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WATER PHASE CONDITION IN THE BUTTER PASTE WITH RED BEET POWDER

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Abstract. *The technology of butter paste with red beet powder based on butter with addition of dry skimmed milk, flaxseeds and inulin is developed. The quantity of the plant food additives in the ready product is red beet powder – 0.80 %, inulin – 1.50 %, flaxseeds – 2.90 %. The condition of the water phase in the fresh product was investigated for the indicators: dispersion of plasma and forms of moisture connection. Dispersion was determined by computing the drops of moisture under the microscope MICROmed XS-2610. The article concludes that the adding of red beet criopowder, flaxseeds, inulin with simultaneously mechanical processing provokes dispersion of moisture in the butter paste with increasing droplets with the diameter of 1...5 microns. Main forms of moisture connection research were conducted by thermogravimetry method with derivatograph Pauli-Erdene Q-1500 D system. These results suggest that the selected complex of plant food additives leads to increasing amount of monomolecular and polymolecular firmly bound moisture.*

Key words: *butter paste, plant food additives, dispersion of the plasma, forms of moisture connection.*

1. Introduction.

Nutrition plays an important role in everyday life. The components of food provide the body with vitamins, minerals, dietary fibers, polyunsaturated fatty acids, which in their turn determine the state of health, support the immunity, physical and mental efficiency. Considering this, it is important and appropriate to develop and improve food technologies that will correspond to the status of health, prophylactic and functional purpose. An assortment of butter with functional properties with: pectin and inulin polysaccharides, red beet, black currant and carrot plant criopowders, artichoke and with flaxseeds was developed in the National University of Food Technologies (NUFT) led by prof. Rashevskaya T. In the clinics Institute of Ecological Hygiene and Toxicology M.I. Medvedya and in the Institute of Microbiology and Virology National Academy of Sciences biomedical tests of butter with pectin, inulin, red beet powder and black currant buds were conducted and Ukraine Health Ministry issued the conclusion about using this assortment into the health, prophylactic and dietary nutrition [1].

It is main today to develop and produce moderate calorie foods with simultaneously increasing of the biological value and dietary properties. Reducing of energy value of butter can be achieved by correcting the composition and correlation changing of the components. Continuation of the work in this direction with these requirements has limitations, such as content of milk fat in butter should be at least 51.00 %, it is not recommended to use non-dairy ingredients, the traditional color of the product is preferred. Therefore, it is appropriate to create a new

group of moderate calorie products with typical consumer characteristics for the traditional composition of butter. For such groups butter paste could be included – dairy product on fat emulsion basė with fat mass fraction of 39...49 % that is produced from cow's milk, dairy products and (or) milk processing byproducts using stabilizers, but not as a replacement of components parts of milk by nondairy components or without them. Composition and technologies of butter paste with honey, cocoa, chicory, fruit and berry, vegetable and fungal additives, spices, herbs were science-based in the All-Russian Research Institute of dairy and cheese manufacturing by Vishemirskii F. [2,3]. Chocolate butter paste "For tea" is produced in Belarus with fat mass fraction of 40.00 % and consists of butter, drinking water, sugar, dry skimmed milk, cocoa powder, stabilizers, iodized salt, potassium sorbate, citric acid. The disadvantage of the above assortment is that these additives do not have functional properties. We give preference to the use of food additives made from plant raw materials, which are a source of biologically active substances. Butter paste assortment with the complex of biologically active substances was developed by the young scientists in NUFT led by prof. Rashevsky T.: "Honey", with carrot powder, with micronutrients antidiabetic purpose, with viburnum syrup [4]. Using of inulin and flaxseed into the composition was the common basis for these types of products, which are technological and have functional properties [5-7]. Recently, red beet attracts attention of medical and food industries. It is rich in anthocyanin coloring agents (betaine and betanin), catechins, flavonoid glycosides, vitamins and minerals that help to strengthen capillaries and blood vessels, increase the hemoglobin content and the amount of red blood cells, reduce blood pressure, prevent cancer, reduce cholesterol blood, enhance detoxification, toxins, salts of heavy metals and radionuclides from the body [8]. Continuing work in this direction, we have developed the technology of the butter paste with red beet powder with fat mass fraction of 42.00 % based on butter with addition of dry skimmed milk. Into the milk-based product plant, namely red beet criopowder, flaxseeds and inulin were contributed. Plant additives were contributed in as a suspension in buttermilk. On the method of producing butter paste with red beet powder the Ukraine patent for the invention has been received [9].

