ABSTRACT AND REFERENCES

TECHNOLOGY AND EQUIPMENT OF FOOD PRODUCTION

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RESEARCH ON OXIDATIVE STABILITY OF PROTEIN-FAT MIXTURE BASED ON SESAME AND FLAX SEEDS FOR USE IN HALVA TECHNOLOGY (p. 6-14)

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The analysis of the main methods of modeling the formulations of protein-fat mixtures for special purposes has been conducted. Considerable attention is paid to the choice of methods for stabilizing their lipid component from oxidative damage. The urgency of increasing the oxidative stability of the protein-fat mixtures due to natural antioxidants is emphasized. The feasibility of comprehensive studies of their effect on the stability to oxidation of the most labile biologically active substances of protein-fat mixtures is substantiated.

The content of furan antioxidants in the sesame seeds of Ilona, Kadet, Boyarin varieties has been determined. The correlation between the content of free and bound sesamol (sesamolin) has been determined. The content of α-linolenic acid and tocopherols in seeds of Southern Night, Kivik, Sympatik flax varieties has been also investigated. The choice of sesame and flax varieties for the creation of protein-fat mixture for special-purpose, which is a source of ω-3 group polyunsaturated fatty acids and antioxidants (sesamol and sesamolin), is justified.

The effect of sesamolin content and moisture in the seeds of Ilona variety sesame on the oxidation resistance of its lipid component has been studied. A mathematical dependence describing such effect has been obtained. A regularity of increasing oxidation stability of sesame lipids with increasing its moisture content from 4.0 to 9.5 % has been revealed. This can be explained by sesamolin hydrolysis intensification with the release of sesamol and samin antioxidants.

The stabilization effect of α-linolenic acid of flaxseed (Southern Night variety) by free sesame sesamol in the protein-fat mixture for special-purpose has been studied. It has been proved that a rational ratio of ω-3 fatty acids and sesamol has a significant effect on the inhibition of lipid oxidation of the protein-fat mixture for special purposes.

The content of the protein-fat mixture for special-purpose in sunflower halva at the level of 20 % has been substantiated using a sensory evaluation method. The oxidative stability, organoleptic and physicochemical quality control parameters of the product have been investigated. It has been determined that the oxidation stability (and, accordingly, the predicted shelf life) of model samples of sunflower halva depend on the content of protein-fat mixture in them.

Keywords: sesame, flax, sesamol, sesamolin, α-linolenic acid, protein-fat mixture, oxidative damage, antioxidants, sunflower halva.

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INVESTIGATION OF FLAXSEED MEAL PROTEINS AND THEIR INFLUENCE ON WHEAT DOUGH (p.15-23)

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For the purpose of enrichment by protein substances, balanced by amino acid composition, the feasibility of using flax meal in the recipe of bakery products, which are the basis of diets, including in restaurants, is substantiated.

As a result of the study of gluten microstructure, it was found that compared to the control, the gluten walls with flaxseed meal thicken and the pore sizes decrease. This increases the elastic properties of gluten.

Experimental studies of extraction of protein fractions by solubility revealed that the main proteins of the meal are albumins and globulins. It should be noted that a significant amount of flaxseed meal protein substances of 14.34 % was in the insoluble precipitate.

It has been established that flax meal proteins also affect the process of conversion of the protein fractions in wheat dough during its maturation. It has been investigated that gluten nitrogen content decreases by 17.0 % due to the transition of gluten nitrogen to water-soluble and intermediate fractions. This leads to an increase of the nitrogen content in these fractions in the test sample, compared with the control and proves changes in the rheological properties of the dough, because such properties depend on the ratio of these fractions.

During the investigation of the mixture of flour with flax meal, it was found that in the case of increasing the dosage of meal from 2.5 to 7.5 %, the water absorption capacity increases, which is associated with a higher hydration capacity of albumin and globulin of flaxseed meal than gluten proteins. The rarefaction grows if the duration of kneading increases, which is associated with the formation of the liquid phase of the dough by water-soluble meal proteins.

