



## CHEMICAL AND TECHNOLOGICAL SYSTEMS

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## RESEARCH OF SAFETY OF FLAX FIBERS FOR PRODUCTS OF MEDICAL AND SANITARY-HYGIENIC APPOINTMENT

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Modern natural fibers, including flax, from the point of view of safety for humans should be considered in terms of their chemical composition. Regulatory documents on this issue are imperfect. The reasons for this are the lack of regulation of the chemical composition of flax fiber and normalization of heavy metals in it. Therefore, the object of this research is the process of development of regulatory documents on the safety of flax fiber of medical and sanitary-hygienic appointment.

It is proposed to develop modern regulatory documents taking into account the requirements of the international standard Oeko-Tex Standard 100 and the requirements of the State Sanitary Norms and Regulations. At the same time, the maximum permissible concentration of all chemical elements in flax fiber is the regulation criteria. The proposed recommendations will contribute to increasing the requirements for fiber safety and minimizing the appearance of dangerous textile products on the Ukrainian market, the production of which spends considerable resources.

The introduction of these results at the enterprise will contribute to the expansion of the assortment of safe products of medical and sanitary-hygienic appointment and markets for its sale.

**Keywords:** maximum permissible concentration, hazard class, heavy metals in flax, safety of flax fiber.

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## FOOD PRODUCTION TECHNOLOGY

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### RESEARCH OF THE OILSEEDS RATIO ON THE OXIDATIVE STABILITY OF THE PROTEIN-FAT BASE FOR SPORTSMEN

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The problem of improving physical performance and accelerating the course of recovery processes after physical exertion is one of the most pressing problems of medicine and sports. Nutrition is one of the main controlled factors that ensure the normal development of the body, health and quality of life. Nowadays the assortment of products is mainly expanded due to introduction of new technologies, application of new chemical compounds, development of genetic engineering. At the same time, daily food cannot provide the athlete's body with nutrients in the required amount. And, as a result, in recent years, to speed up regeneration, actively replenish spent plastic and energy resources, very

often in sports use biologically active additives. One of the promising areas for improving the efficiency of athletes is the introduction in food rations qualitatively new food products that meet the needs of their body and at the same time have a long shelf life.

The aim of this study is to evaluate the oxidation processes of the protein-fat basis, which can be used to organize the rational nutrition of athletes. The oxidative stability of the crushed sunflower seeds, sesame seeds, flax and mixtures was studied at various component ratios. It has been established that sesame seeds are the least susceptible to oxidation, and most of all – flax seeds. Among mixtures of seeds, the most prone to oxidation are mixtures that contain flax seeds and sunflower seeds. When adding sesame seeds to the mixture, the oxidative stability increases sharply. The optimal content (% by weight) of oil seeds in a protein-fat basis was calculated using the method of mathematical experiment planning in the software package «Statistica». The period of induction of oxidation of this mixture is 1.3–1.4 times higher than the induction period of sunflower seeds and 2.7–3.0 times higher than the induction period of flax seed. The use of such basis in food technologies, in particular the confectionery industry, opens up wide opportunities for expanding the range of specialized products for athletes.

**Keywords:** oil seeds, essential amino acids, polyunsaturated fatty acids, stability against oxidation, nutrition of athletes.

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**RESEARCH OF RHEOLOGICAL PROPERTIES OF MAYONNAISE SAUCE WITH GRAPE SKIN POWDER**

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Studies of physico-chemical quality indicators of mayonnaise sauce with grapes skin powder and varying contents of a complex thickener are presented in this article. The optimum values of the concentrations of complex thickener are determined. The emulsion stability values of the mayonnaise sauce with grapes skin powder will be in the range of 97.0–100.0 %. It meets the requirements of the mayonnaise and mayonnaise sauces regulatory documentation. In this case, the effective viscosity values provide optimal organoleptic characteristics of the product. The technological solution of the possibility of the complex thickener concentration varying for produce a low-fat product with a given consistency and the necessary emulsion stability quality indicators is substantiated.

The formulation of a mayonnaise sauce of enhanced biological value with a Black Pearl grapes skin powder (5.0 % by weight) and with a non-starch nature complex thickener (0.4–1.2 % by weight) is proposed. The added ingredients of plant raw materials can influence on the rheological properties of the mayonnaise



emulsion. Dietary fibers of the grapes skin have a tendency to swell and retain moisture. The components of the complex thickener (hydrocolloids) have the ability to form adsorption-solvate stratum on the surface of dispersed phase droplets.

The proposed technological solution will allow producing mayonnaise sauces with a given consistency and the necessary physicochemical parameters.

