ABSTRACT AND REFERENCES

TECHNOLOGY AND EQUIPMENT OF FOOD PRODUCTION

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RESEARCH INTO TECHNIQUES FOR MAKING WHEAT BREAD ON HOP LEAVEN (p. 4-9)

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We investigated saccharification process of bitter scaldings depending on the parameters of their preparation and established that the largest intensity of sugar accumulation occurs within one hour of saccharification at a mass fraction of moisture in scalding of 78.0 %. The developed bitter sourdough is recommended for the technology of rye-wheat bread with a small content of rye flour (10...12 %) or wheat bread from graded flour.

It is recommended using the four-phase technique of dough preparation according to the following scheme: "saccharized" "bitter" scalding → scalding soured with the homofermentative thermophilic lactic acid bacteria L. Delbrükii-76 → hop leaven, soured with yeast of the race S. cerevisiae L-1 and the homofermentative mesophilic lactic acid bacteria L. Plantarum-30 → dough". When using 25 % of sourdough, the acidity of dough and finished products is reduced by 2.0 degrees. That is why we recommend utilizing a given technique for making bakery products from wheat flour. This provides for the better fluffiness and state of the crumb, as well contributes to retaining the freshness of bakery products. The results of research allowed us to devise a technological scheme of production, which can be implemented at specialized lines.

Keywords: bitter scalding, hop leaven, sponge dough, lactic acid bacteria, bread, staling.

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EFFECT OF THE CRYOPOWDER "AMARANTH" ON THE TECHNOLOGY OF MEOLTEN CHEESE (p. 10-15)

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The expediency of using the cryopowder "Amaranth" in the technology of molten cheese is substantiated. The cryopowder "Amaranth" contains necessary vitamins and microelements of natural origin. Applying the cryopowder "Amaranth" in the technology of molten cheese allows enriching it with vitamins, mineral nutrients and food fibers. The main factors for the introduction of cryopowder "Amaranth" were the normative organoleptic assessment of the product and the daily need in its consumption.

Based on the organoleptic characteristics of molten cheese with the cryopowder "Amaranth", it was established that the examined samples of cheese retain delicate, elastic consistency. They have distinctive original taste and flavor (similar to butter). The cut had a homogeneous pattern, the dough was colored from light-yellow to yellow with distinct inclusions of amaranth (black and red color). The surface of the examined samples was clean, shiny, which matches the standards.

The tested samples had attractive physical appearance. Adding the cryopowder "Amaranth" to molten cheese resulted in an increase in biological value. The molten cheese, produced with the use of cryopowder "Amaranth", combines traditional consumer properties with the technological capabilities of functional-technological ingredients of plant origin.

Keywords: molten cheese, energy value, cryopowder, physical-chemical characteristics, biological value.

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SURVEY OF CHARACTERISTICS OF DAIRY-PROTEIN CONCENTRATES IN THE LOW-TEMPERATURE STORAGE PROCESS (p. 16-21)

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The influence of low-temperature refrigeration treatment on the structure and organoleptic parameters of milk-protein concentrates (MPC), obtained with the use of cranberry and viburnum purees, was determined and analyzed.

The study of low-temperature phase transitions and glass transition of the MPC structure was made during cooling at a rate of 200 °C/min by immersion of the samples in liquid nitrogen. It was found that the structure of concentrates is amorphous, it can be considered relatively stable in the solid state. It was determined that the leaps of heat absorption were larger for the concentrates obtained with the use of berry purees than for the control sample. This indicates a large amount of bound liquid in the products, what allows reducing crystallization and avoiding significant structural changes.

The analysis of changes in the color-parametric characteristics of MPC indicates an increase in the intensity of light reflection at 550...700 nm, that is, in the yellow-red area of the spectrum, after 30 days of low-temperature storage. There are gradual yellowing and darkening of the product.

The theoretical and experimental research allowed determining the rational periods of storage of MPC in the frozen state, which are not more than 30 days at temperatures not higher than –20 °C. The possibility of predicting changes in the quality of food products obtained with the use of MPC, if stored at low temperatures, was obtained.

Keywords: milk-protein concentrate, differential scanning calorimetry, color-parametric characteristics, storage time.

