EVALUATION OF QUALITY OF COW'S MILK WHEN USING IMMUNOSTIMULATORY PREPARATIONS

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ABSTRACT

The research was conducted to determine quality parameters of raw milk according to Federal Law № 88 «Technical Regulation on Milk and Milk Products» when using the preparations «Gamavit» and «Eleutherococcus Extract» at different doses. As a result of organoleptic analysis of raw milk, no deviations from permitted values were revealed. Consistency of milk presented homogeneous liquid without precipitation and flakes. Foreign odor and flavor were not detected; the raw material had clear odor and flavor relevant to fresh genuine milk. The colour of milk in the control and experimental groups was white. Due to physical and chemical parameters, raw milk in both groups was not significantly different and fully corresponded to the requirements of Federal Law №88. Thus, the maximum protein content was detected in the 1st experimental group – 3.10 %; fat content in the control group was less than in the 1st experimental group by 0.10%, and less than in the 2nd experimental group by 0.06 %. Acidity of the control and the 2nd experimental groups was on the same level (19.93T0), but acidity of the 1st experimental group was higher by 0.35%. Milk density differed by 0.02%. The mass fraction of dry and non-fat matters was 8.33% on average. Such microbiological parameters as QMAFAnM (Quantity of Mesophilic Aerobic and Facultative Anaerobic Microorganisms) and aflatoxin M1 were not higher than 0.0001 mg/l; pathogenic microorganisms, inhibiting substances and antibiotics were not found in the samples. Due to safety parameters, samples of all groups were within the mark. Generally, due to organoleptic, physical and chemical, microbiological and safety parameters milk of all the groups corresponded to the established requirements; the parameters were not beyond permissible rates.

KEYWORDS: Milk, Preparations, Thermal Stability, Quality, Dose, Safety Indicators

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INTRODUCTION

Milk is a health high-calorie food product containing all necessary nutritional substances in a well-balanced and easily digestible form. As a rule, milk production is evaluated due to quantitative indicators and components of milk. Milk nutritional and biological value, milk products and their quality depend on the composition (Khristoforovich *et al.*, 2016; Smolentsev *et al.*, 2018; Samsonov *et al.*, 2018). Milk quality is a multifactorial category. Full supply of the country's population with health high quality food products, including milk having high nutritional and

biological value, is an essential task of agroindustrial complex (Semenov *et al.*, 2018). Besides, milk is the main raw material for dairy industry. It is necessary to increase productivity of animals to provide the population with milk and milk products, which is mainly possible by means of feeding optimization (Anatolievna *et al.*, 2016; Ilyasovich *et al.*, 2016; Egorov *et al.*, 2018). Balanced feeding with the account of new kinds of food helps to increase milk yield and keep physiological status and productive longevity of cows (Matveeva *et al.*, 2015; Dmitriyevich *et al.*, 2016). Increase of high quality milk production is one of the main tasks of agroindustrial complex of the country as it solves two global problems: economic (providing food safety of the Russian Federation) and the social one (providing working population with workplace) (Popov *et al.*, 2018; Tsaregorodtseva *et al.*, 2019). However, at present dairy cattle breeding is in crisis that is connected with new economic conditions of production and development of the feed sector. The use of biologically active supplements in cattle breeding and fortification of animals' diet considerably reduce the price of a unit production and helps to increase supply of certain components, microelements in particular.

On June 12, 2008 Federal Law № 88-ФЗ «Technical Regulation on Milk and Milk Products» was enacted with the aim to improve quality of processed milk (Valiullin *et al.*, 2017).

MATERIALS AND METHODS

The research was conducted in 2014 in the PLC «Glinki» (Kurgan). Milk of cows taking different doses of immunomodulating preparations was used: 1st sample (control group) – animals received basic diet (OP), 2nd sample (1st experimental group) – 60 ml of the preparation «Gamavit» and 15 ml of «Eleutherococcus Extract» were added to the basic diet, 3rd sample (2nd experimental group) – 40 ml of «Gamavit» and 25 ml of «Eleutherococcus Extract» were added to the basic diet.

RESULTS AND DISCUSSIONS

Quality evaluation of raw milk is carried out by identifying organoleptic, physical and chemical, microbiological and safety parameters. The results of the organoleptic analysis are presented in the Table 1.

