Bioflavonoids in the production process of yoghurt products

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Abstract. When developing food products, the manufacturer strives to satisfy consumer demands and comply with modern nutrition trends whenever possible. Today, the main focus is on the release of products that contain various functional ingredients. To implement this task, a yoghurt product was developed containing plant-based bioflavonoids "green tea" and "echinacea", in the test samples the concentration was from 0.5-2.5%, which not only enrich it with functional ingredients, but also have antioxidant properties. During the study, the dynamics of changes in physicochemical indicators according to GOST 32892-2014 was studied, which showed that with an increase in the shelf life of the samples, active acidity gradually decreases from 4.07 ± 0.02 to 4.10 ± 0.02, when measuring titratable acidity, an inverse relationship was obtained at the end of the shelf life of 93 ± 2 T0, structural and mechanical properties were measured on a HAAKE rotational viscometer; organoleptic indicators were determined by constructing a product profilogram; the content of carbonyl compounds in the product with bioflavonoids was determined using the reaction of thiobarbituric acid with carbonyl compounds - products of oxidative decomposition of glycerides with the formation of colored compounds, the color of which is recorded on the FEC for samples with "green tea" at a concentration of 2.5% (299.1 ± 1.58) for samples with "echinacea" (369.4 ± 1.38). Bioflavonoids of plant origin, introduced into the yogurt product, contribute to an increase in the shelf life of the product to 54 days, which was carried out in accordance with MU 4.2.727-99 while maintaining all quality and safety indicators. For the production of the yogurt product, a process map was constructed in order to minimize the risks of releasing low-quality products.

1 Introduction

When developing food products, the manufacturer strives to satisfy consumer needs as much as possible and comply with modern trends in the nutrition of the population [1,2,3]. Today, the main emphasis is on the production of products that contain various functional ingredients [4,5,6]. To achieve this goal, a yogurt product has been developed containing bioflavonoids of plant origin, which not only enrich it with useful ingredients, but also have antioxidant properties and help increase the shelf life of the product while maintaining the

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organoleptic and physicochemical properties of the dairy product [7,8]. The introduction and maintenance of a QMS in food production allows the enterprise to constantly manage, continuously improve its activities, and promptly respond to emergency situations in production in order to minimize the risks of producing low-quality products [9,10].

2 Materials ad methods

The work is devoted to studying the possibility of using bioflavonoids of plant origin in the production of dairy products, in particular, yoghurt products. We have studied the physico-chemical, structural-mechanical and organoleptic characteristics of the yogurt product. The shelf life of the dairy product MU 4.2.727-99 was determined, a process flow diagram was constructed indicating the sequence of production stages with temperature conditions (Work Flow Modeling), and a map of the dairy product production process was developed (Data Flow Modeling).

3 Results and discussion

Modern approaches to solving this problem consist in the use of inhibitors of natural origin - bioflavonoids, which have not only antioxidant properties, but also biological activity, adaptogenic properties and act as an additional nutritional factor. They are non-toxic, easily available, have P-vitamin activity, anti-inflammatory, anti-allergic, anti-viral and anti-carcinogenic properties, and provide reliable protection against oxidation and free radical damage.

The quality of dairy products depends on many factors, so ensuring quality control is necessary at all stages of the technological process: incoming quality control of raw materials; compliance with the modes of technological process current quality control of finished products.

Today, the market of dairy products is widely represented by various types of yogurt and plain sourdough. To attract consumers, manufacturers strive to develop a product that will contain natural fillers and be stored not only at a temperature of 4 ± 2^0C, but also at 25^0C. To achieve this task, it is necessary to consider biologically active substances. of plant origin from the point of view of their antiradical and antioxidant effects, since these substances will help prevent the increase in oxidative processes in milk fat subject to the second heat treatment (thermalization) and are able to introduce (enrich) the product with additional functional properties. ingredients. As bioflavonoids of plant origin, we chose “green tea”, which helps normalize metabolism, contains vitamin P, which has the ability to strengthen blood vessels, reduce cholesterol levels and helps accumulate vitamin C in the body, and “echinacea”, which helps increase the body’s resistance to colds and has a positive effect on the human immune system. The concentration of bioflavonoids green tea and echinacea in the test samples ranged from 0.5-2.5%. Studies on changes in physicochemical parameters were carried out in accordance with MU 4.2.727-99 “Hygienic assessment of shelf life of food products”. The planned shelf life of the product is 45 days. According to the regulatory document, the established final control point is 54 days. During storage, it was noted that active acidity gradually decreased and ranged from 4.07±0.02 to 4.10±0.02 (Figure 1,2)

