

Features of the Kefir Production Technology Using Whole Wheat of Green Buckwheat Flour

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Abstract—The need to create a new fermented milk product with the addition of gluten-free flour is scientifically substantiated. The main raw materials for production were cow milk of varying fat content; Whole wheat flour of green buckwheat that has undergone heat treatment was selected as a plant component. The feasibility of roasting the plant component is justified by its microbiological safety when further added to the milk base. Additionally, in the process of roasting, the flour acquired a nutty flavor and aroma. A combination of lactic acid organisms of the starter culture FD-DVS CHN 11 and yeast starter culture LAF 3 was used. The effect of the kefir fat content and the dose of roasted whole wheat flour of green buckwheat on the syneresis degree was studied. The kefir storage mode was investigated, and a storage setting was carried out in order to determine the shelf life of the final product. A technology has been developed for the production of kefir product with addition of roasted whole wheat flour of green buckwheat that does not contain gluten. These studies made it possible to determine the dosage of vegetable component and the technological stage of introducing it into the fermented milk product.

Keywords—kefir product, dairy product, gluten-free flour, roasted buckwheat flour, coeliac disease, specialized nutrition, microbiota.

I. INTRODUCTION

Modern medicine connects prevention of a number of diseases with unbalanced nutrition. An important criterion for recovery and preservation of health is the bioavailability of nutrients and the stable consumption of products that contain proteins, carbohydrates, fats, vitamins and minerals in the required amounts [1-5].

Studies have shown that daily inclusion of dairy products in the diet had a protective effect against most chronic non-communicable diseases. This effect is associated with the positive effect of products' microorganisms on the composition of intestinal microbiota. This group of products is also favorably distinguished by presence of complete protein, a fairly low cost and affordability for the consumer [6-10].

Scientists confirm that the introduction of any drug that affects the microflora, including probiotic or prebiotic, can

lead to the emergence of new types of bacteria that will create an ecological niche. Therefore, it is advisable to use foods containing microorganisms in the diet that determine the nature of nutrition, the habitat and other factors that influence the qualitative and quantitative composition of the intestinal microbiota [11].

The main place in the line of fermented milk products is occupied by kefir, kefir product, ryazhenka (fermented baked milk), varenets (stewler), yogurt, etc. In recent years, there has been a tendency to expand the assortment of the above products. There are known technologies and formulations that use fruit, vegetable and bean components. However, given the historical combination of food consumption, it can be noted that milk and dairy products are most often combined with cereals: bread from flour of different cultures, cereals, etc.

One of the current nutrition areas is the gluten-free diets. A gluten-free diet is not only for people with a diagnosed celiac disease, but is also used by a significant contingent of healthy people.

Therefore, the development of new recipes for fermented milk products with the addition of gluten-free components is relevant and promising.

II. RESULTS AND DISCUSSIONS

The basis of development is the technology of kefir product. According to the Technical Regulation of the Customs Union 033/2013, the kefir product is produced according to the kefir technology using sourdough starter, prepared using cultures of lactic acid microorganisms and one or more types of yeast that are part of the microflora of kefir fungi. In our experiments, a combination of lactic organisms of the starter culture FD-DVS CHN 11 and yeast starter culture LAF 3 was used.

In order to enrich the drink we used roasted whole-wheat flour of green buckwheat. In this case, the safety aspect of the combination of dairy and vegetable raw materials was taken into account. The experiments that were carried out to determine the number of mesophilic aerobic and facultative anaerobic microorganisms content, showed that both after the

heat treatment and during storage the microbiological parameters do not change, which indicates a positive effect of the roasting process at a temperature of from 140°C to 180°C for a duration of no more than 15 minutes for the bacteriostatic effect.

Thermal treatment made it possible to obtain not only a safe product from a microbiological point of view, but also improved its organoleptic characteristics. Buckwheat flour has a light creamy color and a pleasant nutty flavor.

At the first stage of the research, we determined the possibility of making roasted buckwheat flour in an amount of 1% to 6% in increments of 1% in milk with fat content: 1.0%; 2.5%; 3.2%; 6%; and fermented with a bacterial starter culture lyophilized direct application of FD-DVS CHN 11 – lactic acid microorganisms *Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *lactis*, *Leuconostoc mesenteroides* subsp. *cremoris*, *Lactococcus lactis* subsp. *diacetylactis* and milk yeast LAF 3 – the culture includes *Debaryomyces hansenii*, *Kluyveromyces* subsp. *marxianus*.

The studies allowed us to determine the dosage of roasted buckwheat flour and to confirm the technological choice of starter culture.