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DEVELOPMENT OF A THEORETICAL MODEL FOR THE INTENSIFICATION OF TECHNOLOGICAL PROCESSES FOR MANUFACTURING DAIRY PRODUCTS (p. 22-32)

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A dependence is established between the amount and forms of calcium in milk and its technological purpose. It is proven that a controlled reduction in the content of calcium in milk (specifically, its ionic form) increases thermal stability of milk in the range of lowered values of pH, which resolves the task on compatible use of milk and acid-containing raw materials (concentrates of juices and puree) in the composition of beverages. The substantiated increase of ionic calcium in milk also implements the principles of optimization of technological processes for its processing, in particular when producing cottage cheese. We constructed a theoretical model of the controlled intensified technologies of dairy products, underlying which is the quantitative and qualitative analysis of physical-chemical properties of the components of compounds in the system "milk", specifically calcium. It was proven that in line with the devised model the process of stabilization/destabilization of the colloidal state of the system "milk" is accompanied by the formation of a new phase under condition of introducing certain substances that can control the thermodynamical potential of the system. The model developed was verified in the course of implementation of the technological process for manufacturing skimmed milk with controlled thermal stability. It was proven that the introduction of sodium alginate to the system "milk" leads to a reduction of the undesirable potential through lowering and redistribution of calcium by forms.

It is shown that a given effect is the result of decomposition of casein micelles into submicelles and it manifests itself by an increase in the resistance of the system to thermal influence. We tested the devised model in the course of implementation of the technological process for manufacturing cottage cheese. It was proven that the controlled regulation of the content of ionized calcium and pH of the system through blending the system "milk" with the transformed system (serum) in certain quantities makes it possible to intensify the technological process for manufacturing sour milk cheese and to obtain products with high organoleptic properties.

Keywords: theoretical modeling, thermodynamic potential, ionic calcium, micellar calcium, phase equilibrium, coagulation, conditions of stability, decalcification, cottage cheese, sour milk cheese.

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DEVELOPMENT OF THE FORMULATION AND QUALITY ASSESSMENT OF IMMUNOSTIMULATING FRESH-MIXES WITH A BALANCED POTASSIUM-PROTEIN COMPOSITION (p. 33-39)

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Using the methods of mathematical modeling, we developed formulations for the immunostimulating fresh-mixes. We determined the percentage of plant raw materials, which corresponds to maximum potassium content in the formulation and the con-

tent of glutin within 1...5 %. In this case, the content of oxylizine and hydroxyproline, the source of which is glutin, was regulated within a range of 0.15... 0.2 g/100 g. The limiting value in mathematical modeling of the developed formulations was an energy value in fresh-mixes, which amounted to 60 kcal.

We determined biological activity of the obtained drinks. The fresh-mix "Potasium mix" has a biological activity of 250 standard units, "Potasium-mix plus" – 1,596 standard units. When developing the fresh-mix "Potasium-mix plus", we established the synergistic effect through the introduction to the formulation of the fresh-mix of spicy-aromatic raw material, turmeric, and the raw material of protein nature – glutin.

Assessment of the quality of these products showed that the weight of significance of the fresh-mixes "Potasium-mix" and "Potasium-mix plus " amounted to 0.94 and 0.98 units, respectively.

By employing the ALST test, we identified storage conditions for the developed fresh-mixes. It was established that when storing the beverages can be stored for 5 days at a temperature of (5±1) °C in an air-tight container without changes in microbiological and sensory indicators.

Keywords: integrated quality assessment, immunostimulating beverage, nutritional value, shelf life.

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DEVELOPMENT OF THE BIOTECHNOLOGY FOR OBTAINING A DIETARY SUPPLEMENT FROM THE SELENIUM-CONTAINING PROBIOTIC CULTURES *LACTOBACILLUS ACIDOPHILUS 412/307* AND *BIFIDOBACTERIUM BIFIDUM 1* (p. 40-49)

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The relevance of creating a new dietary supplement based on the selenium-containing cultures of lacto- and bifidobacteria was proven. We have chosen the optimal source of selenium – sodium selenite (Na_2SeO_3), adding which to the cultivation medium of microorganisms ensures maximum accumulation of organic forms of selenium in the examined microorganisms.

We have established the effect of concentrations of sodium selenite on an increase in the biomass of lacto- and bifidobacteria. Concentrations of Na_2SeO_3 exceeding 8 μg/cm^3 cause the inhibition of growth in the lactobacilli biomass when compared with control. The growth of biomass of bifidobacteria is inhibited under the influence of the concentration of Na_2SeO_3 above 5 μg/cm^3. Applying the indicators of optical density, we determined values for a specific growth rate and the duration of generation of biomass of the examined microorganisms. The dynamics of selenium accumulation by the cultures Lactobacillus acidophilus 412/307 and Bifidobacterium bifidum I was studied. A direct dependence was established between the quantitative content of inorganic selenium in the environment of cultivation and the content of organic selenium in bacterial cells. Adding the concentration of sodium selenite equal to 0.5 μg/cm^3 provides for obtaining 105 μg of organic selenium per one gram of dry biomass of lactobacilli; this indicator for bifidobacteria is 97.5 μg/g. At a concentration of Na_2SeO_3 equal to 20 μg/cm^3, 4,698 μg of organic selenium is biotransformed in the biomass of lactobacilli and 3,149 μg –in the biomass of bifidobacteria.