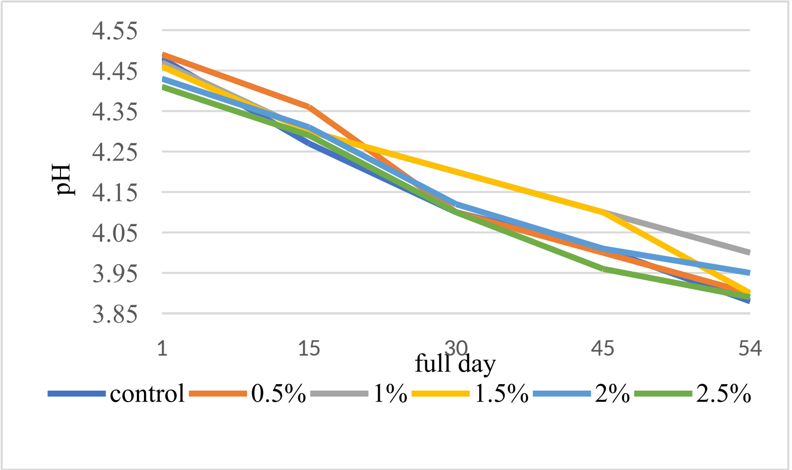

Fig.1. Dynamics of changes in the active acidity of a yogurt product with bioflavonoids green tea

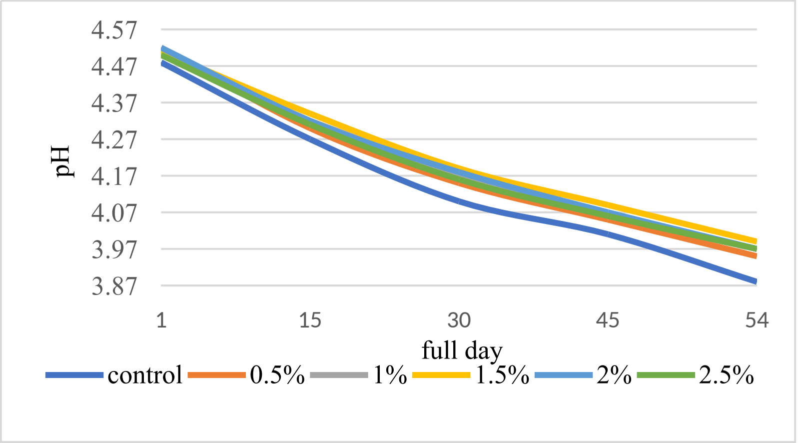

Fig.2. Dynamics of changes in the active acidity of a yogurt product with bioflavonoids echinacea

When measuring titratable acidity, we obtained an inverse relationship: with increasing shelf life of the product, it gradually increased and reached a maximum for a sample of a yoghurt product with "green tea" - 93 ± 2 at a concentration of 2.5%.

To determine the effect of bioflavonoids green tea and echinacea storage of the finished product according to the requirements of MU 4.2.727-99. The work determines the shelf life of the finished product at 45 days and the content of carbonyl compounds according to the regulatory requirements at 30 and 54 days (table 1).

Table 1. Shelf life of yogurt product with green tea and echinacea additives and evaluation of the content of carbonyl compounds

№	Concentration of phyto-additive, %	Storage duration, days	
		30	**54**
1	Control	240.3±0.7	496.5±1.4
Echinacea			
2	0.5	150.2±0.6	374.6±1.02
3	1	133.8±0.7	357.3±1.10

4	1.5	108.5±1.2	331.8±1.5
5	2	92.6±0.98	312.2±1.1
6	2.5	81.4±1.5	299.1±1.58
Green tea			
12	0.5	201.7±1.2	445.7±1.67
13	1	183.9±1.46	423.1±1.06
14	1.5	166.2±0.6	405.3±1.67
15	2	139.9±1.67	384.6±0.98
16	2.5	128.6±1.45	369.4±1.38