In previous works it was found out that red beet criopowder, flaxseeds and inulin affected on the quality indicators of the butter paste. The selected complex of plant additives improves the heat resistance of the ready product, the ability of the structure to keep the liquid phase of fat, promotes its plasticizing and forming the structure with optimal ratio of coagulation and crystallization connections [10,11]. The butter paste is characterized by high moisture content (47.00 %), that's why the state of the water phase, dispersion of plasma, forms of moisture connection with the components play an important role in forming the quality of the ready product. It is known that adding of criopowders and polysaccharides changes the ratio of forms of moisture connection, the amount of strongly bound absorption moisture and dispersion of moisture on the micro- and nanoscale increases, the number of drops with the diameter more than 5 microns is reduced, coalescence of droplets during storage is broken [6, 12, 13]. According to the above information, the aim of this work is the research of the impact of red beet criopowder, flaxseeds and inulin on the state of the water phase in the butter paste.

2. Materials and methods.

The objects of the study were samples of fresh butter paste with red beet powder and butter with fat mass fraction of 63.00 % as a control. The determination of dispersion of plasma product was performed by counting the drops of water under a microscope. By applying a piece of the sample with help of a metal needle with size less than 1 mm microscopic pattern were prepared, carefully covered by coverslip, set a 100 g weight and left for 5 min at 20 ^{0}C. Prepared patterns were studied under a microscope MICROmed XS-2610 with lighting "on the passage". At least five most typical fields and the scale line of the object-micrometer were photographed for calculating the dispersion. According to the obtained images size of droplets of plasma were determined and shared on fractions: (1...2) mm, (3...4) mm, (5...6) mm, (7...8) mm, (9…10) mm. The content of each droplets fraction and the average diameter in the samples were determined. Researching of forms of bond moisture was done by the method of thermogravimetry, which allows the determining of the temperature of the sample, its mass changing, rate of mass changing and enthalpy changing simultaneously. Curves were reflected on the derivatograph Pauli-Erdene Q-1500 D system with speed increasing temperature 5 ^{0}C/min. The weight of the samples was (150...200) mg. Tape speed was 2mm/min. Simultaneous getting of deryvatohrafichnyh curves – differential thermal analysis (DTA), thermogravimetric (TG), differential-thermogravimetric (DTG) and temperature (T) of moisture removal allows to determine the chemical and physical transformations in the studied samples and conduct qualitative and quantitative assessment of these changes. According to the obtained deryvatohramamy curves temperature peaks and intervals of the removal with different types of connection were determined. According to (TG) curve the number of removed moisture in percent was determined. Classification of forms of bonds was moisture held by Rehbinder P., who identified three groups: chemical, physic-chemical and physic-mechanical [14].

3. Results and discussion.

The dispersion of plasma product affects the stability of the ready product on microbial and oxidative deterioration. The research results are presented in Fig. 1.

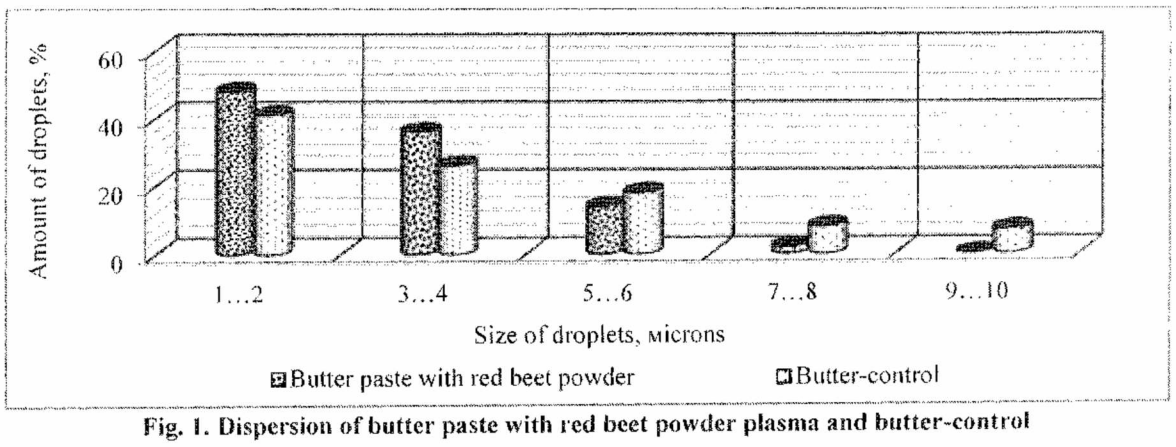

Fig. 1. Dispersion of butter paste with red beet powder plasma and butter-control

