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Use of Food Ingredients of Plant Origin in the Chopped Meat Semi-Finished Products Technology

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barley flour;
dietary fiber*

Abstract

The thesis presents the study results of the plant origin food ingredients influence on the quality indicators of minced meat semi-finished products (MMSP) from poultry meat. The study aim is to develop a recipe and technology for minced meat semi-finished products of centralized production including a complex additive based on grain raw materials, whey and inulin. A man introduced the hydrated complex food additive in the minced meat, which included: first option – a food concentrate from barley with a low glycemic index, whey powder and inulin; second option – oat bran concentrate with a high content of β -glucan, whey powder and inulin in a ratio of 84 : 14 : 4. The researchers selected components of a complex additive taking into account the formation of the necessary rheological (structural and plastic) properties of minced meat. Tasting assessment results of experimental samples MMSP showed that the complex additive introduction in the amount of 8 % of the semi-finished product mass provided the specified organoleptic characteristics of the finished product, namely the consistency (density) of minced meat – dense and tender; the product had a regular shape without cracks; the appearance on the section was uniform, the taste and smell were pronounced. A man found positive effect on the physical and chemical parameters of the meat system product: an increase in the mass fraction of protein compared to the control sample by 7.3 and 12.56 %, dietary fiber – by 3.2 %, a decrease in the mass fraction of fat – by 0.8 and 1.3 %, respectively. There is an increase in the hydrophilicity of minced meat and the moisture-binding capacity by 8.75 %. Based on a comparative results analysis of the fatty acid composition indicators of the developed samples with the formula of “ideal lipid”, the researchers found that studied meatballs samples with the addition of a complex additive had an increased content of linoleic (1.62 and 1.65) and linolenic (0.12 and 0.15) acids, as well as biological value coefficient of 0.77 and 0.83. A comparative analysis of the amino acid prototypes composition showed compliance with the recommended norms of the amino acid composition of the FAO/WHO (an average excess of 5.5 % and 5.0 %), which indicated a balanced amino acid protein composition of the developed minced semi-finished poultry meat products. The quality assessment results indicated the possibility of using a complex food additive based on grain raw materials in the production of minced semi-finished products from poultry meat.

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Использование пищевых ингредиентов растительного происхождения в технологии мясных рубленых полуфабрикатов

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Ключевые слова:

мясные рубленые полуфабрикаты;
централизованное производство;
пищевой ингредиент;
мука овсяная;
мука ячменная;
пищевые волокна

Реферат

Представлены результаты изучения характера влияния пищевых ингредиентов растительного происхождения на качественные показатели рубленых полуфабрикатов из мяса птицы. Целью исследования является разработка рецептуры и технологии мясных рубленых полуфабрикатов централизованного производства, включающих в свой состав комплексную добавку на основе зернового сырья, молочной сыворотки и инулина. В мясной фарш вносилась гидратированная комплексная пищевая добавка следующего состава: первый вариант – пищевой концентрат из ячменя с низким гликемическим индексом, сухая молочная сыворотка и инулин; второй вариант – концентрат овсяный из отрубей с повышенным содержанием β -глюкана, сухая молочная сыворотка и инулин в соотношении 84 : 14 : 4. Подбор компонентов комплексной добавки проводили с учетом формирования необходимых реологических (структурно-пластических) свойств фарша. Результаты дегустационной оценки опытных образцов мясных рубленых полуфабрикатов показали, что внесение комплексной добавки в количестве 8 % от массы полуфабриката обеспечивает заданные органолептические характеристики готового продукта, а именно: консистенция (плотность) мясного фарша – плотная и нежная; изделие имеет правильную форму без трещин; внешний вид на разрезе – однородный; вкус и запах – выраженные. Установлено положительное влияние на физико-химические показатели изделия мясной системы: повышение массовой доли белка в сравнении с контрольным образцом на 7,3 % и 12,56 %, пищевых волокон – на 3,2 %, снижение массовой доли жира – на 0,8 % и 1,3 % соответственно. Отмечено повышение гидрофильности мясного фарша и влагосвязывающей способности на 8,75 %. На основании сравнения полученных показателей жирно-кислотного состава разработанных образцов с формулой «идеального липида» установлено, что исследуемые образцы биточков с внесением комплексной добавки характеризуются повышенным содержанием линолевой (1,62 и 1,65) и линоленовой (0,12 и 0,15) кислот, а также коэффициентом биологической ценности 0,77 и 0,83. Сравнительный анализ аминокислотного состава опытных образцов показал соответствие рекомендуемым ФАО/ВОЗ нормам аминокислотного состава (превышение в среднем на 5,5 % и 5,0 %), что свидетельствует о сбалансированности аминокислотного состава белка разработанных рубленых полуфабрикатов из мяса птицы. Результаты оценки качества свидетельствуют о возможности использования комплексной пищевой добавки на основе зернового сырья при выработке рубленых полуфабрикатов из мяса птицы.

