Development of low-calorie jelly for complex processing of dairy raw materials

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Abstract. The article discusses the relevance and features of using the "Bio-Tone" technology. The proposed technology provides a comprehensive waste-free processing of milk in a closed technological cycle, which has a scientifically proven and practically confirmed therapeutic and health-improving effect on the human body, surpassing the effect of traditional dairy products. Due to the use of complex carbohydrates in the recipe, saturation is felt longer, and due to the production technology, the protein fraction of the product is highly accessible to the human body. Pectin acts as a thickener for jelly, as well as a functional component – enterosorbent.

1. Introduction

The article discusses the relevance and features of using the "Bio-Ton" technology, and the demand for low-calorie dairy products [1, 2, 3].

The "Bio-Ton" technology provides a comprehensive waste-free processing of milk to produce products in a closed technological cycle that have a scientifically proven and practically confirmed therapeutic and health-improving effect on the human body, surpassing the effect of traditional dairy products [4, 5, 6].

Milk jelly, developed on the basis of waste-free technology, contains the following components: fractionated skim milk, pumpkin puree, pectin and vanilla sugar.

The principle of skim milk fractionation is based on the effect of membrane – free reverse osmosis-spontaneous separation of liquid colloidal systems by polysaccharide. This phenomenon explains the formation of two fractions of natural casein concentrate (hereinafter referred to as NC) and the serum-polysaccharide fraction (hereinafter referred to as SPF) [7].

NC contains 20-24% of dry matter, including 65-70% of high-quality milk protein, which contains a full composition of interchangeable and essential amino acids with a preserved native structure, up to 20% of carbohydrates, 7-8% of minerals and 1-2% of fat. Increasing the content of natural casein in the product increases the efficiency of protein use by up to 20%, and increases muscle mass by up to 16%. At the same time, there is a decrease in the content of urea, creatinine and total cholesterol in the blood serum, which indicates a favorable effect of natural casein on metabolic processes in the body. Additional inclusion of NC in the human diet in the amount of 0.15-0.25 g/kg of body weight, or 10-25% of the daily consumed protein with food contributes to adaptation to physical and mental stress in professional activities.
SPF, having a number of useful physiological and technological qualities, improves the functional characteristics of dairy products produced from it. Dry substances of the SPF include up to 15% of protein substances (albumins and globulins, polypeptides, free amino acids) and other biologically active components, up to 75% – carbohydrates, and up to 10% – minerals.

As a source of dietary fiber, an additional layer of jelly is pumpkin puree. Fiber accelerates the passage of food through the digestive system, this property of dietary fiber is very important in the conditions of rapid growth in the number of overweight people. Also, by binding to bile acids, dietary fiber reduces fat absorption and lowers cholesterol levels in the blood.

Pectin acts not only as a polysaccharide for the fractionation of skimmed milk, but also as a source of soluble fiber. Its useful properties are the ability to restore the microflora of the digestive tract, normalize cholesterol levels, reduce blood pressure and weight control [8, 9, 10].

The development of functional food products of a new generation is an innovative direction in the food industry. Recently, there has been a need to develop functional food products for overweight people whose health needs to be corrected in their daily diet [11]. Daily consumption of low-calorie foods with functional ingredients of plant origin allows consumers to block undesirable processes in the body.

2. Materials and methods.
The work consisted of the following stages: selection and preparation of raw materials, development of control and experimental samples, conducting organoleptic and physico-chemical studies to assess the quality of the resulting product.

Objects of research in the development of low-calorie dairy product:

- skimmed milk, fat content 0,05% according to GOST 31450-2013, TR CU 021/2011, TR CU 033/2013;
- pectin according to GOST 29186-91, TR CU 021/2011;
- pumpkin puree according to GOST 32742-2014, TR CU 021/2011;
- vanilla sugar according to GOST 16599-71, TR CU 021/2011;
- developed samples of milk jelly.

The production of the studied samples was carried out in accordance with the developed normative technical documentation on the generally accepted technology for the production of milk jelly.

Sampling and preparation of samples for laboratory studies was carried out according to a single method in accordance with the requirements of GOST 26809.

Organoleptic evaluation of the finished product was performed on the basis of GOST 31986-2012, GOST R ISO 22935-1-2011, GOST R ISO 22935-2-2011.

The acidity of the developed samples was determined by the titrimetric method according to GOST 3624-92.

In the studies, tables of the chemical composition of products, edited by I. M. Skurikhin, were used to calculate the content of nutrients contained in prepared samples [12].

