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ТЕХНОЛОГИЯ ПРОИЗВОДСТВА ФУНКЦИОНАЛЬНОГО КИСЛОМОЛОЧНОГО ПРОДУКТА ОБОГАЩЕННОГО РАСТИТЕЛЬНЫМ КОМПОНЕНТОМ

THE TECHNOLOGY OF PRODUCTION OF A FUNCTIONAL FERMENTED MILK PRODUCT ENRICHED WITH A VEGETABLE COMPONENT

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Аннотация *авторами были проведены исследования и рассмотрена возможность использования гидроколлоида из псиллиума в качестве стабилизирующей добавки для улучшения структурно-механических свойств кисломолочных продуктов, в частности йогуртов. Псиллиум (ground psyllium husk) представляет собой порошок из шелухи семян индийского подорожника, содержащего до 85% растворимой клетчатки. микроэлементы (Ca, Zn, Mg, Cr, Co и др.) витамины группы B1, B2, B3, полиненасыщенными жирные кислоты. Применение псиллиума в рационе эффективно для нормализации пищеварения и профилактики сахарного диабета. В ходе выполнения исследований получены образцы йогурта с различной концентрацией растительной добавки. Выполнены исследования основных показателей качества готовых образцов: получены результаты синерезиса, плотности, вязкости и водосвязывающей способности. Определено, что использование псиллиума позволяет уменьшить продолжительность процесса сквашивания, способствует улучшению внешнего вида, текстуры и консистенции продукта. Установлена оптимальная доза вносимой растительной добавки в йогурте. Применение добавки в количестве 1,5% и 2,0 % способствуют улучшению внешнего вида, текстуры и консистенции. Положительные результаты данного исследования зависят от химического состава растительного гидроколлоида, содержащего порядка 85% пищевых волокон, из которых 15-20% являются легкоусвояемыми, выполняющие роль дополнительного субстрата для микроорганизмов закваски. Результаты физико-химических показателей исследуемых образцов свидетельствуют о положительном влиянии использования гидроколлоида из псиллиума в рецептурах кисломолочных продуктов. Определена оптимальная концентрация вносимой добавки в продукт (1,5%), так как введение добавки в меньших количествах нецелесообразно, а дальнейшее увеличение вносимой дозы негативно влияет на органолептические и физико-химические показатели продукта.*

Ключевые слова: йогурт, закваска, гидроколлоид, псиллиум, молоко, титруемая кислотность, процесс сквашивания, структурно-механические свойства

Abstract

In this article, the authors consider the possibility of using hydrocolloids from psyllium as a stabilizing additive to improve the structural and mechanical properties of fermented dairy products, in particular yoghurts. Psyllium (ground psyllium husk) is a powder from the husk of Indian plantain seeds containing up to 85% soluble fiber. trace elements (Ca, Zn, Mg, Cr, Co, etc.) vitamins of group B1, B2, B3, polyunsaturated fatty acids. The use of psyllium in the diet is effective for the normalization of digestion and prevention of diabetes mellitus. During the research, samples of yogurt with different concentrations of vegetable additives were obtained. Studies of the main indicators of the quality of finished samples were carried out: the results of syneresis, density, viscosity and water-binding ability were obtained. It is determined that the use of psyllium reduces the duration of the fermentation process, improves the appearance, texture and consistency of the product. The optimal dose of the applied vegetable additive in yogurt has been established. The use of additives in the amount of 1.5% and 2.0% contribute to improving the appearance, texture and consistency. The positive results of this study depend on the chemical composition of vegetable hydrocolloids containing about 85% of dietary fibers, of which 15-20% are easily digestible, acting as an additional substrate for microorganisms of the starter culture. The results of the physico-chemical parameters of the studied samples indicate a positive effect of the use of psyllium hydrocolloid in the formulations of fermented milk products. The optimal concentration of the added additive in the product (1.5%) has been determined, since the introduction of the additive in smaller quantities is impractical, and a further increase in the applied dose negatively affects the organoleptic and physico-chemical parameters of the product.

Key words: yogurt, sourdough, hydrocolloid, psyllium, milk, titrated acidity, fermentation process, structural and mechanical properties

Introduction. Dairy products are necessary for every person, regardless of his age and social status. In all countries of the world, serious attention is paid to the development of dairy enterprises through state support. Strict requirements are imposed on the quality of raw materials in the production of dairy products in Western Europe, Asia, and the Middle East. In the Russian Federation, in order to meet the needs of various market segments, more attention should be paid to the quality of raw materials and focus on expanding the product line, since interest in a healthy lifestyle and proper nutrition is growing in almost all countries of the world. [5, 6].