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Background

Recently, there has been a high popularization of chilled types of semi-finished meat products, including poultry meat on the semi-finished meat products market. The factors influencing the growth of

the meat semi-finished products market include: the development of healthy and balanced nutrition trends; the use of modern storage technologies (gas-modified medium, multi-section thermal con-

tainers, barrier plastic containers, protective films with anti-fogging properties, food film with antimicrobial coating, etc.)¹; the reduction of cooking time without biological value and usefulness loss, taste properties variety of the finished dish, and relatively low price [1].

Centralized production of semi-finished meat products helps to reduce labor costs due to the mechanization of labor-intensive production stages, increase production efficiency and flow through the introduction and / or innovative technologies application [2; 3].

One of the promising directions for expanding the public catering products range is the food ingredients use that contribute to increasing the nutritional and biological value, unifying recipes, stable and uniform ingredients distribution, minimizing losses in the production process, which ultimately leads to the creation of a product of stable quality. Increasing the production capacity, extending the shelf life of meat semi-finished products of centralized production, improving consumer functional and technological properties are possible due to the introduction of components that are sources of dietary fiber, minerals and vitamins [4; 5]. At the same time, the use of functional food ingredients is not only a way to obtain a high-quality combined product with regulated properties, but also a tool that enables meeting the needs of various population groups in a healthy diet, considering their traditions, habits and socio-economic situation [6; 7; 8].

The purpose of the study is to develop a recipe and technology for minced meat semi-finished products of centralized production, including poultry meat and a complex additive based on grain raw materials, whey and inulin.

Materials and Methods of the Research

A man developed a complex food additive as a food ingredient with high functional consumer properties, which includes:

Option 1 (Complex grain additive (CGA) 1) – food concentrate from barley – dried sprouted barley powder obtained by extraction and fermentation in order to preserve the maximum amount of useful substances. The food concentrate from barley is high in amino acid (high content of glutamic acid, alanine, isoleucine, leucine, phenylalanine), vitamins content (groups B, PP, H) and biologically active substances (α -amylase, β -glucan). The manufacturer is PLC “Obraz Zhizni” (Altay Area, Barnaul).

¹ Analiz Rynka Myasnyh Polufabrikatov v Rossii v 2016–2020 gg, Prognoz na 2021–2025 gg. Struktura Roznichnoj Torgovli. Ocenka Vliyaniya Koronavirusa [Analysis of the Meat Semi-Finished Products Market in Russia in 2016–2020, Forecast for 2021–2025. Retail Trade Structure. Assessment of the Coronavirus Impact]. BusinesStat Gotovye Obzory Rynkov. URL: <https://businesstat.ru/catalog/id42735/>.

Option 2 (CGA 2) – oat bran concentrate – a product obtained by grinding oat grains (oats), which is a source of dietary fiber, amino acids, and beta-glucan, contributing to the gastrointestinal tract microflora regulation and normalization, the toxins elimination, and lowering cholesterol levels. The manufacturer is PLC “Stashevskoe” (Novgorod Region, Shimsk).