Flax meal can be a source of protein substances for enriching food, due to its chemical composition. However, using meal causes changes in biochemical processes that need to be adjusted to ensure the required quality of products.

Keywords: flax meal, wheat flour, proteins, fractional composition, amino acids, gluten.

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STUDYING THE OPERATION OF INNOVATIVE EQUIPMENT FOR THERMOMECHANICAL TREATMENT AND DEHYDRATION OF FOOD RAW MATERIALS (p. 24-32)

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The paper reports results of investigating innovative equipment for the integrated processing of food raw materials, which would make it possible to implement the local energy influence directly on the particles of a dispersed material, the near-boundary layer, the moisture retained in the product's solution or capillaries.

The analysis of food raw materials processing techniques has been performed, their benefits and shortcomings have been identified. It was found that product quality, energy consumption and cost are mainly determined at the stages of thermal processing, drying.

We have examined innovative equipment based on rotary thermosiphons for evaporating food non-Newtonian liquids. An experimental bench has been designed, and the procedure for studying the hydrodynamics of condensate motion in condensers of rotary thermosyphons of various structures has been devised. The experimental bench represents a model of the device with a rotary thermosiphon made of glass. The result of our study is the established rotational frequency, at which a condensate is locked by the centrifugal force for a branched condenser. Results from visualization of vapor-condensate movement have been presented.

The innovative equipment for the evaporation of food non-Newtonian liquids under SHF radiation conditions has been inves-

tigated. Experiments involved food products and model systems. We have determined the degree of an increase in the concentration of non-aquatic components. Evaporation rate under conditions of SHF radiation is almost constant.

The innovative equipment for drying fruit- and vegetable-based slices under conditions of IR radiation has been examined. An experimental bench has been designed and the research procedure has been devised. We have proposed the structure of an equation for calculating the mass transfer coefficient. The database of experimental findings has been generalized in the equation by similarity numbers. The equation makes it possible to calculate a mass transfer coefficient with error within ±15 %. The influence of IR radiation power on the kinetics of the process of drying fruit and vegetable slices has been determined. We have compared experimental data on slice drying under conditions of SHF and IR radiation.

Keywords: rotary thermosyphons, infrared drying, microwave evaporation, fruit, vegetable slices, process modeling.

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ESTABLISHING TEMPERATURE AND TIME FACTORS FOR THE POST-PASTEURIZATION OF GOURMET MEAT PRODUCTS (p. 33-39)

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Effect of short-term thermal treatment of the ready-to-eat gourmet meat product on microbiological, physicochemical, and organoleptic parameters was investigated.

Based on modeling the processing temperature and time, rational post-pasteurization conditions have been developed that maximize the product shelf life while maintaining its high quality.

Dependences of influence of post-pasteurization on microbiological characteristics were obtained and it was proved that the developed conditions effectively suppress the surface microbiota.

Studies on determining rational conditions of post-pasteurization were performed in a temperature range of 75–90 °C at a duration of 1–4 minutes.

Post-pasteurization at 90 °C for 1–2 min. and at 75–85 °C for 3 min. reduces the degree of bacterial contamination, however, the product shelf life does not increase. Treatment at 90 °C for 4 min.

significantly reduces the amount of microorganisms, extends shelf life but a change of the product appearance was observed.

It was found that the temperature of 90 °C and duration of 3 min. are the rational conditions of post-pasteurization. Study of bacteriological effects achieved by the use of post-pasteurization under these conditions was presented.

Influence of post-pasteurization conditions on the key qualitative characteristics of the ready-to-eat product has been investigated. It was established that the above method of thermal treatment does not cause syneresis of free moisture which is important for vacuum packaging of meat products.

Considering the fact that pH influences microbiota growth, hydrogen ion concentration studies were performed immediately after post-pasteurization and during storage.

It was proved that the use of the developed post-pasteurization conditions makes it possible to extend shelf life of whole-muscle gourmet meat products in vacuum packaging by 10 days.

Keywords: post-pasteurization, thermal treatment, microbiota, gourmet meat products, shelf life.

