The optimal way to add a mixture of vegetable powders to a yogurt recipe based on goat's milk

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Abstract. Combining vegetable and dairy raw materials will allow expanding the range of useful products, while regulating their composition in accordance with the basic provisions of the theory of balanced nutrition. The consumption of cultured milk products that contain beneficial substances for health is an efficient way to enhance the body's protective functions. The article proposes a technology for the production of yogurt based on goat's milk and a plant composition (aronia and hawthorn powder). Work was carried out to study the effect of additives on various stages of fermentation of the developed yogurt. Based on the study findings, a specific stage and method for incorporating a plant additive into the milk mixture were chosen. The ideal dosage of aronia and hawthorn powders in the milk mixture was determined to be 5%. It was observed that adding the additive before fermentation resulted in a decline in appearance and consistency, such as whey separation. However, introducing a combination of aronia and hawthorn powders during the fermentation stage proved beneficial in enhancing the sensory qualities of goat milk-based yogurt.

1 Introduction

A person's diet largely determines his health and the quality of life of the country as a whole. Currently, the population needs for food with improved consumer characteristics and functional food ingredients are increasing. It is known that dairy products have a healing effect on humans. Probiotic, prebiotic and synbiotic dairy products, which play a large role in the prevention of gastrointestinal diseases in humans, have the most pronounced beneficial effect [1,2].

The consumption of cultured milk products and beverages that contain beneficial substances is an efficient way to enhance the body's protective functions. Creating and manufacturing technologies for new functional products is a challenging process. In order to improve the specific functionalities of existing products or develop new ones, it is crucial to justify and approve the use of the ingredients employed [3].

The aim of this study is to find the best way to incorporate a blend of aronia and hawthorn powders into goat milk yogurt, and to assess the sensory and physicochemical characteristics of the resulting samples.

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The main raw material for the production of dairy products is cow's milk. In the world, it ranks first and is 83.5%, and goat's milk is in 3rd place and is 2.2% [4]. Goat milk satisfies the requirements for both quality and quantity of nutrients. It contains a rich concentration of macronutrients while being low in micronutrients. This nutritious option, as compared to cow milk, provides proteins, antioxidant compounds, and vitamins. It offers various health benefits for individuals overall [5].

The fat content in goat milk plays a crucial role in various key aspects such as physiology, technology, nutrition, and sensory perception. It plays a significant part in determining the flavor profile. Furthermore, fat improves the visual appeal, consistency, creaminess, taste, and smoothness of food, while also extending the feeling of fullness after eating [6,7].

Chokeberry (Aroniamelanocarpa) is known for being a highly nutritious fruit, rich in polyphenols and anthocyanins. It is considered an excellent raw material for creating functional foods. The growing popularity of chokeberry is not only due to its nutritional value, but also because of the continuous evidence supporting its positive impact on health [8,9].

The fruits of aronia contain antibacterial substances that prevent the spread of infection in the human body, protect it from the penetration of viruses. Pectin substances help to remove radioactive substances and heavy metal compounds from the body [10,11].

Hawthorn is valued for its various beneficial components. It is rich in vitamins, trace elements (such as iodine, cobalt, and selenium), beta-carotene, tannins, phytosterols, organic acids, and glycosides. Additionally, hawthorn contains essential oils and phytohormones. These berries are low in calories, making them a suitable addition to a weight loss menu while providing essential vitamins and trace elements. This helps combat vitamin deficiencies during the offseason. Hawthorn fruits are packed with biologically active compounds that have therapeutic and preventive effects. Overall, hawthorn promotes general health, boosts immunity, and helps alleviate hypovitaminosis.

Due to the fact that aronia and hawthorn give an acidic taste, it was decided to add a natural sugar substitute - stevia extract to the product under development.

The enzymatically glycosylated stevia extract contains several glucosides in the following ratios in%: stevioside - 9-11%; rebaudioside A - 9-14%; monoglucosylstevioside and rebaudioside A - 23-28%; diglucosylstevioside and rebaudioside A - 22-26%; triglucosylsteviosides and rebaudioside A - 10-14%; other glucosyl steviosides and rebaudioside A-11-14%; rebaudioside C, Dulcoside A and derivatives 7-11% [12, 13].

Also in the technology of yoghurt production used a dry bacterial starter of the company "vivo", containing thermophilic streptococci and Bulgarian stick.

It is known that microorganisms included in the composition of yoghurt starter, depending on physiological characteristics, form milk-protein clots with different types of consistency when milk is fermented: piercing or viscous with different degrees of gravity [14]. As you know, Streptococcus thermophilus is mainly responsible for the production of acid, while Lactobacillus bulgaricus gives yogurt a peculiar aroma [15].

2 Materials and methods

The objects of the study were samples of yogurt enriched with vegetable components (powders of aronia and hawthorn). For the preparation of samples, a traditional thermostat method for preparing yogurt was chosen, but differing in the stages of adding vegetable additives. Test and control samples were prepared from one batch of raw materials.

Goat milk was used for production, with an acidity of not more than 20 ° T, for the reductase sample - not lower than class 1 and for mechanical contamination - not lower than the first group. The fat content must be at least 6%.

Milk pasteurisation is carried out at 85-87 ° C with exposure for 5-10 minutes or at 90-92 ° C with exposure for 2-3 minutes.

Pasteurized milk was immediately cooled in the regenerative section of the pasteurization unit to the fermentation temperature with pure lactic acid cultures. The milk, cooled to the fermentation temperature, was promptly mixed with a starter. The starter was thoroughly blended until a liquid homogeneous consistency was achieved before being added to the milk. The mixture was then poured into the milk while continuously stirring. The last action in the stage of mixture preparation is the addition of a sugar substitute. Further, the obtained mixture was poured into containers and fermented at a temperature of 38 - 42 ° C for 8 - 10 hours.