Both options also include – dry whey by the GOST 33958² – dried milk product with a mass fraction of dry substances of at least 95 %.

For better binding of the components, the complex additive formulation includes inulin. Inulin is an indigestible oligosaccharide, which on the one hand is a prebiotic, and on the other hand has technological properties that allow simulating fat in the product. During hydration, inulin forms a gel with a structure similar to fats, it has a neutral taste and smell and does not affect the MMSP aroma. During heat treatment, inulin reacts with meat proteins, leading to the formation of a dense matrix. Dry powdered inulin has a high ability to retain moisture in the meat system, making possible to obtain MMSP with a low-fat content and good sensory properties [9; 10].

The ingredients ratio in a complex food additive (CGA): 84 % of grain raw materials, 12 % whey powder and 4 % inulin.

The introduction of CGA into the MMSP formulation allows to increase the moisture-retaining capacity of the food system due to the dietary fibers content, to reduce acidity and to increase the shelf life [11].

The Table 1 presents the characteristics of a complex additive based on grain raw materials.

The main raw material for the production of chops minced from poultry meat was the broiler chicken meat (PLC Poultry Farm “Reftinskaya”). A man deboned manually the cooled carcasses of broiler chickens; then crushed the meat mass in a meat grinder with a grate hole diameter of 3 mm.

The prototypes development basis was the traditional recipe of meatballs chopped from poultry meat, presented in the Collection of recipes of culinary products No. 732 [12]. The developed chopped meat semi-finished products from poultry meat (chicken) belong to the culinary products of category B, since the mass fraction of muscle tissue in the recipe is 60 %³.

The researchers studied the possibility of introducing CGA in an amount from 2 to 10 % (2 %-step) of the poultry meat mass. They made a replacement considering the dry substances of CGA and wheat

² GOST 33958-2016. Dry Milk Whey. Technical Conditions. M., 2016. 15 p.

³ GOST 32951-2014. Semi-Finished Meat and Meat-Containing Products. General Technical Conditions. M., 2014. 8 p.

Table 1. Characteristics of a Complex Additive Based on Grain Raw Materials
Таблица 1. Характеристика комплексной добавки на основе зернового сырья

Indicator	Characteristic (Value)	
	CGA 1 Based on Barley Concentrate	CGA 2 Based on Oat Bran Concentrate
Appearance	Homogeneous Fine Powder	
Color	From Light Yellow with a Milky Shade	From White to Light Yellow with a Hint of Gray
Aroma	Weakly Expressed Milk-Barley	Weakly Expressed Milk-Oatmeal
Mass Fraction, % Protein	11.5 ± 0.4	12.3 ± 0.3
Fat	2.2 ± 0.1	2.3 ± 0.1
Dietary Fiber, %	14.3 ± 0.5	14.1 ± 0.4

bread provided by the recipe, rheological indicators of minced meat and the finished product, as well as based on its nutritional value.

The authors made the experimental samples of MMSP with the addition of CGA in the laboratory of the USUE Department of Nutrition Technology, as well as in the production conditions of PLC "PRO-PITANIE". The produced the prototypes of minced meatballs from poultry in accordance with the technological scheme shown in the Fig. 1. Before applying the CGA, a man mixed it with water in a ratio of 1 : 3 in a cutter (Robot Coupe, France). The researchers introduced CGA into the cutter and mixed for 2 minutes with water until a homogeneous mass, then added raw meat and mixed

for another 5 minutes. They formed the product weighing 100 g from the prepared minced meat and cooled until the temperature in the product thickness of $+2 \pm 2^\circ\text{C}$.

The authors introduced the CGA introduction during the minced meat preparation to achieve the specified technological and consumer properties of the developed product.