Based on the data derived, we have developed a technological scheme for obtaining the dietary supplement with the quantitative content of organic selenium at 202.5±1 μg/g. The content of lactobacilli was 1.0×10^9 CFU/cm^3; that of bifidobacteria – 1.2×10^8 CFU/cm^3.

Keywords: probiotics, dietary supplements, sodium selenite, bifidobacteria, lactobacilli, selenoproteins, optical density.

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DEVELOPMENT OF A PHYSICAL-MATHEMATICAL MODEL FOR THE PROCESS OF CRYSTALLIZATION OF MEAT SYSTEMS (p. 50-56)

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It is proven that the complex of processes that occur during freezing-defrosting of meat systems cannot be described within the framework of the theory of freezing out true solutions. A characteristic feature of meat systems is the heterogeneity in terms of chemical composition, structure and properties. Given this, within the framework of the proposed physical-mathematical model for the process of crystallization, meat system is regarded as a colloidal capillary-porous body. In this case, a process of crystallization is considered as the superposition of two processes: freezing out free moisture (basic process) and a competing process for increasing binding energy for the bound moisture. It was established that the aforementioned processes differently depend on temperature: the speed of freezing out moisture decreases with a decrease in temperature while the rate of the competing process, on the contrary, increases. It was theoretically predicted and experimentally proven that a change in the information parameters of effective specific heat capacity is the criterion of reversibility of the process of low temperature treatment. As revealed by computer simulation, the proposed model more adequately reflects the actual character of dependence of the effective specific heat capacity of meat systems with different composition and properties.

Based on the proposed physical-mathematical model for the crystallization of meat systems, we have developed a method for determining effective specific heat capacity (C_e) using the thermograms of freezing-defrosting. Information parameters, which were derived from the temperature dependence of effective specific heat capacity, are: $t_{cr/mel}$ is the temperature of maximum rate of crystal formation (melting), ^oC; Δt_{cr} is the cryoscopic interval of temperatures, ^oC; ΔH_{cr} is the specific heat of phase transition in a cryoscopic interval of temperatures, J/K; $\Delta\omega$ is the share of moisture, which changes its aggregate state in a cryoscopic interval of temperatures (the amount of free frozen out or melted moisture).

The study conducted became the basis for the scientific substantiation of technologies for manufacturing semi-finished frozen minced meat products for the criterion of reversibility.

Keywords: meat systems, freezing, crystallization, physical-mathematical model, effective specific heat capacity.

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STUDY INTO EFFECT OF FOOD FIBERS ON THE FERMENTATION PROCESS OF WHEY (p. 56-62)

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We report the results of research on the effect of food fibers on the fermentation process of whey – the base of beverages. By using the method of IR spectroscopy, we studied various forms of moisture bonds of apple pectin in fiber and orange fruit fibers Citri-Fi with water or whey. The results obtained show the existence of strong hydrogen bonds and high concentration of the movable proton. High sorption capacity for water is observed. This effect is important in terms of regulating the viscosity of wort. By employing mathematical modeling, we established conditions for the preparation and introduction of Citri-Fi to whey for obtaining beverages with enhanced viscosity. The visualization is provided of the transformations of dry Citri-Fi when swelling in whey – an increase in the volume of tubular fibers. For the basic indicators of fermentation (the content of carbon dioxide, the amount of formed ethyl alcohol and yeast cells, the content of reducing sugars) we defined rational conditions for the fermentation of whey-plant wort with enhanced viscosity. During fermentation using the race Zygosaccharomyces lactis 868-K, the most intensive growth of yeast cells at the level from 42.3 to 71.3 mln/cm^3 was observed over the interval of 6...24 hours of fermentation. The dynamics of accumulation of carbon dioxide in wort is correlated to the indicators of growth in yeast cells. The data obtained indicate a certain oppression of yeast development in whey-plant wort. This is due to the presence of colloidal substances of whey and the residue of insoluble components of food fibers. We established a fermentation temperature of whey-plant wort with enhanced viscosity – 30...32 °C, at which there is a sufficient accumulation of ethyl alcohol at the level of 0.64...0.69 % by volume. Further increase or decrease in temperature results in a decrease in the amount of alcohol, indicating a decrease in the activity of cell enzymes. We have proven the possibility to apply the results obtained for developing a technology for manufacturing whey-based fermented beverages with enhanced viscosity.