One of the topical areas of food biotechnology is the improvement of traditional and the creation of new food technologies with functional ingredients that have a positive impact on the quality and properties of products intended for a healthy diet. In addition to taste and nutritional value, the appearance and texture of products also play an important role for the consumer [1,8]. The most common ways to improve the structural and mechanical properties of fermented milk products produced by the reservoir method include the use of starter cultures with thickening properties, the use of special processing modes, the introduction of hydrocolloids of plant and animal origin as stabilizing food additives [4, 3].

Hydrocolloids of plant origin are a heterogeneous group of long chain polymers capable of forming viscous disperse systems. The ability to "bind" water molecules occurs due to the presence of a large number of hydroxo groups (-OH) and carboxyl radicals (-COOH), which determines their hydrophilicity [7]. In this regard, the optimal choice of food hydrocolloids makes it possible to achieve the required consistency of fermented milk products, ensure quality stability, eliminate whey separation, enrich the product with the necessary macro- and microelements, provided that the dose of the added additive is determined correctly. So, an excessive amount of a stabilizer contributes to the appearance of so-called “textural defects” - a jelly-like, mealy, excessively dense, uncharacteristic for yogurt consistency; and an insufficient amount of the additive does not prevent the separation of whey [3, 10].

The ability to form a hydrocolloid system is noted in such plant materials as psyllium. Psyllium (ground psyllium husk) is a powder from the husks of Indian psyllium seeds, containing up to

85% soluble fiber. In addition to fiber, the chemical composition of psyllium is represented by many trace elements (Ca , Zn , Mg , Cr , Co , etc.), vitamins of group B_1 , B_2 , B_3 , polyunsaturated fatty acids. The use of psyllium in the diet is effective for normalizing digestion and preventing diabetes [2,7,8,9].

In connection with the foregoing, the purpose of this work is to study the possibility of using psyllium hydrocolloid as a stabilizing additive to improve the structural and mechanical properties of fermented milk products.

Materials and research methods. Samples of yoghurts made with the use of psyllium in the form of a hydrocolloid were selected as objects of study; control sample - yogurt without the use of additives. When preparing the samples, we used normalized milk (mass fraction of fat 2.5%, protein 3.2%), dry sourdough "Skvaska" (manufacturer Kaprina, Russia), consisting of Streptococcus thermophiles and lactobacillus bulgaricus in the amount specified in the instructions. Before introducing psyllium into the fermented milk product, a preliminary preparation was made. The preparation stage consists in the swelling of psyllium in normalized milk in a ratio of 1:5 at a temperature of 80-90 ° C, the duration is 15-20 minutes. The resulting dispersed phase was added to the product in doses: 1.0; 1.5; 2.0; 2.5% 3 minutes after adding the starter. The finished mixture was kept at 37°C for 7-10 hours until the formation of a clot with an acidity of 75°T. Determination of titratable acidity was performed every 30 minutes, and after fermentation on the 1st and 7th days of storage of finished products.

When performing the experiment and achieving the set goal, we were guided by generally accepted research methods: GOST 31981-2013 “Yogurt. General technical conditions”; GOST 3624-92 “Milk and dairy products. Titrimetric methods for determining acidity.

Research results and their discussion. The main technological operation in the production of yogurt is the process of fermentation of milk. Therefore, at the first stage, it was evaluated (Figure 1).

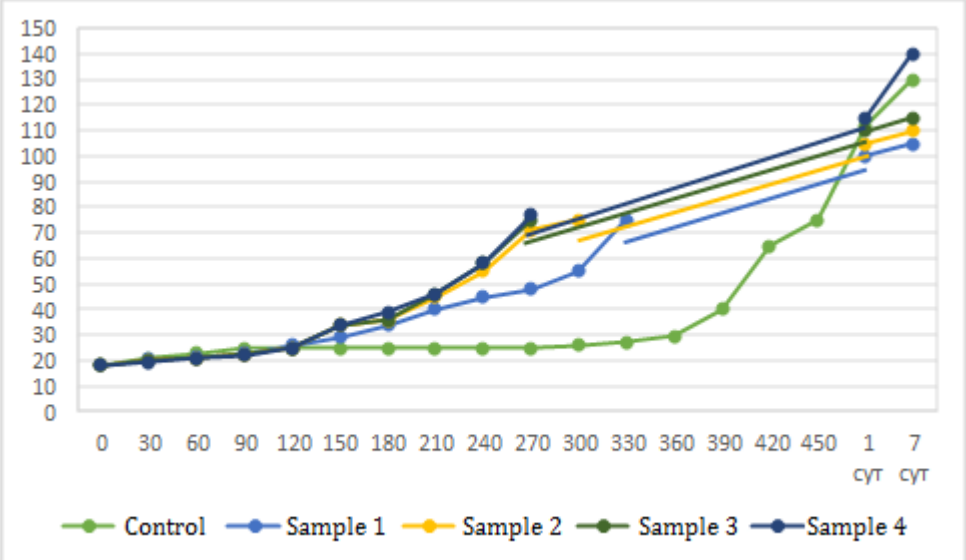

Рисунок 1. Результаты оценки динамики процесса сквашивания/ Fig. 1. The results of the assessment of the dynamics of the ripening process

