Colostrum research and application in the functional food products technology

L E Glagoleva, N P Zatsepilina, E V Kozyrenko and S O Rodionov

Voronezh State University of Engineering Technologies, 19 Revolution Avenue, Voronezh, 394036, Russian Federation

E-mail: nataha.zatsepilina@yandex.ru

Abstract. Nowadays, one of the priorities of the food industry development is the use of non-traditional biologically active raw materials of vegetable and animal origin. Colostrum is a natural concentrate of immunoactive and bio-stimulatory factors and nutrients that has a health-promoting and rejuvenating effect on the whole body. The objective of the research is to develop the curd products technology with complete replacement of eggs and partial replacement of curd with natural immunomodulating raw material which is colostrum. The formed product line group is intended as functional products to provide food for various groups of people. For achieving the objective, the following research tasks have been determined: to study physical and chemical properties of cow's colostrum; to study biological and microbiological properties of cow's colostrum; to examine the influence of colostrum on the organoleptic and structural and mechanical properties of curd products; to select ingredients and define the curd product formulations; to design the curd production technology; to analyze the finished product properties. The developed curd products technology using complete replacement of eggs and partial replacement of curd with cow's colostrum meets quality requirements and provides functional food products with better characteristics for keeping the population healthy in comparison with traditional methods.

1. Introduction
The promotion of health of each individual and the whole nation is one of the most important tasks facing the Government of the Russian Federation. One of the priorities of the food industry development nowadays is the use of non-traditional biologically active raw materials of vegetable and animal origin.

The object of the research is the use of colostrum. Colostrum is a natural concentrate of immunoactive and bio-stimulatory factors and nutrients that has a health-promoting and rejuvenating effect on the whole body [1, 3]. It has extensive therapeutic properties and unique composition provided by G, M, A immunoglobulins, which are the main constituents of the humoral link of our body's immune system [2]. They trigger the immune response against pathogenic organisms – bacteria, viruses, protozoa, and fungi.

Cow's colostrum composition also includes:

Transfer factors are the "immune memory" molecules, which teach the body to fight those infections which it has yet to face.

Lactoferrin is the main constituent that supports the standard iron level in the blood serum (anemia prevention factor).
Colostrinin is the body's immunological response magnitude controller. Interleukins are substances triggering the body's immune cells activation in response to the pathogenic invasion. Interferons are the key elements of our body's antiviral protection, which have an onko-preventive effect. Endorphins are unique painkillers, which are our body's anti-stress protectors increasing the exercise tolerance and regulating our mood (joy hormones). Enzymes such as lysozyme, lactoperoxidase are involved in the process of bacteria neutralization and destruction. Blood serum proteins such as casein, lactoalbumin are nutrients for the whole body. Prebiotics are natural factors ensuring the intestinal microflora growth or normalization. Amino acids are the building blocks from which proteins are formed. In particular, colostrum is exceptionally rich in the amino acid of taurine, which is necessary for the brain, heart and muscles development and maintenance. Phospholipids are important constituents of the cell membrane, the lung surfactant, and blood plasma lipoproteins. Nucleotides are regulatory substances that make it impossible for the body to synthesize DNA and proteins, which implies the body's cells growth, development and renewal. Vitamins and minerals are indispensable stimulators of all life processes, ranging from individual biochemical reactions to the whole body's organs and systems functioning [1, 4].

Based on the colostrums chemical composition, it can be concluded that cow's colostrum is the only product that combines several groups of immunologically active substances in the most optimal proportions. This powerful alliance provides reliable anti-infective protection, proper growth and development, as well as the body's rejuvenation [5- 7].

In connection with the above, the objective of the research is to develop the curd products technology with the complete replacement of eggs and partial replacement of curd with natural immunomodulating raw material, which is colostrum. The formed product line group is intended as functional products to provide food for various groups of people [2, 6].

For achieving this objective, the following research tasks have been determined:
- to study physical and chemical properties of cow’s colostrum;
- to examine the influence of colostrum on the organoleptic, structural and mechanical properties of curd products;
- to select ingredients and define the curd product formulations;
- to determine the technological solution for the curd products technology;
- to analyze the finished product properties.