It was observed that there was an increase in the content of carbonyl compounds in the product depending on the duration of storage. However, when compared with the control sample, there is a tendency to decrease the content of carbonyl compounds was observed. The best results are obtained with echinacea. It is necessary to conduct research on the influence of bioflavonoids green tea and echinacea on structural and mechanical properties, since when designing a new product, it is necessary to consider the opinions of consumers who are accustomed to a certain consistency, therefore it is necessary to find out the degree of influence of these flavonoids on its composition varies [11,12]. The results of the study showed that the character of flow curves of all studied samples of yogurt product with bioflavonoids is the same and can be described by the pseudo flow equation. The best results were obtained with green tea at a concentration of 0.5-1% (Figure 3).

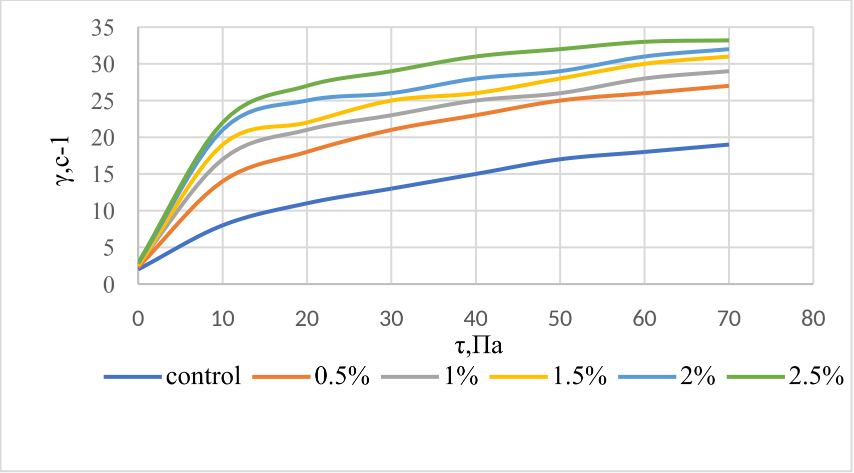

Fig. 3. Dynamics of changes in shear stress versus shear rate of a yoghurt product with green tea

When developing food products, one of the important stages is the determination of organoleptic indicators, since they will primarily influence consumer preferences when choosing a dairy product. The study used descriptor analysis, which made it possible to most fully describe the fullness of taste sensations of tasters. The assessment was carried out on a 5-point scale. After processing the results obtained, a profile of the newly developed product was built (Figure 4)

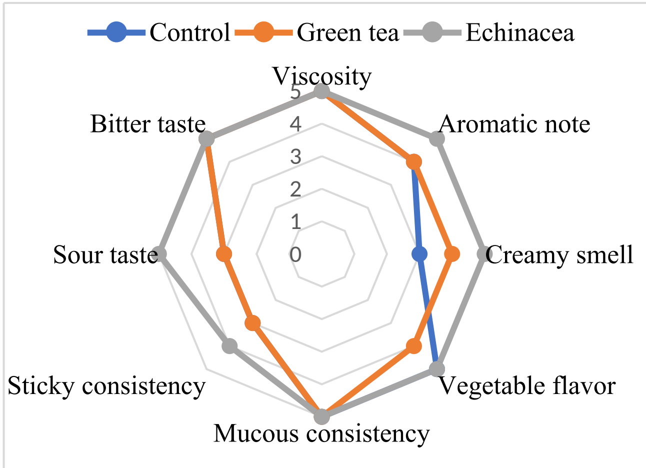

Fig. 4. Organoleptic profile of yoghurt product with bioflavonoids

When analyzing the profilogram, we found that the most preferable addition to the yoghurt product is the bioflavonoid "echinacea"; in terms of consistency and taste, it is close to a 5-point scale, and follows the contour of the profilogram, i.e. meets the requirements. The yogurt product with the bioflavonoid "green tea" is slightly inferior in taste to the first sample, as it has a slight sourness, but this deviation is not critical for the production of this dairy product [13]. Today, the efficiency of a food enterprise directly depends on how it has implemented various methods for implementing a processor approach in order to reduce production costs associated with product output, and what measures need to be taken to improve product quality. We presented the product production process as a "business process". Using various methodologies, such as Work Flow Modeling and Data Flow Modeling, we describe all work processes that we can represent in the form of a flowchart [14, 15].

