LIOPHILIZED FUNCTIONAL DRINK ON THE BASE OF KEFIR FROM GOAT MILK

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Abstract

In a predetermined health direction, a new recipe composition has been created. This is functional drink, based on a fermented goat milk product – kefir. The healthy effect of symbiotic kefir microflora (lactic acid bacteria and yeast), combined with the unique qualities of goat milk and the prebiotics and biologically active substances of various origins, enriches the drink composition and has a positive impact on a number of health problems such as gastrointestinal imbalance, an allergy to cow milk, lactose intolerance and so on. The optimal drying regime of the new drink has been established and organoleptic, physicochemical, biochemical and microbiological analyzes have been performed. As summarizing the data obtained, it was found that this is a lyophilized concentrate with preserved quality characteristics, balanced composition, high biological and energy value, suitable for prophylactic purposes.

Key words: kefir, goat milk, lyophilization, functional drink

Introduction

Lately, the rising supporters of healthy eating, encourages the production of more and more new products enriched with useful elements.

This stimulates rapid growth of production and consumption of innovative functional foods, which are seen as an integral part and logical continuation of the modern way of life.

Functional foods are products that exceed the capabilities of ordinary meal and have a specific, targeted focus on the condition of the body in order to improve the quality of life and/or reduce the risk of disease (Nacheva, 2017).

Fermented dairy products enriched with probiotic, prebiotic components and biologically active substances (omega-3, polyunsaturated fatty acids, etc.) as innovative products are increasing the interest of society (Roshtunkina, 2011). The synergistic interaction between the various biologically active components brings increase in the efficacy of each of them separately and on the biological value of the final product (Nacheva et al., 2016).

Kefir is one of the most beneficial dairy products for children and adults. It has all the beneficial properties of lactic acid beverages and refers to dietary products (Ahmed et al., 2013).

The main objective of the study is the development of a lyophilized functional drink with a high health potential, obtained by fermentation of goat's milk with symbiotic associations of lactic acid bacteria and yeast and included biologically active additives.

Materials and methods

Technological methods:

- Fermentation - Goat milk is used as a medium for the fermentation process, which is pasteurized at 85°C for 15 minutes and cooled to 25°C. The goat milk is inoculated with natural starter culture of kefir grains and lactulose syrup with a concentration of 3%. The fermentation process takes place at an established temperature range of 22-24 °C to 24 hours to obtain a lactic acid product.
- The new beverage contains sources of building and energy elements as well as physiologically active substances of different origins: chia seed, fruits - bananas, peaches, dried dates, almonds, royal jelly and natural sweetener - stevia.
- Sublimation drying - The process was carried out in a laboratory lyophilizer of the company - "Hochvakuum-TG -16.50" with conductive heating of the slabs.

Analytical methods:

- Organoleptic assessment – 9 ball Hedonic scale;
- Physicochemical analyzes - water content, %; active acidity (pH); titratable acidity; total protein - (BDS 9374-82); lipids (BDS 8549-74); total ash (BDS 9373-80); vitamin C, mg.%; carbohydrates; energy value/100g product, (kcal / kJ).
- Biochemical evaluation of fatty acid composition - the extraction of milk fat is carried out using the Rosse-Gottlieb method. Fatty acid methyl esters were analyzed using a Shimadzu 2010 (Kioto, Japan) gas chromatograph equipped with a flame ionization detector and an automatic injection system.

Microbiological assessment (BDS 1670-82):

- Total number of mesophilic aerobic and facultative anaerobic microorganisms — CFU/g (BDS EN ISO 4833-2013);
- Lactic acid bacteria, CFU/g;
- *Escherichia coli* in 0.1 g of product (ISO 16649 -1,2,3);
- Pathogenic microorganisms, including *Salmonella* in 25.0 g of the product (BDS EN ISO 6579:2003).
- Coagulase-positive staphylococci in 1.0 g of product (BDS EN ISO 6888-1-2005);
- Sulfite-reducing clostridium in 0.1 g of the product (ISO 15213-2003);
- Spores of microscopic molds and yeasts, CFU/g (BDS ISO 6611-2006);

Statistical processing: The results are statistically processed through Statistics for Windows.

Results and discussion

The new functional drink is multicomponent, but with balanced composition. Its composition is consistent with the requirements for physiological activity, harmlessness, safety and microbial stability. The component composition of the functional beverage in an optimum quantitative ratio are presented in Table 1.

Table 1. Component and quantitative composition of the lyophilized drink

Component	Quantity g/ml	Content %
Kefir from goat milk	1000	51
Banana	300	15
Peach	500	25
Dried dates	100	5
Chia seed	30	2
Almond flour	10	0.5
Royal jelly	5	0.25
Lactulose syrup	23	1.15
Stevia powder	3	0.1
Total	1 971	100

The new functional drink was lyophilized, as previously was frozen in chambers with forced convection of the air medium at a temperature from - 25^0C to - 30^0C for 12-15 hours. The sublimation drying temperature mode is programmed so as to obtain an optimal drying rate to provide good quality to the final product. The technological parameters of the process are presented in Table 2.

Table 2. Parameters of the process freeze-drying of the new functional drink

Parameters	Functional drink
I. Layer thickness, mm	12-15
II. Freezing temperature, °C	-25 до -30
III. Freeze-drying	
1. Drying temperature, °C	- 22 до -25
2. Temperature of the desublimator,°C	- 55 до -60
3. Partial pressure, Pa	от 20.0 до 25.0
4. Final drying temperature, °C	+ 28
5. Duration of the process, h	60

The lyophilized functional product has a fine, powdery structure, a pleasant lactic acid aroma with a fruity flavor and a pale yellow color.