2. Research materials and methods
The target indicators that allow assessing the prospects of cow's colostrum application in the curd products technology can be combined into the following groups comprehensively [6,7]:
1. *The study of cow’s colostrum properties:*
- physical and chemical properties;
- amino acid composition;
- antioxidant activity.
2. *The study of curd products properties after the cow’s colostrum application:*
- the justification for selecting the formulation solution;
- the product formulation development;
- organoleptic indicators;
- physical and chemical indicators.
3. *The research of quality indicators of curd products with colostrum:*
- technological process schemes;
- the development of technical and technological process flow charts for making curd products.
3. Results
Colostrum’s physical and chemical properties were initially studied. The data obtained are presented in Table 1.

| Table 1. The Colostrum’s Physical and Chemical Properties |
|--------------------------------------------------------|
| Density, kg / m$^3$ | Thermal Stability | Acidity, °T | Moisture Mass Fraction, % | Fat Mass Fraction, % | Protein Mass Fraction, % | Bacterial Contamination, CFU/cm$^3$ (group) | Somatic Cells |
|---------------------|-------------------|------------|--------------------------|---------------------|-------------------------|-----------------------------------------------|--------------|
| 1060                | 8                 | 53         | 44                       | 62.2                | 15                      | 22.8                                          | 6 millions   |
|                     |                   |            |                          |                     |                         | (III)                                         |              |

Figure 1 below shows the antioxidant activity.

![Figure 1. The Colostrum’s Chromatogram](image)

The colostrum’s chromatogram shows 4 peaks for each experiment, which means that at least four groups of substances provide the antioxidant activity.

The total antioxidant activity (CAOA) is 17.0 mg / dm$^3$.

4. Discussion
Based on the literature studied, and the positive results obtained, the formulations of semi-finished curd products such as cheesecakes have been developed. The best organoleptic characteristics have been observed when adding 20 % of colostrum from the mixture weight: pure, sour milk flavour; light brown colour; browned crust; homogeneous consistency. The Dough is thick and well moulded.

The amount of colostrum added varied in the range of 5 - 25 % from the curd and eggs weight. The organoleptic parameters and the moisture mass fraction correspondingly changed. The change of the moisture mass fraction in the curd dough, depending on the amount of colostrum added is shown in Table 2.

| Table 2. Change of the Moisture Mass Fraction in the Dough and the Ready-made Cheesecakes |
|------------------------------------------------------------------------------------------|
| Name of the studied product | Colostrum Content in the Product, % from the Curd Weight |
|--------------------------------|----------------------------------------------------------|
|                               | Test | 5   | 10  | 15  | 20  | 25  | 30  |
| Moisture Mass Fraction in the Dough | 58.4 | 57.8 | 58  | 58.4 | 60.8 | 62  | 62.2 |
| Moisture Mass Fraction in the Cheesecakes   | 63.4 | 64.2 | 64.8| 65.4 | 65.8 | 65.8| 66.0 |

The chemical composition and nutritional value of cheesecakes are shown in Table 3.
Table 3. Chemical Composition and Energy Value

| Proteins, g | Fats, g | Carbohydrates | Energy Value, kcal |
|------------|---------|---------------|-------------------|
| 14,8       | 17,3    | 2,2           | 306,3             |

5. Conclusion
The analysis of the data obtained on the study of the moisture mass fraction is within the standard range. Traditional food technologies have been increasingly changing recently in order to develop food products with functional properties.

The formulation and the technological conditions for making curd products from colostrum using complete replacement of eggs and partial replacement of curd have been developed. It has been found that these products have beneficial organoleptic properties.

The products can be recommended for the nutrition of various groups of people as a functional food product. The curd products made from colostrum can be produced at small-scale enterprises and sold in the network of public catering enterprises. The cost of this product is lower by 27.2 % than that of a product produced through traditional technology.

References
[1] Asafov V A, Tankova N L, Iskakova E L, Kharitonov V D, Kurchenko V P and Golovach T N 2019 Some aspects of regulating the microbiological composition of thecolostrum Food industry 4 (42) 20-25
[2] Zabegalova G N, Polyanskaya I S, Semenikhina V F and Lepeshkin T A 2018 Cow’s colostrum as part of functional food products Dairy industry 8 34-36
[3] Lozovskaya D S and DyMar O V 2016 Essessment of the technological properties ofcolostrum as a raw material for food production Actual issues of processing meat and dairy raw materials 10 140-153
[4] Golovach T N, Kurchenko V P and Tarun E I 2016 Protein-peptide composition and radical-recovering properties of the cow’s fermented colostrum Food industry: science and technology 3 (33) 57-63
[5] Golunova L E 2003 Collection of formulations of dishes and culinary products for public catering enterprises (SPb.: Profix)
[6] McCance R A and Widdowson E M 2006 Chemical composition and energy value of food products. Handbook (SPb.: Profession)
[7] GOST 23453-90 2009 Milk. Methods for determining the number of somatic cells (Moscow: Standardinform)