.220	
Linoleic Acid, g/day	2.268		2.101		2.003	
	Amino Acids					
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine, g/day	0.984	1.093	0.912	1.014	0.816	0.907
Methionine, g/day	0.443	0.491	0.411	0.456	0.367	0.408
Met + Cys, g/day	0.875	0.972	0.812	0.902	0.727	0.807
Threonine, g/day	0.787	0.907	0.730	0.841	0.653	0.753
Tryptophan, g/day	0.226	0.251	0.210	0.233	0.188	0.209
Arginine, g/day	1.102	1.190	1.022	1.104	0.914	0.989
Gly + Ser, g/day	0.934	1.070	0.867	0.993	0.776	0.889
Valine, g/day	0.885	0.983	0.821	0.912	0.735	0.816
Isoleucine, g/day	0.905	0.885	0.839	0.821	0.751	0.735
Leucine, g/day	1.230	1.343	1.141	1.246	1.021	1.116
Histidine, g/day	0.354	0.382	0.328	0.355	0.294	0.318
Phenylalanine, g/day	0.649	0.710	0.602	0.659	0.539	0.590
Phe + Tyr, g/day	1.112	1.212	1.031	1.125	0.923	1.007
Essential Nitrogen, g/day	1.342	1.470	1.245	1.363	1.114	1.221

Table 3.60 - Nutritional Program Developed Based on the Laying Rate of Broiler Breeders (%)

	Nutritional Program					
Laying Rate, %	87 to 75		75 to 65		< 65	
Average Weight, kg	3.83		4.03		4.20	
	Recommended Concentrations					
Metabolizable Energy, kcal/day	458		453		445	
Net Energy, Kcal/day	343		344		341	
Diet Metab Energy, kcal/kg	2750		2750		2750	
Diet Net Energy, kcal/kg	2064		2086		2106	
Intake, g/bird/day	167		165		162	
Crude Protein, %	13.75		12.91		11.77	
Digestible Protein, %	12.56		11.79		10.74	
Calcium, %	2.55		2.58		2.70	
Available Phosphorus, %	0.239		0.241		0.243	
Digestible Phosphorus, %	0.228		0.230		0.231	
Potassium, %	0.477		0.446		0.433	
Sodium, %	0.170		0.159		0.155	
Chlorine, %	0.150		0.140		0.136	
Linoleic Acid, %	1.362		1.274		1.237	
Amino Acids	SID	Total	SID	Total	SID	Total
Lysine, %	0.589	0.654	0.553	0.614	0.504	0.560
Methionine, %	0.265	0.294	0.249	0.276	0.227	0.252
Met + Cys, %	0.524	0.582	0.492	0.546	0.449	0.498
Threonine, %	0.471	0.543	0.442	0.510	0.403	0.465
Tryptophan, %	0.135	0.150	0.127	0.141	0.116	0.129
Arginine, %	0.660	0.713	0.619	0.669	0.564	0.610
Gly + Ser, %	0.560	0.641	0.525	0.602	0.479	0.549
Valine, %	0.530	0.589	0.498	0.553	0.454	0.504
Isoleucine, %	0.542	0.530	0.509	0.497	0.464	0.454
Leucine, %	0.736	0.804	0.691	0.755	0.630	0.689
Histidine, %	0.212	0.229	0.199	0.215	0.181	0.196
Phenylalanine, %	0.389	0.425	0.365	0.399	0.333	0.364
Phe + Tyr, %	0.666	0.726	0.625	0.682	0.570	0.622
Essential Nitrogen, %	0.804	0.880	0.755	0.826	0.688	0.754

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CHAPTER 4

Nutritional Requirements of Japanese and European Quails

Fernando G. P. Costa[1], Matheus R. de Lima[1],
Danilo V. Gonçalves[1] and Horacio S. Rostagno[2]

[1] Department of Animal Science, Federal University of Paraíba, Areia, Brazil
[2] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

Quail rearing for meat and egg production in Brazil has attracted attention due to the increasing number of production flocks and egg production per bird. These achievements are supported by research on housing, nutrition, genetics, health, and the application of modern technologies in commercial farms. In recent years, advancements in breeding Japanese quails led to heavier and more productive birds with larger eggs. These fast changes have not allowed for the standardization of commercial strains, contributing to variations in performance results.

The anatomy, physiology, and behavior of Japanese quails differ from those of commercial laying hens; therefore, they require specific nutritional needs, justifying research to determine the requirements for optimal performance.

For a comprehensive understanding of the nutritional requirements of quails, it is essential to consider various factors that can affect their nutritional needs. These include breed, strain, sex, feed intake, dietary energy level, suitability for meat or egg production, nutrient availability, temperature, air humidity, and the health status of the flock. Moreover, the nutritional program is crucial to ensure the health and well-being of the birds, as well as to maximize meat and egg production.

The nutritional requirement tables for Japanese and European quails presented here were obtained by compiling the results of studies carried out at the Federal University of Northern Tocantins, the Federal University of Paraiba, the Federal University of the Semi-Arid Region, and the Federal University of Viçosa, in particular, as well as by other research institutions.

Feed intake of birds can be estimated through the correlation between the metabolizable energy (ME) requirement and dietary energy values. It is important to note, that when birds are fed *ad libitum*, feed intake, and, more specifically, feed conversion ratio depend largely on the dietary energy content. The tables include examples of nutritional requirements of Japanese and European quails, for diets containing dietary energy values commonly adopted in Brazil. For other dietary energy values, corresponding adjustments in feed intake and other dietary nutrients should be made.

In order to allow dynamic calculation of the quails' nutritional requirements, nutritionists need to apply models that calculate daily nutrient requirements as a function of birds' performance. For this purpose, equations for the daily nutritional requirements for the main nutrients were developed for Japanese quails during the grower, developer, and laying phases considering parameters that can be easily measured, such as body weight, weight gain, and egg mass. Additionally, recommendations for the nutritional requirements of European quails were included, although there is a lack of information about optimal levels for European quails.

Amino acid requirements of quails were determined using diets based mainly on corn and soybean meal. When other feedstuffs are used, corrections should be applied to take into account nutrient digestibility in these feedstuffs. This is the reason why requirements are expressed on standardized ileal digestible (SID) amino acids, which in previous editions were called true digestible amino acids.

Equations to determine the daily requirements of ME corrected for nitrogen balance, crude protein, and available phosphorus were developed for growing Japanese quails in the grower and developer phases. Due to the lack of information, SID lysine requirements for quails during the grower phase were estimated according to the values obtained by Silva et al. (2020). SID lysine requirements for quails during the developer phase were estimated according to data from the thesis of the Federal University of Paraiba (Felix, 2020). The amino acid/lysine ratios used during the growing and laying phases are from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

The daily requirements of laying Japanese quails were estimated as the amount of nutrients per bird per day through equations for ME, protein, and SID lysine. The total lysine requirement for growing and laying quails was calculated considering the average standardized ileal digestibility coefficients of lysine of 90 and 89%, respectively. For European quails, the average standardized ileal digestibility coefficient of lysine was 87.5%. The requirements of other essential amino acids were determined according to the ideal protein concept, expressed as SID amino acids and total amino acids.

In the absence of recent information on specific nutrient level recommendations, it was decided to adopt the values of quail requirements

listed in the previous edition of the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

The nutritional requirements of European quails were determined through the results of nine dose-response experiments (metabolizable energy, crude protein, calcium, phosphorus, SID lysine, SID methionine + cystine, SID threonine, SID tryptophan, and SID valine), during the starter phase (1 to 14 days) and the grower phase (15 to 35 days). The requirement values of the remaining essential amino acids and nutrients were obtained from the Tables for European Quails (Silva & Costa, 2009).

During the starter phase of European quails, quadratic equations were used to determine the needs of metabolizable energy, available phosphorus, SID lysine, and SID threonine, considering weight gain as the main variable. Adjusted quadratic equations for the feed conversion ratio were used to estimate the values of calcium, SID methionine + cystine, SID tryptophan, and SID valine.

To estimate the requirements during the grower phase of European quails, adjusted quadratic equations for weight gain were used to determine the values of metabolizable energy, SID lysine, and SID valine. Adjusted quadratic equations for feed conversion ratio were used to determine the needs of calcium, available phosphorus, SID methionine + cystine, and SID threonine. Crude protein showed a linear increasing effect in both phases, as well as SID tryptophan during the grower phase.

Nutritional Requirements of Japanese Quails

Table 4.01 - Equations Used to Estimate Metabolizable Energy (ME) Requirements (kcal/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases[1]

Grower Phase (01 to 14 days)

ME Req. (kcal/bird/day) = 54.96 x $W^{0.67}$ + 8.30 x G

Developer Phase (15 to 35 days)

ME Req. (kcal/bird/day) = 92.11 x $W^{0.67}$ + 8.91 x G

W: Body Weight (kg); G: Weight Gain (g/bird/day)
ME Req.: Metabolizable Energy Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)
W: 0.025 kg/bird, $W^{0.67}$ = 0.08445; G: 2.34 g/bird/day;
Dietary ME: 2.850 kcal/g

ME Req.: 54.96 x 0.08445 + 8.30 x 2.34; ME Req.: 24.064 kcal/bird/day
Estimated Feed Intake: (24.064/2.850): 8.44 g/bird/day

Example 2: Quails during the Developer Phase (15-35 days of age)
W: 0.080 kg/bird, $W^{0,67}$ = 0.1841; G: 3.12 g/bird/day;
Dietary ME: 2.850 kcal/g

ME Req.: 92.11 x 0.1841 + 8.91 x 3.12; ME Req.: 44.757 kcal/bird/day
Estimated Feed Intake: (44.757/2.850); 15.7 g/bird/day

[1] Metabolizable Energy Requirements of Japanese Quails from 01-35 days of age were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO) and Vieira et al. (2020). (Mathematical models to predict the energy requirements of Japanese quails from 01-35 days of age. Research, Society and Development, 9(8), e777986544-e777986544). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020).

Table 4.02 - Equations Used to Estimate Crude Protein (CP) Requirements (g/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases[1]

Grower Phase (01 to 14 days)

$$\textbf{CP Req. (g/bird/day)} = 2.095 \times W^{0.67} + 0.851 \times G$$

Developer Phase (15 to 35 days)

$$\textbf{CP Req. (g/bird/day)} = 6.30 \times W^{0.67} + 0.894 \times G$$

W: Body Weight (kg); G: Weight Gain (g/bird/day)
CP Req.: Crude Protein Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)
W: 0.025 kg/bird, $W^{0.67}$ = 0.08445; G: 2.34 g/bird/day
Estimated Feed Intake: 8.44 g/bird/day

CP Req.: 2.095 x 0.08445 + 0.851 x 2.34; CP Req.: 2.168 g/bird/day;
Dietary CP: 25.7%

Example 2: Quails during the Developer Phase (15-35 days of age)
W: 0.080 kg/bird, $W^{0.67}$ = 0.1841; G: 3.12 g/bird/day
Estimated Feed Intake: 15.7 g/bird/day

CP Req.: 6.30 x 0.1841 + 0.894 x 3.12; CP Req.: 3.949 g/bird/day;
Dietary CP: 25.1%

[1] Crude Protein Requirements of Japanese Quails from 01-35 days of age were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO) and Vieira et al. (2020) (Mathematical models to predict Japanese quail crude protein requirements from 01 to 35 days old, Research, Society and Development, 9(8), e763986160-e763986160). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020).

Table 4.03 - Equations Used to Estimated Calcium (Ca) Requirements (mg/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases[1]

Grower Phase (01 to 14 days)

Ca Req. (mg/bird/day) = 60.86 x $W^{0.67}$ + 24.91 x G

Developer Phase (15 to 35 days)

Ca Req. (mg/bird/day) = 223.58 x $W^{0.67}$ + 15.67 x G

W: Body Weight (kg); G: Weight Gain (g/bird/day)
Ca Req.: Calcium Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)
W: 0.025 kg/bird, $W^{0.67}$ = 0.08445; G: 2.34 g/bird/day

Ca Req.: 60.86 x 0.08445 + 24.91 x 2.34; Ca Req.: 63.429 mg/bird/day
Estimated Feed Intake: 8.44 g/bird/day
Dietary Ca: 0.752%

Example 2: Quails during the Developer Phase (15-35 days of age)
W: 0.080 kg/bird, $W^{0.67}$ = 0.1841; G: 3.12 g/bird/day

Ca Req.: 223.58 x 0.1841 + 15.67 x 3.12; Ca Req.: 90.052 mg/bird/day
Estimated Feed Intake: 15.70 g/bird/day
Dietary Ca: 0.574%

[1] Calcium Requirements of Japanese Quails from 01-35 days of age were estimated according to Souza (2023) (Ph.D. Thesis, UFNT – Araguaína/TO). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.04 - Equations Used to Estimated Available Phosphorus (Pav) Requirements (mg/bird/day) of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases[1]

Grower Phase (01 to 14 days)

Pav Req. (mg/bird/day) = 43.18 x W $^{0.67}$ + 14.12 x G

Developer Phase (15 to 35 days)

Pav Req. (mg/bird/day) = 106.35 x W $^{0.67}$ + 8.48 x G

W: Body Weight (kg); G: Weight Gain (g/bird/day)
Pav Req.: Available Phosphorus Requirement

Example 1: Quails during the Grower Phase (01-14 days of age)
W: 0.025 kg/bird, W $^{0.67}$ = 0.08445; G: 2.34 g/bird/day

Pav Req.: 43.18 x 0.08445 + 14.12 x 2.34; Pav Req: 36.6874 mg/bird/day
Estimated Feed Intake: 8.44 g/bird/day
Dietary Pav: 0.435%

Example 2: Quails during the Developer Phase (15-35 days of age)
W: 0.080 kg/bird, W $^{0.67}$ = 0.1841; G: 3.12 g/bird/day

Pav Req.: 106.35 x 0.1841 + 8.48 x 3.12; Pav Req.: 46.037 mg/bird/day
Estimated Feed Intake: 15.7 g/bird/day
Dietary Pav: 0.293%

[1] Available Phosphorus Requirements of Japanese Quails from 01-35 days of age were estimated according to Souza (2023) (Ph.D. Thesis, UFNT – Araguaína/TO). Feed Intake, Metabolic Weight, and Weight Gain were estimated according to Oliveira (2020) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.05 - Dietary Lysine Level and Amino Acid to Lysine Ratio (%) Used to Estimate Amino Acid Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35) Phases[1]

Amino Acid[1]		Phase			
		Grower 1 to 14 days		Developer 15 to 35 days	
		SID	Total	SID	Total
Dietary Lysine	%	1.400	1.556	1.150	1.278
Lysine	%	100	100	100	100
Methionine	%	40	40	38	38
Methionine + Cysteine	%	68	68	67	67
Threonine	%	67	70	71	74
Tryptophan	%	17	17	19	19
Arginine	%	108	105	106	103
Glycine + Serine	%	89	92	89	92
Valine	%	82	83	86	87
Isoleucine	%	64	65	71	72
Leucine	%	137	136	137	136
Histidine	%	29	29	29	29
Phenylalanine	%	77	77	77	77
Phenylalanine + Tyrosine	%	146	145	146	145

[1] Standardized Digestible Lysine Requirement of Japanese Quails in the Grower Phase was estimated according to Silva et al. (2020), and in the Developer Phase was estimated according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB) and Lima et al (2016). The Amino Acid to Lysine Ratios were from The Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

Table 4.06 - Nutritional Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases (kcal, g, or mg/day)[1]

Phase (days)		Grower (1-14)		Developer (15-35)	
Body Weight	kg	0.025		0.080	
Weight Gain	g/day	2.34		3.12	
Metabolizable Energy	kcal/day	24.06		44.76	
Diet Metabolizable Energy	kcal/kg	2850		2850	
Feed Intake	g/day	8.44		15.70	
Crude Protein	g/day	2.17		3.95	
Calcium	mg/day	63.43		90.05	
Available Phosphorus	mg/day	36.69		46.04	
Digestible Phosphorus	mg/day	33.02		41.44	
Sodium	mg/day	17.30		33.60	
Amino Acid		SID	Total	SID	Total
Lysine	g/day	0.219	0.243	0.258	0.287
Methionine	g/day	0.087	0.097	0.098	0.109
Methionine + Cysteine	g/day	0.149	0.166	0.173	0.192
Threonine	g/day	0.147	0.163	0.183	0.203
Tryptophan	g/day	0.037	0.041	0.049	0.054
Arginine	g/day	0.236	0.262	0.274	0.304
Glycine + Serine	g/day	0.195	0.217	0.230	0.256
Valine	g/day	0.179	0.199	0.222	0.247
Isoleucine	g/day	0.140	0.156	0.183	0.203
Leucine	g/day	0.300	0.333	0.354	0.393
Histidine	g/day	0.063	0.070	0.075	0.083
Phenylalanine	g/day	0.168	0.187	0.199	0.221
Phenylalanine + Tyrosine	g/day	0.319	0.354	0.377	0.419

[1] Sodium Requirement from the Brazilian Tables Poultry and Swine (Rostagno et al., 2017). SID Lysine Requirement of Japanese Quails in the Grower Phase was according to Silva et al. (2020), and in the Developer Phase was according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB). The other essential amino acid requirements were estimated considering the Amino Acid to Lysine Ratio in Table 4.05.

Table 4.07 - Nutritional Requirements of Japanese Quails During the Grower (01 to 14 days) and Developer (15 to 35 days) Phases (%)

Phase (days)		Grower (1-14)		Developer (15-35)	
Body Weight	kg	0.025		0.080	
Weight Gain	g/day	2.34		3.12	
Metabolizable Energy	kcal/day	24.06		44.76	
Diet Metabolizable Energy	kcal/kg	2850		2850	
Feed Intake	g/day	8.44		15.7	
Crude Protein	%	25.7		25.2	
Calcium	%	0.752		0.574	
Available Phosphorus	%	0.435		0.293	
Digestible Phosphorus	%	0.391		0.264	
Sodium	%	0.205		0.214	
Amino Acid		Dig.	Total	Dig.	Total
Lysine	%	1.400	1.556	1.150	1.278
Methionine	%	0.560	0.622	0.437	0.486
Methionine + Cysteine	%	0.952	1.058	0.771	0.857
Threonine	%	0.938	1.042	0.817	0.908
Tryptophan	%	0.238	0.264	0.219	0.243
Arginine	%	1.512	1.680	1.219	1.354
Glycine + Serine	%	1.246	1.384	1.024	1.138
Valine	%	1.148	1.276	0.989	1.099
Isoleucine	%	0.896	0.996	0.817	0.908
Leucine	%	1.918	2.131	1.576	1.751
Histidine	%	0.406	0.451	0.334	0.371
Phenylalanine	%	1.078	1.198	0.886	0.984
Phenylalanine + Tyrosine	%	2.044	2.271	1.679	1.866

[1] Sodium Requirement from the Brazilian Tables Poultry and Swine (Rostagno et al., 2017). SID Lysine Requirement of Japanese Quails in the Grower Phase was according to Silva et al. (2020), and in the Developer Phase was according to Felix (2020) (Ph.D. Thesis – UFPB, Areia/PB). The other essential amino acid requirements were estimated considering the Amino Acid to Lysine Ratio in Table 4.05.

Table 4.08 - Equation Used to Estimate Metabolizable Energy (ME) Requirements and Feed Intake of Laying Japanese Quails (kcal or g/bird/day)[1]

ME Req (kcal/bird/day) = 150.37 x $W^{0.67}$ + 6.01 x G + 2.349 x Egg

W: Body Weight (kg); G: Weight Gain (g/bird/day)
Egg = Egg Mass (g egg/bird/day) = $\frac{\%\ Lay}{100}$ x Egg Weight

Example:
Laying Japanese Quails at 22 weeks of age
W = 0.179 kg; $W^{0.67}$ = 0.3150; G = 0.09 g/bird/day;
Egg = 10.72 g/bird/day
Dietary ME = 2.850 kcal/g

ME Req. = (150.37 x 0.3150) + (6.01 x 0.09 + (2.349 x 10.72)
ME Req. = 47.3666 + 0.5409 + 25.1812
ME Req. = 73.1 kcal/bird/day
Estimated Feed Intake = 73.1 / 2.850 = 25.7 g/bird/day

[1] Metabolizable Energy Requirements of Laying Japanese Quails were estimated according to Bourdon (2022) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.09 - Equation Used to Estimate Crude Protein (CP) Requirements of Laying Japanese Quails (g/bird/day)[1]

CP Req. (g/bird/day) = 6.99 x W $^{0.67}$ + 0.662 x G + 0.228 x Egg

W: Body Weight (kg); G: Weight Gain (g/bird/day)
Egg = Egg Mass (g egg/bird/day) = $\frac{\%\ \text{Lay}}{100}$ x Egg Weight

Example:
Laying Japanese Quails at 22 weeks of age
W = 0.179 kg; W $^{0.67}$ = 0.3150; G = 0.09 g/bird/day;
Egg = 10.72 g/bird/day
Dietary ME = 2.850 kcal/g

CP Req. = (6.99 x 0.31508) + (0.662 x 0.09) + (0.228 x 10.72)
CP Req. = 2.2018 + 0.0596 + 2.4442
CP Req. = 4.7056 g/bird/day
Estimated Feed Intake = 25.7 g/bird/day (Table 4.08)
Dietary CP = 18.3%

[1] Crude Protein Requirements of Laying Japanese Quails were estimated according to Bourdon (2023) (Ph.D. Thesis, UFNT – Araguaína/TO).

Table 4.10 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Laying Japanese Quails (mg/bird/day)[1]

SID Lys Req. (mg/bird/day) = 156 x W $^{0.75}$ + 21.1 Egg

W: Body Weight (kg)
Egg = Egg Mass (g egg/bird/day) = $\frac{\%\ \text{Lay}}{100}$ x Egg Weight

Example:
Laying Japanese Quails at 22 weeks of age
W = 0.179 kg; W $^{0.75}$ = 0.2752; Egg = 10.72 g/bird/day
Dietary ME = 2.850 kcal/g

SID Lys Req. = (156 x 0.2752) + (21.1 x 10.72)
SID Lys Req. = 42.9312 + 226.192
SID Lys Req. = 269.13 mg/bird/day
Estimated Feed Intake = 25.7 g/bird/day (Table 4.08)
Dietary SID Lys = 1.048%

[1] Standardized Digestible Lysine Requirements of Laying Japanese Quails were estimated according to Silva (2019).

Table 4.11 - Performance, Metabolizable Energy (ME), Crude Protein (CP), Standardized Digestible Lysine (SID Lys) Requirements and Feed Intake of Japanese Quails as a Function of Productivity

Age	Weight	Gain	Egg Mass	ME[1]	Intake[1]	Protein[2]	Protein[2]	SID Lys[3]	SID Lys[3]
weeks	kg	g/day	g/day	kcal/day	g/day	g/day	%	g/day	%
8	0.156	1.30	4.7	–[4]	–[4]	–[4]	–[4]	–[4]	–[4]
14	0.160	0.05	10.7	69	24.4	4.52	18.5	0.265	1.088
22	0.179	0.09	10.7	73	25.7	4.71	18.3	0.269	1.048
29	0.187	0.01	10.6	74	25.9	4.70	18.1	0.269	1.036
35	0.183	0.03	10.5	73	25.6	4.64	18.1	0.264	1.032
48	0.186	0.08	9.9	72	25.4	4.56	18.0	0.252	0.993
55	0.186	0.01	9.6	71	25.0	4.46	17.8	0.247	0.986
62	0.187	0.02	9.4	71	24.9	4.42	17.7	0.242	0.972

[1] Determined by the equation in Table 4.08, using the dietary level of 2850 kcal ME/kg.
[2] Determined by the equation in Table 4.09.
[3] Determined by the equation in Table 4.10.
[4] Use the requirements of week 14.

Table 4.12 - Amino Acid to Lysine Ratio Used to Estimate the Amino Acid Requirements of Laying Japanese Quails[1]

Amino Acid		Laying	
		SID	Total
Lysine	%	100	100
Methionine	%	45	44
Methionine + Cysteine	%	82	81
Threonine	%	61	64
Tryptophan	%	21	21
Arginine	%	115	112
Glycine + Serine	%	114	119
Valine	%	75	76
Isoleucine	%	65	65
Leucine	%	150	148
Histidine	%	42	41
Phenylalanine	%	74	73
Phenylalanine + Tyrosine	%	135	133

[1] Values obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017).

Table 4.13 - Nutritional Requirements of Laying Japanese Quails (kcal or g/bird/day)[1]

Nutrients	Laying Japanese Quails			
Body Weight, g	179		186	
Gain, g/day	0.09		0.08	
Egg Mass, g/day	10.7		9.9	
Metabolizable Energy, kcal/day	73.2		72.3	
Diet Metabolizable Energy, kcal/kg	2850		2850	
Feed Intake, g/day	25.7		25.4	
Crude Protein, g/day	4.71		4.56	
Calcium, g/day	0.773		0.773	
Available Phosphorus, g/day	0.080		0.080	
Digestible Phosphorus, g/day	0.073		0.073	
Sodium, g/day	0.040		0.040	
Linoleic Acid, g/day	0.256		0.256	
Amino Acid	SID	Total	SID	Total
Lysine, g/day	0.269	0.302	0.252	0.283
Methionine, g/day	0.121	0.133	0.113	0.125
Methionine + Cysteine, g/day	0.221	0.245	0.207	0.229
Threonine, g/day	0.164	0.194	0.154	0.181
Tryptophan, g/day	0.057	0.064	0.053	0.059
Arginine, g/day	0.310	0.339	0.290	0.317
Glycine + Serine, g/day	0.307	0.360	0.287	0.337
Valine, g/day	0.202	0.230	0.189	0.215
Isoleucine, g/day	0.175	0.197	0.164	0.184
Leucine, g/day	0.404	0.448	0.378	0.419
Histidine, g/day	0.113	0.124	0.106	0.116
Phenylalanine, g/day	0.199	0.221	0.186	0.207
Phe + Tyr, g/day	0.364	0.402	0.340	0.376

[1] Calcium, Available Phosphorus, Digestible Phosphorus, Sodium, and Linoleic Acid Requirements were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

Table 4.14 - Nutritional Requirements of Laying Japanese Quails (%)[1]

Nutrients	Laying Japanese Quails			
Body Weight, g	179		186	
Gain, g/day	0.09		0.08	
Egg Mass, g/day	10.7		9.9	
Metabolizable Energy, kcal/day	73.2		72.3	
Diet Metabolizable Energy, kcal/kg	2850		2850	
Feed Intake, g/day	25.7		25.4	
Crude Protein, %	18.3		18.0	
Calcium, %	3.01		3.04	
Available Phosphorus, %	0.311		0.080	
Digestible Phosphorus, %	0.284		0.073	
Sodium, %	0.156		0.157	
Linoleic Acid, %	0.996		1.008	
Amino Acid	SID	Total	SID	Total
Lysine, %	1.048	1.177	0.993	1.116
Methionine, %	0.472	0.518	0.447	0.491
Methionine + Cysteine, %	0.859	0.953	0.814	0.904
Threonine, %	0.639	0.753	0.606	0.714
Tryptophan, %	0.220	0.247	0.209	0.234
Arginine, %	1.205	1.318	1.142	1.250
Glycine + Serine, %	1.195	1.401	1.132	1.328
Valine, %	0.786	0.895	0.745	0.848
Isoleucine, %	0.681	0.765	0.645	0.725
Leucine, %	1.572	1.742	1.490	1.652
Histidine, %	0.440	0.483	0.417	0.458
Phenylalanine, %	0.776	0.859	0.735	0.815
Phe + Tyr, %	1.415	1.565	1.341	1.484

[1] Calcium, Available Phosphorus, Digestible Phosphorus, Sodium, and Linoleic Acid Requirements were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).

Nutritional Requirements of European Quails

Table 4.15 - Dietary Lysine Level and Amino Acid to Lysine Ratio (%) Used to Estimate the Amino Acid Requirements of European Quails During Starter, Grower, and Total Production Period

Phase	Starter		Grower		Total	
Age (days)	1 – 14		15 - 35		1 - 35	
Amino Acid	SID	Total[1]	SID	Total[1]	SID	Total[1]
Dietary Lysine	1.401%	1.595%	1.178%	1.351%	1.27%	1.45%
Lysine	100	100	100	100	100	100
Methionine[2]	44	42	37	36	40	38
Methionine + Cysteine	82	85	73	71	77	77
Threonine	87	90	76	78	80	83
Tryptophan	15	14	15	15	15	15
Arginine[2]	140	133	146	137	144	135
Glycine + Serine[3]	89	92	89	92	89	92
Valine[2]	81	80	67	66	73	72
Isoleucine[2]	83	80	88	85	86	83
Leucine[2]	176	163	203	187	192	177
Histidine[2]	57	54	62	58	60	56
Phenylalanine[2]	101	96	110	104	106	101
Phenylalanine+Tyrosine[2]	148	142	161	154	156	149

[1] The values were estimated using the digestibility coefficients from Tables for European Quails 2009 (Silva e Costa, 2009).