When the required acidity was reached and a clot was formed, the yoghurt was immediately cooled - the fermented milk in a small container was transferred to cold storage, where it was cooled. After the cooling time, the obtained samples were evaluated according to organoleptic and physicochemical parameters.

3 Results and discussion

For the preparation of experimental samples, a classic yogurt formulation was chosen.

The use of a 5% mixture of aronia (2.5%) and hawthorn (2.5%) powders in the goat's milk yogurt formulation has proven to be most close to the control sample, especially in terms of organoleptic parameters. The developed formulation of the test sample of goat milk-based yogurt with the addition of vegetable components is presented in Table 1.

Table 1. Formulation of the test sample of yoghurt based on goat's milk with the addition of vegetable components.

Components	**Quantity, g**
Whole drinking pasteurized goat milk	90.0
Dry bacterial starter for yogurt «vivo»	0.05
Aroniadried (powder)	2.5
Hawthorndried (powder)	2.5
Stevioside	5.0
Total	100.0

There were prepared 2 samples according to this formulation. Additives were added to sample No. 1 before the start of the starter process, to sample No. 2 during the starter process, and then additional venting was carried out. A control sample according to the classical formulation was also prepared.

The samples were stored at 2-6 ° C and assayed 4 hours after manufacture. The temperature of the yoghurt samples for tasting was - 12-14 ° C.

For the tasting evaluation, a 5-point scale was used, where 1 point was the lowest acceptance level and 5 points was the highest [16]. Taster-filled maps were analyzed and the mean score for each test item was calculated (Table 2).

Table 2. Results of organoleptic quality assessment of prototypes of yogurt in comparison with control.

Indicators	Control sample	Sample № 1	Sample № 2
Taste	pronounced fermented milk taste and moderate sour taste (4.0)	pronounced fermented milk taste, not sweet enough, with the taste of aronia and hawthorn (4.0)	pure tender fermented milk taste with a pronounced taste of aronia and hawthorn, moderately sweet (4.75)
Smell	weakly pronounced fermented milk smell (3.75)	mild fermented milk smell, with aroma of aronia and hawthorn (4.0)	pronounced fermented milk smell, with aroma of aronia and hawthorn (4.75)
Consistency	thick enough (4.0)	the consistency is not thick enough for this type of yogurt, with a slight presence of food additive inclusions, with serum delamination (2.75)	consistency homogeneous, moderately thick, with the presence of food additive inclusions (5.0)
Color	uniform throughout the mass (4.75)	color characteristic of the additive, non-uniform throughout the mass (3.0)	uniform throughout the mass, characteristic of the additive being added (4.0)

The best result was yoghurt with additives during the ripening process, since it had a pleasant color, uniform throughout the mass, a thick consistency, a pleasant creamy taste and aroma.

A sample of yogurt with additives before the start of ripening received low ratings of appearance and consistency, as the serum began to peel off, but at the same time it had a pleasant taste and smell. However, due to unsatisfactory results at this stage, his further study was not carried out.

Thus, it was found that the most acceptable in terms of organoleptic parameters is the introduction of aronia and hawthorn vegetable powder during the fermentation process (sample No. 2). At the same time, yogurt had a pure delicate fermented milk taste with a pronounced taste of a plant additive, moderately sweet. The color of the sample is uniform throughout the mass. The consistency is homogeneous, thick, with the presence of additive inclusions.

The list of physical and chemical indicators of product quality is specific for each type of product. These indicators are included in the regulatory, technical and technological documentation, which are monitored in accordance with the established procedure. Compliance with physical and chemical quality indicators ensures stability of product composition and consumer properties. Further study of the developed yogurt was carried out according to physical and chemical parameters: mass fraction of fat, mass fraction of dry substances, acidity (Table 3).

Table 3. Physicochemical indices of the developed yogurt in comparison with the reference sample.

Indicators	Control sample	Sample № 2
Weight fraction of fat, %	4.2	3.8
Weight fraction of dry substances, %	8.6	9.0
Acid content, ° T	120.0	145.0

As can be seen from Table 3, the addition of vegetable components has little effect on the weight fraction of fat in the yoghurt sample developed, since aronia and hawthorn contain a small amount of fat in their composition.

In the developed sample, there is a slight increase in the content of dry substances, which can also be explained by the introduction of aronia and hawthorn powder as an enrichment agent.

The data obtained also indicates that the test sample of yogurt has an increase in acidity. This is likely due to the activity of lactic acid microorganisms present in the starter culture and the possibility of postoxidation, which is influenced by the species and quantity of these microorganisms. This is also due to the introduction of vegetable additives with increased acidity.

The increase in the acidity of the product may also be due to the continuation of the development of lactic acid Bulgarian stick, introduced into yogurt with starter. Only with complete and deep cooling does this process stop.

With the addition of aronia chokeberry and hawthorn, the acidity of yogurt increased. Since the enrichment agents listen to an additional nutrient medium for the development of lactic acid bacteria, and with their increase, the acidity of fermented milk products increases.

4 Conclusion

In the course of the studies, it was established that:

- It is advisable to introduce a mixture of aronia and hawthorn powders at the stage of fermentation, and then carry out additional fermentation.
- Introduction of a plant additive at the stage of fermentation has a positive effect on the taste, smell and appearance of yoghurt based on goat's milk.
- According to physical and chemical parameters, the developed yogurt according to the proposed technology is not inferior to the control sample.

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