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The nanostructure's management is the basis for a functional fatty foods' production

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Abstract

For the first time the functional types of butter with herbal supplements (HS) are developed. The effect of HS on micro-and nanostructure of developed types of butter was studied. It was established that the introduction of HS reduces the value of nanostructure's elements of butter in a 5 - 25 times. The nature and properties of HS influence the formation of the butter's nanostructure, the architecture and morphology of its nanoelements. According to comprehensive studies it was found that the decreasing of the size of butter's nanostructure's elements improves the structure, texture and rheological parameters of butter - it increases the thermal stability and plasticity, the ability of the structure to retain the liquid phase of fat and a structure's connection, prevents the formation of layered and brittle consistency of butter, promotes the formation of coagulation-crystallization structure dominated by coagulation, inhibits microbiological and biochemical spoilage of butter. According to the results of clinical trials and the conclusions of the Ministry of Health developed the kinds of butter are recommended to use in health care and dietary nutrition. Based on the results of the study it was recommended to use HS to control the formation of the butter's nanostructure and its quality, physical and chemical properties.

Keywords: functional food products; butter; nanostructure; nanoelements; herbal supplements.

1. Introduction

One of the main problems of the modern food industry is to create functional food products that will not only satisfy human needs for essential nutrients and energy, but also have health, preventive and curative properties. Functional properties can be given to traditional foods by enriching them with biologically active substances and thereby making medicine from food, and medicine – is going to be a meal, as it was recommended by Hippocrates.

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At the 25 and 26 International Dairy Congresses scientists paid attention to the creation of functional foods and developing their concept, which includes the main provisions: the development of functional foods with regard to the nature and specificity of ethnic cuisine, familiar to the population; enriching food products with functional components must have nutritional and medical justification; dairy products can be classified as functional only by the Ministry of Health on the results of clinical studies.

Butter has a significant place in the diet of the population in Ukraine; it is included in the diet of health and child care centers, which makes the feasibility of butter's establishing a functional purpose. In recent years, the physicians and food industry workers pay attention to the use of herbal supplements that have health and medical-preventive properties. This indicates the feasibility of their usage in the development of functional types of butter. Nowadays, the world's leading scientists connect the creation of functional materials with nanoscience and nanotechnology. A number of scientific conferences held in New York, Paris, Tokyo, Seoul, Los Angeles, and Russia were devoted to this problem. It was noted that nanotechnology's creation is the priority areas of science and food industry. Nanotechnology is based on the ability to create a nanostructure materials with desired properties, which are regulated in the nanoscale range (1 nm = 10^{-9} m). Therefore, today it is especially important to study the formation of the nanostructure of food products. The implementation of nanotechnology requires deep knowledge of nanostructured systems' functioning (butter is such a system) and processes of their molecular self-organization.

We were the first who developed the functional types of butter with herbal supplements (HS) such as polysaccharides, pectin and inulin cryopowders of red beets, carrots, black currant's buds, topinambour, which have the properties of surface-active substances (SAS). The purpose of the work is study the effect of plant food additives on the micro-and nano-structures and physicochemical properties of functional types of butter.

2. Materials & Methods

There are the results of a study of the functional types of butter with apple pectin (BP), cryo powder of red beet (BB), the control sample was butter without additives (BC). The samples of fresh prepared butter (BC_f, BP_f, BB_f) and butter stored at 5 °C (BC_5, BP_5, BB_5) and at -18 °C (BC_{-18}, BP_{-18}, BB_{-18}) for 6 months were studied. Micro-and nanostructure of butter was examined by scanning electron microscopy, which is the most effective way of getting images of the sample surface and determining the size of nanoparticles [1]. To prepare the butter samples for the study we used a frosting-break technique that allows capturing the true structure of the butter. Structure of butter was fixed at the temperature of its storage.

3. Results & Discussion

Fat phase in the structure of butter is represented by two kinds of structures: continuous emulsion water/fat and the fat globules with d ≈ 1-8 micrometers, distributed it in. We were the first who studied the nanostructure of butter [2-4]. The results showed that the butter is nonostruktured nanocrystalline material. Electron microscopy studies showed that the microstructure of BC_f consists of a continuous fat phase, in which there are the dispersed droplets of the plasma with a diameter d ≈ 1 ... 10 micrometers and there are distributed single partially destroyed fat globules of d ≈ 1,5-3,5 micrometers (Fig. 1). Interglobular structure contains a number of crystalline layers of 1000-2600 nm, their high is a 30-100 nm. They consist of glyceride monomolecular layers of thickness ~ 5 nm.