[2] Amino Acid to Lysine Ratios were obtained from the Tables for European Quails 2009 (Silva e Costa, 2009).

[3] Amino Acid to Lysine Ratios were obtained from the Brazilian Tables for Poultry and Swine (Rostagno et al., 2017), for Japanese Quails in the Starter and Grower Phases.

Table 4.16 - Equations Used to Estimate Metabolizable Energy, Crude Protein, Calcium, Phosphorus, SID Lysine, SID Methionine + Cystine, SID Threonine, SID Tryptophan, and SID Valine Requirements of Europeans Quails During the Starter and Grower Phases

Nutrients	Tested Levels	Variable	Equation	Effect	R^2
Starter (1 to 14 days)					
ME, kcal/kg	2900 ± 200	G	$-0.00000443X^2 + 0.02628X - 34.93071$	Quadratic	0.8509
CP, %	23 ± 2	FCR	$-0.14383X + 6.29883$	Linear	0.8988
Ca, %	0.850 ± 0.170	FCR	$-1.41943X^2 + 2.47279X + 0.7056$	Quadratic	0.9989
P, %	0.320 ± 0.064	G	$-34.58333X^2 + 25.10556X + 0.46289$	Quadratic	0.8590
SID Lys, %	1.370 ± 0.274	G	$0.785X^2 - 2.19972X + 6.31136$	Quadratic	0.9360
SID Met+Cis, %	1.040 ± 0.208	FCR	$13.54517X^2 - 31.287X + 20.4106$	Quadratic	0.9637
SID Thr, %	1.040 ± 0.208	G	$-8.73409X^2 + 21.3187X - 6.17068$	Quadratic	0.8424
SID Trp, %	0.190 ± 0.038	FCR	$-6.16667X^2 - 2.56667X + 2.69967$	Quadratic	0.8514
SID Val, %	1.010 ± 0.202	FCR	$9.36574X^2 - 21.18611X + 13.84527$	Quadratic	0.9295
Grower (15 to 35 days)					
ME, kcal/kg	3050 ± 200	G	$-0.00001408X^2 + 0.08764X - 127.94762$	Quadratic	0.8734
CP, %	20 ± 2	FCR	$-0.189X + 6.75467$	Linear	0.9502
Ca, %	0.700 ± 0.140	FCR	$5.50278X^2 - 7.75651X + 6.7185$	Quadratic	0.9431
P, %	0.270 ± 0.054	FCR	$97.58333X^2 - 62.21078X + 13.79108$	Quadratic	0.8737
SID Lys, %	1.020 ± 0.204	G	$-13.45652X^2 + 31.69957X - 11.5464$	Quadratic	0.9032
SID Met+Cis, %	0.800 ± 0.160	FCR	$15.53978X^2 - 26.56586X + 14.60265$	Quadratic	0.9484
SID Thr, %	0.780 ± 0.156	FCR	$8.1278X^2 - 1\ 4.5602X + 9.78411$	Quadratic	0.9735
SID Trp, %	0.150 ± 0.030	FCR	$-21.79825X + 7.16667$	Linear	0.8854
SID Val, %	0.760 ± 0.152	G	$-34.33242X^2 + 54.33137X - 14.57972$	Quadratic	0.8589

G: Weight Gain
FCR: Feed Conversion Ratio

Table 4.17 - Nutritional Requirements of European Quails During the Starter, Grower, and Total Production Period (kcal or g/bird/day)

Phase	Starter		Grower		Total	
	(1 to 14)		(15 to 35)		(1 to 35)	
Body Weight, g	8.5 – 63.52		63.52 – 236.98		8.5 – 236.98	
Gain, g/day	3.93		8.26		6.53	
Metab. Energy, kcal/day	34.23		70.36		55.91	
Diet Metab. Energy, kcal/kg	2966		3112		3054	
Intake, g/day	11.54		22.61		18.18	
Crude Protein, g/day	2.885		5.200		4.327	
Calcium, g/day	0.101		0.159		0.140	
Avail. Phosphorus, g/day	0.042		0.072		0.061	
Dig. Phosphorus[1], g/day	0.037		0.065		0.054	
Sodium[2], g/day	0.020		0.034		0.029	
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine, g/day	0.162	0.184	0.266	0.305	0.230	0.263
Methionine, g/day	0.071	0.077	0.099	0.109	0.092	0.101
Met + Cys, g/day	0.133	0.156	0.193	0.218	0.177	0.203
Threonine, g/day	0.141	0.165	0.203	0.239	0.186	0.219
Tryptophan, g/day	0.024	0.027	0.041	0.046	0.035	0.039
Arginine, g/day	0.226	0.245	0.389	0.418	0.330	0.356
Gly + Ser, g/day	0.144	0.169	0.237	0.281	0.205	0.242
Valine, g/day	0.131	0.147	0.179	0.202	0.169	0.191
Isoleucine, g/day	0.285	0.300	0.541	0.571	0.440	0.465
Leucine, g/day	0.285	0.300	0.541	0.571	0.440	0.465
Histidine, g/day	0.092	0.099	0.165	0.177	0.138	0.148
Phenylalanine, g/day	0.163	0.177	0.293	0.318	0.244	0.265
Phe +Tyr, g/day	0.239	0.261	0.429	0.470	0.358	0.392

[1] Values were estimated using the phosphorus digestibility coefficients for Japanese Quails in the Starter and Grower Phase according to the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).
[2] Values obtained from the Tables for European Quails, 2009 (Silva e Costa, 2009).

Table 4.18 - Nutritional Requirements of European Quails During the Starter, Grower, and Total Production Period (%)

Phase	Starter		Grower		Total	
	(1 to 14)		(15 to 35)		(1 to 35)	
Body Weight, g	8.5 – 63.52		63.52 – 236.98		8.5 – 236.98	
Gain, g/day	3.93		8.26		6.53	
Metab. Energy, kcal/day	34.23		70.36		55.91	
Diet Metab. Energy, kcal/kg	2966		3112		3054	
Intake, g/day	11.54		22.61		18.18	
Crude Protein, %	25.0		23.0		23.8	
Calcium, %	0.871		0.705		0.771	
Avail. Phosphorus, %	0.363		0.318		0.336	
Dig. Phosphorus[1], %	0.323		0.283		0.299	
Sodium[2], %	0.170		0.150		0.158	
Amino Acid	SID	Total	SID	Total	SID	Total
Lysine, %	1.401	1.595	1.178	1.351	1.267	1.449
Methionine, %	0.611	0.666	0.438	0.481	0.507	0.555
Met + Cys, %	1.155	1.355	0.855	0.962	0.975	1.119
Threonine, %	1.220	1.432	0.896	1.056	1.026	1.206
Tryptophan, %	0.208	0.230	0.180	0.204	0.191	0.214
Arginine, %	1.961	2.121	1.720	1.851	1.816	1.959
Gly + Ser, %	1.247	1.467	1.048	1.243	1.128	1.333
Valine, %	1.131	1.277	0.791	0.895	0.927	1.048
Isoleucine, %	2.466	2.600	2.391	2.526	2.421	2.556
Leucine, %	2.466	2.600	2.391	2.526	2.421	2.556
Histidine, %	0.799	0.861	0.730	0.784	0.758	0.815
Phenylalanine, %	1.415	1.531	1.296	1.405	1.343	1.456
Phe +Tyr, %	2.073	2.265	1.897	2.081	1.967	2.154

[1] Values were estimated using the phosphorus digestibility coefficients for Japanese Quails in the Starter and Grower Phase according to the Brazilian Tables for Poultry and Swine (Rostagno et al. 2017).
[2] Values obtained from the Tables for European Quails, 2009 (Silva e Costa, 2009).

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CHAPTER 5

Nutritional Requirements of Growing Swine

Melissa I. Hannas[1], Horacio S. Rostagno[1] and Erica B. Schultz[1]

[1] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

The nutritional requirements of swine are influenced by several factors, such as genetics, sex, gender, development stage, feed intake, dietary energy level, nutrient bioavailability, thermal environment, and health conditions, among others.

This recommendation mentions the requirements of the main nutrients: crude and digestible protein, total and digestible amino acids, calcium, available and digestible phosphorus, sodium, potassium, chlorine, and linoleic acid, as well as metabolizable energy requirements. The recommendations for trace minerals and vitamins are assumed to be adequately met, provided the levels supplied are equivalent to those described in 'Chapter 7 of this publication.

The nutritional requirements of growing swine present in this chapter were established according to the systems and procedures adopted in the 4th Edition of the Brazilian Tables for Poultry and Swine – Composition of Feedstuffs and Nutritional Requirements (Rostagno et al., 2017). For estimating the nutritional requirements, the bases of integrated factorial and empirical models, with changes in procedures, estimates, and parameters indices highlighted throughout this chapter.

In updating the nutritional requirements, the impacts of genetic improvement on animal performance over the past five years were considered. The impact resulted in changes in the growth curve of the animals and an increase in the final live weight at the same age, as evidenced by higher daily weight gain, and improved feed conversion ratio.

Models that allow the adjustment of daily requirements based on animal performance were developed to dynamically determine the requirements of growing swine. Data from numerous experiments and lineage guidelines were utilized to establish the parameters of the Gompertz equation models. Subsequently, growth curves were established to estimate the average live weight and daily weight gain of swine in different phases and to set new performance targets, with energy and nutrient equations redefined.

Considering the differences among the numerous systems and models of swine production, additional performance curves can be established, and the models can also be applied to determine the daily requirements of Metabolizable Energy (ME) and digestible lysine for these animals.

The nutritional recommendations were established for herds of high genetic potential and considered estimates for barrows, gilts, entire males up to 100 kg and immuno-castrated from 100 kg onwards, and mixed-sex pigs of high and standard performance.

In this 5th edition, the recommended nutrient levels as nutritional requirements for growing swine were established through dose-response experiments conducted at UFV, and experiments carried out in Brazil and abroad. In addition, a systematic literature review of indexed journals incorporated data from scientific articles from the Web of Science database from the years 2016 to 2023, and dissertations and theses on swine at different ages and production stages. The systematic search was conducted based on keywords, according to the target nutrient. Responses associated with observations on the behavior of commercial herds in various regions of Brazil were also included.

In the development of the equations for predicting metabolizable energy requirements, results from research conducted at UFV and other national institutions, as well as articles published in the indexed Web of Science database, were considered. Additionally, the fundamental concepts outlined by Sakomura & Rostagno (2016) were applied.

In the equations for daily metabolizable energy requirements, the sum of daily Maintenance Metabolizable Energy (MEm) and Production Metabolizable Energy (MEp) requirements was considered, following the model proposed by Rostagno et al. (2017). The MEm requirement was estimated based on values cited in the NRC (1998), where MEm is determined by the equation MEm (kcal/day) = 106 * $W^{0.75}$, with W representing the average live weight of the animal in kg. Other equations are mentioned in the literature to determine MEm requirements; however, Lee et al. (2016) stated that the

equation for determining MEm presented in the NRC (1998) is suitable for predicting feed intake for pigs and for partitioning energy intake for maintenance and production.

In determining the equations for daily MEp of growing swine, information from experiments conducted at UFV, as well as dissertations and theses published in Brazil, and from articles published in indexed journals between 2018 and 2023, were utilized. Performance, feed intake, and ME consumption of swine were considered based on gender, age, and rearing phases. The ME and nutrient intake from various experiments were recalculated using the same nutritional composition base and energy values of the ingredients. From these data, MEm requirements were estimated, and subsequently, equations for the daily requirements of MEp of barrows, gilts, entire males, and immuno-castrated males were obtained, taking into account parameters such as live weight and weight gain of swine at different ages and rearing phases.

The equation to estimate daily metabolizable energy requirements for standard performance growing barrows and gilts was adjusted for an increase of 3% due to bigger challenges in production, handling, environment, and health that occur in these production systems.

Compared to immuno-castrated males, entire males present lower metabolizable energy requirements and feed intake, where distinct equations are adjusted to estimate daily metabolizable energy requirements for production.

The equation of metabolizable energy requirements for the production of immuno-castrated males (100 to 145 kg) was estimated using data from research conducted at UFV (Barcellos, 2023 – unpublished data).

The knowledge of ME requirement (kcal/day) and dietary ME level, allows the estimation of feed intake through the relation of ME requirement /dietary energy content.

Growing swine can adjust their feed intake according to dietary energy level when consuming feed within certain metabolizable energy limits (3200 and 3450 kcal/kg of ME), which allows a dynamic variable of dietary

metabolizable energy level, dependent on economic factors, such as feedstuffs, pork prices, production system, and feed management.

In conditions where oil or animal fat present low competitive prices, it should be indicated to adopt higher dietary energy levels. In production systems with controlled feeding, in which the aim is reaching a better feed conversion ratio, the adoption of high-energy-level diets is also recommended. Diets formulated with low-energy levels can be viable when alternative low-energy ingredients are available at reduced prices. However, increasing fiber levels should be taken with caution, as it is associated with reduced nutrient utilization and swine performance.

In this way, least-cost diets should be formulated to meet the proposed nutritional levels for a given animal productivity; but also must consider environmental sustainability and food safety of the products.

The impact of dietary metabolizable energy on feed conversion ratio responses should be considered. Calculating the efficiency per metabolizable energy intake is recommended, specifically when using alternative ingredients to corn, soybean meal, and commonly used fat sources, also net energy values should be taken into consideration.

Environmental temperature is a critical factor influencing the metabolizable energy requirements of growing swine. The correction of metabolizable energy requirements based on temperature proposed in the 4th edition has been maintained in this update, considering that temperatures above or below thermal comfort induce changes in metabolizable energy requirements and feed intake. Thus, the corrections that should be applied within certain limits of daily average temperature, above or below the comfort temperature (± 6°C), have been maintained.

Corrections to metabolizable energy requirements and feed intake for environmental changes beyond the suggested values are not recommended, as animals may undergo physiological changes that affect performance and may either underestimate or overestimate the calculated values.

Feed processing affects swine performance; in pelleted diets, an improvement of 4 to 6% in feed conversion ratio is observed. These values

should be considered as a reference for adjusting feed intake by animals, since in many literature studies, the use of mash diets is referenced.

In this 5th edition, in addition to ME, the corresponding Net Energy (NE) levels of the diets are mentioned, calculated using the ME and NE values of feedstuffs cited in Chapter 1.

The reference diets utilized in most experiments in Brazil were formulated based on corn and soybean meal, and for this reason, when other ingredients are used, adjustments related to nutrient digestibility or availability will be necessary. This is why the requirements of standardized digestible amino acids are mentioned.

The same procedure of the previous edition was used to estimate the daily requirements of digestible lysine. The requirement for maintenance of the equations has been redefined utilizing the experimental results of Faria (2019) to determine the nitrogen and lysine requirement for maintenance and production of growing swine. It was decided to use for maintenance the average value of 0.039 g of SID Lys per kg of weight$^{0.75}$.

In the case of SID Lys requirements for production, data (weekly and for the total period) from dose-response experiments with different lysine levels conducted at UFV and published in dissertations, theses, and articles indexed in the Web of Science database between 2016 and 2023 were used. The results were cataloged, and daily intake of digestible lysine was determined. Then, the maintenance digestible lysine requirement was calculated, and the amount of digestible lysine per kg of gain in the various grower phases was obtained.

For these determinations, the results of 165 experimental datasets were utilized, with 123 datasets for barrows, 118 for gilts, 107 for entire males, and 3 for immuno-castrated males (100 to 140 kg). The same 88 datasets from the pre-starter and starter phases (5-15 and 15-30 kg of weight) were included in the calculations for barrows, gilts, and entire males. Tables 5.03, 5.11, and 5.19 present the methodologies used and the equations obtained to calculate the amount of SID Lys per kg of live weight of growing swine.

Physiological changes resulting from the castration process alter

protein deposition rates and feed intake of immuno-castrated males after 100 kg. Given this fact, for this category, a specific equation was established to estimate SID Lys requirements per kg of weight gain, using results from research conducted by Aymerich et al. (2020), Lima (2023), and Barcellos (2023), as presented in Table 5.21.

Performance data of barrows, gilts, entire males, immuno-castrated males, and mixed-sex herds of high and standard performance are shown as an example of the variation in lysine nutritional requirements, where the equations were used to estimate daily SID Lys requirements according to the Gompertz equations in Tables 5.01, 5.09, and 5.17.

The use of equations to estimate the amount of daily SID Lys allows the flexibility of requirements. Thus, there is no longer just one requirement, but several, depending on the performance and feed intake of the animals (Rostagno et al., 2017).

In determining the nutritional requirements of other amino acids, the concept of ideal protein was applied, maintaining the amino acid to lysine ratio expressed in the Standardized Ileal Digestibility (SID) and total amino acids. To update the proportion of different amino acids with lysine in the pre-starter, starter, grower, and finisher phases, data from experiments conducted at UFV, other institutions, and the reviewed Web of Science database were used.

Different ratios may be necessary to maximize swine performance under specific production conditions, related to environment, health, and feed ingredients. Imbalances between specific amino acids in some feed ingredients used in swine nutrition can provoke antagonisms that result in reduced performance, even if minimum proportions of amino acids in the ideal protein are maintained.

High levels of leucine and low levels of isoleucine and valine, branched-chain amino acids, should be taken into consideration in ingredients such as blood meal, dried blood cells, and corn by-products like corn gluten meal 60% CP, distillers dried grains with soluble (DDGS), and high protein distillers dried grains (DDG HP). When high levels of these ingredients are used in swine diets, there may be a disproportionate increase in the SID Leu

to SID Lys ratio. It is recommended to increase the SID Ile to SID Lys and the SID Val to SID Lys ratios to maintain optimal performance (Kerkaert et al., 2021; Williams et al., 2021; Clizer et al., 2022).

The levels of amino acids should closely approximate the recommended levels, avoiding excesses. Similarly, excess protein should also be avoided.

Calculations of total lysine requirements for swine considered the SID of lysine in the diet, which is 88% on average.

The SID methionine + cysteine requirements were established to ensure at least 55% of methionine in total sulfur amino acids (Qiao et al., 2008). Phenylalanine + tyrosine requirements considered a minimum ratio of 54% phenylalanine.

Currently, in addition to traditional industrial amino acids added to swine diets, there are other crystalline amino acids available such as valine, isoleucine, arginine, and glutamic acid, allowing for further reduction of dietary protein. According to experiments conducted at UFV, as the protein content is reduced, Non-Essential Nitrogen (Nne) may become limiting in the diets. Therefore, defining an optimal Ne: Total N or Ne: Nne ratio in low-protein diets is important for achieving optimal performance and improved protein utilization efficiency. In this chapter, following the recommendation of the 4th edition, the determination of Ne and Total N and the Ne: Total N ratio for growing swine were maintained.

In determining the quantity of Ne and Total N and the Ne: Total N ratio to subsequently calculate the recommended crude protein and digestible protein in growing swine diets, the procedures described in the 4th edition of the Brazilian Tables were used. In these procedures, the levels of digestible Ne (dig. Ne) and total Ne (Net) are determined taking into account the requirements of digestible and total amino acids and the nitrogen content of essential amino acids. The essential amino acids used to calculate the ratios are lysine, methionine, threonine, tryptophan, arginine, valine, isoleucine, leucine, histidine, and phenylalanine. Subsequently, the total digestible nitrogen (total dig. N) and total nitrogen (total N) were calculated, considering

the dig. Ne: Total N ratio and the Net: Total N ratio. The recommended ratio for growing swine was 37%, and in the pre-starter phase I and II, due to the many functions of this amino acid, in addition to protein synthesis, the contribution of arginine to nitrogen was considered to be 35%.

Once the total digestible N and the total N for each period are obtained, the total and digestible protein requirements in the diets are estimated by multiplying the total digestible N and the total N by 6.25, considering that the average N content of protein is 16%.

The minimum crude and digestible protein levels may be estimated in a simplified manner, using the proportion of digestible lysine in crude and digestible proteins of 6.2 and 7.0%, respectively. As an example, for a swine of 105 days of age, where the estimated SID Lys requirement is 0.893%, the crude protein requirement is calculated as (% SID Lys x 100)/ 6.2 = (0.893 x 100)/ 6.2 = 14.40%, and the digestible protein requirement as (% SID Lys x 100)/ 7.0 = (0.893 x 100)/ 7.0 = 12.75%. The 7.0% SID Lys content in dietary digestible protein is close to the body composition of swine mentioned in the NRC (2012) as 7.10 g of lysine/100 g of protein.

Similarly, to the recommendation for utilizing amino acid requirements based on digestibility, using digestible protein requirements is important to prevent deficiencies in diets with alternative feed ingredients, with lower digestibility, than the traditional corn/soybean-based diet

When using levels of digestible essential amino acids to estimate the requirement for digestible and total protein, it emphasizes the importance of the concept that animals have dietary requirements for amino acids (not protein). According to Wu & Li (2022), the optimal quantity and ratio of all proteinogenic amino acids should be considered.

In general, at the recommended protein levels in corn and soybean meal-based diets, the requirements for arginine, valine, isoleucine, leucine, histidine, and phenylalanine + tyrosine are usually met. Amino acid levels should closely approximate the recommended levels, avoiding excesses. Similarly, excess protein should also be avoided.

In order to reduce the environmental impact of excess nutrients in

swine diets, excellent results have been achieved in experimental trials and commercial herds with diets containing lower protein levels while maintaining recommended levels of essential amino acids (Pena et al., 2013; Cappelaere et al., 2022). A recent literature review by Rocha et al. (2022) recommends the following minimum crude protein levels, which do not affect swine performance: 18.4% (Pre/Starter), 16.2% (Grower), and 11.5% (Finisher). It should be noted, that these protein levels are close to the values mentioned for growing swine in this chapter.

A procedure similar to that used for evaluating lysine requirements was followed to obtain the equations estimating the requirements for digestible and available phosphorus (P) for growing swine. However, it should be noted that the number of studies that have assessed phosphorus requirements for high performance swine is limited.

The estimated maintenance phosphorus requirement was obtained using data on endogenous excretion obtained in the UFV thesis by Bunzen (2009), where the Phosphorus for Maintenance (Pm) requirement is 0.046 x Weight$^{0.75}$. Subsequently, the results of dose-response experiments for digestible and available phosphorus requirements conducted at UFV, other national institutions, and indexed journals were used to calculate the amount of phosphorus (standardized digestible and available) per kg of weight gain in different growing phases of swine.

In this edition, we emphasize the importance of nutritionists using standardized digestible phosphorus base requirements, as they only represent the digestibility coefficients of phosphorus in the ingredients used. While available phosphorus requirements may vary in terms of bioavailability for each phosphorus source, depending on the inorganic source used as the standard (considered 100% available). The values for digestible and available phosphorus in the ingredients determined with growing swine are mentioned in Chapter 1.

It is important to consider that calcium and phosphorus levels higher than recommended may lead to increased deposition of phosphorus and calcium in bones. Similarly, under controlled feed intake conditions, attention

should be given to meeting nutrient intake in grams per swine per day to avoid compromising performance and bone structure and mobilization.

Based on experimental results, total calcium requirements were recommended, taking into account total Ca: digestible P and total Ca: available P ratios of 2.04 and 2.10, respectively.

The calcium requirement was calculated based on the averages of digestible and available phosphorus levels and then multiplied by their respective ratios.

High levels of calcium should be avoided in diets as they not only affect animal performance but also increase environmental contamination.

Calcium levels below the nutritional requirement are commonly recommended for the pre-starter and starter phases of piglets due to their effects on reducing the incidence of diarrhea. In general, values between 0.70% and 0.80% of total calcium are recommended.

The requirements based on digestible calcium were not addressed, as although there is literature data on calcium digestibility in ingredients for swine, recent research (Lagos et al., 2021) did not identify the benefits of formulating diets based on digestible calcium compared to total calcium in diets for swine without the excess of this mineral.

It is important to ensure an adequate dietary electrolyte balance of sodium, chlorine, and potassium for swine. However, due to the lack of scientific literature and experimental results, the equations cited in the 4th edition of the Brazilian Tables were used to estimate requirements, in %, of Mcal of ME according to the live weight of the pig.

The requirement for the essential fatty acid linoleic acid was established based on the recommendation of NRC (2012), calculating the requirement in grams per kilogram of animal body weight, and subsequently, establishing an equation to estimate the linoleic acid requirement.

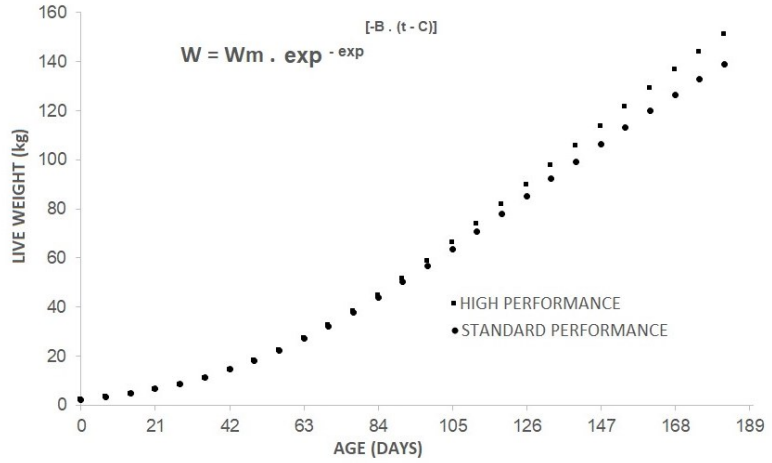
Examples of requirements are presented for swine with high and standard performance, barrows, gilts, entire males, immuno-castrated males, and mixed-sex herds in the starter, grower, and finisher phases to facilitate the use of the Brazilian Tables. Diets were established containing energy levels

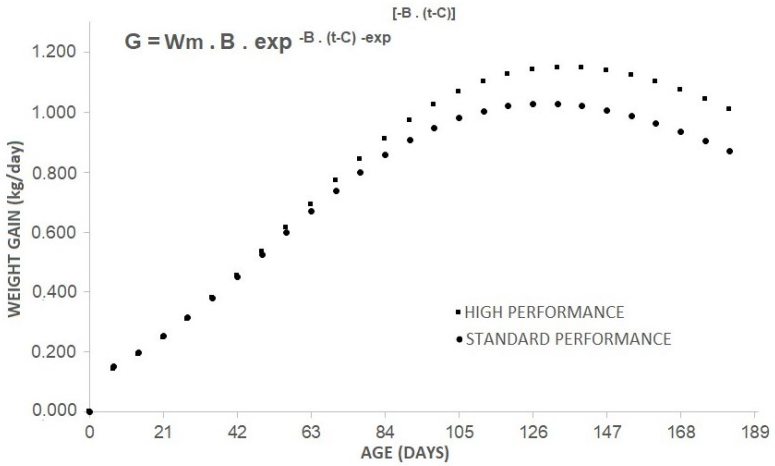
commonly used in Brazil and recommended in the main lineage guidelines. For other energy levels, corresponding adjustments of feed intake and other nutrients should be made.

In Brazil and several Latin American countries, the additive ractopamine is used in the finisher phase as a performance enhancer. When ractopamine is added to the diet, there is an increase in the percentage of lysine and protein in the muscles of the animals. Thus, adjustments in the concentrations of digestible lysine and essential amino acids based on the ideal protein are necessary to achieve benefits on weight gain and feed conversion ratio.

Based on research results conducted at UFV and using the model developed by Schinckel et al. (2003), performance changes and nutritional requirements were estimated, of mixed-sex pigs, fed diets containing 10 or 20 ppm of ractopamine, during 21 or 28 days, respectively.