We develop the technological process for the production of a yoghurt product with bioflavonoids in the form of a sequence of operations and thereby apply the most common method in the field of quality management - a sequence diagram. To obtain a product of a given quality, the ripening process must be controlled. This is set out in a separate, if the active acidity has reached the maximum value, then the product is sent to the next operation; second, if as a result of the control measurement the pH value is not reached, according to the technical documentation, the process continues (Figure 5).

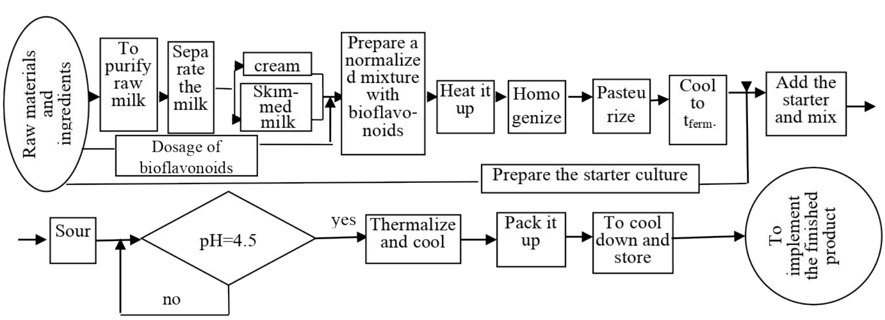

Fig. 5. Sequence diagram for the production of yoghurt product

The application of this methodology is fair if we have a strict sequence of actions that will be decisive for achieving the desired result. In the production of dairy products, in most technological operations the time must be specified; for example, when fermenting a yoghurt product, it is very important to control the operating time of the introduced starter, because when added, its microflora will multiply, acidity will increase and a clot will form, which as a result will have a certain acidity and the technological process will be completed. We have developed a process map that takes into account the time factor. In a graphical representation, we plot two coordinates on a plane, one of which denotes time. On the other axis we place the equipment with which the process of producing the yoghurt product is carried out (Figure 6).

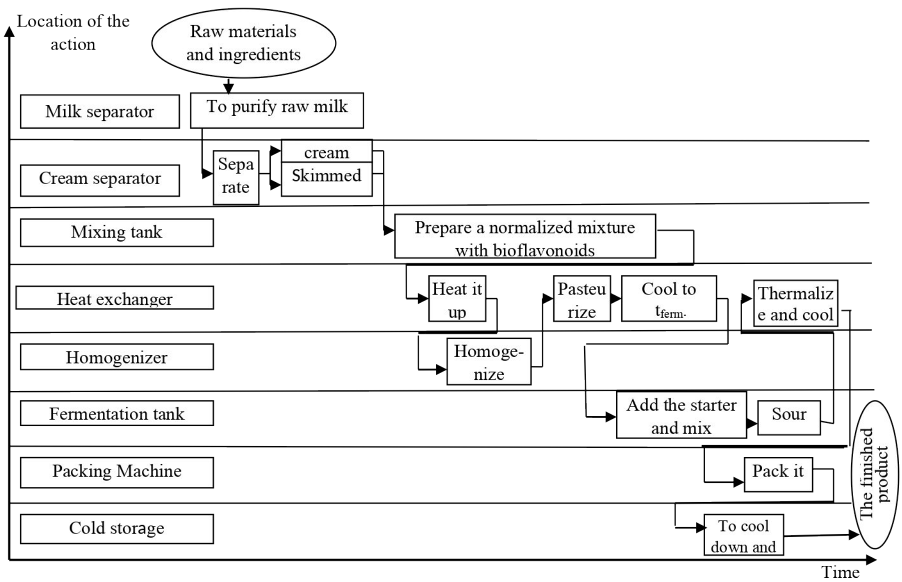

Fig. 6. Process map for the production of yoghurt product

Using a process map for the production of a yoghurt product makes it possible to avoid any delays in production, eliminate the overlap of one operation with another, and also makes it possible to plan the loading of equipment and predict its possible downtime.

