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The antioxidant properties of fermented milk products enriched with resveratrol and syrups of hawthorn

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Abstract. The article presents data on the antioxidant properties of a fermented milk product with resveratrol and hawthorn syrup, obtained experimentally by amperometric method. The purpose of this study was to obtain yogurt enriched with encapsulated resveratrol and hawthorn syrup in various proportions. An increase in the antioxidant activity of a fermented milk product with resveratrol and hawthorn syrup, taken in an amount of 15%, has been proven. Based on organoleptic ratings, a 15% level was selected for further study. Optimized yoghurt was compared to controls for texture, consistency, taste, and smell. The results of the study show the possibility of enriching yogurt with encapsulated resveratrol and hawthorn syrup to enhance the functional properties of the finished product.

1. Introduction

One of the conditions for normal growth and development of the human body, maintaining health is a balanced diet. It is known that a person's health and longevity directly depend on how fully and balanced his diet is. However, not everyone can sustain the modern rhythm of life. Stress, insomnia, heavy workload - all this gets in the nervous system. Often we cannot independently balance their diet according to all the rules, then modern food technologies come to the rescue. Currently, it is very important that the product has not only good organoleptic properties and meets the requirements for the quality of food products, they must have a preventive effect. When recommending a product, it is necessary to take into account its antioxidant activity. This indicator indicates the presence of substances that neutralize the excess of free radicals and interrupt the chain of oxidative reactions that damage the cells of the body. A decrease in antioxidant activity leads to a decrease in immunity and the development of various diseases [1, 2].

It is known that fermented milk products have a beneficial effect on the formation of intestinal microflora, increase the secretion of gastric glands, normalize intestinal peristalsis, its microflora, reduce flatulence, inhibit the growth and development of putrefactive bacteria. In addition, they contribute to a better absorption of calcium, phosphorus, magnesium and iron. Daily intake of fermented milk products normalizes digestion. The use of modern biotechnological techniques in combination with traditional methods of food technology allows us to create dairy products with desired properties. This can be achieved by combining dairy and vegetable components [3, 4].



Among fermented milk products, yogurt is the most famous and most popular all over the world, produced by cultures consisting of *Streptococcus alivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*. In Kazakhstan, yogurt is gradually replacing other dairy products on the market due to its high biological value and health benefits. According to the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan, milk production increased from 4851.6 thousand tons (2012) to 5299.966 thousand tons (2016). To improve the healing properties and enhance antioxidant activity it is advisable fermented milk products to enrich them with berries [5].

One of the rich sources of antioxidants are berries. The development of a fermented milk product enriched with resveratrol and hawthorn syrup, due to the unique composition of the components, will solve this problem [6-8].

The introduction of hawthorn syrup into the composition of the product is due to the fact that it is an important botanical cardiotonic and is used for diseases of the heart and blood vessels, such as: congestive heart failure; angina pectoris; irregular heartbeats, weakness of the heart muscle; high and low blood pressure; loss of elasticity of the arteries (atherosclerosis); high cholesterol. The therapeutic effect is achieved by the content of flavonoids, plant polyphenols (vitexin, quercetin and hyperoside) [9].

Vitexin dilates blood vessels, enhances metabolic processes in the heart muscle. Quercetin is a means of preventing and treating disorders of cerebral circulation and cardiovascular diseases. Hyperoside increases glucose utilization, increases the use of oxygen, enriches the heart with potassium ions. As a result, the contractility of the myocardium, the middle layer of the heart muscle, as well as the amount of cardiac output increases.

Resveratrol is a powerful natural antioxidant that is 5 times more effective than beta-carotene, vitamin C - 20 times, vitamin E - 50 times, is found in the peel of certain fruits, such as grapes, cranberries, raspberries, blueberries. Resveratrol contributes to the regeneration and restoration of nerve cells, including in damaged areas of the brain, and thus helps restore mental abilities in neurological patients or elderly people [10, 11].