Table 5.01 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Standard and High Performance Growing Barrows





Equation parameters for standard performance growing barrows: Wm= 230.6674; b=4.592166; C=0.01211085; R^2=0.96. High performance growing barrows: Wm= 262.0234; b=4.806177; C=0.01190569; R^2=0.95. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b=maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.02 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of High Genetic Potential Barrows (kcal/day)

ME Requirement of High Performance Growing Barrows

$ME\ Req. = (106\ W^{0.75}) + (2069.2 + 69.777\ W - 0.2184\ W^2)\ G$

ME Requirement of Standard Performance Growing Barrows[1]

$ME\ Req. = ((106\ W^{0.75}) + (2069.2 + 69.777\ W - 0.2184\ W^2)\ G)\ 1.03$

[1]Considering Standard Performance Growing Barrows 3% less efficient

$Correction\ for\ temperature = 2.4\ W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN=Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 – 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Growing Barrows (105 days of age)
W = 66.127 kg; $W^{0.75}$ = 23.189; G = 1.065 kg/day; Diet. ME = 3350 kcal/kg

ME Req. = (106 x 23.189) + (2069.2 + 69.777 x 66.127 - 0.2184 x 66.127^2) x 1.065
ME Req. = 2458.04 + 5728.3 x 1.065 = 8561.1 kcal/day
Estimated Feed Intake = 2.556 kg/day

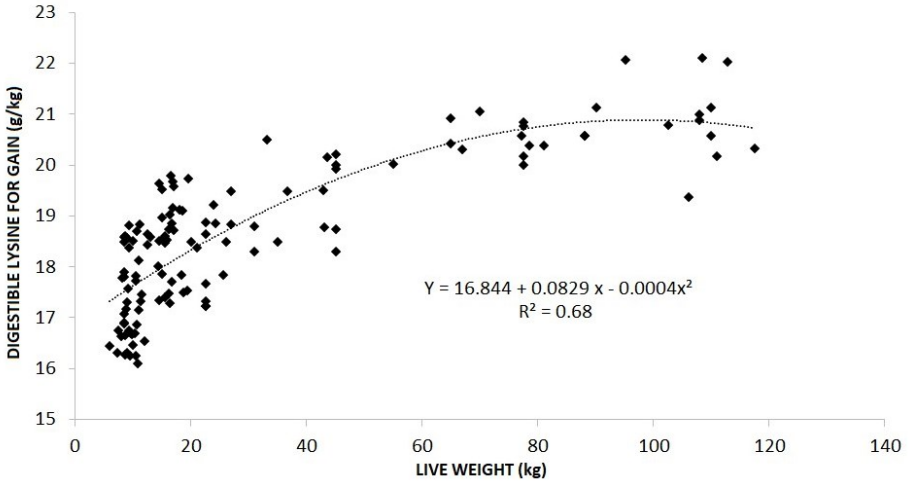
Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 23.189 (23 – 28) = -278.27 kcal/day
ME Req. for 28 °C = 8561.1 – 278.27 = 8282.8 kcal/day
Estimated Feed Intake= 2.472 kg/day

Table 5.03 - Methodology Applied to Obtain the Equation to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of High Genetic Potential Barrows

Weight, kg	5 -15 [3]	15 - 30 [3]	30 - 60	60 – 95	95-135
Experimental Data[1]	42	46	11	13	11
Avg. Weight in Period, kg	9.49	18.93	39.06	79.11	110.22
Feed Intake, g/day	407.14	876.2	1904.7	2907.8	3281.6
SID Lys Intake, g/day	5.502	10.918	18.401	23.575	23.65
SID Lys Maint., g/day[2]	0.210	0.352	0.652	1.013	1.298
SID Lys Weight Gain, g/day	5.292	10.566	17.75	22.561	22.354
Mean Gain, kg/day	0.305	0.578	0.911	1.087	1.086
g. SID Lys / kg Gain	17.34	18.93	19.512	20.58	20.95
Equation, g SID Lys/ kg G	17.59	18.27	19.47	20.9	21.12
Eq: Y (g SID Lys / kg G) = 16.844 + 0.0829 (Avg. Weight, kg) – 0.00042 (Avg. Weight, kg)^2 R^2 = 0.68					

Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.
[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Damaceno (2021) (Ph.D. Thesis).
[3] In this phase, experimental data of barrows, gilts, and entire males were used.



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Barrows as a function of Weight (5 to 155 kg).

Table 5.04 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of High Genetic Potential Barrows

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75})+(16.844 + 0.0829\ W - 0.0004\ W^{2})\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: High Performance Growing Barrows (105 days of age)

W = 66.127 kg; $W^{0.75}$ = 23.189; G = 1.065 kg/day

SID Lys Req. = $(0.039 \times 23.189) + (16.844 + 0.0829 \times 66.127 - 0.0004 \times 66.127^{2}) \times 1.065$
SID Lys Req. = 0.904 + 20.577 x 1.065 = 22.827 g/day
Estimated Feed Intake = 2.556 kg/day (Table 5.02)
Dietary SID Lys = 0.893%

Correction for average temperature of 28°C (TN=23°C)
Estimated Feed Intake = 2.472 kg/day (Table 5.02)
Dietary SID Lys = 0.923%

Table 5.05 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Growing Barrows with High Genetic Potential Using the Equations in Tables 5.01, 5.02, and 5.04

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req. kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.21	0.246	4.42	1031	0.299	2.1	0.429	1.480
28	8.37	0.309	5.61	1338	0.388	4.8	0.419	1.446
35	11.02	0.379	6.95	1707	0.502	8.3	0.407	1.384
42	14.20	0.454	8.43	2145	0.631	12.7	0.393	1.336
49	17.93	0.533	10.03	2655	0.792	18.3	0.378	1.266
56	22.22	0.613	11.73	3236	0.966	25.0	0.362	1.214
63	27.07	0.692	13.48	3887	1.160	33.2	0.347	1.161
70	32.45	0.770	15.24	4600	1.373	42.8	0.331	1.110
77	38.35	0.843	16.98	5362	1.601	54.0	0.317	1.061
84	44.72	0.910	18.65	6158	1.838	66.9	0.303	1.014
91	51.51	0.970	20.20	6971	2.081	81.4	0.290	0.971
98	58.67	1.022	21.61	7778	2.322	97.7	0.278	0.931
105	66.13	1.065	22.83	8561	2.556	115.6	0.267	0.893
112	73.82	1.099	23.83	9299	2.776	135.0	0.256	0.859
119	81.69	1.124	24.61	9976	2.978	155.8	0.247	0.826
126	89.67	1.140	25.14	10578	3.158	177.9	0.238	0.796
133	97.70	1.147	25.44	11094	3.312	201.1	0.229	0.768
140	105.72	1.146	25.50	11520	3.439	225.2	0.221	0.742
147	113.68	1.137	25.34	11852	3.538	250.0	0.214	0.716
154	121.53	1.121	24.99	12092	3.610	275.2	0.207	0.692
161	129.23	1.100	24.46	12246	3.655	300.8	0.200	0.669
168	136.74	1.074	23.78	12319	3.677	326.6	0.193	0.647
175	144.04	1.043	22.98	12320	3.678	352.3	0.187	0.625
182	151.10	1.008	22.09	12259	3.659	377.9	0.180	0.604

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.06 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Growing Barrows with High Genetic Potential Using the Equations in Tables 5.01, 5.02, and 5.04

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req. kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.55	0.253	4.55	1103	0.324	2.3	0.413	1.404
28	8.75	0.314	5.71	1418	0.417	5.2	0.403	1.370
35	11.42	0.381	7.00	1792	0.531	8.9	0.391	1.319
42	14.58	0.451	8.40	2228	0.660	13.5	0.377	1.273
49	18.25	0.524	9.90	2729	0.809	19.2	0.363	1.224
56	22.43	0.597	11.45	3292	1.013	26.3	0.348	1.130
63	27.11	0.668	13.03	3913	1.204	34.7	0.333	1.082
70	32.26	0.736	14.59	4581	1.410	44.6	0.318	1.035
77	37.85	0.799	16.10	5285	1.626	56.0	0.305	0.990
84	43.84	0.856	17.53	6010	1.849	68.9	0.292	0.948
91	50.18	0.905	18.83	6738	2.073	83.4	0.279	0.908
98	56.80	0.946	19.98	7452	2.293	99.5	0.268	0.871
105	63.65	0.979	20.95	8134	2.503	117.0	0.258	0.837
112	70.68	1.003	21.72	8768	2.698	135.9	0.248	0.805
119	77.81	1.019	22.29	9342	2.875	156.0	0.239	0.775
126	84.99	1.027	22.65	9846	3.030	177.2	0.230	0.748
133	92.18	1.026	22.80	10274	3.161	199.3	0.222	0.721
140	99.31	1.019	22.77	10621	3.268	222.2	0.214	0.697
147	106.36	1.006	22.55	10889	3.350	245.7	0.207	0.673
154	113.26	0.987	22.18	11079	3.409	269.5	0.200	0.651
161	120.00	0.963	21.67	11197	3.445	293.6	0.194	0.629
168	126.55	0.935	21.04	11249	3.461	317.9	0.187	0.608
175	132.88	0.904	20.33	11243	3.459	342.1	0.181	0.588
182	138.97	0.870	19.54	11186	3.442	366.2	0.175	0.568

[1] Diet containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.07 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Barrows with High Genetic Potential[1]

Standardized Digestible Phosphorus Requirement

High and Standard Performance Growing Barrows

Dig. P Req. (g/day) = $(0.046\ W^{0.75}) + 5.42\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: High Performance Growing Barrows (105 days of age)

W = 66.127 kg; G = 1.065 kg/day; Feed Intake = 2556 g/day

Dig. P Req. (g/day) = $(0.046 \times 66.127^{0.75}) + 5.42 \times 1.065 = 6.841$g

Dietary Dig. P = (6.841 x 100) / 2556 = 0.268%

Dietary Ca = 0.268 x 2.04 = 0.546%

Available Phosphorus Requirement

High and Standard Performance Growing Barrows

Pav Req. (g/day) = $(0.046\ W^{0.75}) + 5.68\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

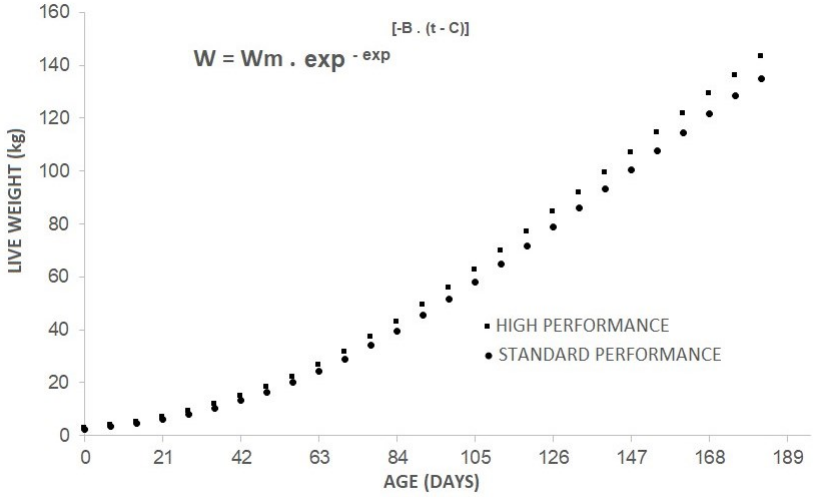
[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

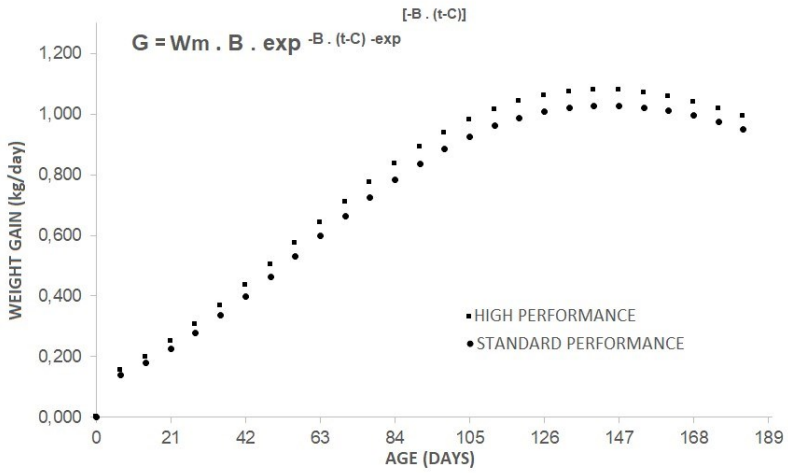
Table 5.08 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Growing Barrows with High Genetic Potential Using the Equations in Table 5.07

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Growing Barrows								
28	8.37	0.309	0.388	1.903	0.491	1.983	0.512	1.038
42	14.20	0.454	0.631	2.798	0.443	2.916	0.462	0.938
56	22.22	0.613	0.966	3.791	0.392	3.951	0.409	0.830
70	32.45	0.770	1.373	4.797	0.349	4.997	0.364	0.738
84	44.72	0.910	1.838	5.728	0.312	5.964	0.324	0.658
98	58.67	1.022	2.322	6.515	0.281	6.781	0.292	0.593
112	73.82	1.099	2.776	7.118	0.256	7.403	0.267	0.542
126	89.67	1.140	3.158	7.519	0.238	7.815	0.247	0.503
140	105.72	1.146	3.439	7.726	0.225	8.024	0.233	0.474
154	121.53	1.121	3.610	7.762	0.215	8.053	0.223	0.454
168	136.74	1.074	3.677	7.658	0.208	7.937	0.216	0.439
182	151.10	1.008	3.659	7.448	0.204	7.710	0.211	0.429
Standard Performance Growing Barrows								
28	8.75	0.314	0.417	1.937	0.465	2.019	0.484	0.982
42	14.58	0.451	0.660	2.790	0.423	2.908	0.440	0.893
56	22.43	0.597	1.013	3.710	0.366	3.865	0.382	0.774
70	32.26	0.736	1.410	4.613	0.327	4.804	0.341	0.692
84	43.84	0.856	1.849	5.421	0.293	5.644	0.305	0.619
98	56.80	0.946	2.293	6.080	0.265	6.326	0.276	0.560
112	70.68	1.003	2.698	6.559	0.243	6.820	0.253	0.513
126	84.99	1.027	3.030	6.851	0.226	7.118	0.235	0.477
140	99.31	1.019	3.268	6.972	0.213	7.237	0.221	0.450
154	113.26	0.987	3.409	6.946	0.204	7.202	0.211	0.430
168	126.55	0.935	3.461	6.804	0.197	7.047	0.204	0.414
182	138.97	0.870	3.442	6.579	0.191	6.806	0.198	0.403

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.09 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Standard and High Performance Growing Gilts





Equation parameters for standard performance growing gilts: Wm= 253.2377; b=4.692423; C=0.01104085; R^2=0.98. High performance growing gilts: Wm= 266.0062; b=4.608439; C=0.01102709; R^2=0.99. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b= maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.10 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of Growing Gilts with High Genetic Potential (kcal/day)

ME Requirement of High Performance Growing Gilts

$ME\ Req. = (106\ W^{0.75}) + (2129.3 + 58.311\ W - 0.1701\ W^2)\ G$

ME Requirement of Standard Performance Growing Gilts[1]

$ME\ Req. = ((106\ W^{0.75}) + (2129.3 + 58.311\ W - 0.1701\ W^2)\ G)\ 1.03$

[1]Considering Standard Performance Growing Gilts 3% less efficient

$Correction\ for\ temperature = 2.4\ W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN= Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 – 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: High Performance Growing Gilts (105 days of age)
W = 62.535 kg; $W^{0.75}$ = 22.238; G = 0.980 kg/day; Diet. ME = 3350 kcal/kg

$ME\ Req. = (106 \times 22.238) + (2129.3 + 58.31 \times 62.535 - 0.1701 \times 62.535^2) \times 0.980$
ME Req. = 2357.20 + 5110.6 x 0.980= 7365 kcal/day
Estimated Feed Intake = 2.198 kg/day

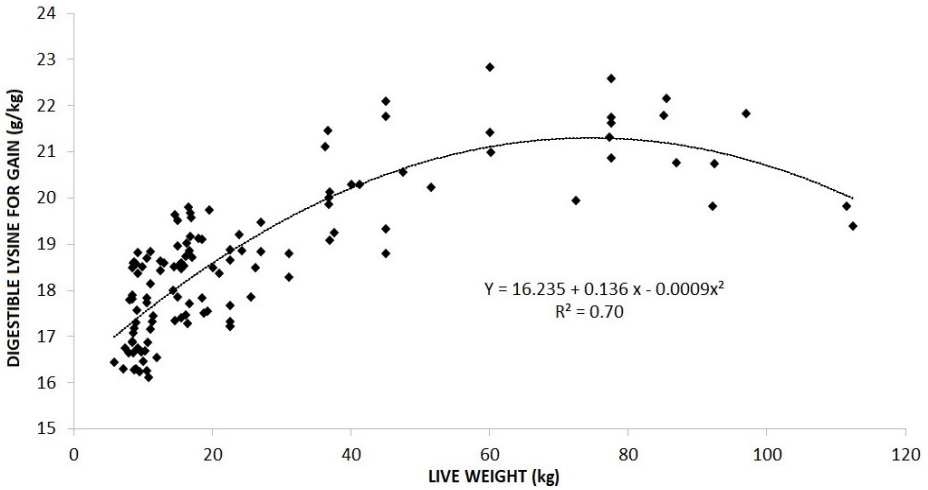
Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 22.24 (23 – 28) = -266.86 kcal/day
ME Req. for 28°C = 7365 – 266.86 = 7098.1 kcal/day
Estimated Feed Intake = 2.119 kg/day

Table 5.11 - Methodology Applied to Obtain the Equation to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of Growing Gilts with High Genetic Potential

Weight, kg	5 – 15 [3]	15 – 30 [3]	30 - 60	60 – 95	95 – 130
Experimental Data[1]	42	46	14	13	3
Avg. Weight in Period, kg	9.49	18.93	41.19	77.3	106.98
Feed Intake, g/day	407.14	876.2	1775	2600.2	2690.3
SID Lys Intake, g/day	5.502	10.918	18.134	21.781	22.025
SID Lys Maint., g/day[2]	0.210	0.352	0.614	1.015	1.297
SID Lys Gain, g/day	5.292	10.566	17.520	20.766	20.728
Mean Gain, kg/d	0.305	0.578	0.869	0.974	1.02
g. SID Lys / kg Gain	17.34	18.93	20.29	21.33	20.35
Equation, g SID Lys/ kg G	17.44	18.49	20.31	21.37	20.48
Eq: Y (g SID Lys / kg G) = 16.235 + 0.136 (Avg. Weight, kg) – 0.0009 (Avg. Weight, kg)^2 R^2 = 0.70					

Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.
[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Damaceno (2021) (Ph.D. Thesis).
[3] In this phase, experimental data of barrows, gilts, and entire males were used.



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Gilts as a Function of Weight (5 to 130 kg).

Table 5.12 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Growing Gilts with High Genetic Potential

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75}) + (16.235 + 0.136\ W - 0.0009\ W^2)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: High Performance Growing Gilts (105 days of age)

W = 62.535 kg; $W^{0.75}$ = 22.238; G = 0.980 kg/day

SID Lys Req. = $(0.039 \times 22.238) + (16.235 + 0.136 \times 62.535 - 0.0009 \times 62.535^2) \times 0.980$
SID Lys Req. = 0.867 + 21.220 x 0.980 = 21.661 g/day
Estimated Feed Intake = 2.198 kg/day (Table 5.10)
Dietary SID Lys = 0.985%

Correction for the average temperature of 28°C (TN=23°C)
W = 62.535; G = 0.980 kg/day
SID Lys Req. = 21.661 g/day
Estimated Feed Intake = 2.119 kg/day (Table 5.10)
Dietary SID Lys = 1.023%

Table 5.13 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Growing Gilts with High Genetic Potential Using the Equations in Tables 5.09, 5.10, and 5.12

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.87	0.250	4.44	1080	0.313	2.2	0.411	1.419
28	9.02	0.306	5.53	1361	0.394	5.0	0.406	1.402
35	11.60	0.368	6.76	1691	0.497	8.4	0.400	1.359
42	14.63	0.434	8.12	2072	0.609	12.7	0.392	1.332
49	18.15	0.503	9.59	2506	0.748	17.9	0.383	1.282
56	22.16	0.572	11.16	2993	0.893	24.2	0.373	1.249
63	26.65	0.642	12.79	3530	1.054	31.6	0.362	1.214
70	31.62	0.710	14.45	4112	1.228	40.2	0.351	1.177
77	37.04	0.774	16.10	4732	1.412	50.0	0.340	1.140
84	42.88	0.835	17.69	5379	1.606	61.3	0.329	1.102
91	49.11	0.889	19.17	6043	1.804	73.9	0.317	1.063
98	55.68	0.938	20.51	6709	2.003	87.9	0.306	1.024
105	62.53	0.980	21.66	7365	2.198	103.3	0.294	0.985
112	69.64	1.014	22.59	7997	2.387	120.0	0.282	0.946
119	76.93	1.041	23.27	8594	2.565	138.0	0.271	0.907
126	84.35	1.061	23.69	9144	2.730	157.1	0.259	0.868
133	91.86	1.073	23.84	9639	2.877	177.2	0.247	0.828
140	99.41	1.079	23.73	10073	3.007	198.3	0.236	0.789
147	106.96	1.077	23.37	10442	3.117	220.1	0.224	0.750
154	114.44	1.070	22.78	10744	3.207	242.6	0.212	0.710
161	121.84	1.057	21.99	10980	3.277	265.5	0.200	0.671
168	129.12	1.039	21.03	11152	3.329	288.8	0.189	0.632
175	136.24	1.017	19.93	11264	3.362	312.3	0.177	0.593
182	143.19	0.992	18.73	11322	3.380	336.0	0.165	0.554

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.14 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Growing Gilts with High Genetic Potential Using the Equations in Tables 5.09, 5.10, and 5.12

Age, Days	Weight, Kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.13	0.226	4.01	1003	0.295	2.1	0.399	1.358
28	8.08	0.279	5.01	1268	0.373	4.7	0.395	1.343
35	10.44	0.337	6.15	1579	0.468	8.0	0.389	1.314
42	13.24	0.399	7.41	1938	0.574	12.0	0.382	1.290
49	16.49	0.464	8.78	2349	0.696	16.8	0.374	1.262
56	20.20	0.531	10.25	2810	0.865	22.9	0.365	1.185
63	24.38	0.597	11.78	3320	1.021	30.0	0.355	1.154
70	29.02	0.662	13.35	3874	1.192	38.4	0.345	1.120
77	34.09	0.725	14.92	4466	1.374	48.0	0.334	1.086
84	39.57	0.783	16.44	5087	1.565	59.0	0.323	1.050
91	45.43	0.837	17.89	5727	1.762	71.3	0.312	1.015
98	51.62	0.885	19.20	6373	1.961	85.0	0.301	0.979
105	58.11	0.926	20.36	7013	2.158	100.1	0.290	0.944
112	64.83	0.960	21.32	7633	2.349	116.6	0.279	0.908
119	71.74	0.988	22.06	8223	2.530	134.3	0.268	0.872
126	78.80	1.008	22.56	8772	2.699	153.2	0.257	0.836
133	85.95	1.021	22.83	9271	2.853	173.1	0.246	0.800
140	93.14	1.028	22.84	9713	2.989	194.1	0.235	0.764
147	100.33	1.028	22.63	10095	3.106	215.8	0.224	0.729
154	107.48	1.022	22.20	10413	3.204	238.2	0.213	0.693
161	114.56	1.011	21.58	10669	3.283	261.2	0.202	0.657
168	121.52	0.995	20.79	10863	3.342	284.6	0.191	0.622
175	128.34	0.974	19.87	10999	3.384	308.3	0.181	0.587
182	135.00	0.951	18.84	11081	3.410	332.2	0.170	0.553

[1] Diets containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.15 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Gilts with High Genetic Potential [1]

Standardized Digestible Phosphorus Requirement

High and Standard Performance Growing Gilts

Dig. P Req. (g/day) = $(0.046\ W^{0.75}) + 5.42\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: High Performance Growing Gilts

W = 62.535 kg; G = 0.980 kg/day; Feed Intake = 2198 g/day

Dig. P Req. (g/day) = $(0.046 \times 62.535^{0.75}) + 5.42 \times 0.980 = 6.334$ g

Dietary Dig. P = (6.334 x 100) / 2198 = 0.288 %

Dietary Ca = 0.288 x 2.04 = 0.588 %

Available Phosphorus Requirement

High and Standard Performance Growing Gilts

Pav Req. (g/day) = $(0.046\ W^{0.75}) + 5.68\ G$

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

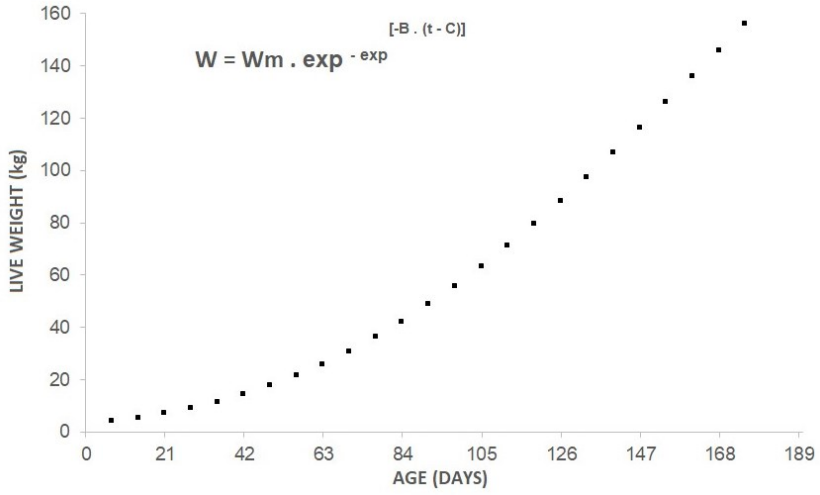
[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

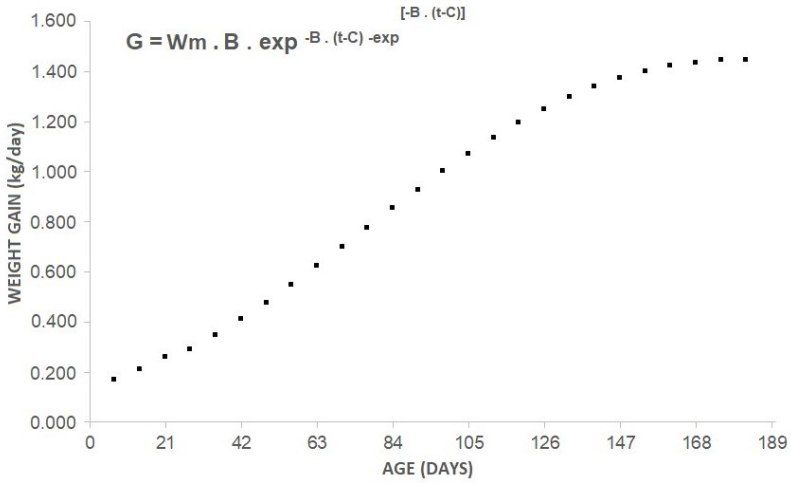
Table 5.16 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Growing Gilts with High Genetic Potential Using the Equations in Table 5.15

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Growing Gilts								
28	9.02	0.306	0.394	1.900	0.482	1.980	0.502	1.018
42	14.63	0.434	0.609	2.697	0.443	2.810	0.461	0.935
56	22.16	0.572	0.893	3.572	0.400	3.721	0.416	0.845
70	31.62	0.710	1.228	4.460	0.363	4.644	0.378	0.768
84	42.88	0.835	1.606	5.294	0.330	5.511	0.343	0.697
98	55.68	0.938	2.003	6.022	0.301	6.266	0.313	0.635
112	69.64	1.014	2.387	6.607	0.277	6.871	0.288	0.584
126	84.35	1.061	2.730	7.031	0.258	7.307	0.268	0.544
140	99.41	1.079	3.007	7.294	0.243	7.574	0.252	0.512
154	114.44	1.070	3.207	7.409	0.231	7.687	0.240	0.487
168	129.12	1.039	3.329	7.396	0.222	7.666	0.230	0.468
182	143.19	0.992	3.380	7.280	0.215	7.538	0.223	0.454
Standard Performance Growing Gilts								
28	8.08	0.279	0.373	1.734	0.465	1.806	0.484	0.983
42	13.24	0.399	0.574	2.483	0.432	2.587	0.450	0.914
56	20.20	0.531	0.865	3.314	0.383	3.452	0.399	0.810
70	29.02	0.662	1.192	4.165	0.349	4.337	0.364	0.738
84	39.57	0.783	1.565	4.971	0.318	5.175	0.331	0.671
98	51.62	0.885	1.961	5.681	0.290	5.911	0.301	0.612
112	64.83	0.960	2.349	6.256	0.266	6.506	0.277	0.563
126	78.80	1.008	2.699	6.680	0.247	6.942	0.257	0.522
140	93.14	1.028	2.989	6.948	0.232	7.215	0.241	0.491
154	107.48	1.022	3.204	7.073	0.221	7.339	0.229	0.466
168	121.52	0.995	3.342	7.074	0.212	7.333	0.219	0.446
182	135.00	0.951	3.410	6.974	0.205	7.221	0.212	0.431

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.17 - Live Weight and Daily Weight Gain Curves According to the Gompertz Equation and the Derivative for Growing Entire Males up to 105 kg and Immuno-Castrated Males (105-155 kg)





Equation parameters for growing entire males and immuno-castrated males: Wm= 433.5277; b= 4.992764; c= 0.0090659; R^2=0.99. W= weight (kg); G= weight gain (kg); t=age (days); Wm= mature weight (kg); b=maturity rate (g/day per g); t*= age at maximum growth rate (days).