4 Conclusion

The use of bioflavonoids of plant origin in the production of yoghurt products will enrich them with natural functional ingredients, will help slow down the oxidation of milk fat and thereby increase the shelf life of the product to 45 days while maintaining organoleptic and physicochemical parameters. To produce high-quality and competitive dairy products at a food enterprise, it is necessary that a quality management system be fully operational, based on a process approach, which makes it possible to highlight the processes of product production and will be a tool with the help of which the enterprise's activities will be continuously improved through control, analysis, if necessary, adjust key production and management processes in accordance with the requirements of GOST R ISO 9001.

Reference

1. Z.S. Zobkova, E.G. Lazareva, I.R. Shelaginova, On the issue of developing scientifically based technologies for fermented milk products with increased relative biological value. Dairy industry.**6**, 40-42 (2021). https://doi.org/10.31515/1019-8946-2021-06-40-42
2. A.I. Khavkin, T.A. Kovtun, D.V. Makarkin, O.B. Fedotova, Fermented milk products and child health. Russian Bulletin of Perinatology and Pediatrics. **65**, 155-165 (2020). https://doi.org/10.21508/1027-4065-2020-65-6-155-165
3. M.M. Korosteleva, E.Y. Agarkova, Principles of food fortification with functional ingredients. Dairy industry.**11**, 6-8 (2020). https://doi.org/10.31515/1019-8946-2020-11-6-8
4. G.A. Donskaya, Antioxidant properties of milk and dairy products: a review. Food industry. **12**, 86-91 (2020). https://doi.org/10.24411/0235-2486-2020-10150
5. Yu. K. Goncharova, S. V. Goncharov, E. M. Kharitonov et al., Plant-based antioxidants and their non-traditional sources. Agricultural Biology. **59**, 39-53(2024). https://doi.org/10.15389/agrobiology.2024.1.39rus
6. A.V. Tarasov, N. V. Zavorokhina, O. V. Chugunova, Investigation of potentially interfering substances in the potentiometric determination of antioxidant activity in food systems. Machinery and technology of food production.**53**, 504-512. (2023). https://doi.org/10.21603/2074-9414-2023-3-2452
7. E. S. Semenova, S. V. Simonenko, E. S. Simonenko et al., Flavonoids: antioxidant properties and preventive potential. Food industry. **6**, 64-67 (2024). https://doi.org/10.52653/PPI.2024.6.6.013
8. A. Parrella, et al., Antioxidant properties of different milk fermented with lactic acid bacteria and yeast. International Journal of Food Science & Technology, **47**, 2493-2502 (2012). https://doi.org/10.1111/j.1365-2621.2012.03127.x
9. A. Röh, et al., Food quality and safety-consumer perception and public health concern. Food Control, **16(8),** 649–65 (2005). https://doi.org/10.1016/j.foodcont.2004.06.001
10. A. C. Panghal, et al., Role of Food Safety Management Systems in safe food production. Journal of Food Safety, **38(4),** e12464 (2018). https://doi.org/10.1111/jfs.12464
11. J. Kruger, J.R. N. Taylor, M.G. Ferruzzi, H.Debelo, What is food fortification? Working definition and structure for evaluating the effectiveness and implementation of best practices. Food Science and Food Safety, **19**, 3618-3658 (2020). https://doi.org/10.1111/1541-4337.12624
12. J.Gao, et al., Probiotics in the dairy industry – Advances and opportunities. Food Science and Food Safety. **20**, 3937-3982 (2021). https://doi.org/10.1111/1541-4337.12755
13. B. Delikanli, T.Ozcan, Improving the Textural Properties of Yogurt Fortified with Milk Proteins. International Journal of Food Science & Technology **41(5),** e13101 (2017). https://doi.org/10.1111/jfpp.13101
14. G.G. Azgaldov, A.V. Kostin, Applied qualimetry: its origins, errors and misconceptions Benchmarking. An International Journal. **18 (3),** 428-444 (2011). https://doi.org/10.1108/14635771111137796
15. S. K. Amit, et al., A review on mechanisms and commercial aspects of food preservation and processing. Agriculture & Food Security**. 6(51),** 1-22 (2017). https://doi.org/ 10.1186/s40066-017-0130-8