A man determined the organoleptic and physico-chemical parameters in the finished products according to the generally accepted methods described in regulatory documents:

- the mass fraction of moisture – according to the GOST 51479-99 (by drying at a temperature of 105°C);

Fig. 1. Technological Production Scheme of the Developed Minced Semi-Finished Meat Products (Minced Meat Balls from Poultry Meat)

Рис. 1. Технологическая схема производства разработанных мясных рубленых полуфабрикатов (биточки рубленые из мяса птицы)

- the moisture-binding and moisture-retaining ability of the meat system – by pressing (the Grau-Hamm method);
- the strength of minced meat and finished meat products – according to the Valent method, the researchers measured the load required for immersion in minced meat and finished meat product by 5 mm [8];
- insoluble dietary fiber – by the enzymatic-gravimetric method according to the GOST R 54014-2010;
- the mass fraction of fat – by the Soxhlet extraction apparatus in accordance with the GOST 23042;
- the mass fraction of protein (according to Kjeldahl) – according to the GOST 25011;
- the mass fraction of sodium chloride – according to the GOST 1841-2-2013 (Mohr method);
- organoleptic indicators – according to the GOST 9959-2015. The researchers run the organoleptic assessment of semi-finished products in raw form and after heat treatment: in the raw form, they measured appearance, color and flavor (aroma) of semi-finished products; in the finished form, they assessed the appearance, consistency, type of minced meat on the cut, flavor (aroma) and taste of semi-finished products, for which the product was heat treated until ready.

- the mass fraction of starch – according to the GOST 10574;
- amino acid and fatty acid composition – by gas-liquid chromatography on the chromatograph Agilent 1260 Infinity II in accordance with the Quality Control Sample “Determination of Amino Acid Composition by High-Performance Liquid Chromatography (HPLC) with Pre-Column Derivatization by the OPA and FMOG agents in food products” of the Gorbатов Federal Scientific Center for Food Systems.

Results of the Study and Their Discussion

The new MMSP development with the addition of a complex additive based on grain raw materials is a promising direction aimed at expanding the range and forming new consumer properties of finished products. The CGA introduction contributes to the specified properties formation of MMSP due to the increased content of non-starch polysaccharides forming viscous colloidal solutions, improves the functional and technological properties of the meat system.

To select the optimal amount of wheat bread tin order to replace with CGA in the MMSP recipe, a man studied the functional and technological characteristics (dry matter content, moisture binding ability, strength) of the meat system (Fig. 2, 3).

Fig. 2. Meat System Moisture Binding Capacity (MBC) of MMSP, Depending on the CGA Amount, %
Рис. 2. Влагосвязывающая способность мясной системы МРПФ в зависимости от содержания КДЗ, %

Fig. 3. Meat System Strength Dependence on the Share of Replacement of the Main Raw Materials by the CGA, %
Рис. 3. Зависимость прочности мясной системы от доли замены основного сырья на КДЗ, %

The study results (Fig. 2) indicate that the wheat bread replacement in the MMSP recipe with CGA in an amount from 2 to 10 % contributes to an increase in the MBC in the experimental samples in comparison with the control sample (85.9 %) by 8.5 and 7.7%, respectively.

When wheat bread was completely replaced with CGA in the amount of 10 % of the meat weight, there was an increase in the hydrophilicity of the meat system. MBC results comparison of the meat system from poultry meat shows that the replacement of wheat bread with CGA has a positive effect on the formation of a three-dimensional structural grid that retains moisture and fat particles of the finished product due to the increased content of protein and fiber, and therefore prevents the meat juice release.

The meat system strength raises with an increase in the CGA introduction proportion (fig. 3). The study results of the meat system strength indicate that the main raw materials replacement with CGA in the amount of 10 % increases the strength of the meat system by 1.6 times. This has a positive effect on the MMSP forming process.

The next stage is the organoleptic evaluation of control and experimental samples of the MMSP on the example of chopped meatballs from poultry (Fig. 4, 5).