Table 5.18 - Equation Used to Estimate Metabolizable Energy (ME) Requirements of Growing Entire Males up to 105 kg and Immuno-Castrated Males (105-155 kg) with High Genetic Potential (kcal/day)

ME Requirement of Growing Entire Males up to 105 kg weight

$ME\ Req. = (106\ W^{0.75}) + (1782.4 + 71.426\ W - 0.4552\ W^2)\ G$

ME Requirement of Immuno-Castrated Males (105 to 155 kg)[1]

$ME\ Req. = (106\ W^{0.75}) + 5876.5\ G$

[1] ME requirement of immuno-castrated males for gain was estimated according to experimental data carried out at UFV by Barcellos (2023) (unpublished data).

$Correction\ for\ temperature = 2.4 \times W^{0.75}\ (TN - T)$

W = Average body weight (kg); G = Weight gain (kg/day);
T= Average temperature (°C); TN= Thermoneutral temperature (°C)

Suggested temperatures for the correction of ME requirements

Weight (kg)	TN (°C)	Temperature Range (°C)
15 – 30	25	18 – 32
30 – 50	24	17 – 31
50 – 70	23	16 – 30
70 – 100	22	15 – 29
100 - 130	21	14 – 28

Higher temperature values may negatively influence swine performance and overestimate corrections for feed intake and nutritional levels.

Example: Growing Entire Males (105 days of age)
W = 63.102 kg; $W^{0.75}$ = 22.389; G=1.069 kg/day; Diet. ME = 3300 kcal/Kg

$ME\ Req. = (106 \times 22.389) + (1782.4 + 71.426 \times 63.102 - 0.4552 \times 63.102^2) \times 1.069$
ME Req. = 2373.22 + 4477.0 x 1.069 = 7160.5 kcal/day
Estimated Feed Intake = 2.170 kg/day

Correction for the average temperature of 28°C (TN=23°C)
Correction for T° = 2.4 x 22.389 (23 – 28) = -268.7 kcal/day
ME Req. for 28°C = 7160.5 – 268.7 = 6891.8 kcal/day
Estimated Feed Intake = 2.088 kg/day

Table 5.19 - Methodology Applied to Obtain the Equations to Calculate Standardized Digestible Lysine (SID Lys) Requirements/kg Weight Gain of Growing Entire Males and Immuno-Castrated Males with High-Genetic Potential

	Growing Entire Males				Immuno-Castrated Males
Weight, kg	5 -15 [3]	15 – 30 [3]	30 - 60	60 – 95	95-155 [4]
Experimental Data[1]	42	46	5	14	3
Avg. Weight in Period, kg	9.49	18.93	39.06	79.11	110.22
Feed Intake, g/day	407.14	876.2	1655.2	2581.8	3415.0
SID Lys Intake, g/day	5.502	10.918	19.065	25.163	25.736
SID Lys Maint., g/day[2]	0.210	0.352	0.600	1.033	1.326
SID Lys Gain, g/day	5.292	10.566	18.465	24.131	24.41
Mean Gain, kg/day	0.305	0.578	0.881	1.163	1.317
g. SID Lys / kg Gain	17.34	18.93	20.93	20.83	18.71
Equation, g SID Lys/ kg G	17.42	18.54	20.22	20.68	18.71

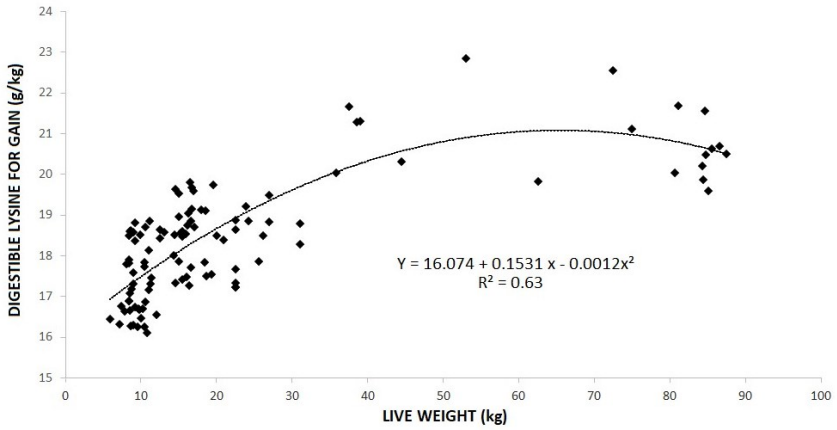
Avg.: Average; Maint.: Maintenance; G: Weight Gain

[1] Experimental data (week and total period) were obtained in dose-response trials with different lysine levels.

[2] Daily Standardized Digestible Lysine Requirement for Maintenance = 0.039 x (Avg. Weight)$^{0.75}$, was estimated according to Faria (2019) (Ph.D. Thesis).

[3] In this phase, experimental data of barrows, entire males, and females were used.

[4] Standardized Digestible Lysine Requirement for Gain (from 95 to 155 kg weight) was estimated with the experimental data of males that received a second dose of the immunocastration vaccine (avg. weight of 100 kg) (Aymerich et al. 2020; and unpublished data of Barcellos, 2023, and Lima, 2023).



Equation to Estimate the Value, in grams, of Standardized Digestible Lysine (SID Lys) / kg Weight Gain of Entire Males as a Function of Weight (5 a 105 kg).

Table 5.20 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Growing Entire Males with High Genetic Potential

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day)= $(0.039\ W^{0.75}) + (16.074 + 0.1531\ W - 0.0012\ W^2)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: Growing Entire Males (105 days of age)

W = 63.102 kg; $W^{0.75}$ = 22.389; G = 1.069 kg/day

SID Lys Req.= $(0.039 \times 22.389) + (16.074 + 0.1531 \times 63.102 - 0.0012 \times 63.102^2) \times 1.069$
SID Lys Req. = 0.873 + 20.957 x 1.069 = 23.282 g/day
Estimated Feed Intake = 2.170 kg/day (Table 5.18)
Dietary SID Lys = 1.073%

Correction for the average temperature of 28°C (TN=23°C)
W = 63.102 kg; G = 1.069 kg/day
SID Lys Req. = 23.282 g/day
Estimated Feed Intake = 2.088 kg/day (Table 5.18)
Dietary SID Lys = 1.115%

Table 5.21 - Equation Used to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Immuno-Castrated Males with High Genetic Potential (100-140 kg)

SID Lys Req. (g/day) = (SID Lys for Maintenance) + (SID Lys for Gain)

SID Lys Req. (g/day) = $(0.039\ W^{0.75}) + (18.71)\ G$

W = Average Body Weight (kg);
G = Weight Gain (kg/day)

Example: Immuno-Castrated Males (161 days of age)

W = 135.911 kg; $W^{0.75}$ = 39.805 kg; G = 1.421 kg/day

SID Lys Req. = (0.039 x 39.805) + (18.71) x 1.421
SID Lys Req. = 1.552 + 26.585 = 28.137 g/day
Estimated Feed Intake = 3.867 kg/day (Equation -Table 5.18)
Dietary SID Lys = 0.728%

Table 5.22 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Entire Males and Immuno-Castrated Males with High Genetic Potential Using the Equations in Tables 5.17, 5.18, 5.20, and 5.21

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.99	0.237	4.21	990.5	0.287	2.0	0.425	1.467
28	9.01	0.289	5.21	1240.7	0.360	4.5	0.420	1.449
35	11.44	0.346	6.36	1538.4	0.452	7.7	0.413	1.405
42	14.30	0.409	7.66	1888.6	0.555	11.6	0.406	1.379
49	17.64	0.477	9.11	2295.3	0.696	16.5	0.397	1.310
56	21.48	0.548	10.70	2760.6	0.837	22.3	0.388	1.279
63	25.83	0.623	12.42	3284.1	0.995	29.3	0.378	1.248
70	30.73	0.699	14.24	3862.3	1.170	37.5	0.369	1.216
77	36.16	0.776	16.12	4487.6	1.360	47.0	0.359	1.186
84	42.12	0.852	18.03	5148.1	1.560	57.9	0.350	1.156
91	48.62	0.928	19.90	5827.7	1.766	70.3	0.341	1.127
98	55.62	1.000	21.67	6506.3	1.972	84.1	0.333	1.099
105	63.10	1.069	23.28	7160.5	2.170	99.3	0.325	1.073
112	71.04	1.134	24.65	7764.6	2.353	115.7	0.317	1.048
119	79.40	1.194	25.71	8291.9	2.513	133.3	0.310	1.023
126	88.13	1.248	26.39	8716.6	2.641	151.8	0.303	0.999
133	97.20	1.296	26.63	9014.4	2.732	170.9	0.295	0.975
140	106.56	1.337	26.38	9164.8	2.777	190.4	0.288	0.950
147	116.17	1.372	25.61	9151.6	2.816	210.1	0.280	0.910
154	125.97	1.400	27.66	12210.5	3.757	236.4	0.226	0.736
161	135.91	1.421	28.14	12568.5	3.867	263.5	0.224	0.728
168	145.96	1.435	28.49	12885.8	3.965	291.2	0.221	0.719
175	156.06	1.444	28.73	13162.7	4.050	319.6	0.218	0.709
182	166.18	1.446	28.85	13400.4	4.123	348.4	0.215	0.700

[1] Diet containing 3450, 3400, 3300, and 3250 kcal ME/kg for the phases 21-35, 35-49, 49-147, and 147-182 days of age.

Table 5.23 - Equations Used to Estimate Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium to Phosphorus Ratio Requirements of Growing Entire Males and Immuno-castrated Males with High Genetic Potential[1]

Standardized Digestible Phosphorus Requirement

Growing Entire Males and Immuno-Castrated Males

Dig. P Req. (g/day) = 0.046 $W^{0.75}$ + 5.42 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Dig. P Ratio: 2.04

Example: Growing Entire Males and Immuno-Castrated Males

W = 63.102 kg; G = 1.069 kg/day; Feed Intake = 2170 g/day

Dig. P Req. (g/day) = 0.046 x $(63.102)^{0.75}$ + 5.42 x 1.069 = 6.824 g/day

Dietary Dig. P = (6.824 x 100) / 2170 = 0.314 %

Dietary Ca = 0.314 x 2.04 = 0.642 %

Available Phosphorus Requirement

Growing Entire Males and Immuno-Castrated Males

Pav Req. (g/day) = 0.046 $W^{0.75}$ + 5.68 G

W = Average Body Weight (kg); G = Daily Gain (kg/day)

Recommended Total Ca: Pav Ratio: 2.10

[1] Daily phosphorus requirements for maintenance and gain were estimated according to Bünzen (2009) (Ph.D. Thesis, UFV), Jongbloed et al (1993), and performance data obtained from dissertations, thesis, and scientific papers.

Table 5.24 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Growing Entire Males and Immuno-Castrated Males with High Genetic Potential Using the Equations in Table 5.23

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
Growing Entire Males and Immuno-Castrated Males								
28	9.01	0.289	0.360	1.803	0.501	1.878	0.522	1.060
42	14.30	0.409	0.555	2.556	0.460	2.662	0.479	0.973
56	21.48	0.548	0.837	3.431	0.410	3.573	0.427	0.867
70	30.73	0.699	1.170	4.388	0.375	4.570	0.390	0.792
84	42.12	0.852	1.560	5.381	0.345	5.602	0.359	0.729
98	55.62	1.000	1.972	6.358	0.322	6.618	0.336	0.681
112	71.04	1.134	2.353	7.273	0.309	7.567	0.322	0.653
126	88.13	1.248	2.641	8.087	0.306	8.411	0.318	0.647
140	106.56	1.337	2.777	8.773	0.316	9.121	0.328	0.667
154	125.97	1.400	3.757	9.316	0.248	9.680	0.258	0.523
168	145.96	1.435	3.965	9.712	0.245	10.085	0.254	0.517
182	166.18	1.446	4.123	9.964	0.242	10.340	0.251	0.510

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.25 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.05 and 5.13

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.54	0.248	4.43	1056	0.306	2.2	0.420	1.450
28	8.70	0.308	5.57	1350	0.391	4.9	0.413	1.424
35	11.31	0.374	6.86	1699	0.500	8.4	0.404	1.372
42	14.42	0.444	8.28	2109	0.620	12.7	0.393	1.334
49	18.04	0.518	9.81	2581	0.770	18.1	0.381	1.274
56	22.19	0.593	11.45	3115	0.930	24.6	0.368	1.232
63	26.86	0.667	13.14	3709	1.107	32.4	0.355	1.188
70	32.04	0.740	14.85	4356	1.301	41.5	0.341	1.144
77	37.70	0.809	16.54	5047	1.507	52.0	0.329	1.101
84	43.80	0.873	18.17	5769	1.722	64.1	0.316	1.058
91	50.31	0.930	19.69	6507	1.943	77.7	0.304	1.017
98	57.18	0.980	21.06	7244	2.163	92.8	0.292	0.978
105	64.33	1.023	22.25	7963	2.377	109.5	0.281	0.939
112	71.73	1.057	23.21	8648	2.582	127.5	0.269	0.903
119	79.31	1.083	23.94	9285	2.772	146.9	0.259	0.867
126	87.01	1.101	24.42	9861	2.944	167.5	0.249	0.832
133	94.78	1.110	24.64	10367	3.095	189.2	0.238	0.798
140	102.57	1.113	24.62	10797	3.223	211.8	0.229	0.766
147	110.32	1.107	24.36	11147	3.328	235.1	0.219	0.733
154	117.99	1.096	23.89	11418	3.409	258.9	0.210	0.701
161	125.54	1.079	23.23	11613	3.466	283.2	0.200	0.670
168	132.93	1.057	22.41	11736	3.503	307.7	0.191	0.640
175	140.14	1.030	21.46	11792	3.520	332.3	0.182	0.609
182	147.15	1.000	20.41	11791	3.520	357.0	0.173	0.579

[1] Diets containing 3450, 3400, and 3350 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.26 - Performance and Standardized Digestible Lysine (SID Lys) and Metabolizable Energy (ME) Requirements of Standard Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.06 and 5.14

Age, Days	Weight, kg	Gain, kg/day	SID Lys Req., g/day	ME Req., kcal/day[1]	Feed Intake, kg/day	Cumulative Intake, kg	Lys/ME Ratio, %/Mcal	SID Lys Diet, %
21	6.34	0.240	4.28	1053	0.310	2.2	0.406	1.381
28	8.42	0.297	5.36	1343	0.395	5.0	0.399	1.357
35	10.93	0.359	6.58	1686	0.500	8.5	0.390	1.317
42	13.91	0.425	7.91	2083	0.617	12.8	0.380	1.282
49	17.37	0.494	9.34	2539	0.753	18.0	0.369	1.243
56	21.32	0.564	10.85	3051	0.939	24.6	0.357	1.158
63	25.75	0.633	12.41	3617	1.113	32.4	0.344	1.118
70	30.64	0.699	13.97	4228	1.301	41.5	0.332	1.078
77	35.97	0.762	15.51	4876	1.500	52.0	0.320	1.038
84	41.71	0.820	16.99	5549	1.707	64.0	0.308	0.999
91	47.81	0.871	18.36	6233	1.918	77.4	0.296	0.962
98	54.21	0.916	19.59	6913	2.127	92.3	0.285	0.925
105	60.88	0.953	20.66	7574	2.331	108.6	0.274	0.891
112	67.76	0.982	21.52	8201	2.524	126.3	0.264	0.857
119	74.78	1.004	22.18	8783	2.703	145.2	0.254	0.824
126	81.90	1.018	22.61	9309	2.865	165.2	0.244	0.792
133	89.07	1.024	22.82	9773	3.007	186.2	0.234	0.761
140	96.23	1.024	22.81	10167	3.129	208.2	0.225	0.731
147	103.35	1.017	22.59	10492	3.228	230.8	0.216	0.701
154	110.37	1.005	22.19	10746	3.307	253.9	0.207	0.672
161	117.28	0.987	21.63	10933	3.364	277.4	0.198	0.643
168	124.04	0.965	20.92	11056	3.402	301.3	0.189	0.615
175	130.61	0.939	20.10	11121	3.422	325.2	0.181	0.588
182	136.99	0.911	19.19	11134	3.426	349.2	0.173	0.561

[1] Diet containing 3400, 3375, and 3250 kcal ME/kg for the phases 21-35, 35-49, and 49-182 days of age.

Table 5.27 - Performance and Available Phosphorus (Pav), Standardized Digestible Phosphorus (Dig. P), and Calcium Requirements of Standard and High Performance Mixed-Sex Pigs with High Genetic Potential Using the Equations in Tables 5.08 and 5.16

Age, days	Weight, kg	Gain, kg/day	Intake, kg/day	Dig. P, g/day	Dig. P, %	Pav, g/day	Pav, %	Ca[1], %
High Performance Mixed-Sex Pigs								
28	8.70	0.308	0.391	1.902	0.487	1.982	0.507	1.028
42	14.42	0.444	0.620	2.748	0.443	2.863	0.462	0.937
56	22.19	0.593	0.930	3.682	0.396	3.836	0.413	0.838
70	32.04	0.740	1.301	4.629	0.356	4.821	0.371	0.753
84	43.80	0.873	1.722	5.511	0.321	5.738	0.334	0.678
98	57.18	0.980	2.163	6.269	0.291	6.524	0.303	0.614
112	71.73	1.057	2.582	6.863	0.267	7.137	0.278	0.563
126	87.01	1.101	2.944	7.275	0.248	7.561	0.258	0.524
140	102.57	1.113	3.223	7.510	0.234	7.799	0.243	0.493
154	117.99	1.096	3.409	7.586	0.223	7.870	0.232	0.471
168	132.93	1.057	3.503	7.527	0.215	7.802	0.223	0.454
182	147.15	1.000	3.520	7.364	0.210	7.624	0.217	0.442
Standard Performance Mixed-Sex Pigs								
28	8.42	0.297	0.395	1.836	0.465	1.913	0.484	0.983
42	13.91	0.425	0.617	2.637	0.428	2.748	0.445	0.904
56	21.32	0.564	0.939	3.512	0.375	3.659	0.391	0.792
70	30.64	0.699	1.301	4.389	0.338	4.571	0.353	0.715
84	41.71	0.820	1.707	5.196	0.306	5.410	0.318	0.645
98	54.21	0.916	2.127	5.881	0.278	6.119	0.289	0.586
112	67.76	0.982	2.524	6.408	0.255	6.663	0.265	0.538
126	81.90	1.018	2.865	6.766	0.237	7.030	0.246	0.500
140	96.23	1.024	3.129	6.960	0.223	7.226	0.231	0.471
154	110.37	1.005	3.307	7.010	0.213	7.271	0.220	0.448
168	124.04	0.965	3.402	6.939	0.205	7.190	0.212	0.430
182	136.99	0.911	3.426	6.777	0.198	7.014	0.205	0.417

[1] Average %Ca was calculated by multiplying %Dig. P by the factor of 2.04 and %Pav by the factor of 2.10.

Table 5.28 - Equations Used to Estimate the Recommended Dietary Levels (Y) of Potassium, Sodium, and Chlorine for Growing Pigs with High Genetic Potential, in % per Mcal of ME, as a Function of Average Body Weight (X)[1]

Nutrients	Equation[1]
Barrows, Gilts, and Entire Males (5 to 135 kg)	
Potassium	$Y = (154.9 – 0.427\ X + 0.0006\ X^2) / 1000$
Sodium	$Y = (68.4 – 0.346\ X + 0.0014\ X^2) / 1000$
Chlorine	$Y = (65.4 – 0.346\ X + 0.0014\ X^2) / 1000$

[1] In order to determine nutrient percentage in the diet of a nutritional program, use the equations above. Y = nutrients % by 1.0 Mcal of ME/kg and X = average weight (kg). The obtained value must be multiplied by the dietary ME in Mcal; E.g.: The sodium requirement of high performance growing barrows at 105 days of age (average weight of 66.13 kg) is: $Y = 68.4 – 0.346\ (66.13) + 0.0014\ (66.13^2) / 1000 = 0.052\%$ Mcal x 3.350 Mcal ME/kg diet = 0.173 % of sodium.

Table 5.29 - Equation Used to Estimate the Recommended Dietary Levels (Y) of Linoleic Acid of Growing Pigs with High Genetic Potential, in g per day, as a Function of Average Body Weight (X)[1]

Nutrients	Equation[1]
Barrows, Gilts, and Entire Males (5 to 135 kg)	
Linoleic Acid	$Y= 1.3476 + 0.0152\ X$

[1] In order to determine linoleic acid in the diet of a nutritional program, use the equation above. Y= Linoleic acid (g/day) and X = average weight (kg). Dietary linoleic acid in percentage must be determined in function of the estimated feed intake at age, e.g.: Linoleic acid requirement of high performance growing barrows at 105 days of age (average weight = 66.13 kg; estimated feed intake = 2.556 kg) is $Y= 1.3476 + 0.0152\ (66.13) = 2.353$ g/day and 0.092% of linoleic acid in the diet.

Table 5.30 - Amino Acid to Lysine Ratios Used to Estimate the Amino Acid Requirements of Growing Swine

Phase		Pre Starter I and II		Starter		Grower		Finisher	
Age		Up to 49 days		49 - 63		63 - 119		119 - 175	
Amino Acids		SID	Total	SID	Total	SID	Total	SID	Total
Lysine	%	100	100	100	100	100	100	100	100
Methionine	%	33	32	33	32	33	32	33	32
Met + Cys	%	60	59	60	59	60	59	60	59
Threonine	%	68	71	68	71	68	71	68	71
Tryptophan	%	21	21	20	20	20	20	20	20
Arginine	%	100	99	45	44	42	40	40	38
Valine	%	70	71	70	71	69	70	69	70
Isoleucine	%	55	55	55	55	55	55	55	55
Leucine	%	102	99	102	99	100	97	100	97
Histidine	%	33	32	33	32	33	32	33	32
Phenylalanine	%	54	53	54	53	54	53	54	53
Phe + Tyr	%	100	98	100	98	100	98	100	98

Table 5.31 - Example for Calculation of Digestible Essential Nitrogen (Dig. Ne), Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of Growing Swine[1]

Amino Acids	N (%)	SID AA Req. (%)	Dig. Ne (%)	Total AA Req. (%)	Net (%)
Lysine	19.16	0.893	0.171	1.015	0.194
Methionine	9.39	0.295	0.028	0.325	0.031
Threonine	11.76	0.607	0.071	0.721	0.085
Tryptophan	13.72	0.179	0.025	0.203	0.028
Arginine[2]	32.16	0.375	0.121	0.406	0.131
Valine	11.96	0.616	0.074	0.711	0.085
Isoleucine	10.68	0.491	0.052	0.558	0.060
Leucine	10.68	0.893	0.095	0.985	0.105
Histidine	27.08	0.295	0.080	0.325	0.088
Phenylalanine	8.48	0.482	0.041	0.538	0.046
Ne Req.		0.758		0.852	
Total N Req.[3]		2.048		2.301	
Protein Req.[4]		12.80		14.38	

[1] High Performance Growing Barrows (50 to 80 kg).
[2] Due to the diverse arginine functions during the pre-starter I and II phases, the N contribution was considered of 35%.
[3] Ne:Nt ratio used 37%.
[4] N to a protein conversion factor of 6.25.

The total lysine requirement was calculated considering 88.0% the ileal digestibility of lysine in the diet, and the total amino acid to total lysine ratios were used to estimate total amino acid requirements (Table 5.30).

- Simplified calculation of Crude and Digestible Protein levels using the SID Lys percentage on Crude Protein of 6.2% (6.09 – 6.30) and on Digestible Protein of 7.0% (6.87 – 7.13), respectively.

- Example: High Performance Growing Barrows (105 days)

Average Weight = 66.127 kg, $W^{0.75}$ = 23.189; G = 1.065 kg / day; Estimated Feed Intake = 2.556 g/day; Dietary SID Lys = 0.893%

Dietary Crude Protein = (% SID Lys x 100)/6.2 = (0.893x100)/ 6.2 = 14.40%
Dietary Digestible Protein=(% SID Lysx100)/7.0=(0.893x100)/7.0= 12.75%

Table 5.32 - Nutritional Requirements of High Genetic Potential Piglets in the Pre-Starter Phase – Barrows, Gilts, and Entire Males

Age	Days	14 - 21	21 - 35	35 - 49
Weight Range	kg	4.4 to 6.2	6.2 to 8.4	8.4 to 17.9
Average Weight	kg	-	8.37	14.20
Gain	kg/day	-	0.309	0.454
SID Lys Requirement	g/day	-	5.61	8.43
Digestible P Requirement	g/day	-	1.90	2.80
Available P Requirement	g/day	-	1.98	2.92
Metabolizable Energy Req.	kcal/day	-	1338	2145
Diet Metabolizable Energy	kcal/kg	3450	3450	3400
Diet Net Energy	kcal/kg	2588	2588	2550
Intake	kg/day	-	0.388	0.631
		Nutrients		
Calcium*	%	1.086	1.038	0.938
Available Phosphorus	%	0.514	0.491	0.443
Digestible Phosphorus	%	0.535	0.512	0.462
Potassium	%	0.527	0.522	0.506
Sodium	%	0.230	0.226	0.217
Chlorine	%	0.219	0.216	0.207
Linoleic Acid	%	0.554	0.380	0.248
		Digestible Protein and Amino Acid		
Digestible Protein	%	20.94	20.29	18.75
Lysine	%	1.493	1.446	1.336
Methionine	%	0.493	0.477	0.441
Methionine + Cysteine	%	0.896	0.868	0.802
Threonine	%	1.015	0.984	0.909
Tryptophan	%	0.313	0.304	0.281
Arginine	%	1.493	1.446	1.336
Valine	%	1.045	1.012	0.936
Isoleucine	%	0.821	0.796	0.735
Leucine	%	1.522	1.475	1.363
Histidine	%	0.493	0.477	0.441
Phenylalanine	%	0.806	0.781	0.722
Phenylalanine + Tyrosine	%	1.493	1.446	1.336
Digestible Essential Nitrogen	%	1.240	1.201	1.110
		Total Protein and Amino Acid		
Crude Protein	%	23.68	22.94	21.20
Lysine	%	1.696	1.644	1.519
Methionine	%	0.543	0.526	0.486
Methionine + Cysteine	%	1.001	0.970	0.896
Threonine	%	1.204	1.167	1.078
Tryptophan	%	0.356	0.345	0.319
Arginine	%	1.679	1.627	1.504
Valine	%	1.204	1.167	1.078
Isoleucine	%	0.933	0.904	0.835
Leucine	%	1.679	1.627	1.504
Histidine	%	0.543	0.526	0.486
Phenylalanine	%	0.899	0.871	0.805
Phenylalanine + Tyrosine	%	1.662	1.611	1.488
Total Essential Nitrogen	%	1.402	1.358	1.255

*Values between 0.800 and 0.700% of Total Calcium are recommended to reduce the incidence of diarrhea.

