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Assessment of safety indicators for the developed functional bioyogurt

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Abstract. Yoghurts are superior to milk in many ways in preventive nutrition and can be used in daily human nutrition. The purpose of the research is to assess the safety indicators of the developed functional bioyogurt. The safety indicators of the developed product are revealed. Microbiological indicators of the fermented milk product meet the requirements of the current regulatory documentation. The content of toxic elements is significantly lower than the established permissible levels and meets the requirements of technical regulations. Antibiotics were not found in the studied products. The content of pesticides and mycotoxins in functional bioyogurt meets the requirements of regulatory documents. The content of radionuclides does not exceed the norm. The developed bioyogurt for functional purposes is completely safe (from the point of view of the requirements of technical regulations).

1. Introduction

Providing the population with high-quality food, including functional and special-purpose food, is one of the most important factors determining human health [1–5]. A balanced diet, with a high biological and nutritional value, contributes to the prevention of a fairly wide range of diseases, increased efficiency and resistance to the adverse effects of unfavorable environmental factors [6–10].

Milk and dairy products are one of the most valuable food products (balanced composition of nutrients, high digestibility) [11–14].

Yoghurts are actively used in therapeutic and preventive nutrition; consumer demands continue to grow steadily, especially for bioyoghurts and functional yoghurt products [15–19].

2. Material and methods

A prescription composition of yoghurt is proposed: fresh cow milk, fine oat flakes, sourdough (BK-Altai-LSBifi), natural honey, stabilizer Genu-pectin LM-106 AS, concentrated milk whey, candied fruits from beets, carrots, pumpkin and watermelon (samples 1, 2, 3 and 4, respectively). Bioyogurt production technology is presented in the patent application No. 2014118700 RU “Functional bioyogurt” [20].



Samples of yoghurt for testing were stored at the recommended temperature set in the national standard for this product group. Bioyoghurt studies were carried out four hours after the end of the manufacturing process.

Standard and original research methods were used, the following indicators of finished fermented milk products for functional purposes were determined:

- Lead content in accordance with GOST (State Standard) 30178-96.
- Arsenic content in accordance with GOST 51766-2001.
- Content of cadmium in accordance with GOST 30178-96.
- Mercury content in accordance with MT (Measurement Technique) No. 2740-2002.
- Content of hexachlorocyclohexane in accordance with MUK (Guidelines) 1222-75.
- Content of DDT (dichlorodiphenyl trichloromethylmethane) and its metabolites – MU 2142-80. Guidelines for the determination of organochlorine pesticides in water, food, feed and tobacco products by thin layer chromatography.
- Determination of the number of mesophilic aerobic and facultative anaerobic microorganisms (NMAFAM) – in accordance with GOST 10444.15-94.
- Determination of the amount of mold and yeast – in accordance with GOST 10444.12-88.
- Determination of the number of bacteria of the group of *E. coli* (coliform bacteria) – in accordance with GOST R 52816-2007.
- Determination of the number of coagulase-positive staphylococci and *Staphylococcus aureus* – in accordance with GOST R 52815-2007.
- Identification of bacteria of the genus *Salmonella* – in accordance with GOST R 52814-2007.
- Determination of aflatoxin M_1 – in accordance with GOST 30711, MU No 4082 (control of raw materials).
- Determination of antibiotics – in accordance with GOST R 51600; determination of chloramphenicol – according to MT-4-18/189 (raw material control).
- Determination of radionuclides Sr-90 and Cs-137 carried out according to the method described in MUK 2.6.1.1193-2003.

3. Results and discussion

The safety compliance assessment of the developed bioyogurt was carried out according to the following indicators: microbiological (presented in table 1); the content of heavy metals (toxic elements) is presented in table 2; the content of antibiotics (research results are presented in table 3); pesticide content (table 4); the content of mycotoxins (table 5); the content of oxidative spoilage (table 6); content of radionuclides (table 7).

Table 1. Microbiological indicators of functional purpose bioyogurt.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
KMAFAnM, CFU / cm³ (g)	no less than 1x10 ⁷ lactic acid microorganisms		3.1x10 ⁸	3.1x10 ⁸	3.0x10 ⁸	3.3x10 ⁸
Product mass (g) in which are not allowed						
BGKP (coliforms)	0.1	0.1	Not detected			
pathogenic, including salmonella and listeria	25	25	Not detected			
L.monocytogenes						
Staphylococci						
S.aureus	1.0	1.0	Not detected			

bacteria <i>B. cereus</i> , CFU / cm ³ (g), no more	—	—	Not detected
yeast (D) mold (P), CFU / cm ³ (g), no more	—	—	Not detected

The table 1 shows that the content of lactic acid microorganisms in all samples meets the requirements of these documents, and the remaining microbiological indicators of the developed product were not found, which also meets the requirements.