**Keywords:** grapes skin powder, complex thickener, emulsion stability, effective viscosity.

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**IMPROVEMENT OF IR EMITTER TO CREATE NON-REFLECTOR DRYER FOR PLANT RAW MATERIALS**

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The object of research is an improved flexible film resistive electric heater of emitting type (FFREHET) for creating a non-reflector IR dryer and vegetable raw material on the example of Antonovka apples.

It is proposed to improve the FFREHET by spraying a resistive element based on current-conducting nichrome paste on a flexible electrical insulating film with additional coating on top and bottom by layers of a flexible electrical insulating film. Also, FFREHET is provided with drainages for connection to the power grid.

The spectral-optical properties of the Antonovka apple are determined, namely the acceptable IR regions of its absorbing capacity (2.5...3, 6, 9 and 12...15 μm). This confirms the effectiveness of using FFREHET during the drying of plant raw materials. It is confirmed the low inertia of the FFREHET at a temperature of 60 °C with the heating duration  $\tau = 87$  s, which simultaneously corresponds to the constant uniform temperature of the working surface and is characterized by a clear dynamics of operation.

Non-reflector VC IR dryer with a vibrating mechanism and a heat exchanger is developed. Improved FFREHET follows the geometric shape of the working chamber of the device, ensuring a reduction in the geometric dimensions and simplicity of device design. According to experimentally obtained kinetics of moisture content for Antonovka apples, the shortest duration of heat treatment is 160 s<sup>-1</sup> with conservation of BAS and natural color.

**Keywords:** flexible film resistive electric heater, non-reflector IR dryers of plant raw materials, quality of dried semi-finished products.

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**OPTIMIZATION OF FORMULATION COMPOSITION OF THE CRISPBREAD WITH IMPROVED CONSUMER PROPERTIES**

page 22–29

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A promising direction in the development of the production of prophylactic food is the creation of enriched cereal-based products. Due to the relatively low cost of raw materials, they are available to a wide range of people and are able to compensate for the lack of biologically active substances (BAS) in the diet. They have a particular interest among cereal-based products, are ready-to-eat foods – crispbread. They have a long shelf life, are convenient for transportation and consumption, are in demand among various segments of the population, do not contain residual fermentation products, and are characterized by high food and biological value.

To optimize the formulation composition of crispbread, the methodology of the response surface is used. Simulation and processing of experimental data is performed in the environment of the software package Statistica 10 (StatSoft, Inc., USA). Raw material is wheat grain, powder of milk thistle concentrate, salt and vitamin-mineral mixture.

On the basis of methods of mathematical modeling, the optimal mass fractions of the powder of milk thistle concentrate and table salt are 5.27 and 0.92 %, respectively, as components of crispbread. In the laboratory conditions, experimental samples of crispbread are made with addition of raw ingredients in the formulation at optimum concentrations. On the basis of the conducted researches it is established that the products differ with improved consumer properties, characterized by good organoleptic properties, normalized physical and chemical indicators, high food and biological value and absolutely safe.

**Keywords:** crispbread, spelt, whole-grain products, optimization of the formulation composition, complex quality index.

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**RESEARCH OF POLYSACCHARIDE AND PROTEIN SUPPLEMENTS INFLUENCE ON VISCOUS PROPERTIES OF GLUTEN-FREE DOUGH**

page 30–35

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Development of measures to improve the structural and mechanical properties of dough and bread is important issue of improving of gluten-free bread technology. For this purpose, it was suggested to use polysaccharide and protein supplements during dough making process. It is shown that implementation of hydrocolloids in non-yeast gluten-free dough improves its rheological characteristics. It indicates the formation of more stable systems to improve the porous structure of gluten-free non-yeast bread. It was found that the presence of 0.5 % aqueous solution of carboxymethyl cellulose, gluten-free flour suspension for non-yeast bread increases «falling number» index to almost 700 eq. un., thereby providing the need for forming of viscoelastic properties of dough to retain gas during dough making and rising of bread.

Taking into account increased viscosity of corn and rice flour, some reduction of maximum viscosity of suspension by 5.5...8.3 % and 34.2...47.3 % with the addition of 5...20 % sorghum flour to corn and rice respectively in comparison with control sample was showed. It can improve the elastic-plastic properties of dough and bring them closer to characteristics of wheat dough. In addition, the introduction of flour additives (sorghum flour) can adjust beginning and completion of starch gelatinization in aqueous suspensions of flour for gluten-free yeast bread. Thus, adding flour supplement to corn flour increases beginning of starch



gelatinization in 7.4...14.8 % and reduces completion of starch gelatinization in 2.2...6.6 %. Adding to the rice flour also increases beginning of starch gelatinization in 3.1...6.25 %, and reduces the time completion of starch gelatinization in 4.25...17 %. It leads to lengthening of shelf life of the product. The resultant effect of rheological changes under the influence of polysaccharide and protein supplements of gluten-free dough is improvement of quality indicators of gluten-free and non-yeast and yeast bread.

