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Flaxseed additive application in dairy products production

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Abstract

Nowadays the special attention of scientists is focused on flaxseed that is rich in polyunsaturated fatty acids ω-3 and ω-6, proteins, water-soluble polysaccharides, dietary fibre, lignin, vitamins, minerals and phenolic compounds. Paying attention is caused by flaxseed ability to have a great influence on human health, prevent cardiovascular diseases, gastrointestinal problems and cancer. New butter with flaxseed additive and flaxseed additive technology were developed by us. The suspension microstructure of flaxseed additive was studied. It was revealed that microstructure of flaxseed additive is multicomponent and structured system. It consists of uninterrupted phase of polysaccharides solution and structural elements such as particles of flaxseed, globules and areas with a cellular structure from polygonal cells. As a result the mechanism of microstructure suspension formation was proposed. It has a few stages. They are the formation of dispersion of globules, the aggregation of globules and formation of areas with a cellular structure. Sensory evaluation has shown that butter with flaxseed additive has pure creamy flavour and odor without flavour and odor of additive, yellow color and good spreadability and plasticity. It was proven that addition of structured suspension of flaxseed additive makes structure destruction decrease and plasticity increase. It was also revealed that recovering ability of butter structure soars when flaxseed additive dose increases. This fact indicates that butter with the flaxseed additive has coagulation-crystallization structure with domination of the coagulation one. Decrease of structure destruction and increase of recovering ability of butter structure apparently due to the formation of additional intermolecular bonds between the components of flaxseed additive and butter.

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Keywords: Flaxseed additive; butter; microstructure; cellular structure; coagulation-crystallization structure.

1. Introduction

In recent years, physicians all over the world state the fact of health deterioration of the world's population, reduction in life expectancy, decrease in working capacity and body's resistance to infection.

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The possible solution to this problem is physiologically balanced, healthy diet that is rich in biologically active substances, including essential components. Nowadays there are over a thousand items of functional ingredients that are used for creating therapeutic food products. Polyunsaturated fatty acids (PUFA) ω-3 and ω-6 have attracted the special attention of physicians because these acids have an ability to participate in the structural and functional organization of cell membranes, they regulate fat metabolism, reduce blood cholesterol level and have the cardioprotective effect [1]. PUFA ω-3 and ω-6 can be found abundantly in flaxseed. In recent years, scientists and nutritionists around the world pay attention to the health benefits of flaxseed. According to its physical-chemical composition, flaxseed is a multicomponent system with plant biologically active substances such as oil (it is rich in essential fatty acids ω-3 (α-linolenic acid) and ω-6 (linoleic acid)), protein, dietary fibre, soluble polysaccharides, lignin, phenolic compounds, vitamins A, C, F, E and mineral elements P, Mg, K, Na, Fe, Cu, Mn, Zn [2, 3]. In flaxseed oil PUFA ω-3 and ω-6 are contained in the optimum ratio 1:10. Currently flaxseed and flaxseed preparations are widely used in medicine as an enveloping and wound-healing agent in the treatment of gastrointestinal, cardiovascular, nervous diseases and cancer. It is particularly useful for the elderly, weakened children and postsurgical patients. Flaxseed is needed for all healthy people during their mental and physical activities, for students and pupils in order to improve their academic achievement, for everyone who works with the computer or is exposed to various radiations. A detailed analysis of published data has shown the applicability of multicomponent flaxseed system in food technology. It is corresponds to world tendencies of food industry development.

Taking the above mentioned into consideration a new kind of butter with flaxseed additive and flaxseed additive technology were developed at the National University of Food Technologies. Flaxseed additive adds to butter as a suspension in buttermilk. Previous studies [4] have revealed that the addition of plant additives affects significantly the formation of butter micro-and nanostructure. Therefore, to better understand the micro-and nanostructure of butter with flaxseed additive it is necessary to study the microstructure of water suspension of flaxseed additive.

2. Materials & Methods

Microstructure of aqueous suspension of flaxseed additive was studied by the optical microscope. The suspension was prepared by stirring flaxseed additive with distilled water in a ratio 1:4 at 20 ± 2 °C, the stirrer speed was 250 rpm. Model samples of butter with flaxseed additive were manufactured. The percentage of additive in butter were 0,8; 1,2; 1,6%. Butter without additive was used as a control sample. The moisture content in all samples was 25%. Butter samples were stored at +5 °C. The degree of structure destruction and the relaxation behaviour of butter structure (butter structure restoration) were measured at +18 °C as had been described in [5].

3. Results & Discussion

The effect of stirring on the microstructure formation of the flaxseed additive suspension was investigated. After the first 5 minutes of stirring suspension microstructure (Fig. 1,a) contains flaxseed particles **F** (up to 10 micrometers), globules **G** (d~2-10 micrometers) and uninterrupted phase of polysaccharides solution. Globules are mostly spherical in shape, and only some of them are ellipsoid. The formation of aggregate **A** from globules is viewed near the flaxseed particle $\mathbf{F_1}$. Stirring the suspension for 10 minutes cause the further microstructure formation (Fig. 1,b). Particles of additive swell, they increase in size 2 times, and globules **G** form aggregates in size 20-40 micrometers. After 20 minutes of stirring the formation of the cellular structure **K** (Fig. 1, c) in microstructure of flaxseed additive suspension is observed. The cellular structure consists of polyhedral cells 17-30 micrometers. There are small globules d~2-6 micrometers at the periphery of the cells. Fig. 1, d shows an area of the cellular structure, which was formed in the suspension after 25 minutes of stirring. In Fig. 1,d well-defined cell's bonds and cell's internal structure is seen. There is