According to the tasting evaluation results of the experimental samples of the MMSP with CGA 1 added, a man found that in the experimental samples, the addition of the CGA in the amount of 2.0 to 8.0 % does not significantly affect the organoleptic parameters, whereas when adding 8.0 % the products are juicier, softer and more delicate consistency, taste and smell are pronounced, and pleasant.

According to the organoleptic parameters study results of the MMSP prototypes with the introduction of CGA 2, the optimal amount of the additive is 8%, namely, the product has a delicate and soft consistency, the taste and smell are pronounced and pleasant, the type of minced meat on the section is homogeneous.

According to the organoleptic parameters evaluation results of the experimental samples of culinary products, a man selected the optimal recipes (Table 2, Fig. 6).

Fig. 4. Organoleptic Indicators of the Control and Experimental Samples Depending on the Percentage of the CGA 1 (Based on Barley Flour) Introduced into the Meat System, Point

Рис. 4. Органолептические показатели контрольного и опытных образцов в зависимости от процента вносимой КДЗ 1 (на основе ячменной муки) в мясную систему, балл

Fig. 5. Organoleptic Indicators of the Control and Experimental Samples Depending on the Percentage of the CGA 2 (Based on Oat Flour) Introduced into the Meat System, Point

Рис. 5. Органолептические показатели контрольного и опытных образцов в зависимости от процента вносимой КДЗ 2 (на основе овсяной муки) в мясную систему, балл

Table 2. Recipes of Chopped Meatballs from Poultry Meat with the Addition of CGA, g
Таблица 2. Рецептуры биточков рубленых из мяса птицы с добавлением КДЗ, г

Prescription Component	Control		CGA 1		CGA 2	
	Gross	Net	Gross	Net	Gross	Net
Poultry Meat	206.0	74.0	206.0	74.0	206.0	74.0
Wheat Bread	18.0	18.0	–	–	–	–
Complex Additive Based on Grain Raw Materials	–	–	10.5	9.7	11.0	9.8
Water	26.0	26.0	36.0	36.0	36.0	36.0
Internal Fat	4.0	4.0	–	–	–	–
Mass of the Semi-Finished Product with Mechanical Losses	–	114.0	–	114.0	–	114.0
Butter		3.0		3.0		3.0
Mass of Stewed Meat Balls		100.0		100.0		100.0

Fig. 6. Point Tasting Assessment Results of Control and Experimental Samples of the MMSP (with 8% CGA Introduction) (after Heat Treatment), Point

Рис. 6. Результаты балльной дегустационной оценки контрольных и опытных образцов МРПФ (с добавлением КДЗ 8 %) (после тепловой обработки), балл

The inulin use as part of a complex additive, which has a high ability to retain moisture in the meat system, has technological properties that mimic the fat in the product, enables to exclude internal fat from the recipe.

According to the organoleptic analysis results a man found that the products obtained higher organoleptic indicators when replacing wheat bread, which was part of the traditional recipe, with CGA in the amount of 8 %. For example, the product appearance in comparison with the control one had smooth edges without breaks, the smell and taste were pleasant, pronounced corresponding to the added additive, the consistency was softer and juicier.

In accordance with the developed technological scheme for the MMSP production with the CGA addition, the researchers studied quality indicators by the requirements regulated in the GOST 32951 (Table 3).

Based on the results of the analysis of physico-chemical indicators, a man found that in the experimental samples of minced meatballs with the

addition of CGA in comparison with the control sample: the protein mass fraction was higher by 7.3 and 12.56 %, and the fat mass fraction decreased by 0.8 and 1.3 %, respectively. The fat mass fraction decrease and the protein mass fraction increase was due to the content of dry whey, inulin, concentrate from barley or oats.