According to the obtained results the amount of drops of plasma with diameter (1...2) microns is 48 % in fresh butter paste, in butter-control – 41 %. Moisture droplets with diameter (9...10) microns in the paste are not available, however in the control there are 7 %. In our opinion, the dispersion of droplets of plasma in the butter paste happens by adding red beet criopowder, flaxseeds and inulin with simultaneous realization of homogenization process during the adding of supplements into the product composition. In previous works it is established that red beet criopowder, flaxseeds and inulin are characterized by the ability to connect free moisture and to swell [6,15,16]. Due to such properties of plant additives and simultaneous using of mechanical processing of mix, the presence of more number of the droplets plasma with diameter (1...5) microns was caused, increasing the stability of the ready product to oxidation and microbial deterioration.

Food products are systems in which the moisture has different forms of connection with the hard skeleton. We can identify them, using the method of thermogravimetry. The deryvatohramies of the butter paste with red beet powder and butter-control are shown in Fig.2.

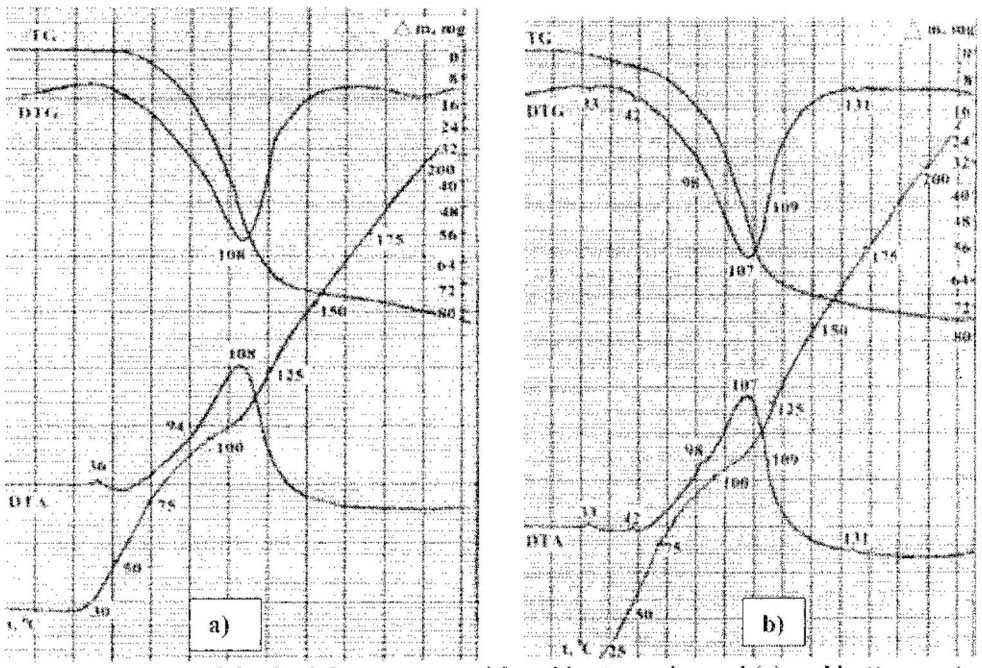

Fig. 2. Deryvatohramms of the fresh butter paste with red beet powder and (a) and butter-control (b)

Analyzing DTA curves of the butter paste with red beet criopowder and butter-control, four main forms of connection of moisture were highlighted by the temperature peaks. By TG curves their number in percent was defined (Table 1).

Butter-control is characterized by a weakly bound in an amount of 11.91 % and 35.09 % strongly bound moisture. Removal of free moisture is held in several stages: first, mechanically connected one at temperatures of 33 ^{0}C and 42 ^{0}C in an amount of 3.76 % is removed, then – 8.15

% osmotic at 98 ^{0}C. Firmly connected moisture is presented by polymolecular form that is removed at temperatures of 107 ^{0}C and 109 ^{0}C in an amount of 33.21 % and by monomolecular with the fixed peak at 131 ^{0}C in an amount of 1.88 %.