Table 2. The content of toxic elements in functional purpose bioyogurt, mg / kg (l), no more.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
lead	0.02	0.02	less than 0.001			
arsenic	0.05	0.05	less than 0.001			
cadmium	0.03	0.03	less than 0.001			
mercury	0.005	0.005	less than 0.0001			

According to table 2, it can be concluded that the developed samples in terms of the content of toxic elements comply with the standards presented in the regulatory documents TR CU (Technical Regulations of the Customs Union) and Federal Law No. 88.

Table 3. The content of antibiotics in functional purpose bioyogurt, mg / kg.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
chloramphenicol	less than 0.01	not allowed (less than 0.01)	Not detected			
tetracycline group	less than 0.01 u / g	not allowed (less than 0.01)	Not detected			
penicillin	less than 0.01 u / g	not allowed (less than 0.004)	Not detected			
streptomycin	less than 0.5 u / g	not allowed (less than 0.2)	Not detected			

The table 3 shows that the content of antibiotics in the developed bioyogurt for functional purposes was not found, which meets the requirements of regulatory documents.

Table 4. The content of pesticides in functional purpose bioyogurt, mg / kg (l).

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
- HCH (α , β , γ - isomers)	no more than 0.05	no more than 0.05	less than 0.0001			
- DDT and its metabolites	no more than 0.05	no more than 0.05	less than 0.0001			

The table 4 shows that the content of HCH (α , β , γ - isomers) and DDT and its metabolites in the developed samples is less than 0.0001 mg/kg, which meets the established requirements.

Table 5. Mycotoxin content in functional purpose bioyogurt.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
Aflatoxin M ₁ , permissible levels, mg / kg (l)	0.0005	0.0005	less than 0.00001			

The table 5 shows that the content of mycotoxins in the developed functional purpose bioyogurt is less than 0.00001 mg/kg, this indicates that the developed product meets the requirements of regulatory documents.

Table 6. Oxidative damage in functional purpose bioyogurt.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
Peroxide value, no more	4 mmol of active oxygen / kg of fat (for products with a fat content of more than 5 g / 100 g and products fortified with vegetable oils)		no studies have been carried out since functional bioyogurt is low-fat, not enriched with vegetable oils			

Table 6 shows that studies on the content of oxidative spoilage in the developed bioyogurt for functional purposes have not been carried out, since the product is not enriched with vegetable oils.

Table 7. The content of radionuclides (Bq / kg (l)), specific activity in functional purpose bioyogurt.

Indicators	Requirements		Research results, samples			
	FL № 88	TR TS	1	2	3	4
Cesium-137	100	100	12	10	14	18
Strontium-90	25	25	4	4	8	2

Table 7 shows that the content of radionuclides in the developed bioyogurt for functional purposes does not exceed 100 Bq/kg in terms of cesium-137 content, and does not exceed 25 Bq/kg in terms of strontium-90 content, which meets the requirements of regulatory documents.

4. Conclusion

The safety indicators of the developed product have been identified:

- microbiological indicators: KMAFAnM contains more in the sample with the addition of candied fruit from watermelon and is 3.3×10^8 lactic acid microorganisms, CFU/cm³ (g), the sample with the addition of candied fruit from pumpkin (3.0×10^8 lactic acid microorganisms, CFU/cm³ (g)), which meets the requirements of regulatory documents. BGKP (coliforms), pathogenic, including salmonella and listeria L.monocytogenes, staphylococcus S.aureus, bacteria B.Cereus, yeast, molds were not found in the developed products;

– the content of toxic elements in all four test samples is: lead content - less than 0.001 mg/kg (l), arsenic content - less than 0.001 mg/kg (l), cadmium content - less than 0.001 mg/kg (l), mercury content - less than 0.0001 mg/kg (l), which meets the requirements of regulatory documents;

– the content of antibiotics (chloramphenicol, tetracycline group, penicillin, streptomycin) was not detected in the developed samples;

– the content of pesticides and mycotoxins in functional purpose bioyogurt in all the samples under study is: HCH (α , β , γ - isomers) - less than 0.0001 mg/kg (l), DDT and its metabolites - less than 0.0001

mg/kg (I), Aflatoxin M₁ - less than 0.00001 mg/kg (I), which meets the requirements of regulatory documents;

– the content of cesium-137 and strontium-90 in the sample with the addition of candied fruits from watermelon is 18 and 2 Bq/kg (I), respectively, in the sample with the addition of candied fruits from pumpkin – 14 and 8 Bq/kg (I), respectively, in a sample containing candied fruits from carrots - 10 and 4 Bq/kg (I), respectively, in a sample containing candied fruits from beets – 12 and 4 Bq/kg (I), respectively. The results obtained meet the requirements of regulatory documents.

Thus, the developed functional purpose bioyogurt is completely safe (meets the updated requirements of regulatory documents).

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