The Nanostructure's Management is the Basis for a Functional Fatty Foods' Production

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INTRODUCTION

One of the main problems of the modern food industry is to create functional food products with health properties. 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. The physicians and food industry workers pay attention to the use of herbal supplements that have health and medical-preventive properties. Nowadays, the world's leading scientists connect the creation of functional materials with nanoscience and nanotechnology. It 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). We were the first who developed the functional types of butter with herbal supplements (HS) – such as polysaccharides and cryopowders. 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.

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.

RESULTS & DISCUSSION

The results showed that the butter is nanostructural nanocrystalline material. The microstructure consists of a continuous emulsion - plasma/fat and fat globules, crystalline glyceride layers, aggregates and nanoblocks distributed in it, formed from nanograins and nanocrystals. While butter storage with the temperature -18 ° C (BC_{-18}) an extremely layered nanostructure is formed, and consistency has flaws: lamination and crumbling. the introduction of small amounts of pectin reduces the structural elements of the quantity of butter to 5-25 times and is in the nanoscale range, including the 1-100 nm. Grinding mechanism is based on the Rehbinder effect and is associated with surfactant adsorption of the pectin on interphase surfaces and nanoelements' interfaces that promotes the adsorption reduction of strength of their structure and formation of micro-and nanocracks, forming a new phase. In BP_f and BP_5 the pectin-lipid layers of membranes are composed of plate-like nanocrystals, mostly rhombic shape with the parties size of 8 ... 10 nm and nanoparticles of moisture on the rough boundaries of the section (Fig. 1). Interglobular nanostructure consists of a three-dimensional polyhedral, spherical and cylindrical aggregates and nanoblocks with a size of 100-800 nm.The nanostructure of BP_{-18} contains crystalline nanograins with d ~ 40 ... 60 nm and units that have the form of a low cylinder with base d ~ 200 ... 280 nm and a layer of adsorptive bounded moisture on the lateral surface, as well as individual nano globules - d ~ 60 ... 150 nm, separated from the fat globules in which they were emerged. The surface fat globules and nanoelements of BB_f contains the aqueous phase's nanoparticles, dimensional chains of nanoparticles from the aqueous phase, interfacial rough surface of their division with a continuous fat phase and

nanobumps with d ~ 40 ... 100 nm. Bumps' nanostructure consists of concentric layers of glycerides' nanograins with d ~ 3 ... 6 nm and the layers of aqueous phase's nanoparticles with d ~ 3 ... 12 nm.

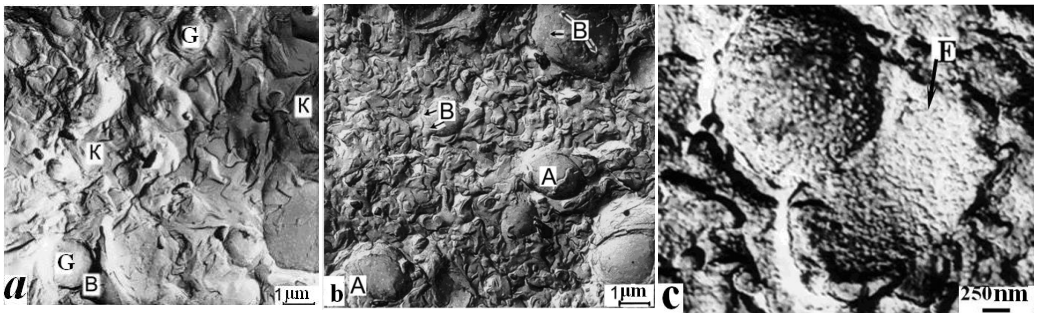

Figure 1. Microstructure BC_f (a), BP_f (b), BB_{-18} (c): A, B, G - fat globules, E - cellular nanostructure, K - crystalline layer.

In the BB_{-18} the value of the nanostructure's elements decreases in 5 ... 25 times relative to the BC_{-18}. Interglobular microstructure is composed of crystalline nanoaggregates that are formed from crystalline layers with a thickness of 10 ... 50 nm, they also have a cellular nanostructure, the width of the cells is 60 ... 100 nm, with the shape of octahedra , dodecahedra andicosahedra with nanoparticles of aqueous phase d ~ 6-12 nm on the edges and vertices. Cell are also composed of polyhedral cells, their width is 8 ... 15 nm (according to the principle of "like in like") [1]. This indicates the hierarchical subordination of nanoelements and fractal forms. Comprehensive studies showed that the HS are multifunctional. They not only give butter medical and dietary properties, but also contribute to crumbling of the structure's elements; their size is in the nanoscale range, including the 1-100 nm that improves the structure, texture and ability for product's keeping. It is established [2, 3] that the introduction of small doses of HS with the properties of surfactants, allows you to control the nanostructure and physicochemical and functional properties of butter.

CONCLUSION

1. It was established that the introduction of herbal food supplements (polysaccharides and cryopowders) reduces the size of the nanostructure's elements of butter in 5-25 times. The nature and properties of the additives significantly affect the formation of the nanostructure of butter, the architecture and morphology of its nanoelements.
2. It was established that the introduction of small doses of herbal supplements that have the properties of surfactants, are useful for controlling the nanostructure formation of butter and, accordingly, its quality and physical and chemical properties. The influence of nanostructure on the functional properties of the product was studied for the first time.
3. Theoretical data of the nanostructure's formation of butter are the scientific bases to the new direction of creation the food nanotechnology of functional products with desired properties, primarily butter.

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