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COMPARISON OF PRODUCTS OF WHEY PROTEINS CONCENTRATE PROTEOLYSIS, OBTAINED BY DIFFERENT PROTEOLYTIC PREPARATIONS (p. 40-47)

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An important source of bioactive peptides is hydrolyzed products based on milk whey: hypoallergenic products, hydrolyzates for baby food, and products for athletes. However, in their production, proteolytic preparations of different origin are used. This may affect the degree of proteolysis of the biologically active peptides (BAP) proteins-precursors, the proteolysis products molecular weight distribution and, accordingly, the probability of BAP formation. A comparison of the degree of whey protein concentrate (WPC) proteins proteolysis and the molecular weight distribution of proteolysis products obtained by the action of proteolytic preparations of animal, plant and microbiological origin has been carried out. The following enzyme preparations were used for proteolysis: papain, neutral protease, trypsin, chymotrypsin and pancreatin. WPC was used as the substrate. The proteins fractional composition and the molecular weight distribution of proteins and peptides were characterized in it before the proteolysis. Proteolysis of 15 % WPC solution was carried out at a temperature of 37°C, pH 7.9 and enzyme: substrate ratio 1:20. During proteolysis, samples were periodically taken off for spectrophotometric determination of proteolysis products soluble in 5 % trichloroacetic acid (TCA). Molecular weight distribution of the resulting polypeptides and peptides was established by gel filtration of the reaction mixture after deposition of the unsplit proteins in 5 % TCA.

As a result of the research, it was found that the majority of proteolysis products were formed during the first 30–60 minutes. Proteolysis was mostly completed by 120 minutes. Gel filtration on Sephadex G-50 showed that hydrolysates differ by molecular weight distribution. The highest amount of low molecular weight peptides (M<1,500 Da) was obtained by the action of neutral protease (29 %) and pancreatin (25 %). The main precursor of BAP – β-lactoglobulin, according to the results of electrophoresis, showed the highest sensitivity to the action of neutral protease (79 %), pancreatin (81 %) and trypsin (71 %).

Keywords: whey protein concentrate, proteolytic preparation, proteolysis, bioactive peptides, gel filtration, electrophoresis.

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SUBSTANTIATION OF THE EXPEDIENCY TO USE IODINE-ENRICHED SOYA FLOUR IN THE PRODUCTION OF BREAD FOR SPECIAL DIETARY CONSUMPTION (p. 48-55)

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We have studied the possibility of using iodine-enriched soy flour in the process of making bread for people suffering from iodine deficiency, diabetes and celiac disease. The organoleptic, physical-and-chemical, and microbiological indicators have been investigated, as well as the content of toxic elements and iodine content in the developed soy flour. The rationally permissible formulation ratios have been proven experimentally. The quality indicators confirmed the possibility of using enriched soy flour in the process of making bread for special dietary consumption.

The conducted complex of studies provides recommendations for technologists for production of bread with special dietary properties. That will make it possible to expand a range and to fill the market with products, which are in short supply now. A lack of the mentioned products is about 15 % of the total production of bakery products. We established that the iodine content is 50 μg per 100 g in the developed soy flour. The developed flour complies with the regulatory and technical documentation for food soy flour in terms of quality and safety. The rational dosage of the developed soy flour to green buckwheat flour is 10 % in new bread formulations. It will be rational to replace 15 % of buckwheat flour with 10 % of the developed soy flour and 5 % of carrot or beet powder in products with vegetable powders.

The bread developed according to new formulations complies with DSTU 4588 for "Bakery products for special dietary consumption" in terms of organoleptic and physical-and-chemical parameters. The content of organically bound iodine is 48.9; 49.4; 50.0 mcg per 100 g 72 hours after baking in the bread made by the new formulations.

Our study has made it possible to state that bread that is made according to the new formulations satisfies 1/3 % of the daily need for iodine.

Keywords: soy flour, diabetes, celiac disease, bakery for special dietary consumption.