Table 5.33 - Nutritional Requirements of High Performance Barrows with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 51	51 to 82	82 to 113	113 to 145
Average Weight	kg	22.22	38.35	66.13	97.70	129.23
Gain	kg/day	0.613	0.843	1.065	1.147	1.100
SID Lys Requirement	g/day	11.73	16.98	22.83	25.44	24.46
Digestible P Requirement	g/day	3.79	5.28	6.84	7.65	7.73
Available P Requirement	g/day	3.95	5.50	7.12	7.94	8.01
Metabolizable Energy Req.	kcal/day	3236	5362	8561	11094	12246
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2462	2543	2578	2601	2622
Intake	kg/day	0.966	1.601	2.556	3.312	3.655
				Nutrients		
Calcium	%	0.830	0.697	0.566	0.487	0.446
Digestible Phosphorus	%	0.392	0.330	0.268	0.231	0.211
Available Phosphorus	%	0.409	0.343	0.279	0.240	0.219
Potassium	%	0.488	0.467	0.433	0.398	0.368
Sodium	%	0.206	0.192	0.173	0.161	0.158
Chlorine	%	0.196	0.182	0.163	0.151	0.148
Linoleic Acid	%	0.174	0.121	0.092	0.086	0.091
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.66	15.20	12.80	10.92	9.52
Lysine	%	1.214	1.061	0.893	0.768	0.669
Methionine	%	0.401	0.350	0.295	0.253	0.221
Methionine + Cysteine	%	0.728	0.636	0.536	0.461	0.401
Threonine	%	0.825	0.721	0.607	0.522	0.455
Tryptophan	%	0.243	0.212	0.179	0.154	0.134
Arginine	%	0.546	0.446	0.375	0.307	0.268
Valine	%	0.850	0.732	0.616	0.530	0.462
Isoleucine	%	0.668	0.583	0.491	0.422	0.368
Leucine	%	1.238	1.061	0.893	0.768	0.669
Histidine	%	0.401	0.350	0.295	0.253	0.221
Phenylalanine	%	0.655	0.573	0.482	0.415	0.361
Phenylalanine + Tyrosine	%	1.214	1.061	0.893	0.768	0.669
Digestible Essential Nitrogen	%	1.045	0.900	0.758	0.647	0.563
				Total Protein and Amino Acid		
Crude Protein	%	19.92	17.08	14.38	12.27	10.69
Lysine	%	1.379	1.205	1.015	0.873	0.760
Methionine	%	0.441	0.386	0.325	0.279	0.243
Methionine + Cysteine	%	0.814	0.711	0.599	0.515	0.449
Threonine	%	0.979	0.856	0.721	0.620	0.540
Tryptophan	%	0.276	0.241	0.203	0.175	0.152
Arginine	%	0.607	0.482	0.406	0.332	0.289
Valine	%	0.979	0.844	0.711	0.611	0.532
Isoleucine	%	0.759	0.663	0.558	0.480	0.418
Leucine	%	1.366	1.169	0.985	0.847	0.738
Histidine	%	0.441	0.386	0.325	0.279	0.243
Phenylalanine	%	0.731	0.639	0.538	0.463	0.403
Phenylalanine + Tyrosine	%	1.352	1.181	0.995	0.855	0.745
Total Essential Nitrogen	%	1.179	1.011	0.852	0.727	0.633

Table 5.34 - Nutritional Requirements of High Performance Barrows with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	27 to 51	51 to 82	82 to 113	113 to 145
Average Weight	kg	38.35	66.13	97.70	129.23
Gain	kg/day	0.843	1.065	1.147	1.100
SID Lys Requirement	g/day	16.98	22.83	25.44	24.46
Digestible P Requirement	g/day	5.28	6.84	7.65	7.73
Available P Requirement	g/day	5.50	7.12	7.94	8.01
Metabolizable Energy Req.	kcal/day	5177	8283	10721	11786
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2535	2571	2596	2616
Intake	kg/day	1.545	2.472	3.200	3.518
			Nutrients		
Calcium	%	0.722	0.585	0.504	0.463
Digestible Phosphorus	%	0.341	0.277	0.239	0.220
Available Phosphorus	%	0.356	0.288	0.248	0.228
Potassium	%	0.467	0.433	0.398	0.368
Sodium	%	0.192	0.173	0.161	0.158
Chlorine	%	0.182	0.163	0.151	0.148
Linoleic Acid	%	0.125	0.095	0.089	0.094
			Digestible Protein and Amino Acid		
Digestible Protein	%	15.74	13.23	11.30	9.89
Lysine	%	1.099	0.923	0.795	0.695
Methionine	%	0.363	0.305	0.262	0.229
Methionine + Cysteine	%	0.659	0.554	0.477	0.417
Threonine	%	0.747	0.628	0.541	0.473
Tryptophan	%	0.220	0.185	0.159	0.139
Arginine	%	0.461	0.388	0.318	0.278
Valine	%	0.758	0.637	0.548	0.480
Isoleucine	%	0.604	0.508	0.437	0.382
Leucine	%	1.099	0.923	0.795	0.695
Histidine	%	0.363	0.305	0.262	0.229
Phenylalanine	%	0.593	0.499	0.429	0.375
Phenylalanine + Tyrosine	%	1.099	0.923	0.795	0.695
Digestible Essential Nitrogen	%	0.932	0.783	0.669	0.585
			Total Protein and Amino Acid		
Crude Protein	%	17.69	14.87	12.70	11.11
Lysine	%	1.249	1.049	0.903	0.790
Methionine	%	0.400	0.336	0.289	0.253
Methionine + Cysteine	%	0.737	0.619	0.533	0.466
Threonine	%	0.886	0.745	0.641	0.561
Tryptophan	%	0.250	0.210	0.181	0.158
Arginine	%	0.499	0.420	0.343	0.300
Valine	%	0.874	0.734	0.632	0.553
Isoleucine	%	0.687	0.577	0.497	0.435
Leucine	%	1.211	1.018	0.876	0.766
Histidine	%	0.400	0.336	0.289	0.253
Phenylalanine	%	0.662	0.556	0.479	0.419
Phenylalanine + Tyrosine	%	1.224	1.028	0.885	0.774
Total Essential Nitrogen	%	1.047	0.880	0.752	0.658

Table 5.35 - Nutritional Requirements of Standard Performance Barrows with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 78	78 to 106	106 to 133
Average Weight	kg	22.43	37.85	63.65	92.18	120.00
Gain	kg/day	0.597	0.799	0.979	1.026	0.963
SID Lys Requirement	g/day	11.45	16.10	20.95	22.80	21.67
Digestible P Requirement	g/day	3.71	5.03	6.34	6.93	6.89
Available P Requirement	g/day	3.87	5.24	6.60	7.20	7.14
Metabolizable Energy Req.	kcal/day	3292	5285	8134	10274	11197
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2432	2464	2496	2487	2504
Intake	kg/day	1.013	1.626	2.503	3.161	3.445
				Nutrients		
Calcium	%	0.774	0.654	0.535	0.463	0.421
Available Phosphorus	%	0.366	0.309	0.253	0.219	0.200
Digestible Phosphorus	%	0.382	0.322	0.264	0.228	0.207
Potassium	%	0.473	0.454	0.423	0.392	0.365
Sodium	%	0.199	0.186	0.169	0.157	0.153
Chlorine	%	0.190	0.177	0.159	0.148	0.143
Linoleic Acid	%	0.167	0.118	0.093	0.087	0.092
				Digestible Protein and Amino Acid		
Digestible Protein	%	16.44	14.19	11.99	10.26	8.94
Lysine	%	1.130	0.990	0.837	0.721	0.629
Methionine	%	0.373	0.327	0.276	0.238	0.208
Methionine + Cysteine	%	0.678	0.594	0.502	0.433	0.377
Threonine	%	0.768	0.673	0.569	0.491	0.428
Tryptophan	%	0.226	0.198	0.167	0.144	0.126
Arginine	%	0.509	0.416	0.352	0.289	0.252
Valine	%	0.791	0.683	0.578	0.498	0.434
Isoleucine	%	0.622	0.545	0.460	0.397	0.346
Leucine	%	1.153	0.990	0.837	0.721	0.629
Histidine	%	0.373	0.327	0.276	0.238	0.208
Phenylalanine	%	0.610	0.535	0.452	0.390	0.340
Phenylalanine + Tyrosine	%	1.130	0.990	0.837	0.721	0.629
Digestible Essential Nitrogen	%	0.973	0.840	0.710	0.607	0.529
				Total Protein and Amino Acid		
Crude Protein	%	18.55	15.95	13.48	11.53	10.05
Lysine	%	1.284	1.125	0.951	0.820	0.715
Methionine	%	0.411	0.360	0.304	0.262	0.229
Methionine + Cysteine	%	0.758	0.664	0.561	0.484	0.422
Threonine	%	0.912	0.799	0.675	0.582	0.507
Tryptophan	%	0.257	0.225	0.190	0.164	0.143
Arginine	%	0.565	0.450	0.380	0.312	0.272
Valine	%	0.912	0.788	0.666	0.574	0.500
Isoleucine	%	0.706	0.619	0.523	0.451	0.393
Leucine	%	1.271	1.091	0.923	0.795	0.693
Histidine	%	0.411	0.360	0.304	0.262	0.229
Phenylalanine	%	0.681	0.596	0.504	0.434	0.379
Phenylalanine + Tyrosine	%	1.258	1.103	0.932	0.803	0.700
Total Essential Nitrogen	%	1.098	0.944	0.798	0.682	0.595

Table 5.36 - Nutritional Requirements of High Performance Gilts with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 77	77 to 107	107 to 137
Average Weight	Kg	22.16	37.04	62.53	91.86	121.84
Gain	kg/day	0.572	0.774	0.980	1.073	1.057
SID Lys Requirement	g/day	11.16	16.10	21.66	23.84	21.99
Digestible P Requirement	g/day	3.57	4.89	6.33	7.18	7.42
Available P Requirement	g/day	3.72	5.09	6.59	7.46	7.69
Metabolizable Energy Req.	kcal/day	2993	4732	7365	9639	10980
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2501	2526	2550	2556	2604
Intake	kg/day	0.893	1.412	2.198	2.877	3.277
				Nutrients		
Calcium	%	0.845	0.731	0.609	0.527	0.477
Available Phosphorus	%	0.400	0.346	0.288	0.250	0.226
Digestible Phosphorus	%	0.416	0.360	0.300	0.259	0.235
Potassium	%	0.488	0.469	0.437	0.404	0.374
Sodium	%	0.206	0.193	0.175	0.162	0.158
Chlorine	%	0.196	0.183	0.165	0.152	0.147
Linoleic Acid	%	0.189	0.135	0.105	0.095	0.098
				Digestible Protein and Amino Acid		
Digestible Protein	%	18.18	16.33	14.12	11.78	9.54
Lysine	%	1.249	1.140	0.985	0.828	0.671
Methionine	%	0.412	0.376	0.325	0.273	0.221
Methionine + Cysteine	%	0.750	0.684	0.591	0.497	0.402
Threonine	%	0.850	0.775	0.670	0.563	0.456
Tryptophan	%	0.250	0.228	0.197	0.166	0.134
Arginine	%	0.562	0.479	0.414	0.331	0.268
Valine	%	0.875	0.787	0.680	0.572	0.463
Isoleucine	%	0.687	0.627	0.542	0.456	0.369
Leucine	%	1.274	1.140	0.985	0.828	0.671
Histidine	%	0.412	0.376	0.325	0.273	0.221
Phenylalanine	%	0.675	0.616	0.532	0.447	0.362
Phenylalanine + Tyrosine	%	1.249	1.140	0.985	0.828	0.671
Digestible Essential Nitrogen	%	1.076	0.967	0.836	0.697	0.565
				Total Protein and Amino Acid		
Crude Protein	%	20.51	18.35	15.87	13.24	10.72
Lysine	%	1.420	1.295	1.120	0.941	0.762
Methionine	%	0.454	0.414	0.358	0.301	0.244
Methionine + Cysteine	%	0.838	0.764	0.661	0.555	0.450
Threonine	%	1.008	0.920	0.795	0.668	0.541
Tryptophan	%	0.284	0.259	0.224	0.188	0.152
Arginine	%	0.625	0.518	0.448	0.358	0.290
Valine	%	1.008	0.907	0.784	0.659	0.534
Isoleucine	%	0.781	0.712	0.616	0.518	0.419
Leucine	%	1.406	1.256	1.086	0.913	0.739
Histidine	%	0.454	0.414	0.358	0.301	0.244
Phenylalanine	%	0.752	0.687	0.593	0.499	0.404
Phenylalanine + Tyrosine	%	1.391	1.269	1.097	0.923	0.747
Total Essential Nitrogen	%	1.214	1.087	0.939	0.784	0.635

Table 5.37 - Nutritional Requirements of High Performance Gilts with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	27 to 50	50 to 77	77 to 107	107 to 137
Average Weight	kg	37.04	62.53	91.86	121.84
Gain	kg/day	0.774	0.980	1.073	1.057
SID Lys Requirement	g/day	16.10	21.66	23.84	21.99
Digestible P Requirement	g/day	4.89	6.33	7.18	7.42
Available P Requirement	g/day	5.09	6.59	7.46	7.69
Metabolizable Energy Req.	kcal/day	4552	7098	9283	10539
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2517	2551	2583	2616
Intake	kg/day	1.359	2.119	2.771	3.146
			Nutrients		
Calcium	%	0.760	0.631	0.547	0.497
Digestible Phosphorus	%	0.360	0.299	0.259	0.236
Available Phosphorus	%	0.375	0.311	0.269	0.244
Potassium	%	0.469	0.437	0.404	0.374
Sodium	%	0.193	0.175	0.162	0.158
Chlorine	%	0.183	0.165	0.152	0.147
Linoleic Acid	%	0.141	0.108	0.099	0.102
			Digestible Protein and Amino Acid		
Digestible Protein	%	16.98	14.65	12.23	9.94
Lysine	%	1.185	1.022	0.860	0.699
Methionine	%	0.391	0.337	0.284	0.231
Methionine + Cysteine	%	0.711	0.613	0.516	0.419
Threonine	%	0.806	0.695	0.585	0.475
Tryptophan	%	0.237	0.204	0.172	0.140
Arginine	%	0.498	0.429	0.344	0.280
Valine	%	0.818	0.705	0.594	0.482
Isoleucine	%	0.652	0.562	0.473	0.384
Leucine	%	1.185	1.022	0.860	0.699
Histidine	%	0.391	0.337	0.284	0.231
Phenylalanine	%	0.640	0.552	0.465	0.377
Phenylalanine + Tyrosine	%	1.185	1.022	0.860	0.699
Digestible Essential Nitrogen	%	1.005	0.867	0.724	0.588
			Total Protein and Amino Acid		
Crude Protein		19.08	16.46	13.75	11.17
Lysine	%	1.347	1.162	0.978	0.794
Methionine	%	0.794	0.685	0.577	0.469
Methionine + Cysteine	%	0.431	0.372	0.313	0.254
Threonine	%	0.956	0.825	0.694	0.564
Tryptophan	%	0.269	0.232	0.196	0.159
Arginine	%	0.539	0.465	0.371	0.302
Valine	%	0.943	0.813	0.684	0.556
Isoleucine	%	0.741	0.639	0.538	0.437
Leucine	%	1.306	1.127	0.948	0.770
Histidine	%	0.431	0.372	0.313	0.254
Phenylalanine	%	0.714	0.616	0.518	0.421
Phenylalanine + Tyrosine	%	1.320	1.138	0.958	0.778
Total Essential Nitrogen	%	1.130	0.975	0.814	0.661

Table 5.38 - Nutritional Requirements of Standard Performance Gilts with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	15 to 25	25 to 45	45 to 70	70 to 100	100 to 129
Average Weight	kg	20.20	34.09	58.11	85.95	114.56
Gain	kg/day	0.531	0.725	0.926	1.021	1.011
SID Lys Requirement	g/day	10.25	14.92	20.36	22.83	21.58
Digestible P Requirement	g/day	3.31	4.58	5.99	6.83	7.09
Available P Requirement	g/day	3.45	4.77	6.23	7.10	7.35
Metabolizable Energy Req.	kcal/day	2810	4466	7013	9271	10669
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2421	2444	2475	2471	2499
Intake	kg/day	0.865	1.374	2.158	2.853	3.283
				Nutrients		
Calcium	%	0.810	0.704	0.586	0.506	0.455
Available Phosphorus	%	0.383	0.333	0.277	0.240	0.216
Digestible Phosphorus	%	0.399	0.347	0.289	0.249	0.224
Potassium	%	0.476	0.458	0.429	0.399	0.370
Sodium	%	0.201	0.189	0.172	0.159	0.153
Chlorine	%	0.192	0.180	0.163	0.150	0.143
Linoleic Acid	%	0.191	0.136	0.103	0.093	0.094
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.25	15.56	13.52	11.38	9.35
Lysine	%	1.185	1.086	0.944	0.800	0.657
Methionine	%	0.391	0.358	0.311	0.264	0.217
Methionine + Cysteine	%	0.711	0.651	0.566	0.480	0.394
Threonine	%	0.806	0.738	0.642	0.544	0.447
Tryptophan	%	0.237	0.217	0.189	0.160	0.131
Arginine	%	0.533	0.456	0.396	0.320	0.263
Valine	%	0.830	0.749	0.651	0.552	0.454
Isoleucine	%	0.652	0.597	0.519	0.440	0.362
Leucine	%	1.209	1.086	0.944	0.800	0.657
Histidine	%	0.391	0.358	0.311	0.264	0.217
Phenylalanine	%	0.640	0.586	0.509	0.432	0.355
Phenylalanine + Tyrosine	%	1.185	1.086	0.944	0.800	0.657
Digestible Essential Nitrogen	%	1.021	0.921	0.800	0.674	0.553
				Total Protein and Amino Acid		
Crude Protein	%	19.46	17.48	15.19	12.79	10.50
Lysine	%	1.347	1.234	1.072	0.909	0.747
Methionine	%	0.431	0.395	0.343	0.291	0.239
Methionine + Cysteine	%	0.795	0.728	0.633	0.536	0.441
Threonine	%	0.956	0.876	0.761	0.646	0.530
Tryptophan	%	0.269	0.247	0.214	0.182	0.149
Arginine	%	0.593	0.493	0.429	0.346	0.284
Valine	%	0.956	0.864	0.751	0.637	0.523
Isoleucine	%	0.741	0.679	0.590	0.500	0.411
Leucine	%	1.334	1.197	1.040	0.882	0.725
Histidine	%	0.431	0.395	0.343	0.291	0.239
Phenylalanine	%	0.714	0.654	0.568	0.482	0.396
Phenylalanine + Tyrosine	%	1.320	1.209	1.051	0.891	0.732
Total Essential Nitrogen	%	1.152	1.035	0.899	0.757	0.622

Table 5.39 - Nutritional Requirements of Standard Performance Entire Males and Immuno-Castrated Males with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	17 to 26	26 to 49	49 to 80	80 to 116	116 to 156
Average Weight	kg	21.48	36.16	63.10	97.20	135.91
Gain	kg/day	0.548	0.776	1.069	1.296	1.421
SID Lys Requirement	g/day	10.70	16.12	23.28	26.63	28.14
Digestible P Requirement	g/day	3.43	4.88	6.83	8.45	9.53
Available P Requirement	g/day	3.57	5.08	7.10	8.78	9.90
Metabolizable Energy Req.	kcal/day	2761	4488	7161	9014	12569
Diet Metabolizable Energy	kcal/kg	3300	3300	3300	3300	3250
Diet Net Energy	kcal/kg	2455	2473	2494	2511	2485
Intake	kg/day	0.837	1.360	2.170	2.732	3.867
				Nutrients		
Calcium	%	0.867	0.759	0.665	0.653	0.520
Digestible Phosphorus	%	0.410	0.359	0.315	0.309	0.246
Available Phosphorus	%	0.427	0.374	0.327	0.322	0.256
Potassium	%	0.482	0.463	0.430	0.393	0.351
Sodium	%	0.203	0.190	0.172	0.158	0.154
Chlorine	%	0.193	0.181	0.162	0.148	0.144
Linoleic Acid	%	0.200	0.140	0.106	0.103	0.088
				Digestible Protein and Amino Acid		
Digestible Protein	%	18.61	16.99	15.38	13.86	10.35
Lysine	%	1.279	1.186	1.073	0.975	0.728
Methionine	%	0.422	0.391	0.354	0.322	0.240
Methionine + Cysteine	%	0.768	0.711	0.644	0.585	0.437
Threonine	%	0.870	0.806	0.730	0.663	0.495
Tryptophan	%	0.256	0.237	0.215	0.195	0.146
Arginine	%	0.576	0.498	0.451	0.390	0.291
Valine	%	0.895	0.818	0.740	0.673	0.502
Isoleucine	%	0.704	0.652	0.590	0.536	0.400
Leucine	%	1.305	1.186	1.073	0.975	0.728
Histidine	%	0.422	0.391	0.354	0.322	0.240
Phenylalanine	%	0.691	0.640	0.579	0.526	0.393
Phenylalanine + Tyrosine	%	1.279	1.186	1.073	0.975	0.728
Digestible Essential Nitrogen	%	1.102	1.006	0.910	0.821	0.613
				Total Protein and Amino Acid		
Crude Protein	%	21.00	19.09	17.28	15.58	11.63
Lysine	%	1.454	1.347	1.219	1.108	0.827
Methionine	%	0.465	0.431	0.390	0.354	0.265
Methionine + Cysteine	%	0.858	0.795	0.719	0.654	0.488
Threonine	%	1.032	0.957	0.866	0.786	0.587
Tryptophan	%	0.291	0.269	0.244	0.222	0.165
Arginine	%	0.640	0.539	0.488	0.421	0.314
Valine	%	1.032	0.943	0.854	0.775	0.579
Isoleucine	%	0.800	0.741	0.671	0.609	0.455
Leucine	%	1.439	1.307	1.183	1.074	0.802
Histidine	%	0.465	0.431	0.390	0.354	0.265
Phenylalanine	%	0.770	0.714	0.646	0.587	0.438
Phenylalanine + Tyrosine	%	1.425	1.320	1.195	1.086	0.810
Total Essential Nitrogen	%	1.243	1.130	1.023	0.922	0.688

Table 5.40 - Nutritional Requirements of High Performance Entire Males and Immuno-Castrated Males with High Genetic Potential Reared at +5 °C Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91- 119	119 - 147	147 - 175
Weight Range	kg	25 to 45	45 to 70	70 to 105	105 to 145
Average Weight	kg	36.16	63.10	97.20	135.91
Gain	kg/day	0.776	1.069	1.296	1.421
SID Lys Requirement	g/day	16.12	23.28	26.63	28.14
Digestible P Requirement	g/day	4.88	6.83	8.45	9.53
Available P Requirement	g/day	5.08	7.10	8.78	9.90
Metabolizable Energy Req.	kcal/day	4311	6892	8643	12091
Diet Metabolizable Energy	kcal/kg	3300	3300	3300	3250
Diet Net Energy	kcal/kg	2462	2485	2502	2479
Intake	kg/day	1.306	2.088	2.619	3.720
			Nutrients		
Calcium	%	0.790	0.691	0.681	0.541
Digestible Phosphorus	%	0.374	0.327	0.323	0.256
Available Phosphorus	%	0.389	0.340	0.335	0.266
Potassium	%	0.463	0.430	0.393	0.351
Sodium	%	0.190	0.172	0.158	0.154
Chlorine	%	0.181	0.162	0.148	0.144
Linoleic Acid	%	0.145	0.110	0.108	0.092
			Digestible Protein and Amino Acid		
Digestible Protein	%	17.69	15.97	14.46	10.76
Lysine	%	1.234	1.115	1.017	0.756
Methionine	%	0.407	0.368	0.336	0.250
Methionine + Cysteine	%	0.741	0.669	0.610	0.454
Threonine	%	0.839	0.758	0.691	0.514
Tryptophan	%	0.247	0.223	0.203	0.151
Arginine	%	0.518	0.468	0.407	0.303
Valine	%	0.852	0.769	0.702	0.522
Isoleucine	%	0.679	0.613	0.559	0.416
Leucine	%	1.234	1.115	1.017	0.756
Histidine	%	0.407	0.368	0.336	0.250
Phenylalanine	%	0.667	0.602	0.549	0.408
Phenylalanine + Tyrosine	%	1.234	1.115	1.017	0.756
Digestible Essential Nitrogen	%	1.047	0.946	0.856	0.637
			Total Protein and Amino Acid		
Crude Protein	%	19.88	17.95	16.25	12.09
Lysine	%	1.403	1.267	1.155	0.859
Methionine	%	0.449	0.405	0.370	0.275
Methionine + Cysteine	%	0.828	0.747	0.682	0.507
Threonine	%	0.996	0.899	0.820	0.610
Tryptophan	%	0.281	0.253	0.231	0.172
Arginine	%	0.561	0.507	0.439	0.327
Valine	%	0.982	0.887	0.809	0.602
Isoleucine	%	0.771	0.697	0.635	0.473
Leucine	%	1.361	1.229	1.121	0.834
Histidine	%	0.449	0.405	0.370	0.275
Phenylalanine	%	0.743	0.671	0.612	0.456
Phenylalanine + Tyrosine	%	1.375	1.242	1.132	0.842
Total Essential Nitrogen	%	1.177	1.063	0.962	0.715

Table 5.41 - Nutritional Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	18 to 27	27 to 50	50 to 80	80 to 110	110 to 141
Average Weight	kg	22.19	37.70	64.33	94.78	125.54
Gain	kg/day	0.593	0.809	1.023	1.110	1.079
SID Lys Requirement	g/day	11.45	16.54	22.25	24.64	23.23
Digestible P Requirement	g/day	3.68	5.09	6.59	7.42	7.58
Available P Requirement	g/day	3.84	5.30	6.86	7.70	7.85
Metabolizable Energy Req.	kcal/day	3115	5047	7963	10367	11613
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2482	2535	2564	2579	2613
Intake	kg/day	0.930	1.507	2.377	3.095	3.466
				Nutrients		
Calcium	%	0.838	0.714	0.588	0.507	0.462
Available Phosphorus	%	0.396	0.338	0.278	0.241	0.219
Digestible Phosphorus	%	0.413	0.352	0.290	0.250	0.227
Potassium	%	0.488	0.468	0.435	0.401	0.371
Sodium	%	0.206	0.192	0.172	0.158	0.154
Chlorine	%	0.196	0.183	0.158	0.150	0.147
Linoleic Acid	%	0.182	0.128	0.099	0.091	0.095
				Digestible Protein and Amino Acid		
Digestible Protein	%	17.92	15.77	13.46	11.35	9.53
Lysine	%	1.232	1.101	0.939	0.798	0.670
Methionine	%	0.407	0.363	0.310	0.263	0.221
Methionine + Cysteine	%	0.739	0.660	0.564	0.479	0.402
Threonine	%	0.838	0.748	0.639	0.543	0.456
Tryptophan	%	0.247	0.220	0.188	0.160	0.134
Arginine	%	0.554	0.463	0.395	0.319	0.268
Valine	%	0.863	0.760	0.648	0.551	0.463
Isoleucine	%	0.678	0.605	0.517	0.439	0.369
Leucine	%	1.256	1.101	0.939	0.798	0.670
Histidine	%	0.407	0.363	0.310	0.263	0.221
Phenylalanine	%	0.665	0.595	0.507	0.431	0.362
Phenylalanine + Tyrosine	%	1.232	1.101	0.939	0.798	0.670
Digestible Essential Nitrogen	%	1.061	0.934	0.797	0.672	0.564
				Total Protein and Amino Acid		
Crude Protein	%	20.22	17.72	15.13	12.76	10.71
Lysine	%	1.400	1.250	1.068	0.907	0.761
Methionine	%	0.448	0.400	0.342	0.290	0.244
Methionine + Cysteine	%	0.826	0.738	0.630	0.535	0.450
Threonine	%	0.994	0.888	0.758	0.644	0.541
Tryptophan	%	0.280	0.250	0.214	0.182	0.152
Arginine	%	0.616	0.500	0.427	0.345	0.290
Valine	%	0.994	0.876	0.748	0.635	0.533
Isoleucine	%	0.770	0.688	0.587	0.499	0.419
Leucine	%	1.386	1.213	1.036	0.880	0.739
Histidine	%	0.448	0.400	0.342	0.290	0.244
Phenylalanine	%	0.742	0.663	0.566	0.481	0.404
Phenylalanine + Tyrosine	%	1.372	1.225	1.046	0.889	0.746
Total Essential Nitrogen	%	1.197	1.049	0.896	0.756	0.634

Table 5.42 - Nutritional Requirements of High Performance Mixed-Sex Pigs with High Genetic Potential Reared at +5 ºC Above Thermo-neutral Temperature