Table 1: Organoleptic Parameters of Raw Milk

Parameters	Acceptable Values According to Φ3 № 88	Group		
		Control	I Experimental	II Experimental
Consistency	Homogeneous liquid without precipitation and flakes	Corresponds	Corresponds	Corresponds
Flavor and odor	Clear odor and flavor without foreign odor and flavor relevant to old genuine milk	Corresponds	Corresponds	Corresponds
Colour	From white to cream white	White	White	White

As a result of this analysis, no deviations from permitted values were revealed. It means that raw milk corresponds to the requirements of Federal Law №88. The main physical, chemical and sanitary and hygienic parameters of the raw material include mass fraction of fat and protein, percentage of dry and non-fat matters, acidity and density, bacterial number, somatic cells, thermal stability and purity group (Table 2).

Table 2: Physical, Chemical and Sanitary and Hygienic Parameters of Milk

Parameters	Acceptable Values According to $\Phi 3$ № 88	Group		
		Control	I Experimental	II Experimental
Protein mass fraction, %	Not less than 2.8	3.06 ± 0.01	3.10 ± 0.01	3.08 ± 0.03
Fat mass fraction, %	2.8–6.0	3.92 ± 0.04	4.02 ± 0.03	3.98 ± 0.03
Acidity, T^0	16.0–21.0	19.93 ± 0.07	20.00 ± 0.00	19.93 ± 0.07
Density, kg/cm^3	Not less than 1027.0	1030.30 ± 0.49	1030.10 ± 0.50	1029.97 ± 0.89
Mass fraction of dry and non-fat matters, %	Not less than 8.2	8.30 ± 0.06	8.37 ± 0.09	8.33 ± 0.07
Bacterial number	500–4000 thousand/ cm^3	127.70 ± 12.99	108.00 ± 8.02	114.70 ± 10.11
Somatic cells, g	Not more than 1×10^6 in cm^3	99.70 ± 14.70	87.70 ± 11.90	97.30 ± 5.17
Caloric value, kcal	–	64.68 ± 5.30	79.77 ± 5.53	75.85 ± 5.53
Thermal stability	–	1 st group	1 st group	1 st group
Purity group, not less	–	1	1	1

The protein mass fraction in all the groups corresponded to the permissible values. The maximum content was 3.10 % in the 1st experimental group that is higher than in the control and the 2nd experimental groups by 0.04% and 0.02 % respectively. Fat content in the control group was less than in the 1st experimental group by 0.10 %, and less than in the 2nd group by 0.06 %. The difference of this parameter in the experimental groups was 0.04 % to the advantage of the 1st one. Acidity of the control and the 2nd experimental groups was on the same level ($19.93T^0$), but it was less than in the 1st experimental group by 0.35 %. Milk density in the control and the 1st groups was higher than in the 2nd one by an insignificant amount (0.02%). The mass fraction of dry and non-fat matters was 8.33 % on average. The bacterial number in the 1st and 2nd experimental groups differed by 6.20 % to the advantage of the 2nd one. The bacterial number of the control group was higher than in the 1st one by 18.24% and the 2nd one by 11.33%. Generally, due to this parameter, milk in all groups was within the normal range and corresponded to premium quality milk. The number of somatic cells in the control group was higher than in the 1st experimental group by 13.68 %, and the 2nd one by 2.47 %. The difference between the experimental groups was 10.95 % to the advantage of the 2nd one. Energy value in the 1st group was higher than in the control and the 2nd groups by 23.33% and 5.17 % respectively. Making of products that require heat treatment depends on thermal stability of milk. This parameter had the 1st group in all the groups. It shows that milk was good for making of milk products that require sterilization and high temperature processing under the conditions of long-term keeping. Milk purity group is determined by presence of mechanical impurities in it. Due to this parameter, all groups had a one, which is an indicative of good sanitary condition at the enterprise. Microbiological parameters of raw milk are presented in the Table 3.

