Complex plant food systems in the production technology of dietary cottage cheese desserts

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Abstract. The current priority trend in the food-processing industry is the use of non-traditional biologically active plant raw materials. In this regard, the potential application of stevia syrup and a dry pumpkin-based vegetable complex in the design of an integrated food system and further use in the production technology of dietary cottage cheese desserts with sucrose being completely replaced has been investigated. Thus, the content of the selected components has been determined to be 0.175 g of stevia syrup and 4 g of a pumpkin-based vegetable complex per 100 g of the cottage cheese base. The data obtained were used in the development of a recipe of dietary cottage cheese-based desserts.

1. Introduction
Currently, various methods of improving the quality of food products and improving the technological process are used in the food industry [1]. The most profitable and affordable was the use of complex food systems (CPS), which are understood as a group of substances of plant or artificial origin used to improve technology, produce specialized products, for example, dietary, preserve or give food the necessary properties, increase stability or improve organoleptic properties. CPS can be added to a food product at different stages of its production in order to improve or facilitate the technological process, increase the resistance of the product to various types of spoilage, preserve the structure and appearance of the product, or intentionally change the organoleptic properties. Replacing sugar in traditional products with intensive sweeteners and creating products of reduced energy value are an integral trend in the development of food technology in accordance with modern requirements of trophology and dietetics [2].

In connection with the above, the possibility of using stevia syrup and a dry vegetable complex from pumpkin in the design of a complex food system with further use in the production technology of cottage cheese desserts for dietary purposes, with a complete replacement of sucrose, was investigated [3].

2. Materials and methods
Stevia is a harmless natural sweetener of low energy value, non-toxic, does not have a mutagenic, carcinogenic, teratogenic effect. Stevia honey (Stevia Rebaudiana) is a member of the genus Stevia of the family Compositaceae. In accordance with the scheme of the experiment, it was planned to study a set of indicators using standard and original methods that allow obtaining information about the composition and properties of the objects of research. As the object of the study, we selected stevia and a plant complex from pumpkin seeds. Stevia is one of the most valuable plants that contribute to increasing the level of bioenergetic capabilities of the human body, allowing you to lead an active
lifestyle until old age. Stevia leaves and their syrup are allowed for use in the production of food products as food additives in Russia. The sweetness of stevia leaves is determined by the presence of a complex of sweet diterpene glycosides, which are organic compounds of a non-carbohydrate nature. The main advantages of diterpene glycosides – sweet taste without foreign taste; practically zero energy value; resistance to heat and long-term storage, exposure to acids and alkalis, non-digestibility by microorganisms, good solubility in water, small dosage; harmlessness with prolonged use; inclusion in the metabolic process without the participation of insulin, since they do not change, but normalize the level of glucose in the blood. Glycosides in combination with other components contained in stevia prevent the development of pathogenic bacteria and viruses, and also have an anti-inflammatory ability [4, 5].

In addition to sweet diterpene glycosides, stevia leaves contain the following components that provide its unique therapeutic, preventive and health-improving properties: flavonoids, water-soluble chlorophylls and xanthophylls, oxyacids (caffeic, chlorogenic, etc.), neutral water-soluble oligosaccharides, free sugars, amino acids, mineral compounds. In turn, from 17 amino acids-eight essential, vitamins D, E, K, P, A, C, saponins, protein, fiber, tannins, trace elements, essential oil and much more. The absence of enzymes in the human digestive system that break down stevioside into steviol and glucose causes a 30% decrease in the caloric content of stevioside-containing desserts compared to products produced with sugar [6, 7, 8].

The vegetable complex (PK) from pumpkin seeds is an accumulator of biologically active substances. This is a protein-vitamin complex of plant origin. It contains all the essential amino acids, vitamins B, C, macro and micro elements (calcium, phosphorus, iron, manganese, zinc), dietary fiber, cucurbitin up to 0.3%. Due to this successful combination in its composition, pumpkin flour is a necessary product for the vital activity of the human body. A special role is played by a mineral such as zinc, which is not produced in the body. The plant complex from pumpkin seeds stimulates the immune system, improves the functioning of the cardiovascular and hematopoietic systems, increases mental and physical performance (due to the high content of amino acids), relieves the toxic load on the liver, lowers the content of sugar and cholesterol in the blood, normalizes metabolism. In medicine, it is used as an antiparasitic, anthelmintic agent [8, 9].