Table 1

Forms of connection of moisture in,the butter paste with red beet powder and butter-control

Forms of connection of moisture	Name of fresh sample					
	butter paste with red beet powder			Butter-cjntrol		
	moisture, %		Temperature, ^{0}C	moisture, %		Temperature, ^{0}C
	absolute	relative		absolute	relative	
Weakly bound:	8.02	17.05	-	11.91	25.33	-
mechanical	0	0	36	0.63 3.13	1.33 6.67	33 42
osmotic	8.02	17.05	94	8.15	17.33	98
Firmly bound:	38.98	82.95	-	35.09	74.67	-
polymolecular	32.10	68.30	108	27.57 5.64	58.67 12.00	107 109
monomolecular	6.88	14.65	127	1.88	4.00	131

Unlike butter-control, in the butter paste with red beet powder mechanically bound moisture was not found. Weakly bound moisture is presented by only osmotic connections in an amount of 8.02 %. The temperature peak of removal is 94 ^{0}C. The number of firmly bound monomolecular moisture increases on 5.00 % in comparison with the butter-control. In our opinion, such redistribution forms of connection of moisture is due to the microstructure of plant supplements. In a previous work it is established that red beet criopowder has indestructible mechanical and leading texture of the vegetable that connects free moisture [15]. So, when adding criopowder, the joining of adsorption of moisture of the butter paste by additive particles is done. Proved that inulin has the ability to form strong hydrogen bonds in the structure of butter, increasing the content of tightly bound monomolecular moisture [13]. It is known that adding of the flaxseeds into the composition of butter helps thin dispersion of water's phase droplets due to the formation of additional intermolecular bonds [16]. We assume that inulin and flaxseed have similar properties in the structure of the butter paste as well to. Due the complex effects of plant food supplements the mechanical weakly bound moisture in the ready product is not available, increasing the number of monomolecular tightly connected one.

4. Conclusion.

Adding the complex of plant food additives promotes the dispersion of plasma in the ready product, increasing the amount of droplets with diameter of (1...5) microns.

Red beet criopowder, flaxseeds and inulin lead to increasing the amount of firmly bound, especially monomolecular and absence of mechanical weakly bound moisture in the butter paste.

5. References

[1]. RASHEVSKAYA T., GULYI I., UKRAINETS A. Biochemical studies of the butter with plant food additives during storage, *Food industry*, 2: 15–18, (2003)

[2]. VISHEMIRSKII F., TOPNIKOVA E., LOBACHEVA T. Assortment of the butter with flavor filler, *Cheese and butter manufacture*, 6: 37–39, (2005)

[3]. TOPNIKOVA E. Butter with low fat mass and his analogues, *Cheese and butter manufacture,* 3: 10–12, (2006)
[4]. IVANOV S., RASHEVSKAYA T. The butter paste with complex of biologically active plant micronutrients of antidiabetic purpose, *The Scientific works of NUFT,* 43: 85–94.
[5]. BARCLAY T. Inulin – a versatile polysaccharide with multiple pharmaceutical and food chemical uses, *J. Excipients and Food Chem.,* 1(3): 27–50, (2010)
[6]. IVANOV S. Flaxseed additive application in dairy products production, *Procedia Food Science,* 1: 275–280, (2011)
[7]. MUIR A. Flax seed constituents and human health, *Flax: The genus Linum, ed. by A.D Muir, N.D Westcott, Taylor & Francis Inc.:* 243–257, (2003)
[8]. UPUR L., KOVALEV V. The research of biologically active substances in beetroot, *Physiologically active substances,* 2(32): 82–86, (2001)
[9]. RASHEVSKAYA T., GONCHAROV G., PODKOVKO O. The method of the producing of the butter paste. Patent UA, no. 108443, 2015.
[10]. RASHEVSKAYA T., GONCHAROV G., PODKOVKO O. Butter paste with red beet powder, *The Scientific works of NUFT,* 53: 7–14, (2013)
[11]. PODKOVKO O., RASHEVSKAYA T. Indicators of structure and consistency of butter paste research, *Scientific works of UFT (Plovdiv),* LXI, I: 163–166, (2014)
[12]. RASHEVSKAYA T. Analysis of water connection in the butter with red beet criopowder, *News of Higher Education. Food technology,* 1: 36–38, (1999)
[13]. RASHEVSKAYA T. Influence of Pectin on Water and Fatty phases states in Butter, *Journal of Food Physics,* XI–XII: 39–45, (1999)
[14]. REBINDER P. Surfactants in science and technology. Moscow, 1961. 46 p.
[15]. PODKOVKO O. RASHEVSKAYA T. Investigation of technological characteristics of red beet powders for use in the composition of the butter paste, *Collection scientific works of VNAU. Technical science,* 2(90): 62–66, (2015)
[16]. MACHONINA M., RASHEVSKAYA T., UKRAINETS A. Dispersion of the plasma in butter with flaxseeds, *The Scientific works of NUFT,* 32: 94–96, (2010)