Keywords: whey, food fibers, fermentation, yeast Zygosaccharomyces lactis 868-K, whey-plant wort with enhanced viscosity.

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DETERMINATION OF THE ENZYME DESTRUCTION RATIONAL MODE OF BIOMASS AUTOLYSATE OF LACTIC ACID BACTERIA (p. 63-68)

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It is shown that the degradation products of peptidoglycans of lactic acid bacteria cell walls that are related to the muramyl peptide series compounds are promising components of food ingredients and dietary supplements for the nutritional support of the population suffering from disorders of the immune system.

The expediency of autolysis of lactic acid bacteria biomass to increase the enzymatic degradation efficiency of peptidoglycans of their cell walls has been proven. The accumulation of low molecular weight peptides in the enzymatic hydrolysis of biomass under rational parameters, which was not subjected to autolysis, is 0.260 mg/cm^3, in the enzymatic hydrolysis of biomass that was subjected to autolysis is 0.569 mg/cm^3. Rational regimes of enzymatic hydrolysis of the composition of lactic acid bacteria (enzyme concentration of 12.5 mg/cm^3, substrate concentration of 70.0 mg/cm^3, duration of enzymatic hydrolysis of 245.6 min) were determined using mathematical planning methods of multifactorial experiments, which made it possible to significantly optimize and improve the work efficiency.

The affiliation of low molecular weight peptides obtained under the rational conditions of enzymatic hydrolysis to immunological compounds of the muramyl peptide series has been proven by gel chromatography and IR spectroscopy methods. It is determined that the molecular weight of the obtained low molecular weight peptides is in the range of 294–650 Da, which, in fact, corresponds to the molecular weight of muramyl dipeptide and glucosaminylmuramyl dipeptide. In the IR spectrum of low molecular weight peptides, the absorption bands are noted, which correspond to fluctuations of free amino groups, peptide bonds, which, in fact, occur in the structure of peptides, pyranose glucose forms that are part of muramic acid and N-acetylglucosamine of peptidoglycan, muramyl dipeptide and glucosaminylmuramyl dipeptide. Also, fluctuations of β-glycoside bonds, which binds the remains of muramic acid and N-acetylglucosamine in peptidoglycan and glucosaminylmuramyl dipeptide are marked in the IR spectrum of low molecular weight peptides.

Keywords: biomass, lactic acid bacteria, autolysate, enzymatic hydrolysis, pancreatin, peptidoglycan, muramyl peptide, immunotropic properties, mathematical modeling.

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EFFECT OF LACTIC ACID MICROORGANISMS ON THE CONTENT OF NITRATES IN TOMATO IN THE PROCESS OF PICKLING (p. 69-75)

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We established the content of nitrates in vegetables and studied special features in the course of microbiological and denitrification processes during pickling of tomatoes with a different content of nitrates. It was found that 15 % on average of the samples of vegetable produce, grown in open ground, contained the amount of nitrates that exceeded MPC (maximum permissible concentration). For vegetables grown in greenhouses, the number of samples with the nitrate content above the norm reached 25–30 %. It was discovered that in the process of pickling tomatoes with the amount of nitrates at 137±10 mg/kg (within MPC), there occurs an intensive growth of lactic acid microorganisms. As a result of the reproduction of lactic acid microflora, there happens a denitrification process with the amount of nitrates in pickled tomatoes reduced to 17±2 mg/kg. When pickling tomatoes with a nitrate content twice as large than MPC at 619±32 mg/kg, microbiological and denitrification processes slow down at the beginning. Then they are recovered with the amount of nitrates reduced to 134±5 mg/kg. When pickling tomatoes with the nitrate content five times larger than MPC (1,576±114 mg/kg), the pickling does not occur because of the inhibiting influence of nitrates on the growth of microflora.

Thus, the data obtained indicate that the tomatoes that contain nitrates within 600–700 mg/kg can be used for the preparation of pickled products. Vegetable produce containing nitrates in the amount above 1,500 mg/kg must not be used in pickling due to the inhibiting influence of nitrates on lactic acid microflora.

Keywords: nitrates, vegetable produce, denitrification process, microbiological process, lactic acid microflora.

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