The moisture-retaining capacity of the experimental samples of culinary products increased by an average of 8.75 % compared to the control, which was due to the dietary fibers content in the CGA that can swell and retain moisture during heat treatment. The same trend was when determining the product mass after the heat treatment. For example, in the control samples, the loss of the finished product was 18 %, and in the samples with 8 % of CGA 1 – 9.8 %.

Further, the authors studied of the amino acid and fatty acid composition of MMSP samples. Lipids and fatty acids of the poultry meat muscle tissue are connected with other prescription components and are held not only mechanically, but also chemically

Table 3. Physical and Chemical Parameters of Control and Developed Samples of Minced Meat Balls from Poultry Meat
Таблица 3. Физико-химические показатели контрольных и разработанных образцов биточков рубленых из мяса птицы

Indicator	GOST 32951 Requirement	Control Sample	Developed Sample	
			with CGA 1 Added	with CGA 2 Added
Protein Mass Fraction, %	not less than 12.0	15.28 ± 0.09	16.4 ± 0.1	17.2 ± 0.1
Fat Mass Fraction, %	not more than 35.0	23.4 ± 0.14	22.6 ± 0.15	22.1 ± 0.15
Starch Mass Fraction, %	not more than 6.0	1.4 ± 0.16	0.52 ± 0.02	0.54 ± 0.13
Sodium Chloride Mass Fraction	not more than 0.2	0.038 ± 0.003	0.016 ± 0.001	0.015 ± 0.002
Moisture-Retaining Capacity of Finished Products, %	not rated	85.2 ± 0.51	93.53 ± 0.547	93.15 ± 0.54
Dietary Fiber Mass Fraction, %	not rated	0.3	3.1 ± 0.18	3.2 ± 0.15
Mass of the Product: before Heat Treatment, g after Heat Treatment, g	not rated	114.0 ± 1.0 100.0 ± 2.6	114.0 ± 1.0 100.1 ± 1.4	114.0 ± 1.0 100.2 ± 1.7

by covalent and ionic hydrogen bonds. Changes in the amino acid and fatty acid composition that occur during the storage of products, cooking and re-generation modes depend on the raw materials and their chemical composition, temperature and humidity conditions, storage periods and heating duration. During the regeneration process, occurred hydrolytic and oxidative changes in lipids have a significant impact on the quality of the finished MMSP. Based on the study of works devoted to the fatty acid composition determination and the recommendations of the Nutrition Institute of the

Russian Academy of Medical Sciences and All-Russian Research Institute of Metrological Service, the researchers suggested to use an "ideal (reference) lipid" characterized by the content of PSFA, SFA and oleic acid in the required proportion to assess the fats quality [2]. The Table 4 demonstrates comparative assessment of the fatty acid composition of the simulated "ideal lipid" formula and the developed MMSP samples with the CGA added.

On the comparative analysis basis of obtained fatty-acid composition indicators of produced MMSP with CGA with the formula "ideal lipid" a man stated

Table 4. Comparative Fatty Acid Composition Assessment of the Simulated "Ideal Lipid" Formula and the Developed MMSP Samples with the CGA Added

Таблица 4. Сравнительная оценка жирно-кислотного состава смоделированной формулы «идеального липида» и разработанных образцов МРПФ с добавлением КДЗ

Indicator	"Ideal Lipid" Formula, %	Minced Poultry Meat Balls with the CGA 1		Minced Poultry Meat Balls with the CGA 2	
		g/100 g of the Product	g/100 g of Lipids	g/100 g of the Product	g/100 g of Lipids
SFA	0.53–0.62	3.55	32.1	3.57	32.4
PSFA	0.38–0.47	6.39	53.6	6.43	54.1
Oleic Acid	0.3–0.32	5.18	43.9	5.23	44.1
Linoleic Acid	0.07–0.12	1.62	14.1	1.65	14.4
Linolenic Acid	0.005–0.01	0.12	0.95	0.15	1.05
Content Ratio					
USFA to SFA	0.6–0.9	2.26		2.34	
Linoleic to Linolenic Acids	7–40	14.9		15.2	
Linoleic to Oleic Acids	0.2–0.4	0.35		0.41	
Oleic to Linolenic Stearic Acids	0.9–1.4	10.6		10.8	
Pentadecanoic to Stearic Acids	0.9–1.4	10.6		10.8	
Coefficient of Biological efficiency of Lipids	1	0.77		0.83	