Phase		Grower		Finisher	
Age	Days	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	27 to 50	50 to 80	80 to 110	110 to 141
Average Weight	kg	37.70	64.33	94.78	125.54
Gain	kg/day	0.809	1.023	1.110	1.079
SID Lys Requirement	g/day	16.54	22.24	24.64	23.23
Digestible P Requirement	g/day	5.08	6.59	7.41	7.57
Available P Requirement	g/day	5.29	6.85	7.70	7.85
Metabolizable Energy Req.	kcal/day	4865	7691	10002	11163
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2526	2561	2590	2616
Intake	kg/day	1.452	2.296	2.986	3.332
			Nutrients		
Calcium	%	0.741	0.608	0.526	0.480
Digestible Phosphorus	%	0.351	0.288	0.249	0.228
Available Phosphorus	%	0.366	0.300	0.259	0.236
Potassium	%	0.468	0.435	0.401	0.371
Sodium	%	0.193	0.174	0.162	0.158
Chlorine	%	0.183	0.164	0.152	0.148
Linoleic Acid	%	0.133	0.102	0.094	0.098
			Digestible Protein and Amino Acid		
Digestible Protein	%	16.36	13.94	11.77	9.92
Lysine	%	1.142	0.973	0.828	0.697
Methionine	%	0.377	0.321	0.273	0.230
Methionine + Cysteine	%	0.685	0.584	0.497	0.418
Threonine	%	0.777	0.662	0.563	0.474
Tryptophan	%	0.229	0.195	0.166	0.140
Arginine	%	0.480	0.409	0.331	0.279
Valine	%	0.788	0.671	0.571	0.481
Isoleucine	%	0.628	0.535	0.455	0.383
Leucine	%	1.142	0.973	0.828	0.697
Histidine	%	0.377	0.321	0.273	0.230
Phenylalanine	%	0.617	0.526	0.447	0.376
Phenylalanine + Tyrosine	%	1.142	0.973	0.828	0.697
Digestible Essential Nitrogen	%	0.969	0.825	0.697	0.587
			Total Protein and Amino Acid		
Crude Protein		18.67	15.91	13.43	11.30
Lysine	%	1.298	1.106	0.941	0.792
Methionine	%	0.419	0.357	0.303	0.256
Methionine + Cysteine	%	0.766	0.652	0.555	0.468
Threonine	%	0.921	0.785	0.668	0.563
Tryptophan	%	0.260	0.221	0.189	0.159
Arginine	%	0.519	0.443	0.357	0.301
Valine	%	0.909	0.774	0.658	0.555
Isoleucine	%	0.714	0.608	0.518	0.436
Leucine	%	1.259	1.073	0.912	0.768
Histidine	%	0.416	0.354	0.301	0.254
Phenylalanine	%	0.681	0.580	0.494	0.416
Phenylalanine + Tyrosine	%	1.272	1.083	0.922	0.776
Total Essential Nitrogen	%	1.105	0.942	0.795	0.669

Table 5.43 - Nutritional Requirements of Standard Performance Mixed-Sex Pigs with High Genetic Potential

Phase		Starter	Grower		Finisher	
Age	Days	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range	kg	16 to 26	26 to 47	47 to 74	74 to 103	103 to 131
Average Weight	kg	21.32	35.97	60.88	89.07	117.28
Gain	kg/day	0.564	0.762	0.953	1.024	0.987
SID Lys Requirement	g/day	10.85	15.51	20.66	22.82	21.63
Digestible P Requirement	g/day	3.51	4.81	6.17	6.88	6.99
Available P Requirement	g/day	3.66	5.01	6.42	7.15	7.25
Metabolizable Energy Req.	kcal/day	3051	4876	7574	9773	10933
Diet Metabolizable Energy	kcal/kg	3250	3250	3250	3250	3250
Diet Net Energy	kcal/kg	2427	2454	2486	2479	2501
Intake	kg/day	0.939	1.500	2.331	3.007	3.364
				Nutrients		
Calcium	%	0.792	0.679	0.561	0.485	0.438
Available Phosphorus	%	0.375	0.321	0.265	0.230	0.208
Digestible Phosphorus	%	0.391	0.335	0.277	0.239	0.216
Potassium	%	0.475	0.456	0.426	0.396	0.368
Sodium	%	0.200	0.188	0.171	0.158	0.153
Chlorine	%	0.191	0.179	0.161	0.149	0.143
Linoleic Acid	%	0.179	0.127	0.098	0.090	0.093
				Digestible Protein and Amino Acid		
Digestible Protein	%	16.85	14.88	12.76	10.82	9.15
Lysine	%	1.158	1.038	0.891	0.761	0.643
Methionine	%	0.382	0.343	0.294	0.251	0.213
Methionine + Cysteine	%	0.695	0.623	0.534	0.457	0.386
Threonine	%	0.787	0.706	0.606	0.518	0.438
Tryptophan	%	0.232	0.208	0.178	0.152	0.129
Arginine	%	0.521	0.436	0.374	0.305	0.258
Valine	%	0.811	0.716	0.615	0.525	0.444
Isoleucine	%	0.637	0.571	0.490	0.419	0.354
Leucine	%	1.181	1.038	0.891	0.761	0.643
Histidine	%	0.382	0.343	0.294	0.251	0.213
Phenylalanine	%	0.625	0.561	0.481	0.411	0.348
Phenylalanine + Tyrosine	%	1.158	1.038	0.891	0.761	0.643
Digestible Essential Nitrogen	%	0.997	0.881	0.755	0.641	0.541
				Total Protein and Amino Acid		
Crude Protein	%	19.01	16.72	14.34	12.16	10.28
Lysine	%	1.316	1.180	1.012	0.865	0.731
Methionine	%	0.421	0.378	0.324	0.277	0.234
Methionine + Cysteine	%	0.777	0.696	0.597	0.510	0.432
Threonine	%	0.934	0.838	0.718	0.614	0.519
Tryptophan	%	0.263	0.236	0.202	0.173	0.146
Arginine	%	0.579	0.472	0.405	0.329	0.278
Valine	%	0.934	0.826	0.709	0.606	0.512
Isoleucine	%	0.724	0.649	0.557	0.476	0.402
Leucine	%	1.303	1.144	0.982	0.839	0.709
Histidine	%	0.421	0.378	0.324	0.277	0.234
Phenylalanine	%	0.698	0.625	0.536	0.458	0.388
Phenylalanine + Tyrosine	%	1.289	1.156	0.992	0.847	0.716
Total Essential Nitrogen	%	1.125	0.990	0.849	0.720	0.609

Table 5.44 - Changes in Performance and Standardized Digestible Lysine (SID Lys) Requirements of High and Standard Performance Growing Mixed-Sex Pigs Fed Diets Containing Different Ractopamine Levels[1]

Days of Usage		High		Standard	
		Ractopamine Levels (ppm)			
	0	10	20	10	20
	Change in Weight Gain (g/day)				
21	0	+0.154	+0.176	+0.141	+0.162
28	0	+0.129	+0.151	+0.118	+0.138
	Change in Feed Intake (g/day)				
21	0	-44	-86	-41	-82
28	0	-56	-116	-51	-106
	Change in SID Lys Requirement (g/day)				
21	0	+3.87	+4.42	+3.59	+4.10
28	0	+3.16	+3.69	+2.95	+3.44
	Change in SID Lys Requirement (%)				
21	0	0.839	0.866	0.862	0.889
28	0	0.770	0.798	0.797	0.825

[1] Values were estimated according to two Thesis of the Department of Animal Science (UFV) and the model proposed by Schinckel et al. (J. Anim. Sci. 81:1106, 2003).

Table 5.45 - Example of Performance and Nutritional Requirements of High Performance Finishing Mixed-Sex Pigs with 125 kg Average Weight (110-140 kg) Fed Diets Containing Different Ractopamine Levels for 21 or 28 days

Days of Usage		21		28	
Ractopamine (ppm)		10	20	10	20
Gain	kg/day	1.256	1.278	1.208	1.230
SID Lys Requirement	g/day	27.87	28.42	26.24	26.77
Digestible Phosphorus	g/day	8.43	8.55	8.31	8.43
Available Phosphorus	g/day	8.76	8.88	8.62	8.75
Metabolizable Energy Req.	kcal/day	11135	10994	11424	11241
Diet Metabolizable Energy	kcal/kg	3350	3350	3350	3350
Diet Net Energy	kcal/kg	2612	2612	2612	2612
Feed Intake	kg/day	3.324	3.282	3.410	3.355
			Nutrients		
Calcium	%	0.535	0.550	0.514	0.530
Digestible Phosphorus	%	0.254	0.261	0.244	0.251
Available Phosphorus	%	0.263	0.271	0.253	0.261
Potassium	%	0.382	0.382	0.371	0.371
Sodium	%	0.158	0.158	0.158	0.158
Chlorine	%	0.148	0.148	0.147	0.147
Linoleic Acid	%	0.093	0.094	0.095	0.097
			Digestible Protein and Amino Acid		
Digestible Protein	%	11.93	12.32	10.94	11.35
Lysine	%	0.839	0.866	0.770	0.798
Methionine	%	0.277	0.286	0.254	0.263
Methionine + Cysteine	%	0.503	0.520	0.462	0.479
Threonine	%	0.570	0.589	0.523	0.543
Tryptophan	%	0.168	0.173	0.154	0.160
Arginine	%	0.335	0.346	0.308	0.319
Valine	%	0.579	0.598	0.531	0.551
Isoleucine	%	0.461	0.476	0.423	0.439
Leucine	%	0.839	0.866	0.770	0.798
Histidine	%	0.277	0.286	0.254	0.263
Phenylalanine	%	0.453	0.468	0.416	0.431
Phenylalanine + Tyrosine	%	0.839	0.866	0.770	0.798
Digestible Essential Nitrogen	%	0.706	0.729	0.648	0.672
			Total Protein and Amino Acid		
Crude Protein		13.40	13.84	12.30	12.75
Lysine	%	0.953	0.984	0.875	0.907
Methionine	%	0.305	0.315	0.280	0.290
Methionine + Cysteine	%	0.562	0.581	0.516	0.535
Threonine	%	0.677	0.699	0.621	0.644
Tryptophan	%	0.191	0.197	0.175	0.181
Arginine	%	0.362	0.374	0.332	0.345
Valine	%	0.667	0.689	0.612	0.635
Isoleucine	%	0.524	0.541	0.481	0.499
Leucine	%	0.924	0.955	0.848	0.879
Histidine	%	0.305	0.315	0.280	0.290
Phenylalanine	%	0.505	0.522	0.464	0.481
Phenylalanine + Tyrosine	%	0.934	0.965	0.857	0.889
Total Essential Nitrogen	%	0.793	0.819	0.728	0.755

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CHAPTER 6

Nutritional Requirements of Swine Breeders

- Gestation and Lactation -

Márvio Lobão Teixeira de Abreu[1] and Alysson Saraiva[2]

[1] Department of Animal Science, Federal University of Lavras, Lavras, Brazil
[2] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

The high prolificacy of swine breeders has allowed for an increase in the number of animals sold, thereby enhancing the profitability of the production system. Nonetheless, higher physiological and metabolic demands have been observed in hyper-prolific sows, influencing their nutritional requirements, especially in terms of energy and amino acids.

The nutritional requirement tables present in this chapter were determined from research carried out with female swine breeders reared under national conditions, enriched by data from international literature regarding physiological and metabolic conditions.

The advancement in nutritional concepts concerning the amino acid requirements of hyper-prolific swine breeders has led to the understanding that some amino acids are essential for the production of metabolites important for specific physiological functions, in addition to being necessary for maintenance and tissue synthesis, as well as having regulatory roles within the animal's body.

The metabolic demands on current swine breeders frequently result in body weight losses during lactation and post-weaning, necessitating recuperation in the subsequent gestation. This highlights the importance of taking into account adjustments in nutritional requirements to ensure adequate reproductive performance in the future.

Swine breeders exhibit differences in nutritional requirements based on parity order, attributable to different physiological components, including body growth, the number of piglets born, and weight loss during lactation, among others. As a result, as gilts and sows advance in the number of parities, the deposition of maternal protein decreases, and the protein and amino acid requirements are focused on replenishing the reserves that were mobilized during the previous lactation.

In this chapter, metabolizable energy, crude and digestible protein, total and digestible essential amino acids, minerals, total calcium, available and digestible phosphorus, sodium, potassium, and chloride requirements are presented. The recommendations for trace minerals

and vitamins are assumed to be adequately met, provided the levels supplied are equivalent to those described in Chapter 7.

The macronutrient requirements of swine breeders were established as the amount of nutrients per day per animal for optimal performance. Equations to determine the daily metabolizable energy (ME) and standardized ileal digestible (SID) lysine requirements for gestating and lactating sows are presented. These equations take into account factors during the gestation phase such as body weight, weight gain, number of piglets, reproductive gain, mammary gland development, maternal growth, and recovery from weight loss from the previous lactation. For the lactation phase, factors considered include litter size, body weight, weight loss, litter weight gain, mammary gland involution, and weight loss during the weaning-to-estrus interval. This information is detailed in the Guidelines Tables (Tables 6.06 and 6.15).

The nutritional requirements of gestating swine breeders are estimated across four categories: nulliparous, primiparous, secundiparous, and multiparous. For lactating swine breeders, the requirements are estimated for three categories: primiparous, secundiparous, and multiparous. Additionally, the body mobilization of swine breeders was considered, taking into account their parity order. Daily feed intake was estimated using values obtained from the ME equation and the dietary energy content, enabling the calculation of the percentage of dietary nutrients.

As an example of the variation in ME and SID lysine requirements, data on the performance of gestating and lactating swine breeders are presented, in which the daily requirements for ME and SID lysine are calculated.

The nutritional requirements of the other essential amino acids were calculated by applying the ideal protein concept, i.e., by maintaining the ratio of each amino acid to lysine and expressed in standardized ileal digestibility (SID) and total content. The total lysine requirement was

calculated considering an average standardized ileal lysine digestibility of 88%.

To ensure that nonessential amino acids are not limiting when synthetic amino acids are included in commercial diets, the 35% essential nitrogen to total nitrogen (Ne:Total N) ratio was considered for the gestation phase, and the 39% Ne:Total N was considered for the lactation phase of swine breeders. The minimum levels of dietary crude and digestible protein for gestating and lactating swine breeders may be estimated through the proportions of SID lysine in crude and digestible protein, respectively.

The main nutrients are presented in g/day and as a % of the diet for swine breeders with different productivity levels.

Nutritional Requirements of Swine Breeders

- Gestation -

Table 6.01 - Equations to Estimate Maternal Weight Gain (MWG) and Reproductive Weight Gain (RWG) of Gestating Gilts and Sows[1]

MWG (kg/day) = (0.01503 – 0.00011 x average days) x total MWG (kg)

$RWG_{0-85\ days}$ (kg/day) = (0.000246 x average days) x Nº. piglets

$RWG_{86-115\ days}$ (kg/day) = (- 0.0307 + 0.000726 x average days) x Nº. piglets

MWG = Maternal Weight Gain (kg/day)
RWG = Reproductive Weight Gain (uterus + fetuses + fluids + placenta + mammary tissue = 2.33 kg/piglet)
Gestation = 115 days

Example:
Initial Sow Weight = 150 kg
Total MWG = 30 kg; No. piglets = 14

Average Days (period of gestation de 0 – 85 days) = 42.5 days
Average Days (period of gestation de 86 – 115 days) = 100.5 days

$MWG_{0-85\ days}$ (kg/day) = (0.01503 - 0.00011 x 42.5) x 30 = 0.311 kg/day
$MWG_{86-115\ days}$ (kg/day) = (0.01503 - 0.00011 x 100.5) x 30 = 0.119 kg/day

$RWG_{0-85\ days}$ (kg/day) = (0.000246 x 42.5) x 14 = 0.146 kg/day
$RWG_{86-115\ days}$ (kg/day) = (-0.0307 + 0.000726 x 100.5) x 14 = 0.592 kg/day

[1] Estimated values from Brazilian experimental data, NRC (1998, 2012), Close & Cole (2001), and Mejia et al. (2007).

Table 6.02 - Equation to Estimate Metabolizable Energy (ME, kcal/day) Requirements and Feed Intake of Gestating Gilts and Sows (g/day)[1]

ME Req. = 106 $W^{0.75}$ + 4915 MWG + 1826 RWG

W = Average Body Weight (kg)
MWG = Maternal Weight Gain (kg/day)
RWG = Reproductive Weight Gain (uterus+ fetuses + fluids + placenta + mammary tissue = 2.33 kg/piglet) kg/day; Gestation = 115 days

Example:
[2]AWP $_{0\ -\ 85\ days}$= 169 kg ($W^{0.75}$= 46.872); AWP $_{86\ -\ 115\ days}$= 200.9 kg ($W^{0.75}$= 53.362); No. piglets = 14
MWG $_{0\ -\ 85\ days}$ (kg/day) = 0.311; MWG $_{86\ -\ 115\ days}$ (kg/day) = 0.119 (Table 6.01)
RWG $_{0\ -\ 85\ days}$ (kg/day) = 0.146; RWG $_{86\ -\ 115\ days}$ (kg/day) = 0.592 (Table 6.01)

ME Req. $_{0\text{-}85\ days}$ = (106 x 46.872 + (4915 x 0.311) + (1826 x 0.146)
ME Req. $_{0\text{-}85\ days}$ = 6764 kcal/day
ME Gestation Diet = 3100 kcal/kg
Recommended Feed Intake $_{0\text{-}85\ days}$ = 6764 / 3100 = 2182 g/day

ME Req. $_{86\text{-}115\ days}$ = (106 x 53.367) + (4915 x 0.119) + (1826 x 0.592)
ME Req. $_{86\text{-}115\ days}$ = 7322kcal/day
ME Gestation Diet = 3100 kcal/kg
Recommended Feed Intake $_{86\text{-}115\ days}$ = 7322 / 3100 = 2362 g/day

[1] Estimated values from Brazilian experimental data, NRC (1998, 2012), Close & Cole (2001), and Mejia et al. (2007).
[2] AWP = average weight in the phase.

Table 6.03 - Equation to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Gestating Gilts and Sows (g/day)[1]

SID Lys (g/day) = $(0.036\ W^{0.75})/0.7 + 22.6\ MWG + 22.6\ RWG$

W = Average Body Weight (kg)
MWG=Maternal Weight Gain (kg/day)
RWG=Reproductive Weight Gain (uterus + fetuses + fluids + placenta + mammary tissue = 2.33 kg/piglet) kg/day; Gestation = 115 days

Example:

AWP $_{0\text{-}85}$ = 169 kg ($W^{0.75}$ = 46.872); AWP $_{86\text{-}115}$ = 200.8 kg ($W^{0.75}$ = 53.362); No. piglets = 14
MWG $_{0\ –\ 85\ days}$ (kg/day) = 0.311; MWG $_{86\ –\ 115\ days}$ (kg/day) = 0.119 (Table 6.02)
RWG $_{0\ –\ 85\ days}$ (kg/day) = 0.146; RWG $_{86\ –\ 115\ days}$ (kg/day) = 0.592 (Table 6.02)

AWP = average weight in the phase.

SID Lys Req. $_{0\text{-}85\ days}$ = (0.036 x 46.872) / 0.7 + (22.6 x 0.311) + (22.6 x 0.146)
SID Lys Req. $_{0\text{-}85\ days}$ = 12.74 g/day
Recommended Feed Intake $_{0\text{-}85\ days}$ = 2182 g/day
Dietary % SID Lysine = 0.583 %

SID Lys Req. $_{86\text{-}115\ days}$ = (0.036 x 53.362) / 0.7 + (22.6 x 0.119) + (22.6 x 0.592)
SID Lys Req. $_{86\text{-}115\ days}$ = 18.81 g/day
Recommended Feed Intake $_{86\text{-}115\ days}$ = 2362 g/day
Dietary % SID Lys = 0.796 %

[1] Estimated values from Brazilian experimental data, NRC (1998, 2012), Close & Cole (2001), and Mejia et al. (2007).

Table 6.04 - Amino Acid to Lysine Ratio Used to Estimate Amino Acid Requirements of Swine Breeders: Gestation

Phase		Gestation			
		0 – 85 days		86 – 115 days	
Amino Acids		SID	Total	SID	Total
Lysine	%	100	100	100	100
Methionine	%	34	33	35	34
Methionine + Cysteine	%	68	67	70	69
Threonine	%	77	80	80	83
Tryptophan	%	20	20	20	20
Arginine	%	100	97	113	110
Valine	%	73	73	77	77
Isoleucine	%	60	60	60	60
Leucine	%	100	89	100	94
Histidine	%	35	34	35	34
Phenylalanine	%	55	54	56	55
Phenylalanine + Tyrosine	%	110	108	112	110

Table 6.05 - Example of Calculation of Digestible Essential Nitrogen (Dig. Ne), Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of Swine Breeders: Gestation[1]

Amino Acids	N (%)	SID AA Req. (%)	Dig. Ne (%)	Total AA Req. (%)	Net (%)
Lysine	19.16	0.742	0.142	0,843	0,163
Methionine	9.39	0.260	0.024	0,287	0,027
Threonine	11.76	0.593	0.070	0,700	0,083
Tryptophan	13.72	0.148	0.020	0,169	0,023
Arginine	32.16	0.838	0.270	0,927	0,299
Valine	11.96	0.571	0.068	0,649	0,078
Isoleucine	10.68	0.445	0.048	0,506	0,054
Leucine	10.68	0.742	0.079	0,792	0,085
Histidine	27.08	0.260	0.070	0,287	0,078
Phenylalanine	8.48	0.415	0.035	0,463	0,040
Dig. Ne Req.		0.827		0.925	
Net Req.[2]		2.362		2.644	
Protein Req.[3]		14.76		16.53	

[1] Example for second parity sows (period of gestation from 86 to 115 days).
[2] Dig. Ne: Nt ratio of 35%.
[3] Conversion factor of N to protein: 6.25.
86 to 115 days – SID Lys: Digestible Protein ratio of 5.0.
86 to 115 days – SID Lys: Crude Protein ratio of 4.5.

- Total lysine requirement was calculated considering 88.0% the ileal digestibility of lysine in the diet. Total amino acid to total lysine ratios were used to estimate total amino acid requirements (Table 6.04).

Example. Simplified calculation of protein level from 86 to 115 days:
% Digestible Protein = (% SID Lys x 100) / 5 = (0.742 x 100) / 5 = 14.8%
% Crude Protein = (% SID Lys x 100) / 4.5 = (0.742 x 100) / 4.5 = 16.5%

Example. Simplified calculation of protein level from 0 to 85 days:
% Digestible Protein = (% SID Lys x 100) / 5.3 = (0.453 x 100) / 5.3 = 8.6%
% Crude Protein = (% SID Lys x 100) / 4.7 = (0.453 x 100) / 4.7 = 9.6%

Table 6.06 - Guidelines for Swine Breeders: Gestation

Phase / Variable	Parity Order[1]			
	Nulliparous	PO1	PO2	≥PO3
At Insemination				
Average Body Weight, kg	150	172	188	219
BT P2[2], mm[2]	14	15	15	15
At Gestation				
Body Weight Gain, kg	63	68	72	78
Number of Piglets	14	15	15	15
Reproductive Gain, kg	28	30	30	30
Mammary Gland Development	5.0	5.0	5.0	5.0
Maternal Development, kg	30	20	15	13
Weight Lost/ Recovery, kg	0	13	22.2	30
At Farrowing				
Average Body Weight, kg[3]	213	240	260	298
BT P2, mm	18	19	19	19

[1]PO1 = parity 1 (Primiparous); PO2= parity 2 (Secundiparous); ≥PO3= Multiparous with 3 or more parities. Calculations of parity 4 sows were used for this category.
[2]Backfat thickness at point P2 (6 cm away from dorsal midline at the last rib).
[3]Sow weight before farrowing.

Table 6.07 - Daily Nutritional Requirements of Gestating Swine Breeders (kcal/day and g/day)

Item		Nulliparous		PO1	
		0 – 85	86 – 115	0 – 85	86 – 115
Average Body Weight	kg	150	189	172	203
Maternal Weight Gain	kg/day	0,311	0,119	0,207	0,080
Reproductive Weight Gain	kg/day	0,146	0,592	0,157	0,634
Metabolizable Energy (ME)	kcal/day	6772	7323	6676	7634
Diet ME (DME)	kcal/kg	3100	3100	3100	3100
Diet Net Energy	kcal/kg	2400	2400	2400	2400
Intake (ME/DME)	g/day	2184	2362	2153	2461
Nutrient					
Calcium	g/day	17.0	18.5	17.5	19.0
Available Phosphorus	g/day	8.9	9.7	9.2	10.0
Digestible Phosphorus	g/day	8.0	8.7	8.3	9.0
Potassium	g/day	7.4	8.0	8.5	9.1
Sodium	g/day	3.7	3.9	4.2	4.4
Chlorine	g/day	2.9	3.0	3.2	3.4
Digestible Protein and Amino Acids					
Digestible Protein	g/day	241.8	374.4	205.6	379.7
Lysine	g/day	12.73	18.80	10.83	19.07
Methionine	g/day	4.32	6.59	3.68	6.67
Methionine + Cysteine	g/day	8.67	13.18	7.36	13.36
Threonine	g/day	9.81	15.05	8.33	15.26
Tryptophan	g/day	2.56	3.76	2.17	3.81
Arginine	g/day	12.73	21.26	10.83	21.56
Valine	g/day	9.30	14.48	7.90	14.69
Isoleucine	g/day	7.64	11.29	6.50	11.44
Leucine	g/day	12.73	18.80	10.83	19.07
Histidine	g/day	4.46	6.59	3.79	6.67
Phenylalanine	g/day	7.01	10.53	5.96	10.68
Phenylalanine + Tyrosine	g/day	14.00	21.07	11.91	21.36
Digestible Essential Nitrogen	g/day	13.54	20.97	11.52	21.26
Total Protein and Amino Acids					
Crude Protein	g/day	268.4	412.9	228.4	429.0
Lysine	g/day	14.46	21.35	12.29	21.68
Methionine	g/day	4.76	7.25	4.05	7.38
Methionine + Cysteine	g/day	9.70	14.74	8.25	14.96
Threonine	g/day	11.58	17.72	9.84	17.99
Tryptophan	g/day	2.88	4.28	2.45	4.33
Arginine	g/day	14.02	23.48	11.93	23.85
Valine	g/day	10.55	16.44	8.98	16.69
Isoleucine	g/day	8.67	12.80	7.38	13.02
Leucine	g/day	12.86	20.08	10.94	20.38
Histidine	g/day	4.91	7.25	4.18	7.38
Phenylalanine	g/day	7.80	11.74	6.63	11.94
Phenylalanine + Tyrosine	g/day	15.62	23.48	13.28	23.85
Total Essential Nitrogen	g/day	14.59	23.12	12.79	22.64

Table 6.07 - Daily Nutritional Requirements of Gestating Swine Breeders (kcal/day and g/day) continuation...