A comparative assessment of the organoleptic and physico-chemical parameters of the samples allowed us to determine the technological parameters of the kefir drink.

High organoleptic characteristics were noted in the sample with a fat mass fraction of 3.2% both on the 1st day and at the end of the expiration date. The structure is homogeneous, not stratified, the color is light creamy and the taste is pure sour-milk with a pronounced nutty aroma. Low values were observed in samples with a mass fraction of fat of 1.0% and 6.0%. Stratification of consistency and increase in viscosity of the product were noted.

The effect of the kefir product fat content and the dose of roasted whole wheat flour of green buckwheat on the syneresis degree was studied. Fermented milk with the selected starter culture without the addition of a plant component was used as a control experiment (Figure 1).

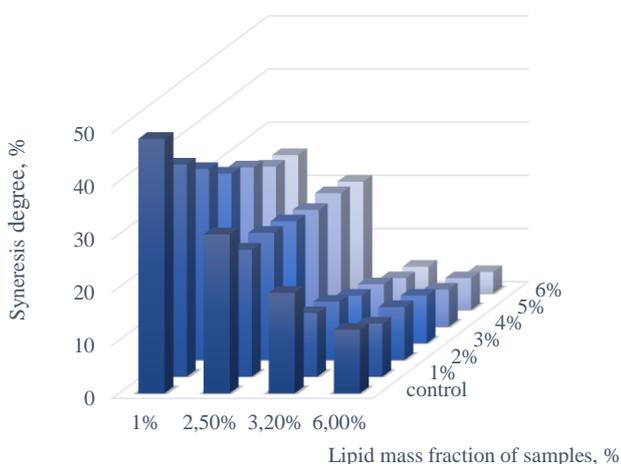


Fig. 1. Dependence of the whey syneresis degree on the introduction ratio of roasted whole wheat green buckwheat flour in studied samples of kefir product

Studies have shown that the syneresis degree is directly dependent on the dose of introduced filler and the increasing fat content of milk base the values of the indicator decrease.

From a technological point of view, the samples with a fat content of 3.2% and 6% were the most stable. They were separated slowly and in small quantities. Obviously, these values must be taken into account in conjunction with the organoleptic evaluation of the samples and titratable acidity.

An important indicator determining the shelf life of a kefir product is titratable acidity. Storage conditions and duration were of standard selection, taking into account the implementation of the final product at a temperature of $4 \pm 2^\circ\text{C}$. Studies were conducted for 14 days (Figure 2).

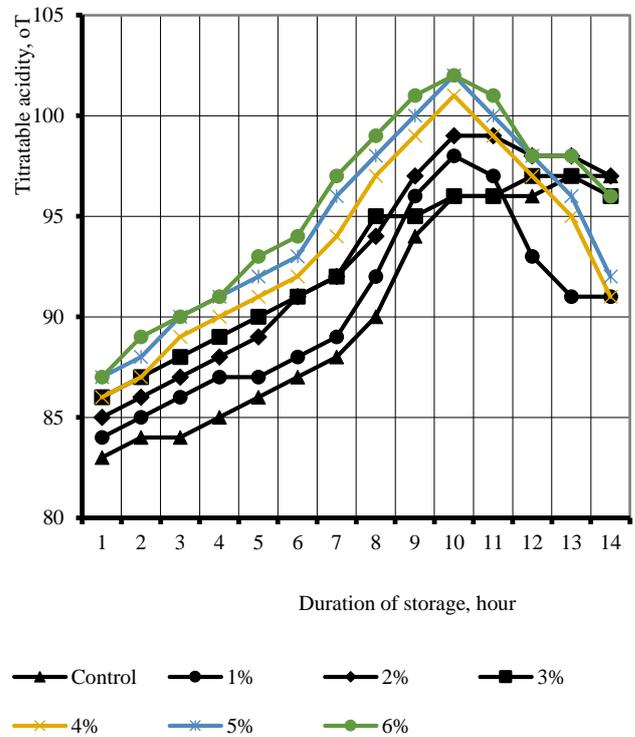


Fig. 2. Changes in titratable acidity during storage of kefir product using milk 3.2% with different doses of roasted whole wheat green buckwheat flour

Value change dynamics was not stable in samples with a mass fraction of fat of 1.0%, 2.5% and 6.0% with a dose of roasted buckwheat flour from 3% to 6%. Obviously, the increased value of more than 3% of roasted whole wheat green buckwheat flour has a positive effect on the development of microorganisms in the kefir product by activating the production of lactic acid.