Table 5. Amino Acid Protein Composition of MMSP Experimental Samples with CGA in Comparison with the Norms Recommended by the FAO/WHO

Таблица 5. Аминокислотный состав белка опытных образцов МРПФ с добавлением КДЗ в сравнении с нормами, рекомендуемыми ФАО/ВОЗ

Amino Acid	Recommended Norms of the FOA/WHO, g/100 g of protein	Minced Poultry Meatballs with the CGA 1 Added, g/100 g	Minced Poultry Meatballs with the CGA 2 Added, g/100 g	Comparison of the Amino Acid Content with the Recommended FAO/WHO Standards, %	
				Minced Poultry Meatballs with the CGA 1 Added	Minced Poultry Meatballs with the CGA 2 Added
Isoleucine	4.0	4.36	4.32	109.0	108.0
Leucine	7.0	7.91	7.84	113.0	112.0
Lysine	5.5	6.85	6.93	124.5	126.0
Methionine + Cysteine	3.5	3.82	3.75	109.1	107.1
Phenylalanine + Tyrosine	6.0	6.76	6.81	112.6	113.5
Threonine	4.0	4.64	4.71	116.0	117.75
Tryptophan	1.0	1.42	1.39	142.0	139.0
Valin	5.0	5.12	5.08	102.4	101.6
Total Amount of Essential Amino Acids	36.0	40.88	40.83	–	–

that the studied meatballs samples with CGA had a high content of linoleic (1.62 and 1.65 in) and linolenic acids (of 0.12 and 0.15), and the biological value coefficient of 0.77 and 0.83.

At the final stage of the experiment the authors studied amino acid protein score of the MMSP prototypes with CGA in comparison with the FAO/WHO recommendations¹ (Table 5).

The Table 5 shows that the experimental samples of minced meat semi-finished products with the addition of a complex grain-based additive exceed the recommended amino acid composition norms of the FAO/WHO by an average of 5.5% and 5.0%, which indicates the advantages and balanced amino acid protein composition of the developed meatballs with the addition of a vegetable component.

Conclusion

The complex grain-based additive use a in the meat systems formulation has a positive effect on physical and chemical parameters (mass fraction increase of protein, fat and dietary fiber), contributes to an increase in the hydrophilicity of minced meat and moisture-binding ability.

Organoleptic assessment of experimental samples of minced meat semi-finished products showed

the complete replacement feasibility of wheat bread: minced meat consistency (density), product appearance (integrity, absence of cracks), uniformity of appearance in the section, juiciness and severity of taste and smell.

According to the study results of organoleptic and physico-chemical properties, a man developed minced meatballs recipes from poultry meat with the introduction of a complex grain-based additive, which included a food concentrate from barley or oat bran concentrate, whey powder and inulin. The samples with the introduction of a complex grain-based additive in the amount of 8% are the best according to the comprehensive analysis results.

The obtained results of the fatty acid and amino acid compositions study of the prototypes with the addition of a complex additive based on grain raw materials correspond to the recommended amino acid composition norms of the FAO/WHO, which indicates the amino acid and fatty acid protein composition balance of the developed recipes of minced meat semi-finished products.

The introduction of a complex grain-based additive into the recipe of minced meat semi-finished products increases the nutritional value of the product due to vegetable raw materials rich in the BAS and dietary fibers, increases the technological and consumer properties of minced meat systems.

¹ MR 2.3.1.2432-08. Rational Nutrition. Norms of Physiological Needs for Energy and Nutrients for Various Groups of the Population of the Russian Federation.

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