The main physicochemical indicators are presented in Table 3.

Table 3. Physicochemical indicators of the lyophilized product (n = 5)

Indicators	Functional drink
Total moisture, %	4.31± 0.01
Total protein, %	18.01± 0.03
Lipids, %	12.13 ± 0.02
Total ash content, %	4.67 ± 0.03
Carbohydrates, %	60.88 ± 0.01
Active acidity, pH	4.46 ± 0.03
Titratable acidity, ^{o}T	98.5 ± 0.01
Vitamin C, mg.%	4.634 ± 0.04
Energy value/ 100 g product, (kcal/ kJ)	436.6/1826.8

The obtained experimental data show that the lyophilized functional beverage is a concentrate with a residual moisture content after lyophilization - 4.31%.

Values of titratable (98.5^{o}T) and active acidity (pH 4.46) are within the limits of the lactic acid product. The pH of the medium influences to a great extent the enzymatic and biochemical activity of the microorganisms, which is important for their viability and probiotic effect.

The increased total protein content, reducing sugars and vitamin C, is due to the nutrients added in the formula of the new product. Relatively low for concentrated food is the quantitative value of total lipids - 12.13%. Carbohydrates are of the polysaccharide type, as a result of the polysaccharides included in the composition, fruit ingredients, seeds and others. The hydrocolloid used (lactulose) has water-binding ability and interacts in a characteristic way with the proteins of the products. This interaction has a mainly electrostatic character and as a result a strong connection between the individual particles of the products has been build. Their quality is improved and after rehydration, the lyophilized products receive the necessary density. Lactic acid products are poor in water-soluble vitamin C (ascorbic acid), which is easily destroyed by heat treatment and is used by lactic acid bacteria in fermentation. The established content of vitamin C in the concentrate is higher (4.6 mg%) in comparison with the content in the yogurt from goat milk (3.1 mg%), which is due to the imported additional ingredients and gives a high antioxidant properties of the product. Royal jelly, containing 18 amino acids, proteins, vitamins (A, B- complex, B_5, B_6, C, D, E), carbohydrates, enzymes, fatty acids, mineral salts, etc., increases the biological value of the product.

Stevia is included in the product composition as a sweetener, a substitute for sucrose. It is rich in nutrients, contains significant amounts of protein, calcium, phosphorus and others and exhibits antihypertensive and antihyperglycaemic action.

Based on the chemical composition, the energy value of the obtained lyophilized product (436.6 kcal) was calculated, which was higher than the initial feedstock - kefir (58.47 kcal).

Table 4 presents the fatty acid content by group in кefir and functional drink.

Table 4. Groups of fatty acids in kefir and functional drink, g /100g of fat

Fatty acids - groups	Kefir	Functional drink
SFA	58.32	43.65
MUFA	31.02	20.43
PUFA	4.87	33.41
∑n-3	0.52	16.93
∑ n-6	4.13	16.03
∑n-6/Σn-3	7.98	0.95

The obtained data show the following regularities in the lipid profile of the product:

- Saturated fatty acids (SFA) content in the functional drink is reduced by 14.67g /100g fat, mainly as a result of a decrease in the content of short-chain fatty acids, lauric acid, myristic acid, and palmitic acid, due to the chia seed.
- Monounsaturated fatty acids (MUFA) decrease by 10.59 g /100g of fat.
- The content of polyunsaturated fatty acids (PUFA) of 4. 87 g /100g of kefir fat is significantly increasing to 33.41 g /100g of fat in the final product.
- The values of omega-3 (n-3) and omega-6-(n-6) fatty acids increase by 16.41 and 11.9 g /100g of fat respectively and the ratio between the two groups (n-6/n-3) decreases from 7.98 in kefir to 0.95 in the final product.

The results of the microbiological analyzes proved, that the indicators of lyophilized product are within the permissible norms and meet the requirements and criteria of BDS ISO

Table 5. Microbiological indicators of lyophilized functional drink

Indicators	Lyophilized drink	
	CFU/g	Log
Total number of mesophilic aerobic and facultative anaerobic microorganisms – CFU/g	2.8×10^2	2.45
Escherichia coli in 0.1g of product	Not detected	-
Pathogenic microorganisms, including *Salmonella* in 25.0 g of the product	Not detected	-
Coagulase-positive staphylococci in 1.0 g of product	Not detected	-
Sulfite-reducing clostridium in 0.1 g of the product	Not detected	-
Spores of microscopic molds, CFU/g	1.0×10^1	1.0

Table 6. Lactic acid bacteria and yeast in lyophilized functional drink

Microbiological groups	Lyophilized drink	
	CFU/g	Log
Lactobacilli	0.5×10^7	6.63
Streptococci	1.3×10^6	6.11
Yeasts	1.6×10^4	4.2

The data in Tables 5 and 6 show the content of microorganisms by groups in kefir and the final product, respectively. Values are high enough and satisfactory the needs of the body from probiotic components.

Conclusions

The new lyophilized drink is a multicomponent functional product, based on goat's milk.

Its formulations includes, besides the biofermented drink and further imported prebiotics and biologically active components. The qualitative composition of the product ensures its positive health effect.

The applied biotechnology approach and the sublimation drying method ensure the production of lyophilized products of high quality, high biological activity and long-lasting storage.

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