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DEVELOPMENT OF A POLICOMPONENT COMPOSITION OF SMUZ USING BIOTECHNOLOGICAL AND MATHEMATICAL MODELING AND DETERMINATION OF ITS FOOD VALUE (p. 56-65)

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We have determined parameters for an amino acid SCORE of the protein system, which consisted of solutions with different concentrations of collagen hydrolysate in whey (2 %, 4 % and 6 %). It has been shown that all solutions have a balanced content of essential amino acids. However, we selected to study a food system, which had a collagen hydrolysate concentration of 4 %, to ensure the daily need of the human body.

Foaming in the carbohydrate-protein system was studied depending on the ratio of apple pectin and collagen hydrolysate in whey (0.5: 1.1:1, 1:0.5). We carried out whipping at a temperature of 10 °C for 60 seconds. The obtained data revealed the optimal ratio of basic carbohydrate-protein raw materials: the concentration of collagen hydrolysate – 4 %, the ratio of pectin:collagen hydrolysate –1:0.5.

A formulation has been developed for aerated smoothies based on whey, fruit juice, apple pectin and collagen hydrolysate with a high content of macronutrients using mathematical modeling. Analysis of the consumer value of the developed product showed that the content of the main macronutrients was 22.64 g per serving (200 g) or 11.32 g per 100 g. The ratio of the main mineral substances of calcium, magnesium and phosphorus was 1:0.11:0.6. Analysis of the amino acid SCORE showed that the developed product had a high degree of digestibility of essential amino acids due to the absence of a limiting amino acid with a SCORE less than 100 %.

Determination of biological activity showed that the biological activity was 8.1 times higher on average for a finished smoothie than for its components, which indicated the synergism of antioxidant substances.

Evaluation of sensory parameters of the developed smoothie showed high quality characteristics of the new product, which is important for products for restaurant establishments. The total score by sensory indicators was 33.8 points out of 35 possible points.

Keywords: mathematical modeling of product formulations, quality determination, aerated drinks, collagen hydrolysate, foaming, food foams.

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STUDYING THE EFFECT OF FORMULATION COMPONENTS ON THE PHYSICAL-CHEMICAL PROPERTIES OF SWEET SAUCES THAT CONTAIN PHYSICALLY-MODIFIED STARCHES (p. 66-73)

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We have defined reference indicators for the consistency of sweet sauces depending on the content of starches, which has become a prerequisite for the development of a formulation for sweet sauces using physically-modified starches.

The influence of formulation components (the type and content of physically-modified starches, fruit and berry raw materials, sugar content) has been examined on the physical-chemical and structural-mechanical properties of model fruit and berry systems, which predetermines a possibility to regulate the rheological characteristics of sweet sauces. It has been established that the effective viscosity is increased with an increase in the concentration of physically-modified starches from the "Prime" and "Endura" series. Based on the rheological study into fruit-and-berry model systems, the rational ranges of content of the physically-modified starches have been determined for dressings, toppings, dips, and fillings. Thus, to obtain dressings based on a fruit and berry puree or concentrated juice, the content of starch "Prime" should be from 0.5 % to 1.5 %, starch "Endura" – 1.5....3.0 %. To prepare toppings, the rational content range of starch "Prime" in the system should vary from 3.0 % to 5.5 %.

For fillings, dips, which have a denser consistency with a "short" texture, the content of starch should be about 7.0 %.

During an experimental study, the rational range of white sugar concentration for sweet sauces has been determined. Thus, the concentration of white sugar exceeding 15 % leads to forming viscous-fluid elastic systems suitable for toppings. It was established that at concentration of 20 % the consistency is viscous-dense, characteristic of the consistency of dip sauces. It was found that further increase in the concentration of sugar from 25 to 30 % leads to forming a gel-like elastic consistency.

The rheological indicators of model fruit and berry systems at different content of starch during long-term storage (90 days) have been examined. The terms of storing sweet sauces have been defined.

A research was carried out to determine the stable indicators for sweet sauces during a "freezing-thawing" cycle.

Keywords: sweet sauces, physically-modified starches, fruit and berry raw materials, model systems, viscosity.

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