Item		PO2		≥PO3	
		0 – 85	86 – 115	0 – 85	86 – 115
Average Body Weight	kg	188	214	219	244
Maternal Weight Gain	kg/day	0,155	0,060	0,135	0,052
Reproductive Weight Gain	kg/day	0,157	0,634	0,157	0,634
Metabolizable Energy (ME)	kcal/day	6710	7857	7237	8480
Diet ME (DME)	kcal/kg	3100	3100	3100	3100
Diet Net Energy	kcal/kg	2400	2400	2400	2400
Intake (ME/DME)	g/day	2164	2534	2334	2735
Nutrient					
Calcium	g/day	18.0	19.5	18.0	19.5
Available Phosphorus	g/day	9.5	10.3	9.5	10.3
Digestible Phosphorus	g/day	8.5	9.2	8.5	9.2
Potassium	g/day	8.7	9.3	8.7	9.3
Sodium	g/day	4.5	4.7	4.5	4.7
Chlorine	g/day	3.3	3.5	3.3	3.5
Digestible Protein and Amino Acids					
Digestible Protein	g/day	186.0	373.7	182.5	376.3
Lysine	g/day	9.80	18.79	9.62	18.93
Methionine	g/day	3.33	6.58	3.27	6.62
Methionine + Cysteine	g/day	6.66	13.15	6.54	13.24
Threonine	g/day	7.55	15.01	7.42	15.12
Tryptophan	g/day	1.97	3.75	1.91	3.77
Arginine	g/day	9.80	21.22	9.62	21.36
Valine	g/day	7.16	14.46	7.03	14.55
Isoleucine	g/day	5.88	11.27	5.76	11.35
Leucine	g/day	9.80	18.79	9.62	18.93
Histidine	g/day	3.44	6.58	3.36	6.62
Phenylalanine	g/day	5.39	10.51	5.30	10.58
Phenylalanine + Tyrosine	g/day	10.77	21.04	10.57	19.28
Digestible Essential Nitrogen	g/day	10.43	20.94	10.22	21.09
Total Protein and Amino Acids					
Crude Protein	g/day	207.0	418.5	203.04	401.0
Lysine	g/day	11.14	21.34	10.94	21.51
Methionine	g/day	3.68	7.27	3.60	7.31
Methionine + Cysteine	g/day	7.46	14.74	7.34	14.83
Threonine	g/day	8.91	17.72	8.74	17.85
Tryptophan	g/day	2.23	4.28	2.20	4.30
Arginine	g/day	10.82	23.47	10.61	23.68
Valine	g/day	8.13	16.43	8.00	16.56
Isoleucine	g/day	6.68	12.81	6.57	12.92
Leucine	g/day	9.91	20.05	9.75	20.23
Histidine	g/day	3.79	7.27	3.72	7.31
Phenylalanine	g/day	6.01	11.75	5.92	11.82
Phenylalanine + Tyrosine	g/day	12.03	23.47	11.81	23.68
Total Essential Nitrogen	g/day	11.59	23.42	11.39	22.47

Table 6.08 - Nutritional Requirements of Gestating Swine Breeders (kcal/day and %)

Item		Nulliparous		PO1	
		0 – 85	86 – 115	0 – 85	86 – 115
Average Body Weight	kg	150	189	172	203
Maternal Weight Gain	kg/day	0.311	0.119	0.207	0.080
Reproductive Weight Gain	kg/day	0.146	0.592	0.157	0.634
Metabolizable Energy (ME)	kcal/day	6772	7323	6676	7634
Diet ME (DME)	kcal/kg	3100	3100	3100	3100
Diet Net Energy	kcal/kg	2400	2400	2400	2400
Intake (ME/DME)	g/day	2184	2362	2153	2461
Nutrient					
Calcium	%	0.778	0.783	0.813	0.772
Available Phosphorus	%	0.408	0.411	0.428	0.406
Digestible Phosphorus	%	0.366	0.368	0.386	0.366
Potassium	%	0.339	0.339	0.395	0.370
Sodium	%	0.169	0.165	0.195	0.179
Chlorine	%	0.133	0.127	0.149	0.138
Digestible Protein and Amino Acids					
Digestible Protein	%	11.07	15.85	9.55	15.43
Lysine	%	0.583	0.796	0.503	0.775
Methionine	%	0.198	0.279	0.171	0.271
Methionine + Cysteine	%	0.396	0.557	0.342	0.543
Threonine	%	0.449	0.637	0.387	0.620
Tryptophan	%	0.117	0.159	0.101	0.155
Arginine	%	0.583	0.899	0.503	0.876
Valine	%	0.426	0.613	0.367	0.597
Isoleucine	%	0.350	0.478	0.302	0.465
Leucine	%	0.583	0.796	0.503	0.775
Histidine	%	0.204	0.279	0.176	0.271
Phenylalanine	%	0.321	0.446	0.277	0.434
Phenylalanine + Tyrosine	%	0.641	0.892	0.553	0.868
Digestible Essential Nitrogen		0.620	0.888	0.535	0.864
Total Protein and Amino Acids					
Crude Protein	%	12.29	17.48	10.61	16.43
Lysine	%	0.662	0.904	0.571	0.881
Methionine	%	0.218	0.307	0.188	0.300
Methionine + Cysteine	%	0.444	0.624	0.383	0.608
Threonine	%	0.530	0.750	0.457	0.731
Tryptophan	%	0.132	0.181	0.114	0.176
Arginine	%	0.642	0.994	0.554	0.969
Valine	%	0.483	0.696	0.417	0.678
Isoleucine	%	0.397	0.542	0.343	0.529
Leucine	%	0.589	0.850	0.508	0.828
Histidine	%	0.225	0.307	0.194	0.300
Phenylalanine	%	0.357	0.497	0.308	0.485
Phenylalanine + Tyrosine	%	0.715	0.994	0.617	0.969
Total Essential Nitrogen	%	0.668	0.979	0.594	0.920

Table 6.08 - Nutritional Requirements of Gestating Swine Breeders (kcal/day and %) continuation...

Item		PO2		≥PO3	
		0 – 85	86 – 115	0 – 85	86 – 115
Average Body Weight	kg	188	214	219	242
Maternal Weight Gain	kg/day	0.155	0.060	0.104	0.040
Reproductive Weight Gain	kg/day	0.157	0.634	0.157	0.634
Metabolizable Energy (ME)	kcal/day	6706	7849	7247	8484
Diet ME	kcal/kg	3100	3100	3100	3100
Diet Net Energy	kcal/kg	2400	2400	2400	2400
Intake (ME/DME)	g/day	2163	2532	2338	2737
Nutrient					
Calcium	%	0.832	0.770	0.770	0.712
Available Phosphorus	%	0.439	0.407	0.406	0.376
Digestible Phosphorus	%	0.393	0.363	0.364	0.336
Potassium	%	0.402	0.367	0.372	0.340
Sodium	%	0.208	0.186	0.192	0.172
Chlorine	%	0.153	0.138	0.141	0.128
Digestible Protein and Amino Acids					
Digestible Protein	%	8.60	14.76	7.82	13.76
Lysine	%	0.453	0.742	0.412	0.692
Methionine	%	0.154	0.260	0.140	0.242
Methionine + Cysteine	%	0.308	0.519	0.280	0.484
Threonine	%	0.349	0.594	0.317	0.554
Tryptophan	%	0.091	0.148	0.082	0.138
Arginine	%	0.453	0.838	0.412	0.782
Valine	%	0.331	0.571	0.301	0.533
Isoleucine	%	0.272	0.445	0.247	0.415
Leucine	%	0.453	0.742	0.412	0.692
Histidine	%	0.159	0.260	0.144	0.242
Phenylalanine	%	0.249	0.416	0.227	0.388
Phenylalanine + Tyrosine	%	0.498	0.831	0.453	0.775
Digestible Essential Nitrogen		0.482	0.827	0.438	0.771
Total Protein and Amino Acids					
Crude Protein	%	9.57	16.53	8.70	14.65
Lysine	%	0.515	0.843	0.468	0.786
Methionine	%	0.170	0.287	0.154	0.267
Methionine + Cysteine	%	0.345	0.582	0.314	0.542
Threonine	%	0.412	0.700	0.374	0.652
Tryptophan	%	0.103	0.169	0.094	0.157
Arginine	%	0.500	0.927	0.454	0.865
Valine	%	0.376	0.649	0.342	0.605
Isoleucine	%	0.309	0.506	0.281	0.472
Leucine	%	0.458	0.792	0.417	0.739
Histidine	%	0.175	0.287	0.159	0.267
Phenylalanine	%	0.278	0.464	0.253	0.432
Phenylalanine + Tyrosine	%	0.556	0.927	0.505	0.865
Total Essential Nitrogen	%	0.536	0.925	0.487	0.821

Nutritional Requirements of Swine Breeders

- Lactation -

Table 6.09 - Equation to Estimate Metabolizable Energy Requirements (ME, kcal/day) and Feed Intake of Lactating Gilts and Sows (g/day)[1]

ME Req. (kcal/day) = 106 $W^{0.75}$ + 6230 LWG - 4600 FWL

Correction for temperature = 2.4 x $W^{0.75}$ (TN – T)

W = Average Body Weight (kg)
LWG = Litter Weight Gain (kg/day)
FWL = Female Weight Loss Postpartum (kg/day)
TN =Thermoneutral Temperature (°C) = 20 °C
T = Average Temperature (°C)

Suggested average temperatures for ME requirement correction: between 14 and 26°C. Higher range temperature values may negatively influence performance and overestimate corrections for feed intake and nutritional levels.

Example:
W = 240 kg; $W^{0.75}$= 60.976
Litter = 14.1; Piglet birth weight = 1.3 kg; Piglet weaning weight = 5.90;
Lactation days = 23 days

LWG = ((5.90 – 1.3) x 14.1) / 23 = 2.82 kg/day

Weight at the Start of Lactation=240 kg; Weight at the End of Lactation=218.4 kg
FWL = (240 – 218.4) / 23 = 0.939 kg/day

ME Req. = (106 x 60.976) + (6230 x 2.82) - (4600 x 0.939)
ME Req. = (6463) + (17568) - (4319.4) = 19712 kcal/day
ME Lactation Diet = 3400 kcal/kg
Estimated Feed Intake = 19712 / 3.40 = 5798 g/day

Correction for Average Temperature of 25°C (TN = 20°C)
Correction for T° = 2.4 x 60.976 (20 – 25) = -731.7 kcal/day
ME Req. for 25 °C = 19712 – 731.7 = 18980 kcal/day
Estimated Feed Intake = 5582 g/day

[1] Estimated values from Brazilian experimental data, NRC (1998, 2012), Close & Cole (2001), and e Mejia et al. (2007).

Table 6.10 - Equation to Estimate Standardized Digestible Lysine (SID Lys) Requirements of Lactating Gilts and Sows (g/day)[1]

SID Lys (g/day) = 0.036 $W^{0.75}$ + 23.6 LWG – 7.0 FWL

W = Average Body Weight (kg)
LWG = Litter Weight Gain (kg/day)
FWL = Female Weight Loss (kg/day)

Example:

W = 240 kg; $W^{0.75}$ = 60.976
[2]Litter = 14.1; Piglet birth weight = 1.3 kg; Piglet weaning weight = 5.90; Lactation days = 23 days

LWG = ((5.90 – 1.3) x 14.1) / 23 = 2.82 kg/day

Weight at the Start of Lactation=240 kg; Weight at the End of Lactation=218.4 kg

FWL = (240 – 218.4) / 23 = 0.939 kg/day

SID Lys Req. = (0.036 x 60.976) + (23.6 x 2.82) - (7.0 x 0.939)
SID Lys Req. = (2.195) + (66.552) - (6.573) = 62.17 g/day

Estimated Feed Intake = 5798 g/day (Table 6.09)
% Dietary SID Lys = 1.072 %

Correction for Average Temperature of 25°C (TN = 20°C)
SID Lys Req. = 62.17 g/day
Estimated Feed Intake = 5582 g/day (Table 6.09)
% Dietary SID Lys = 1.114 %

[1] Estimated values from Brazilian experimental data, NRC (1998, 2012), Close & Cole (2001), and e Mejia et al. (2007).
[2] Considering suckling piglets' mortality rate of 6%.

Table 6.11 - Amino Acid to Lysine Ratio Used to Estimate Amino Acid Requirements of Swine Breeders: Lactation

Amino Acids		Lactation	
		SID	Total
Lysine	%	100	100
Methionine	%	28	27
Methionine + Cysteine	%	56	55
Threonine	%	65	68
Tryptophan	%	22	22
Arginine	%	100	98
Valine	%	83	83
Isoleucine	%	60	60
Leucine	%	115	115
Histidine	%	40	39
Phenylalanine	%	58	57
Phenylalanine + Tyrosine	%	116	114

Table 6.12 - Example of Calculation Digestible Essential Nitrogen (Dig. Ne), Total Essential Nitrogen (Net), and Digestible and Total Crude Protein Requirements of Swine Breeders: Lactation[1]

Amino Acids	N (%)	SID AA Req. (%)	Dig. Ne (%)	Total AA Req. (%)	Net (%)
Lysine	19.16	1.081	0.207	1.228	0.235
Methionine	9.39	0.303	0.028	0.335	0.031
Threonine	11.76	0.703	0.083	0.835	0.098
Tryptophan	13.72	0.238	0.033	0.270	0.037
Arginine	32.16	1.082	0.348	1.203	0.387
Valine	11.96	0.897	0.107	1.019	0.122
Isoleucine	10.68	0.649	0.069	0.737	0.079
Leucine	10.68	1.243	0.133	1.412	0.151
Histidine	27.08	0.432	0.117	0.479	0.130
Phenylalanine	8.48	0.627	0.053	0.700	0.059
Dig. Ne Req.		1.178		1.329	
Net Req.[2]		3.023		3.408	
Protein Req.[3]		18.88		21.30	

[1] Example for second parity order sows, litter weight gain of 3.10 kg/day, weight loss of 0.639 kg/day.
[2] Ne: Nt ratio of 39%.
[3] Conversion factor of N to protein of 6.25.
SID Lys: Digestible Protein ratio of 5.7.
SID Lys: Crude Protein ratio of 5.1.

- Total lysine requirement was calculated considering 88.0% the ileal digestibility of lysine in the diet. Total amino acid to total lysine ratios were used to estimate total amino acid requirements (Table 6.11).

Example. Simplified calculation of protein level:
% Digestible Protein = (% SID Lys x 100) / 5.7 = (1.081 x 100) / 5.7 = 18.9 %
% Crude Protein = (% SID Lys x 100) / 5.1 = (1.081 x 100) / 5.1 = 21.2 %

Table 6.13 - Guidelines for Swine Breeders: Lactation

Phase/Variable	Parity Order[1]		
	PO1	PO2	≥PO3
Body Weight of Pre-Partum Sow, kg	213	240	280
BT P2[2], mm	18	20	20
No. Piglets	13.2	14.1	14.1
Body Weight of Postpartum Sow, kg	185	210	240
Female Weight Loss During Lactation, kg	13	14.7	21.6

[1] PO1 = parity 1 (Primiparous); PO2= parity 2 (Secundiparous); >PO3= Multiparous with 3 or more parities. Calculations of parity 4 sows were used for this category.
[2] Backfat thickness at point P2 (6 cm away from dorsal midline at the last rib).

Table 6.14 - Nutritional Requirements of Lactating Gilts and Sows (kcal/day and g/day)

Parity Order		**PO1**	
Female Weight Postpartum	kg	185	
Litter Weight Gain	kg/day	2.63	2.89
Weight Loss	kg/day	0.563	0.563
Metabolizable Energy	kcal/day	19125	20764
Diet Metabolizable Energy	kcal/kg	3400	3400
Diet Net Energy	kcal/kg	2540	2540
Intake	g/day	5625	6107
Nutrient			
Calcium	g/day	47.0	47.0
Available Phosphorus	g/day	26.0	28
Digestible Phosphorus	g/day	23.0	23.0
Potassium	g/day	17.5	17.5
Sodium	g/day	12.0	12.0
Chlorine	g/day	11.0	11.0
Digestible Protein and Amino Acids			
Digestible Protein	g/day	1047	1156
Lysine	g/day	59.96	66.20
Methionine	g/day	16.76	18.57
Methionine + Cysteine	g/day	33.58	37.07
Threonine	g/day	38.98	43.05
Tryptophan	g/day	13.22	14.53
Arginine	g/day	59.96	66.20
Valine	g/day	49.78	54.96
Isoleucine	g/day	36.00	39.70
Leucine	g/day	68.96	76.15
Histidine	g/day	23.96	26.50
Phenylalanine	g/day	34.76	38.41
Phenylalanine + Tyrosine	g/day	69.58	76.76
Digestible Essential Nitrogen	g/day	65.36	72.18
Total Protein and Amino Acids			
Crude Protein	g/day	1181	1305
Lysine	g/day	68.12	75.24
Methionine	g/day	18.39	20.34
Methionine + Cysteine	g/day	37.46	41.41
Threonine	g/day	46.29	51.18
Tryptophan	g/day	14.96	16.55
Arginine	g/day	66.77	73.71
Valine	g/day	56.53	62.47
Isoleucine	g/day	40.89	45.13
Leucine	g/day	78.36	86.54
Histidine	g/day	26.55	29.31
Phenylalanine	g/day	38.81	42.87
Phenylalanine + Tyrosine	g/day	77.68	85.74
Total Essential Nitrogen	g/day	73.74	81.41

Table 6.14 - Nutritional Requirements of Lactating Gilts and Sows (kcal/day and g/day) continuation...

Parity Order		**PO2**		**≥ PO3**	
Female Weight Postpartum	kg	210		240	
Litter Weight Gain	kg/day	2.82	3.10	2.82	3.10
Weight Loss	kg/day	0.639	0.639	0.939	0.939
Metabolizable Energy	kcal/day	20476	22233	19712	21469
Diet Metabolizable Energy	kcal/kg	3400	3400	3400	3400
Diet Net Energy	kcal/kg	2540	2540	2540	2540
Intake	g/day	6022	6539	5798	6314
Nutrient					
Calcium	g/day	52	52	50.0	50.0
Available Phosphorus	g/day	28.0	28.0	27.0	27.0
Digestible Phosphorus	g/day	25.0	25.0	25.0	25.0
Potassium	g/day	20.0	20.0	19.0	19.0
Sodium	g/day	13.0	13.0	13.0	13.0
Chlorine	g/day	12.0	12.0	12.0	12.0
Digestible Protein and Amino Acids					
Digestible Protein	g/day	1119	1235	1085	1202
Lysine	g/day	64.07	70.69	62.15	68.82
Methionine	g/day	17.95	19.81	17.39	19.26
Methionine + Cysteine	g/day	35.89	39.56	34.79	38.52
Threonine	g/day	41.67	45.97	40.41	44.77
Tryptophan	g/day	14.09	15.56	13.68	15.15
Arginine	g/day	64.07	70.69	62.15	68.82
Valine	g/day	53.17	58.65	51.60	57.14
Isoleucine	g/day	38.42	42.44	37.28	41.29
Leucine	g/day	73.71	81.28	71.49	79.18
Histidine	g/day	25.65	28.25	24.87	27.53
Phenylalanine	g/day	37.16	41.00	36.06	39.90
Phenylalanine + Tyrosine	g/day	74.31	82.00	72.13	79.81
Digestible Essential Nitrogen	g/day	69.86	77.03	67.72	75.01
Total Protein and Amino Acids					
Crude Protein	g/day	1263	1393	1225	1356
Lysine	g/day	72.81	80.30	70.62	78.17
Methionine	g/day	19.63	21.71	19.08	21.09
Methionine + Cysteine	g/day	40.05	44.14	38.85	43.00
Threonine	g/day	49.50	54.60	48.01	53.16
Tryptophan	g/day	16.02	17.66	15.54	17.17
Arginine	g/day	71.36	78.66	69.23	76.65
Valine	g/day	60.40	66.63	58.62	64.91
Isoleucine	g/day	43.66	48.19	42.38	46.91
Leucine	g/day	83.71	92.33	81.23	89.91
Histidine	g/day	28.42	31.32	27.54	30.50
Phenylalanine	g/day	41.49	45.77	40.24	44.58
Phenylalanine + Tyrosine	g/day	82.98	91.55	80.53	89.15
Total Essential Nitrogen	g/day	78.83	86.84	76.42	84.61

Table 6.15 - Daily Nutritional Requirements of Lactating Gilts and Sows (kcal/day and %)

Parity Order		PO1	
Female Weight Postpartum	kg	185	
Litter Weight Gain	kg/day	2.63	2.90
Weight Loss	kg/day	0.563	0.563
Metabolizable Energy	kcal/day	19125	20764
Diet Metabolizable Energy	kcal/kg	3400	3400
Diet Net Energy	kcal/kg	2540	2540
Intake	g/day	5625	6107
Nutrient			
Calcium	%	0.836	0.770
Available Phosphorus	%	0.462	0.458
Digestible Phosphorus	%	0.409	0.377
Potassium	%	0.311	0.287
Sodium	%	0.213	0.196
Chlorine	%	0.196	0.180
Digestible Protein and Amino Acids			
Digestible Protein	%	18.62	18.93
Lysine	%	1.066	1.084
Methionine	%	0.298	0.304
Methionine + Cysteine	%	0.597	0.607
Threonine	%	0.693	0.705
Tryptophan	%	0.235	0.238
Arginine	%	1.066	1.084
Valine	%	0.885	0.900
Isoleucine	%	0.640	0.650
Leucine	%	1.226	1.247
Histidine	%	0.426	0.434
Phenylalanine	%	0.618	0.629
Phenylalanine + Tyrosine	%	1.237	1.257
Digestible Essential Nitrogen	%	1.162	1.182
Total Protein and Amino Acids			
Crude Protein	%	21.00	21.37
Lysine	%	1.211	1.232
Methionine	%	0.327	0.333
Methionine + Cysteine	%	0.666	0.678
Threonine	%	0.823	0.838
Tryptophan	%	0.266	0.271
Arginine	%	1.187	1.207
Valine	%	1.005	1.023
Isoleucine	%	0.727	0.739
Leucine	%	1.393	1.417
Histidine	%	0.472	0.480
Phenylalanine	%	0.690	0.702
Phenylalanine + Tyrosine	%	1.381	1.404
Total Essential Nitrogen	%	1.311	1.333

Table 6.15 - Daily Nutritional Requirements of Lactating Gilts and Sows (kcal/day and %) continuation…

Parity Order		**PO2**		**≥ PO3**	
Female Weight Postpartum	kg	210		240	
Litter Weight Gain	kg/day	2.82	3.10	2.82	3.10
Weight Loss	kg/day	0.639	0.639	0.939	0.939
Metabolizable Energy	kcal/day	20476	22233	19712	21469
Diet Metabolizable Energy	kcal/kg	3400	3400	3400	3400
Diet Net Energy	kcal/kg	2540	2540	2540	2540
Intake	g/day	6022	6539	5798	6314
Nutrient					
Calcium	%	0.864	0.795	0.862	0.792
Available Phosphorus	%	0.465	0.428	0.466	0.428
Digestible Phosphorus	%	0.415	0.382	0.431	0.396
Potassium	%	0.332	0.306	0.328	0.301
Sodium	%	0.216	0.199	0.224	0.206
Chlorine	%	0.199	0.184	0.207	0.190
Digestible Protein and Amino Acids					
Digestible Protein	%	18.58	18.88	18.72	19.04
Lysine	%	1.064	1.081	1.072	1.090
Methionine	%	0.298	0.303	0.300	0.305
Methionine + Cysteine	%	0.596	0.605	0.600	0.610
Threonine	%	0.692	0.703	0.697	0.709
Tryptophan	%	0.234	0.238	0.236	0.240
Arginine	%	1.064	1.081	1.072	1.090
Valine	%	0.883	0.897	0.890	0.905
Isoleucine	%	0.638	0.649	0.643	0.654
Leucine	%	1.224	1.243	1.233	1.254
Histidine	%	0.426	0.432	0.429	0.436
Phenylalanine	%	0.617	0.627	0.622	0.632
Phenylalanine + Tyrosine	%	1.234	1.254	1.244	1.264
Digestible Essential Nitrogen	%	1.160	1.178	1.168	1.188
Total Protein and Amino Acids					
Crude Protein	%	20.97	21.30	21.13	21.48
Lysine	%	1.209	1.228	1.218	1.238
Methionine	%	0.326	0.332	0.329	0.334
Methionine + Cysteine	%	0.665	0.675	0.670	0.681
Threonine	%	0.822	0.835	0.828	0.842
Tryptophan	%	0.266	0.270	0.268	0.272
Arginine	%	1.185	1.203	1.194	1.214
Valine	%	1.003	1.019	1.011	1.028
Isoleucine	%	0.725	0.737	0.731	0.743
Leucine	%	1.390	1.412	1.401	1.424
Histidine	%	0.472	0.479	0.475	0.483
Phenylalanine	%	0.689	0.700	0.694	0.706
Phenylalanine + Tyrosine	%	1.378	1.400	1.389	1.412
Total Essential Nitrogen	%	1.309	1.329	1.318	1.340

Table 6.16 - Daily Nutritional Requirements of Lactating Gilts and Sows (Average Temperature of 25 °C) (kcal/day and %)

Parity Order		**PO1**	
Female Weight Postpartum	kg	185	
Litter Weight Gain	kg/day	2.63	2.90
Weight Loss	kg/day	0.565	0.565
Metabolizable Energy	kcal/day	18523	20162
Diet Metabolizable Energy	kcal/kg	3400	3400
Diet Net Energy	kcal/kg	2540	2540
Intake	g/day	5448	5930
Nutrient			
Calcium	%	0.862	0.792
Available Phosphorus	%	0.477	0.472
Digestible Phosphorus	%	0.422	0.388
Potassium	%	0.321	0.295
Sodium	%	0.220	0.202
Chlorine	%	0.202	0.185
Digestible Protein and Amino Acids			
Digestible Protein	%	19.23	19.49
Lysine	%	1.101	1.116
Methionine	%	0.308	0.312
Methionine + Cysteine	%	0.617	0.625
Threonine	%	0.716	0.725
Tryptophan	%	0.242	0.246
Arginine	%	1.101	1.116
Valine	%	0.914	0.926
Isoleucine	%	0.661	0.670
Leucine	%	1.266	1.284
Histidine	%	0.440	0.447
Phenylalanine	%	0.639	0.647
Phenylalanine + Tyrosine	%	1.277	1.295
Digestible Essential Nitrogen	%	1.200	1.216
Total Protein and Amino Acids			
Crude Protein	%	21.70	22.00
Lysine	%	1.251	1.268
Methionine	%	0.338	0.342
Methionine + Cysteine	%	0.688	0.697
Threonine	%	0.851	0.862
Tryptophan	%	0.275	0.279
Arginine	%	1.226	1.243
Valine	%	1.038	1.052
Isoleucine	%	0.751	0.761
Leucine	%	1.439	1.458
Histidine	%	0.488	0.495
Phenylalanine	%	0.713	0.723
Phenylalanine + Tyrosine	%	1.426	1.446
Total Essential Nitrogen	%	1.354	1.373

Table 6.16 - Daily Nutritional Requirements of Lactating Gilts and Sows (Average Temperature of 25 °C) (kcal/day and %) continuation...

Parity Order		**PO2**		**≥ PO3**	
Female Weight Postpartum	kg	210		240	
Litter Weight Gain	kg/day	2.82	3.10	2.82	3.10
Weight Loss	kg/day	0.652	0.652	0.939	0.939
Metabolizable Energy	kcal/day	19814	21571	18890	20737
Diet Metabolizable Energy	kcal/kg	3400	3400	3400	3400
Diet Net Energy	kcal/kg	2540	2540	2540	2540
Intake	g/day	5828	6344	5582	6099
Nutrient					
Calcium	%	0.892	0.820	0.896	0.820
Available Phosphorus	%	0.480	0.442	0.484	0.443
Digestible Phosphorus	%	0.429	0.394	0.448	0.410
Potassium	%	0.343	0.315	0.340	0.311
Sodium	%	0.223	0.205	0.233	0.213
Chlorine	%	0.189	0.173	0.197	0.180
Digestible Protein and Amino Acids					
Digestible Protein	%	19.20	19.47	19.54	19.70
Lysine	%	1.099	1.115	1.119	1.128
Methionine	%	0.308	0.312	0.313	0.316
Methionine + Cysteine	%	0.615	0.624	0.627	0.632
Threonine	%	0.714	0.725	0.727	0.733
Tryptophan	%	0.242	0.245	0.246	0.248
Arginine	%	1.099	1.115	1.119	1.128
Valine	%	0.912	0.925	0.929	0.936
Isoleucine	%	0.659	0.669	0.671	0.677
Leucine	%	1.264	1.282	1.287	1.297
Histidine	%	0.440	0.446	0.448	0.451
Phenylalanine	%	0.637	0.647	0.649	0.654
Phenylalanine + Tyrosine	%	1.275	1.293	1.298	1.308
Digestible Essential Nitrogen	%	1.198	1.215	1.219	1.229
Total Protein and Amino Acids					
Crude Protein	%	21.66	21.98	22.05	22.24
Lysine	%	1.249	1.267	1.271	1.282
Methionine	%	0.337	0.342	0.343	0.346
Methionine + Cysteine	%	0.687	0.697	0.699	0.705
Threonine	%	0.849	0.862	0.864	0.872
Tryptophan	%	0.275	0.279	0.280	0.282
Arginine	%	1.224	1.242	1.246	1.256
Valine	%	1.037	1.052	1.055	1.064
Isoleucine	%	0.749	0.760	0.763	0.769
Leucine	%	1.436	1.457	1.462	1.474
Histidine	%	0.487	0.494	0.496	0.500
Phenylalanine	%	0.712	0.722	0.724	0.731
Phenylalanine + Tyrosine	%	1.424	1.444	1.449	1.461
Total Essential Nitrogen	%	1.352	1.372	1.376	1.387

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CHAPTER 7

Vitamin and Trace Mineral Supplementation for Poultry and Swine

Gabriel C. Rocha[1], Janslller L. Genova[1],
Arele A. Calderano[1] and Horacio S. Rostagno[1]

[1] Department of Animal Science, Federal University of Viçosa, Viçosa, Brazil

INTRODUCTION

The vitamin and trace mineral requirements of poultry and swine are difficult to estimate because there are a large number of variables that can influence experimental results, including feed intake, genetics, physiological state, stress, and health challenges.

In this chapter, supplementation of vitamin and trace mineral levels in poultry and swine diets is suggested, not nutritional requirements. Some articles used here present optimal levels of supplementation based on the animal's health (immunity, antioxidant capacity, etc.), which indirectly affects performance. Vitamin and trace mineral supplementation levels in IU or mg/kg of feed were based on articles, breeding company manuals, and industry recommendations.