3. The results and their analysis.
The main component of the developed formula of low-calorie milk jelly is skimmed milk, namely its fractions of NC and SPF. The food filler is pumpkin puree with added vanilla sugar for a light vanilla flavor.

Skimmed milk is a secondary raw material, which significantly reduces the cost of this dessert. In terms of nutritional value, it is not inferior to whole cow's milk, and when it is fractionated, it even exceeds it due to the content of native protein. This indicator has a positive effect on the digestibility of the product in the body.

NC improves the provision of plastic and energy needs of the working body, increases the energy-plastic effect, stimulates the growth of heart muscle mass and skeletal muscles. It activates the formation of hemoglobin, normalization of deviations in protein, lipid, carbohydrate metabolism, positively affects
the activity of the hypothalamic-pituitary-adrenal, sympathoadrenal and immune systems, reduces lipid peroxidation and activates the course of the pentose phosphate cycle and the Krebs cycle.

SPF has a beneficial effect on the nitrogen balance, stimulates protein-synthetic processes, activates the adrenal and immune systems. In addition, SPF normalizes blood flow after blood loss and deviations in protein, mineral, carbohydrate, and vitamin metabolism. It reduces lipid peroxidation and normalizes atherogenic changes in lipid metabolism, increases the body's adaptive capabilities and resistance to adverse effects of environmental factors and professional activities, strengthens the body's energy-plastic processes.

The recipe for jelly based on secondary dairy raw materials includes the following components, %: skimmed milk-70; pumpkin puree-28.0; pectin-1.99; vanilla sugar-0.01%. The method of production of the new product is based on a promising technology of fractionation of skimmed milk with biopolymers "Bio-Ton", which is possible due to the phenomenon of limited compatibility of casein and polysaccharides. Sparing modes of technological influences allow to preserve the native properties of milk components as much as possible [1]. To increase the nutritional value and improve the consumer properties of the product, it is advisable to add a vegetable component to the recipe – pumpkin puree. Food filler along with the gelling agent – pectin acts as a source of fiber.

When evaluating the organoleptic characteristics of the product, its high indicators were revealed. The taste profilogram (figure 1) clearly reflects the unusual combination of taste profiles of the main components of the product recipe – the sour-milk taste is achieved thanks to a perfectly selected combination of components of secondary dairy raw materials and pumpkin puree with the addition of vanilla sugar.

![Figure 1. Profilogram of jelly taste based on secondary milk raw materials.](image-url)

Quality indicators and characteristics of the finished product produced using the developed technology are shown in table 1.
Table 1. Organoleptic and physical and chemical indicators of the quality of the finished product.

| Indicator          | Characteristic                                                                 |
|--------------------|--------------------------------------------------------------------------------|
| Appearance         | Non-flowing, homogeneous mass that preserves the shape of the package with no adhesion to the packaging material |
| Taste and smell    | Moderately sweet taste, characteristic pumpkin flavor                             |
| The consistency    | Gelatinous with small inclusions of pumpkin puree                                   |
| Acidity, °T        | 35.0                                                                              |
| Fat, %             | 0.05                                                                              |
| Protein, %         | 22.00                                                                             |
| Carbohydrate, %    | 12.00                                                                             |
| Mineral content, % | 0.86                                                                              |
| Energy value, kcal/100 g | 66                                      |

The absence of simple carbohydrates in the product and the presence of complex ones not only eliminates weight gain, but also helps to reduce it without harm to the health of the consumer. Dietary fibers quickly swell and fill the stomach, creating a feeling of satiety, normalize the balance of intestinal microflora, stimulating the development of probiotic microorganisms, whose enzymes contribute to maintaining an acidic environment, which stimulates metabolic processes and eliminates the development of putrid microflora.

Jelly obtained using the "Bio-Ton" technology is characterized by increased nutritional and biological value due to enrichment with native protein.

4. Conclusion
The "Bio-Ton" technology provides a comprehensive waste-free processing of milk to produce products in a closed technological cycle that have a scientifically proven and practically confirmed therapeutic and health-improving effect on the human body, surpassing the effect of traditional dairy products. Milk jelly is produced using resource-saving technology from secondary milk raw materials, which corresponds to the current trend in the development of the dairy industry. At the same time, the use of a natural vegetable component of regional origin to form its taste and color eliminates the need to add sugar, dyes and flavors, which increases the attractiveness for the consumer. In terms of nutritional value, milk jelly has a high coefficient of efficiency of assimilation, digestibility and biological value of protein.

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