The shortest ripening time is noted for samples No. 3, 4 (4 hours 30 minutes), the content of the dispersed phase in which is 2.0 and 2.5%, the longest fermentation process took place in the control sample without the addition of psyllium hydrocolloid (7 hours 30 minutes) . With an increase in the introduced dose of non-dairy filler, the fermentation time for the samples decreased; therefore, when psyllium hydrocolloid is introduced into the yoghurt formulation, it is necessary to

reduce the fermentation time. We assume that the results of this study depend, first of all, on the chemical composition of the plant hydrocolloid, which contains about 85% dietary fiber, of which 15-20% are easily digestible, acting as an additional substrate for starter microorganisms.

In addition to the ripening time, the effect of the additive on the results of titratable acidity during long-term storage of products was studied (Figure 1). The samples were stored in a refrigerator at 4°C for 7 days. So, in the control and in sample No. 4, the highest values of titratable acidity are noted and amounted to: on day 1 - 112 and 115°T, on day 7 - 130 and 140°T, respectively. Probably, this factor is due to the fact that the optimal content of psyllium hydrocolloid acts as a stabilizing additive and prevents the separation of whey and, accordingly, increases the shelf life of the product.

Along with the assessment of the dynamics of the ripening process, studies were also carried out on the main indicators of the quality of finished samples (Figure 2).