3. Results
At the first stage of the work, the optimal concentration of stevia syrup in the curd base was determined, taking into account sensory properties, with the greatest attention being paid to the taste characteristics of the sample, since stevia syrup’s sweetness is different from the traditional sweetness of sucrose, namely, its increasing concentration causes characteristic bitterness. The amount of stevia syrup varied in the range of 0.075; 0.125; 0.175; and 0.225 g/100 g of the base. The data obtained are presented in table 1.

| Amount of stevia syrup | Sensory properties | Consistency | Taste and smell |
|------------------------|--------------------|-------------|----------------|
| 0.075                  | White, slightly creamy, homogeneous | Homogeneous, plastic, spreadable | Fermented milk, the taste of stevia syrup is very weak, slight sweetness |
| 0.125                  | Light creamy, homogeneous | Homogeneous, plastic, spreadable | Fermented milk, the taste of stevia syrup is more pronounced, the taste is not sweet enough |
| 0.175                  | Creamy, homogeneous | Homogeneous, plastic, spreadable | Fermented milk, sweetish taste with a tangible pleasant aftertaste of stevia syrup |
Thus, we can conclude that the optimal sensory properties are provided by the concentration of 0.175 g of stevia syrup per 100 g of the mixture.

4. Discussion
In the course of the technological process, the product must retain a certain shape due to the specifics of the hardware design of the production process. The consistency of the product depends on the mass fraction of moisture in the curd, and since the adsorption capacity of plant complexes contributes to the stabilization of the mass fraction of moisture in the mixture, the selection of the optimal concentration of PK can reduce the duration of such a technological operation as pre-pressing the curd, which reduces the energy costs of production. The consistency of products based on cottage cheese is significantly affected by the content of dry substances or the level of protein. An increase in the dry skim milk residue (SOMO) in the product leads to a noticeable increase in the viscosity, density of the product and a decrease in the tendency to syneresis during storage.

The amount of vegetable complex from pumpkin from 1 to 10 g was added to 100 g of the basic curd base, taking into account the change in the mass fraction of moisture. The best indicators – the mass fraction of moisture 56 %, taste and smell-pure, sour-milk with a pleasant taste of pumpkin were noted when applying 4 g of PK from pumpkin per 100 g.

5. Conclusion
The content of the selected components was determined to be 0.175 g of stevia syrup and 4 g of pumpkin plant complex per 100 g of cottage cheese base. The obtained data were used in the development of the recipe-component composition of dietary desserts based on cottage cheese.

Improving the range of food products determines the search and development of new areas of food production that meet the objectives of improving traditional and creating innovative technologies, more efficient use of raw materials, improving the quality of semi-finished products and finished products, and resource conservation. One of the most relevant directions is the development of complex food systems using components with a range of functional and technological properties for the production of food products with improved consumer and functional properties, as well as with increased shelf life. The use of such systems provides a number of advantages: the consumer properties of the products are improved; no change in the technological process is required; the possibility of directional regulation of the rheological properties and consistency of finished products is provided, and the number of risk points in the production cycle is reduced. Based on the results of studies of the physical-chemical, functional-technological and organoleptic properties of plant complexes from various plant raw materials, the directions in the design of complex food biosystems for use in food technology were determined.

The introduction of the additive in dry form makes it difficult to fully distribute it over the entire volume of the product, and, as a result, gives an uneven, rough structure of the product, which is difficult to mold. Studies have shown that the product with the introduction of components that were previously subjected to swelling at 40°C for 30 minutes in a small amount of water, taking into account the regulation of the mass fraction of moisture by additional application of dry whey, had the best consumer properties. The obtained data were used in the development of the recipe-component composition of desserts based on cottage cheese.

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References
[1] Cheshinsky V L, Glagoleva L E, Zatsepinina N P and Alexandrova A V 2019 Technology of flour and culinary semi-finished products for hepatoprotective purposes Bread products 8 46-8
[2] Antipova L V, Rodionova N S and Popov E S 2018 Trends in the development of the scientific foundations of food design Izvestiya vysshikh uchebnykh zavedeniy Food technology 1(361) 8-11
[3] Vasyukova A T, Bunievich D K and Penukhina O A 2020 The use of food additives from vegetable raw materials in the production of cottage cheese desserts with increased nutritional value In the collection Quality and environmental safety of food products and industries: materials of the international scientific and practical conference with elements of a scientific school for young people pp 25-9
[4] Polyansky K K, Pelevina A, Surkova N E and Vostroilova A In 2015 Products of complex processing of stevia for improving the quality of milk Cheese making and butter making 2 40-5
[5] Polyansky K K, Pronina O V, Chusova A E, Kovalchuk N S and Klyuchnikov A I 2016 Drink on whey with the addition of stevia extract Dairy industry 4 52-3
[6] Aleksashina S A and Makarova N V 2016 Investigation of the chemical composition and antioxidant activity of carrots, beets and pumpkins Storage and processing of agricultural raw materials 6 29-32
[7] Skidanova M A and Binkova O V 2016 Pumpkin seeds—a source of non-essential vitamins for the human body A new word for science:development prospects 3(9) 58-9
[8] Glagoleva L E et al. 2021 IOP Conf. Ser.: Earth Environ. Sci. 640 032048
[9] Serba E M, Rimareva L V, Sokolova E N, Borshcheva Yu A, Kurbatova E I, Volkova G, Pogorzhelskaya N S and Martynenko N N 2017 Biotechnological bases of directed conversion of agricultural raw materials and secondary biological resources for obtaining food ingredients, functional food and feed (Moscow: Biblio-Globus)