The most positive results were noted in the sample with a fat content of milk basis of 3.2%. The values of acidity increased more slowly from 85°T to 96°T with the addition of roasted whole wheat green buckwheat flour from 1% to 3%. The closest to the control sample was a sample of kefir product with the addition of not more than 4% of flour.

In the course of the studies, the dynamics of an increase in titratable acidity of the test samples of roasted whole wheat green buckwheat flour in an amount of 4–6% was confirmed. The maximum value was 102°T, and then during storage, it occurs, it decreased to 92°T. This is due to the fact that the lactose that contained in the studied samples, as well as the sugars obtained as a result of thermal degradation of starch, undergoes enzymatic hydrolysis under the influence of microorganisms with the formation of lactic and some other

acids. Accumulating during storage, lactic acid affects the quality of the kefir product.

With prolonged storage, a decrease in acidity is observed due to the development of processes associated with the enzymatic decomposition of milk proteins and roasted whole wheat green buckwheat flour with the formation of polypeptides containing alkaline groups. The product acquires defects of taste, smell and texture and becomes unsuitable for consumption.

Analysis of the acidity values showed that the most suitable is a kefir product with a fat mass fraction of 3.2% and the addition of buckwheat flour not more than 4%.

When creating combined dairy products, microbiological contamination should be taken into account, recording with the fact of plant materials introduction. Based on the fact that the microbiological parameters of raw materials meet the requirements of TP TS 033/2013 (revised on July 15th, 2018) and TP TS 021/2011 and GOST R 55290-2012, the objective at this stage was to study the safety of the kefir product with and without introduction of a plant component. Samples were analyzed by microbiological indicators: number of mesophilic aerobic and facultative anaerobic microorganisms; coliform bacteria. According to the control experiment results presented in table I, we can conclude that adding of roasted buckwheat flour in an amount of up to 4% will not worsen the bacterial contamination of the final product since there is no pathogenic microflora.

The number of lactic acid microorganisms throughout the expiration date meets the requirements: more than 1×10^9 . This amount is sufficient for consumption in the daily diet and to improve the microbiota. It is noted that physiological changes are observed when taking at least $10^8 - 10^9$ CFU per day, which corresponds to 100 g of kefir or yogurt [11].

TABLE I. MICROBIOLOGICAL INDICATORS OF A MIXED FERMENTED KEFIR PRODUCT WITH ADDITION OF ROASTED WHOLE WHEAT GREEN BUCKWHEAT FLOUR

Control frequency, day	Controlled indicators			
	CFU in 1 cm ³	Coliform bacteria in 0,1 cm ³	Fungi in 1 cm ³	Listeria monocytogenes in 25 cm ³
1-7	more than 1×10^9	not detected	less than 1	not detected
8-14	more than 1×10^9	not detected	less than 1	not detected

When consuming such products, it should be borne in mind that introduced probiotic microorganisms that are not protected by special membranes undergo complete or partial destruction in the stomach. However, microorganisms and their destroyed fragments stimulate the reproduction of normal microflora, which is controlled by the immune system [11].

The experimental results of the nutritional and energy value of kefir product are shown in Table II. It should be noted that the obtained kefir product has a low energy value and does not contain gluten, which makes it possible to use it in the nutrition of wide layers of the population, including specialized nutrition.

TABLE II. NUTRITIONAL AND ENERGY VALUE OF MIXED FERMENTED KEFIR PRODUCT WITH THE ADDITION OF ROASTED WHOLE WHEAT GREEN BUCKWHEAT FLOUR

Sample	Indicator per 100 g of sample			
	Proteins, g	Lipids, g	Carbohydrates, g	Energy value, kcal
Kefir product with roasted buckwheat flour	3.19	3.20	7.04	69.08

III. CONCLUSION

The task has been solved – a technology for a fermented milk product that is made by using kefir technology and enriched in gluten-free roasted whole wheat green buckwheat flour has been developed. The plant component allowed not only to improve the organoleptic characteristics of the kefir product, but also to provide a stable consistency and microbiological safety.

According to the organoleptic and physico-chemical parameters, the flour dose in an amount not exceeding 4% was established. Vitamins and minerals contained in the flour contribute to development of lactic acid microorganisms' and one or more types of yeast cultures that are part of the microflora of kefir fungi.

The nutritional and energy value of the new kefir product and its microbiological indicators are determined. The obtained values of the colony forming units quantity of lactic acid bacteria make it possible to recommend a kefir product in clinical practice to restore microbiota and treat a number of other diseases.

Kefir product has a low energy value. It can be recommended in the preparation of diets of all age groups and as a part of specialized nutrition.

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