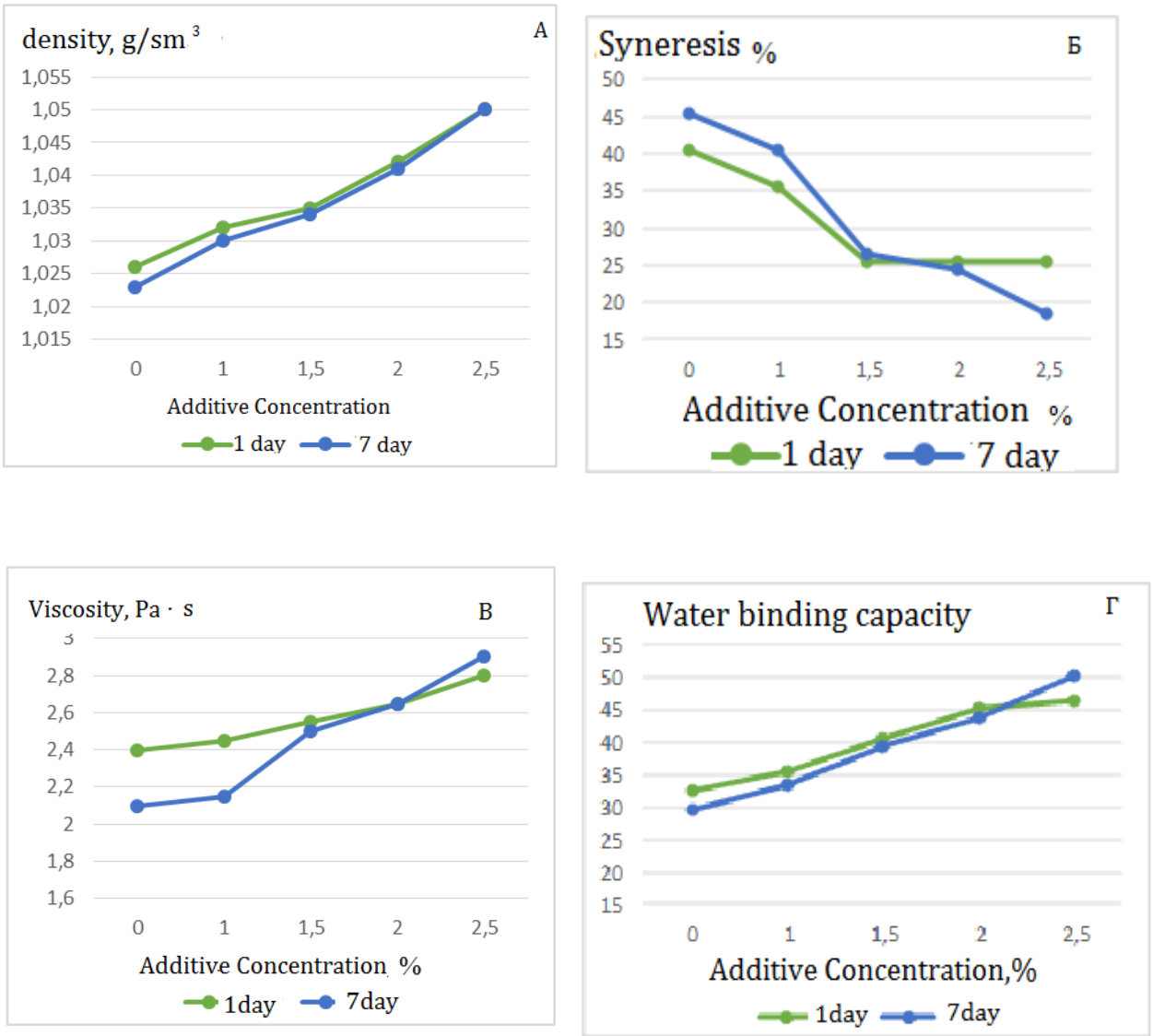

Рисунок 2. Изменение физико-химических показателей исследуемых образцов в зависимости от длительности хранения

А-плотность; Б – синерезис; В – вязкость; Г – водосвязывающая способность/ **Fig. 2. Change in the physico-chemical parameters of the studied samples depending on the duration of storage**

A-density; B - syneresis; C - viscosity; D - water-binding capacity

The results of the physicochemical parameters of the studied samples (Figure 2) indicate a positive effect of the use of psyllium hydrocolloid in the formulations of fermented milk products.

In a sample with an additive concentration of 1.5%, a high density and viscosity are characteristic, which affects the formation of a pleasant texture of the product. In this case, the degree of syneresis decreases. In the control sample and with the addition of a plant additive in an amount of 1.0%, the syneresis values are quite high, and, on the contrary, the water-binding capacity of the samples decreases during storage. This indicates that the amount of the added additive is not enough to form a homogeneous, dense clot, and whey separation is observed during storage. The use of hydrocolloid plant compounds in the technology of preparing yogurt in the amount of 2.0 and 2.5% leads to a significant increase in viscosity and density, while during the storage of samples, these indicators continue to increase. This is probably due to the fact that a high content of hydrophilic compounds continue to "bind" liquid molecules, which leads to the appearance of so-called "textural defects" - a jelly-like, excessively dense consistency uncharacteristic of yoghurts.

The next stage of the work was the study of the organoleptic characteristics of the obtained samples according to GOST 31981-2013, the data are presented in table 1.

Table 1 - Organoleptic characteristics of samples

Index	Control sample	Sample #1 (conc. 1.0%)	Sample #2 (conc. 1.5%)	Sample #3 (conc. 2.0%)	Sample #4 (conc. 2.5%)
Appearance	Homogeneous, with a dense clot, a small amount of whey separated	Homogeneous, with a dense clot, a small amount of whey separated	Homogeneous ny, with a dense curd, no serum, creamy texture	Homogeneous, with a dense curd, no whey, creamy texture	Homogeneous, with a dense curd, no whey, jelly-like texture
Taste, smell	Pure sour milk	Pure sour milk	Pure sour milk	There is a grassy taste and smell	Pronounced grassy taste and smell
Color	Milky white, homogeneous	milky white, slight presence of psyllium husk	milky white, slight presence of psyllium husk	milky white, clear presence of psyllium husk	Milky white, high content of psyllium husk
Final tasting score	4.56	4,60	**4,87**	4, 55	3,84

According to the data from table 1, the introduction of psyllium in the form of a hydrocolloid into the samples affects the organoleptic characteristics of yogurt. The use of the additive in the amount of 1.5% and 2.0% contributes to the improvement of the appearance, texture and consistency, the release of whey was not observed. This is due, as mentioned earlier, to the ability of psyllium to gel. However, at 2.0% and 2.5% plant hydrocolloid concentrations, the samples exhibited a grassy taste and smell, which is not attractive to consumers. Thus, sample No. 2 received the highest rating at the tasting.

Conclusions. Thus, as a result of the research, a fermented milk product was obtained, enriched with a vegetable component, which acts as a stabilizing additive. The optimal concentration of the additive introduced into the product (1.5%) was determined, since the introduction of the additive in smaller quantities is impractical, and a further increase in the applied dose negatively affects the organoleptic and physico-chemical parameters of the product. The positive results obtained during the experiment indicate the possibility of introducing this technology in production.

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