Taking into account the improved efficiency for production (meat, piglets, eggs, etc.) of current genetics lines, it is highlighted that feed intake capacity may be limiting the production potential. This fact draws attention to the need to adjust the levels of vitamins and trace minerals so that poultry and swine express their maximum genetic potential. Furthermore, variations in ingredient concentration, bioavailability, and the degradation of vitamins and trace minerals resulting from storage or feed manufacturing conditions, among others, must be considered in each production system.

With the advancement of knowledge about minerals from organic sources and the availability of new supplements for animals, nutritionists have the possibility of choosing to use inorganic or organic sources of trace minerals. An average equivalency factor, calculated from published papers, was used to calculate organic mineral supplementation in mg/kg of weight gain.

The recommendation of vitamins and trace minerals (IU or mg/kg) supplementation to broiler chicken diets, in the different growing phases was made using a proportion ratio, considering the level of growing phase I (17 to 27 days) = 1.0, with the proportion of the pre-starter phase being 1.3 and that of the finisher phase being 0.7. The recommended amount, in IU or mg/kg of

feed, for each phase was calculated with the aim of keeping the intake of vitamins and minerals per kg of weight gain constant.

The amount of trace minerals for laying birds and broiler breeders was calculated as 1.1 and 1.2 times (ratio), respectively, to that recommended for replacement pullet birds in the breeding phase.

A ratio was also established in the recommendations for vitamins and trace minerals, in IU or mg/kg of feed, for growing swine. Grower phase I (63 to 91 days) was used as a reference = 1, while for the other phases, ratios ranging from 1.6 for the pre-starter phase and up to 0.6 for the finisher phase II were stipulated. The recommended proportion in each phase aims to maintain a constant intake of vitamins and minerals per kg of weight gain.

For breeding swine, the trace mineral recommendation was calculated following the ratio of 1.3 to that used for growing swine phase I.

The content and relative bioavailability of inorganic and organic sources of trace minerals for poultry and swine are presented in Table 7.08. A literature review was carried out for each mineral, from which the average bioavailability was obtained, presented as a percentage relative to the standard source. In theory, organic trace minerals are more available to the animal than inorganic ones. However, it should be noted that there are several types of organic trace minerals, some with greater bioavailability than others, depending on the Chelation Index (Qi) and the Stability Constant (Ks) between the mineral and the ligand. Trace minerals with high Qi and Ks have high bioavailability coefficients and performance.

Table 7.01 - Vitamin Supplementation Levels for Broilers

Phase		**Pre Starter**	**Starter**	**Grower I & II**		**Finisher I & II**	
Age (days)		0-8	8-17	17-27	27-35	35-43	43-49
Weight Range (kg)		0.05-0.24	0.24-0.68	0.68-1.49	1.49-2.29	2.29-3.11	3.11-3.70
Weight Gain (g/day)		19.4	50	86.3	104.4	103.7	93.8
Feed Intake (g/day)		23.2	64.6	131.5	185.1	203.9	197.9
Vitamins	**UI or mg/kg of Gain**	**UI or mg/day**					
Vitamin A, UI	16493	320	825	1423	1722	1710	1547
Vitamin D3, UI	4039	78	202	349	422	419	379
Vitamin E, UI	61.9	1.201	3.094	5.341	6.461	6.417	5.805
Vitamin K3, mg	3.48	0.068	0.174	0.300	0.364	0.361	0.327
Vitamin B1, mg	4.10	0.080	0.205	0.354	0.428	0.425	0.385
Vitamin B2, mg	10.2	0.198	0.510	0.880	1.065	1.058	0.957
Vitamin, B6, mg	5.73	0.111	0.287	0.495	0.599	0.595	0.538
Vitamin B12, mg	0.026	0.0005	0.0013	0.0022	0.0027	0.0027	0.0024
Pantothenic Acid, mg	21.5	0.417	1.075	1.855	2.245	2.230	2.017
Nicotinic Acid, mg	68.3	1.325	3.416	5.896	7.132	7.084	6.408
Folic Acid, mg	1.66	0.032	0.083	0.143	0.173	0.172	0.156
Biotin, mg	0.159	0.0031	0.0079	0.0137	0.0166	0.0165	0.0149
Choline, mg	713	13.83	35.65	61.53	74.44	73.94	67
		UI or mg/kg Feed					
Vitamin A, UI		13791	12765	10824	9302	8388	7817
Vitamin D3, UI		3378	3126	2651	2278	2054	1915
Vitamin E, UI		51.7	47.9	40.6	34.9	31.5	29.3
Vitamin K3, mg		2.91	2.69	2.29	1.96	1.77	1.65
Vitamin B1, mg		3.43	3.17	2.69	2.31	2.09	1.94
Vitamin B2, mg		8.53	7.90	6.70	5.75	5.19	4.84
Vitamin, B6, mg		4.79	4.44	3.76	3.23	2.92	2.72
Vitamin B12, mg		0.0217	0.0201	0.0171	0.0147	0.0132	0.0123
Pantothenic Acid, mg		17.98	16.64	14.11	12.13	10.93	10.19
Nicotinic Acid, mg		57.1	52.9	44.8	38.5	34.7	32.4
Folic Acid, mg		1.389	1.286	1.090	0.937	0.845	0.787
Biotin, mg		0.1327	0.1228	0.1041	0.0895	0.0807	0.0752
Choline, mg		596	552	468	402	363	338
Ratio		**1.27**	**1.18**	**1.00**	**0.86**	**0.77**	**0.72**

Table 7.02 - Vitamin Supplementation Levels for Replacement Pullets, Layers, and Breeders

Type		**Replacement Pullets**			
Phase		**Starter[1]**	**Grower[1]**	**Layers**	**Breeders**
Egg Mass (g/day)		-	-	60	-
Feed Intake (g/day)		-	-	100	-
Vitamins	**UI or mg/kg Egg Mass**			**UI or mg/day**	
Vitamin A, UI	15571			934	
Vitamin D3, UI	4167			250	
Vitamin E, UI	21.2			1.270	
Vitamin K3, mg	3.76			0.226	
Vitamin B1, mg	3.15			0.189	
Vitamin B2, mg	8.00			0.480	
Vitamin, B6, mg	3.66			0.220	
Vitamin B12, mg	0.0283			0.0017	
Pantothenic Acid, mg	19.2			1.150	
Nicotinic Acid, mg	50.0			3.000	
Folic Acid, mg	1.10			0.066	
Biotin, mg	0.1000			0.0060	
Choline, mg	473			28.4	
				UI or mg/kg Feed	
Vitamin A, UI		12765	10824	9343	11500
Vitamin D3, UI		3126	2651	2500	3150
Vitamin E, UI		47.9	40.6	13	55.0
Vitamin K3, mg		2.69	2.29	2.26	3.20
Vitamin B1, mg		3.17	2.69	1.89	2.80
Vitamin B2, mg		7.90	6.70	4.80	8.50
Vitamin, B6, mg		4.44	3.76	2.20	3.00
Vitamin B12, mg		0.0201	0.0171	0.0170	0.0270
Pantothenic Acid, mg		16.64	14.11	11.50	15.00
Nicotinic Acid, mg		52.9	44.8	30.0	35.0
Folic Acid, mg		1.286	1.090	0.660	1.100
Biotin, mg		0.123	0.104	0.060	0.120
Choline, mg		552	468	284	450
Ratio		**1.18**	**1.00**	**-**	**-**

[1]For replacement pullets, vitamin supplementation levels are the same as broilers in the starter and grower I phases (Table 7.01).

Table 7.03 - Trace Mineral Supplementation Levels for Broilers

Phase		**Pre Starter**	**Starter**	**Grower I & II**		**Finisher I & II**	
Age (days)		0-8	8-17	17-27	27-35	35-43	43-49
Weight Range (kg)		0.05-0.24	0.24-0.68	0.68-1.49	1.49-2.29	2.29-3.11	3.11-3.70
Weight Gain (g/day)		19.4	50	86.3	104.4	103.7	93.8
Feed Intake (g/day)		23.2	64.6	131.5	185.1	203.9	197.9
Trace Minerals	**mg/kg of Gain**	**mg/day**					
Inorganic							
Copper	14.45	0.280	0.722	1.247	1.508	1.498	1.355
Iron	69.20	1.342	3.460	5.972	7.224	7.176	6.491
Manganese	101.3	1.965	5.064	8.741	10.574	10.503	9.500
Selenium	0.437	0.008	0.022	0.038	0.046	0.045	0.041
Zinc	94.96	1.842	4.748	8.195	9.914	9.848	8.908
Iodine	1.470	0.029	0.073	0.127	0.153	0.152	0.138
Organic							
Copper	6.50	0.126	0.325	0.561	0.679	0.674	0.610
Iron	31.1	0.604	1.557	2.687	3.251	3.229	2.921
Manganese	45.6	0.884	2.279	3.933	4.758	4.726	4.275
Selenium	0.196	0.004	0.010	0.017	0.021	0.020	0.018
Zinc	42.7	0.829	2.137	3.688	4.461	4.431	4.008
		mg/kg Feed					
Inorganic							
Copper		12.08	11.18	9.48	8.15	7.35	6.85
Iron		57.87	53.56	45.41	39.03	35.19	32.80
Manganese		84.69	78.39	66.47	57.13	51.51	48.01
Selenium		0.365	0.338	0.287	0.246	0.222	0.207
Zinc		79.41	73.50	62.32	53.56	48.30	45.01
Iodine		1.229	1.138	0.965	0.829	0.747	0.697
Organic							
Copper		5.44	5.03	4.27	3.67	3.31	3.08
Iron		26.04	24.10	20.44	17.56	15.84	14.76
Manganese		38.11	35.28	29.91	25.71	23.18	21.60
Selenium		0.164	0.152	0.129	0.111	0.100	0.093
Zinc		35.73	33.08	28.05	24.10	21.73	20.25
Ratio		**1.27**	**1.18**	**1.00**	**0.86**	**0.77**	**0.72**

Table 7.04 - Trace Mineral Supplementation Levels for Replacement Pullets, Layers, and Breeders

Type	**Replacement Pullets**			
Phase	**Starter[1]**	**Grower[1]**	**Layers**	**Breeders**
Egg mass (g/day)	-	-	60	-
Feed Intake (g/day)	-	-	100	-
Trace Minerals	**mg/kg feed**			
Inorganic				
Copper	11.18	9.48	10.43	11.38
Iron	53.56	45.41	49.96	54.50
Manganese	78.39	66.47	73.12	79.76
Selenium	0.338	0.287	0.315	0.344
Zinc	73.50	62.32	68.55	74.79
Iodine	1.138	0.965	1.061	1.157
Organic				
Copper	5.03	4.27	4.69	5.12
Iron	24.10	20.44	22.48	24.52
Manganese	35.28	29.91	32.90	35.89
Selenium	0.152	0.129	0.142	0.155
Zinc	33.08	28.05	30.85	33.65
Ratio	**1.18**	**1.00**	**1.10**	**1.20**

[1]For replacement pullets, trace mineral supplementation levels are the same as broilers in the starter and grower I phases, respectively (Table 7.03).

Table 7.05 - Vitamin Supplementation Levels for Growing Swine

Phase		**Pre Starter I & II**		**Starter**	**Grower I & II**		**Finisher I & II**	
Age (days)		21 - 35	35- 49	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range (kg)		6.2 - 8.4	8.4 - 17.9	16 - 26	26 - 47	47 - 74	74 - 103	103 - 131
Average Weight (kg)		8.4	14.2	21.3	36.0	60.9	89.1	117.3
Weight Gain (g/day)		309	454	564	762	953	1024	987
Feed Intake(g/day)		388	631	939	1500	2331	3007	3364
Vitamins	**UI or mg/kg of Gain**	**UI or mg/day**						
Vitamin A, UI	14298	4418	6492	8064	10895	13626	14642	14113
Vitamin D3, UI	3498	1081	1588	1973	2665	3333	3582	3452
Vitamin E, UI	93.4	28.9	42.4	52.7	71.2	89.0	95.6	92.2
Vitamin K3, mg	6.81	2.10	3.09	3.84	5.19	6.49	6.97	6.72
Vitamin B1, mg	2.27	0.70	1.03	1.28	1.73	2.16	2.32	2.24
Vitamin B2, mg	8.67	2.68	3.93	4.88	6.60	8.26	8.87	8.55
Vitamin, B6, mg	4.54	1.40	2.06	2.56	3.46	4.32	4.65	4.48
Vitamin B12, mg	0.051	0.016	0.023	0.029	0.039	0.049	0.052	0.050
Pantothenic Acid, mg	34.0	10.5	15.5	19.2	25.9	32.4	34.8	33.6
Nicotinic Acid, mg	65.0	20.1	29.5	36.7	49.5	61.9	66.6	64.2
Folic Acid, mg	0.743	0.230	0.337	0.419	0.566	0.708	0.761	0.734
Biotin, mg	0.247	0.076	0.112	0.139	0.188	0.235	0.253	0.244
Choline, mg	454	140.2	206.0	256.0	345.8	432.5	464.7	447.9
				UI or mg/kg Feed				
Vitamin A, UI		11387	10288	8588	7264	5846	4869	4195
Vitamin D3, UI		2786	2517	2101	1777	1430	1191	1026
Vitamin E, UI		74.4	67.2	56.1	47.4	38.2	31.8	27.4
Vitamin K3, mg		5.42	4.89	4.09	3.46	2.78	2.32	1.99
Vitamin B1, mg		1.808	1.633	1.364	1.153	0.928	0.773	0.666
Vitamin B2, mg		6.90	6.23	5.20	4.40	3.54	2.95	2.54
Vitamin, B6, mg		3.61	3.26	2.73	2.30	1.85	1.54	1.33
Vitamin B12, mg		0.041	0.037	0.031	0.026	0.021	0.017	0.015
Pantothenic Acid, mg		27.1	24.5	20.4	17.3	13.9	11.6	10.0
Nicotinic Acid, mg		51.8	46.8	39.0	33.0	26.6	22.1	19.1
Folic Acid, mg		0.592	0.535	0.446	0.378	0.304	0.253	0.218
Biotin, mg		0.196	0.178	0.148	0.125	0.101	0.084	0.072
Choline, mg		361.4	326.5	272.6	230.5	185.5	154.5	133.2
Ratio		**1.57**	**1.42**	**1.18**	**1.00**	**0.80**	**0.67**	**0.58**

Table 7.06 - Trace Mineral Supplementation Levels for Growing Swine

Phase		**Pre Starter I & II**		**Starter**	**Grower I & II**		**Finisher I & II**	
Age (days)		21 - 35	35- 49	49 - 63	63 - 91	91 - 119	119 - 147	147 - 175
Weight Range (kg)		6.2 - 8.4	8.4 - 17.9	16 - 26	26 - 47	47 - 74	74 - 103	103 - 131
Average Weight (kg)		8.4	14.2	21.3	36.0	60.9	89.1	117.3
Weight Gain (g/day)		309	454	564	762	953	1024	987
Feed Intake (g/day)		388	631	939	1500	2331	3007	3364
Trace Minerals	**mg / kg of Gain**				**mg/day**			
Inorganic								
Copper	23.0	7.11	10.44	12.97	17.53	21.92	23.55	22.70
Iron	146	45.1	66.3	82.3	111.3	139.1	149.5	144.1
Manganese	70.0	21.6	31.8	39.5	53.3	66.7	71.7	69.1
Selenium	0.630	0.195	0.286	0.355	0.480	0.600	0.645	0.622
Zinc	208	64.3	94.4	117.3	158.5	198.2	213.0	205.3
Iodine	1.73	0.535	0.785	0.976	1.318	1.649	1.772	1.708
Organic								
Copper	10.3	3.20	4.70	5.84	7.89	9.86	10.60	10.22
Iron	65.7	20.3	29.8	37.1	50.1	62.6	67.3	64.8
Manganese	31.5	9.73	14.30	17.77	24.00	30.02	32.26	31.09
Selenium	0.284	0.088	0.129	0.160	0.216	0.270	0.290	0.280
Zinc	93.6	28.9	42.5	52.8	71.3	89.2	95.8	92.4
					mg/kg Feed			
Inorganic								
Copper		18.32	16.55	13.81	11.68	9.40	7.83	6.75
Iron		116.3	105.0	87.7	74.2	59.7	49.7	42.8
Manganese		55.7	50.4	42.0	35.6	28.6	23.8	20.5
Selenium		0.502	0.453	0.378	0.320	0.258	0.215	0.185
Zinc		165.6	149.7	124.9	105.7	85.0	70.8	61.0
Iodine		1.378	1.245	1.039	0.879	0.707	0.589	0.508
Organic								
Copper		8.24	7.45	6.22	5.26	4.23	3.52	3.04
Iron		52.3	47.3	39.5	33.4	26.9	22.4	19.3
Manganese		25.09	22.66	18.92	16.00	12.88	10.73	9.24
Selenium		0.226	0.204	0.170	0.144	0.116	0.097	0.083
Zinc		74.5	67.3	56.2	47.5	38.3	31.9	27.5
Ratio		**1.57**	**1.42**	**1.18**	**1.00**	**0.80**	**0.67**	**0.58**

Table 7.07 - Vitamin and Trace Mineral Supplementation Levels for Swine Breeders

Phase	**Swine Breeders**
Vitamins	**UI or mg/kg Feed**
Vitamin A, UI	9927
Vitamin D3, UI	1660
Vitamin E, UI	61.5
Vitamin K3, mg	2.70
Vitamin B1, mg	1.38
Vitamin B2, mg	5.50
Vitamin. B6, mg	2.10
Vitamin B12, mg	0.028
Pantothenic Acid, mg	21.8
Nicotinic Acid, mg	31.2
Folic Acid, mg	1.36
Biotin, mg	0.340
Choline, mg	750
Trace Minerals[1]	**mg/kg Feed**
Inorganic	
Copper	15.2
Iron	96.4
Manganese	46.2
Selenium	0.416
Zinc	137.4
Iodine	1.142
Organic	
Copper	6.84
Iron	43.4
Manganese	20.8
Selenium	0.187
Zinc	61.8
Ratio[1]	**1.30**

[1] Trace minerals recommended ratio of 1.3 relative to the grower phase I - 26 a 47 kg (Table 7.06).

Table 7.08 - Trace Mineral Content and Relative Bioavailability of Inorganic and Organic Sources for Poultry and Swine

Sources	Cu (%)	Relative Bioavailability (%)	
		Broilers (n[1])	Swine (n[1])
Inorganic			
Copper sulfate pentahydrate	25.2	100	100
Copper carbonate	54.6	77 (3)	62 (1)
Copper chloride	64.2	120 (3)	-
Tribasic copper chloride	54.7	100 (3)	97 (1)
Copper hydroxychloride	54.0	112 (3)	-
Copper oxide I	88.8	95 (2)	21 (2)
Copper sulfate monohydrate	34.5	-	-
Organic			
Copper lysine FG[2]	7.6	99 (1)	-
Lysine copper complex	10.4	117 (4)	112 (1)
Copper methionine complex	20.9	92 (2)	107 (1)
Copper glycinate	24.0	-	146 (1)
Copper propionate	29.0	-	-
Copper proteinate	10.0	101 (4)	114 (1)
Chelate copper amino acid	8.9	109 (2)	-
Chelate copper MHA[3]	15.0	112 (1)	145 (1)
Sources	**Fe (%)**		
Inorganic			
Ferrous sulfate monohydrate	30.0	100	100
Iron carbonate	43.0	3 (4)	18 (2)
Ferric chloride hexahydrate	20.7	103 (1)	-
Ferric oxide	69.9	10 (2)	-
Ferrous oxide	77.8	-	12 (1)
Ferrous sulfate heptahydrate	20.0	-	-
Organic			
Iron citrate	19.0	86 (2)	183 (5)
Iron amino acid complex	11.1	-	-
Lysine iron complex	11.1	-	-
Iron methionine complex	13.1	104 (2)	168 (2)
Iron - EDTA	13.0	99 (1)	90 (1)
Iron fumarate	32.5	96 (2)	-
Iron glycinate	21.0		130 (3)
ferrous gluconate	2.0	94 (2)	-
iron proteinate	13.4	110 (17)	132 (2)
Sources	**Mn (%)**		
Inorganic			
Manganese sulfate monohydrate	30.3	100	100
Manganese carbonate	46.7	34 (2)	-
manganese dioxide	63.1	70 (1)	-
Manganese hydroxychloride	44.0	106 (3)	-
Manganese oxide	56.9	82 (9)	96 (1)
Manganese oxide FG[2]	58.5	69 (6)	-
Manganese sulfate pentahydrate	22.7	-	-
Organic			
Amino acid manganese chelate	8.1	120 (16)	-
Manganese methionine complex	8.3	107 (8)	-
Manganese glycinate	21.0	125 (1)	124 (1)
Amino acid manganese	7.7	-	-
Manganese methionine FG[2]	15.7	120 (2)	-
Amino acid manganese chelate	8.1	84 (1)	-
MHA[3] manganese chelate	13.0	116 (1)	158 (1)
Manganese propionate	12.0	139 (1)	-
Manganese proteinate	15.5	110 (6)	-

[1] Literature consulted to obtain the average bioavailability value. [2] Feed Grade; [3] Methionine hydroxy analogue.

Table 7.08 - Trace Mineral Content and Relative Bioavailability of Inorganic and Organic Sources for Poultry and Swine (cont.)

Sources	**I** (%)	**Relative Bioavailability (%)**	
		Broilers (n[1])	**Swine (n[1])**
Inorganic			
Calcium iodate	62.8	-	-
Potassium iodate	59.2	-	-
Copper iodide	66.3	-	-
Potassium iodide	76.0	-	-
Organic			
Ethylenediamine hydroiodide	79.5	-	-
Sources	**Se (%)**		
Inorganic			
Sodium Selenite	45.0	100	100
Sodium selenate	42.0	114 (5)	-
Sodium selenate decahydrate	21.4	-	-
Selenium metal	99.9	83 (4)	-
Calcium selenite	41.4	102 (4)	101 (2)
Organic			
Selenium yeast	0.1-0.3	190 (4)	214 (6)
L-Selenium methionine	4.0	119 (3)	147 (2)
Selenium MHA	2.0	270 (2)	415 (2)
Sources	**Zn (%)**		
Inorganic			
Zinc sulfate heptahydrate	22.2	100	100
Zinc carbonate	54.0	107 (1)	98 (1)
Basic zinc carbonate	58.5	77 (1)	-
Zinc chloride	54.8	-	-
Tetrabasic zinc chloride	62.2	107 (2)	-
Zinc hydroxychloride	54.0	120 (3)	125 (1)
Zinc oxide	72.5	72 (4)	55 (3)
Zinc oxide FG[2]	73.4	58 (18)	74 (3)
Zinc Metallic Dust	98.3	67 (1)	-
Zinc sulfate monohydrate	35.0	-	-
Zinc sulfate monohydrate FG[2]	35.6	87 (1)	-
Zinc sulfate heptahydrate FG[2]	22.0	-	-
Organic			
Zinc amino acid complex	12.0	122 (3)	-
Zinc lysine complex	7.2	106 (1)	60 (4)
Zinc methionine complex	21.9	169 (3)	92 (5)
Zinc amino acid chelate	9.4	108 (1)	-
Zinc MHA[3] chelate	16.0	-	125 (1)
Zinc propionate	27.0	117 (3)	-
Zinc proteinate	14.8	121 (13)	-
Zinc glycinate	26.0	-	124 (1)
Zinc polysaccharide	19.0	94 (1)	-

[1] Literature consulted to obtain the average bioavailability value. [2] Feed Grade; [3] Methionine hydroxy analogue.

CHAPTER 8

Bibliography

- Dissertations and Theses -
- Other Literature -

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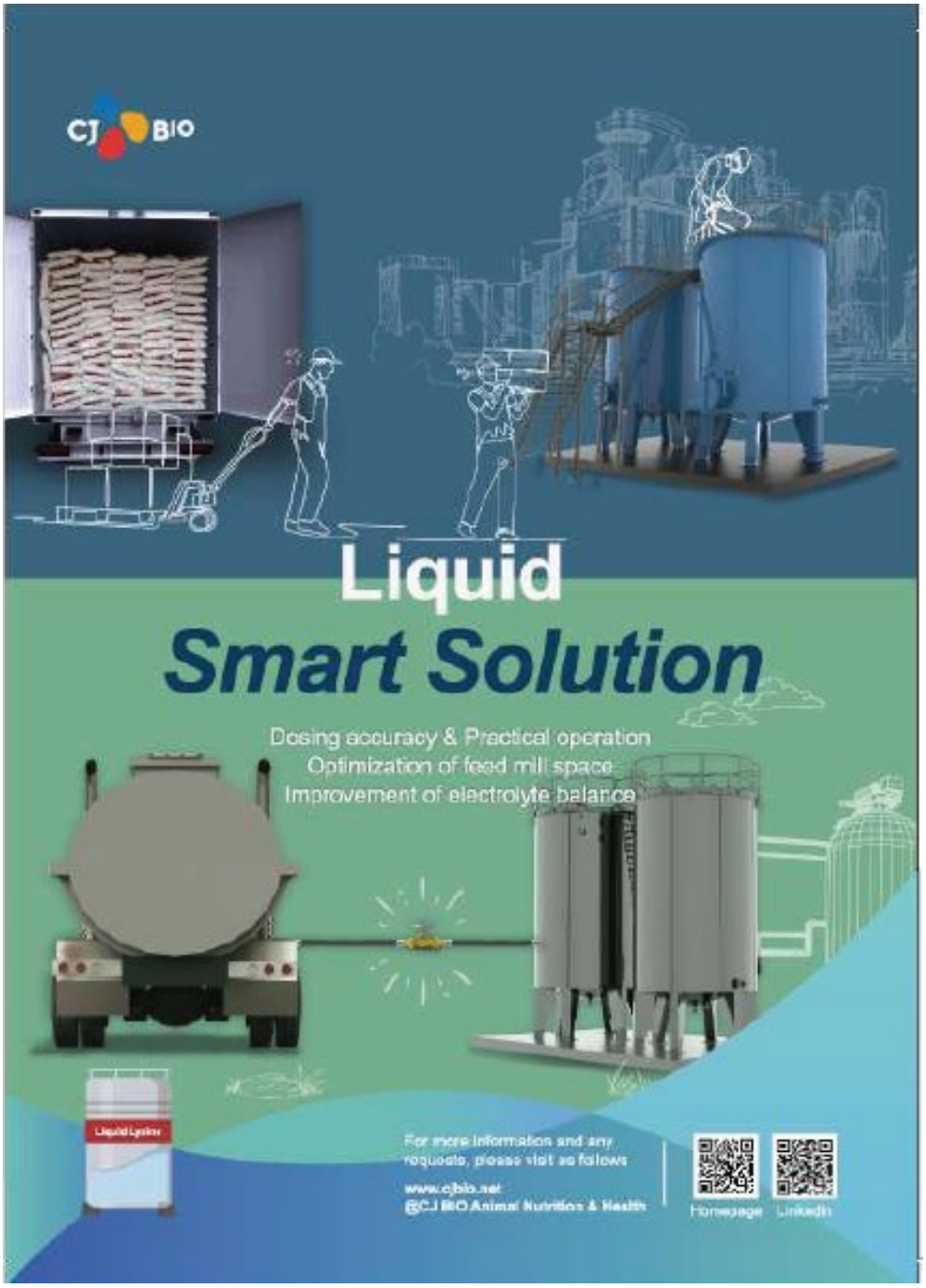
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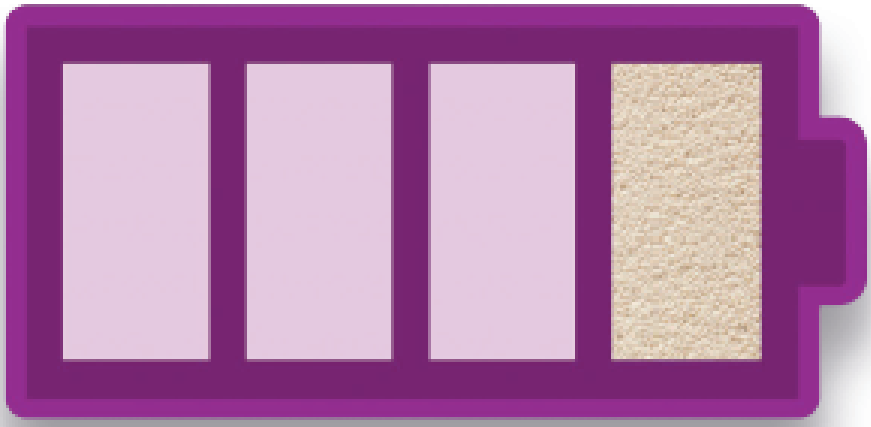

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