Table 3: Microbiological Parameters of Raw Milk

Parameters	Acceptable Values According to $\Phi 3$ № 88	Group		
		Control	I Experimental	II Experimental
QMAFAnM, CFU/g	Not more than 5×10^5	$4.4 \cdot 10^4 \pm 1.96$	$3.1 \cdot 10^5 \pm 1.05$	$4.0 \cdot 10^3 \pm 0.12$
Pathogenic microorganisms, including salmonella, g	Not allowed in 25,0 g	Not found	Not found	Not found
Somatic cells, g	Not more than 1×10^6 in cm^3	99.70 ± 14.70	87.70 ± 11.90	97.30 ± 5.17
Mycotoxins: aflatoxin M, mg/l	0.0005	Less than 0.0001	Less than 0.0001	Less than 0.0001
Inhibiting substances	Not allowed	Not found	Not found	Not found
Antibiotics: tetracycline group, mg/kg	Less than 0.01 mg/kg	Not found	Not found	Not found
Streptomycin, mg/kg	Less than 0.5 mg/kg	Not found	Not found	Not found
Penicillin, mg/kg	Less than 0.004 mg/kg	Not found	Not found	Not found
Laevomycetin, mg/kg	Less than 0.01 mg/kg	Not found	Not found	Not found

When determining this parameter, quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM) plays an important role. It increases when microorganisms reproduce. High level of microorganisms can cause food poisoning (gastroenteritis). The maximum content of QMAFAnM was $4.4 \cdot 10^4$ CFU/g in the control group, which is higher than in the 1st experimental group by 14.19 % and the 2nd group by 11.00%. Generally, this parameter was within normal limits – not more than $5 \cdot 10^5$ CFU/g. The amount of aflatoxin M1 was also within the limits in all groups and it was not higher than 0.0001 mg/l. Such parameters as pathogenic microorganisms, inhibiting substances and antibiotics were not found in the samples that corresponds to the requirements of the technical regulation. The content of chemical pollutants is determined by the correspondence of food products to the hygienic regulations in Sanitary Regulations and Norms 2.3.2.1078-01. Toxic elements, cadmium and lead in particular, are not necessary microelements and belong to cumulative toxins (Table 4). Cadmium content in raw milk of all groups was not over the permissible levels (0.03 mg/l); it was less than 0.005 mg/l. The control group had the maximum lead content – 0.071 mg/l, which is higher than in the 1st and 2nd groups by 7.58% and 39.22 % respectively. The 1st experimental group contained more lead than the 2nd one by 29.41%. This parameter was minimal in the 2nd group. Mercury gets into animals' organism with water or food. It was less than 0.002 mg/l in all groups when the acceptable value is 0.1 mg/l.

Table 4: Safety Parameters of Raw Milk

Parameters	Acceptable Values According to $\Phi 3$ № 88	Group		
		Control	I experimental	II experimental
Toxic elements: cadmium, mg/l	0.03	less than 0.005	less than 0.005	less than 0.005
Mercury, mg/l	0.005	less than 0.002	less than 0.002	less than 0.002
Lead, mg/l	0.1	0.071 ± 0.028	0.066 ± 0.026	0.051 ± 0.021
Arsenic, mg/l	0.05	less than 0.005	less than 0.005	less than 0.005
Pesticides: HCCH (a,b,g-isomers), mg/l	0.05	less than 0.001	less than 0.001	less than 0.001
DDT and its metabolites, mg/l	0.05	less than 0.007	less than 0.007	less than 0.007
Radionuclides: Cesium-137, Bq/kg	100.0	less than 4.5	less than 3.5	less than 3.0
Strontium-90, Bq/kg	25.0	less than 5.6	less than 5.7	less than 5.0

The level of pesticides, DDT and its metabolites was the same in all the groups. Cesium-137 and Strontium-90 were found in cow's milk. The 2nd group had the minimal amount of cesium – 3.0 Bq/kg, which is less than in the control and the 1st groups by 15.00 % and 11.67 % respectively. The maximum level of strontium was revealed in the control and the 1st groups, where the difference was 0.1 Bq/kg. The 2nd group had less strontium than the control and the 1st group by 11.2% and 11.4 % respectively.

CONCLUSIONS

Generally, the evaluation of raw milk due to organoleptic, physical and chemical, microbiological and safety parameters

shows that milk of all the samples corresponded to the requirements, the parameters were within the limits, and, as a result, milk can be used for further production of dairy products.

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