2. Materials and methods

The purpose of this study was to study the antioxidant activity of yogurts with a different ratio of hawthorn syrup. Were used goat milk obtained from goats of Zaanen breed, hawthorn syrup, 10 samples of yogurt. Used the yeast YO MIX 495LYO 100 DCU, which is a culture with a specific combination of strains, includes *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*. Ferment gives a rapid increase in acidity to a pH of 4.7-4.6, and then a slower increase in acidity to achieve a lower pH. This feature contributes to the excellent stabilization of the pH level at the end of the ripening process and during storage. The use of culture is possible in the range of 43-37 C. Hawthorn (species: *Crataegus almaatensis* Pojark, Almaty hawthorn) was collected in the Almaty region, Karasai district, Zailiysky Alatau ridge, the gorge of the Shamalgan river.

Determination of the total content of antioxidants in yogurt with a different ratio of hawthorn syrup and resveratrol syrup was carried out on a Tsvet Yausa-01-AA device, based on the amperometric measurement method.

The amperometric method for the determination of antioxidants is based on the measurement of the electric current in the cell that occurs when the analyte is oxidized on the surface of the working electrode when a certain potential is applied to it. The signal is recorded as differential output curves. With the help of special software, the areas or heights of peaks (differential curves) of the analyzed and standard substances are calculated. For analysis, the average value of a series of five consecutive measurements is used. Well-known antioxidants were used as standard substances: quercetin, gallic acid. The amperometric method has several advantages in determining the antioxidant activity: without taking sample preparation into account, the time for separate determination takes several minutes; analysis (registration and processing of results) takes place in real time; the accuracy and reproducibility of the analysis is ensured by accurate dosing with a six-way valve; standard deviation (SD) of the dispensing by the crane is less than 0.5%; SD of consecutive measurements of the analyzed

samples less than 5%; the detection limit of polyphenols and flavonoids at the level of nano-, picograms (10^{-9} – 10^{-12} g). At such low concentrations, there is less likelihood of the mutual influence of different antioxidants when they are present together, in particular, the manifestation of synergy.

Extraction of antioxidants was performed by water, water-alcohol and alcohol methods. The preparation of the analyzed samples was carried out by mixing the corresponding substances with the solvent. Solids were converted to liquid forms before analysis.

3. Results and discussion

Water-alcohol, alcohol and water extracts of antioxidants were determined based on the peak areas of the differential curves of the respective extracts [6]. The content of resveratrol in all samples is 0.5 mg / ml. The antioxidant activities of the following samples were determined: 1 - yogurt without additives (control), 2-yogurt with hawthorn syrup (5%), 3 - yogurt with hawthorn syrup (10%), 4 - yogurt with hawthorn syrup (15%), 5 - yogurt with hawthorn syrup (20%); 6 yogurt with resveratrol, 7 - yogurt with resveratrol and hawthorn syrup (5%), 8 - yogurt with resveratrol and hawthorn syrup (10%), 9 - yogurt with resveratrol and hawthorn syrup (15%), 10 - yogurt with resveratrol (0.49 mg / 100 ml) and hawthorn syrup (20%).

The results of studies on the concentration of antioxidants in terms of quercetin, are presented in table 1.

Table 1. The content of antioxidants in yogurt samples.

Object of study: Vegetable Yogurt	Peak area (S, NA*s)	AOA (in terms of quercetin, mg / 100 g)
Sample 1	457.98	31.7 ± 0.4
Sample 2	763.74	42.0 ± 0.4
Sample 3	1516.45	83.2 ± 0.2
Sample 4	747.66	67.2 ± 0.3
Sample 5	608.02	39.0 ± 0.2
Sample 6	657.31	53.9 ± 0.1
Sample 7	717.61	60.3 ± 0.2
Sample 8	1303.06	75.9 ± 0.5
Sample 9	1396.04	77.6 ± 0.3
Sample 10	798.64	65.8 ± 0.4

Based on the experimental data presented in table 1, it can be concluded that the maximum content of antioxidants was found in samples 3 and 9, obtained by extraction with 70% ethyl alcohol. Thus, the antioxidant activity of fermented milk products with the addition of resveratrol and hawthorn syrup is significantly higher than the antioxidant activity of the control sample without additives.

4. Conclusion

The increased content of antioxidants in yogurt samples with the addition of hawthorn and resveratrol indicates the antioxidant focus of the raw materials used and the possibility of using these yoghurts in the prevention of diseases associated with the activation of lipid peroxidation processes in the body. First of all, it concerns cardiovascular diseases, oncopathology, as well as prevention of exposure to the body of adverse factors that contribute to the initiation of lipid peroxidation processes in the body.

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