**Keywords:** starch gelatinization, falling number, flour mixes, gluten-free bread, carboxymethyl cellulose.

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### INVESTIGATION OF CHANGES OF THE SOFT BODY OF FRESHWATER MUSSELS UNDER INFLUENCE OF THERMAL PROCESSING IN THE TECHNOLOGY OF BOILED-FROZEN SEMI-FINISHED PRODUCT

page 36–41

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The water holding capacity and pH of raw cooled bivalve freshwater genus *Anodonta* mussels in the north of Ukraine are determined. During the research it is established that the soft body of freshwater mussels has low indicators of water holding capacity. Therefore, it is advisable to use it independently in the technology of minced products. But with the use of a water-holding agent (fiber) – this is possible from the point of view of further research. According to above-mentioned, research is aimed at developing a semi-finished product, in its technology did not contain the grinding process. The technology of cooked-frozen semi-finished product includes the following stages (cooling of freshly-caught raw materials, preparation of raw materials for use in technological process, thermal processing, cooling, freezing, storage). To determine the optimal terms of thermal processing, a number of experiments are carried out. Investigation of structural changes is determined by penetration. This method allows to get a semi-finished product with a delicate and juicy consistency. To confirm this method, experiments are conducted to determine the loss of mass and water in the soft body of mussels under the influence of different times of thermal processing. Periods of thermal processing are proved in terms of preserving nutritional value. The change in the amount of protein in different periods of thermal processing is determined. This technology is simple in its technological essence and is an effective way of processing a huge freshwater source of raw materials containing a high-grade protein. Implementation of this technology will expand the range of products made from hydrobionts.

**Keywords:** freshwater bivalve genus *Anodonta* mussels, degree of soft body penetration, boiled-frozen semi-finished product.

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**EXPERIMENTAL INVESTIGATIONS OF SUGAR CONCENTRATION FOR COUNTERFLOW JET MIXING OF DRINKS**

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The object of this research is mixing of fluid components (in particular, water with blend syrup) in the production of sweet non-alcoholic drinks.

Today, the demand for this type of product is very large, therefore it is necessary to develop and introduce continuous mixing devices into production. These devices include jet devices, which provide a quality mixing of fluid components with minimal energy and time. It is possible to significantly increase the mixing efficiency due to the use of counterflow mixing. Today it is little explored. A single-mixing method is implemented in five zones in the counterflow jet mixer. This makes it possible to significantly increase the mixing intensity at low energy inputs, and also significantly reduce the mixing time.

The paper presents a scheme of the developed counterflow jet mixer, a general view of the manufactured experimental device, variable factors of the mixing process, and a methodology for carrying out experimental studies.

As a result of the analysis of the obtained experimental data, it is determined that the distance between the nozzles is a significant factor in the effect on the sugar concentration in the mixed product.

The least impact is the blend syrup supply pressure. There is a very close connection between such factors as the clearance in the receiving chamber and the water supply pressure. The reason for this is an increase in the pressure in the collision zone of coaxial jets, which leads to decrease in the pressure drop at the inlet and outlet of the nozzles and, consequently, to decrease in the injection coefficient.

It is determined that the optimal conditions for the production of a sweet drink «Lemonade» using sugar syrup (50 %) and injector nozzle diameter of 8 mm, are:

- distance between nozzles is 24 mm;
- blend syrup supply pressure is 200–450 mm;
- water supply pressure is 3.5–4 atm.

The obtained data are the necessary basis for further research and design of experimental samples of a counterflow jet mixer for drinks. They can also be useful in the development of counterflow jet mixers for fluid components in other branches of the national economy.

**Keywords:** jet mixing, counterflow jet mixer, mixer of sweet drinks, mixing of water with blend syrup.

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## INVESTIGATION OF THE MOBILITY OF WATER MOLECULES IN PRODUCTS WITH FOAM STRUCTURE AND HIGH IODINE CONTENT

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The object of research is foam structures enriched with iodine. The problem of addition of iodine into these objects, which are developed on the basis of kelp use, is that its use gives the products an unpleasant aftertaste that reduced their organoleptic characteristics.

A method for enriching the foam structures is proposed by using an elamin that has a neutral taste and eliminates the noted drawback. Technologically, the addition of the elamin is carried out by means of its preliminary steaming. Using this approach, foams with high structural and mechanical properties are obtained. For example, the foam-forming ability of the studied sample, to which the elamin is added in the steamed state, is 10–20 % higher than the control. The result is achieved due to the presence of sodium alginate salts in the elamin, which can adsorb water and exhibit the properties of the thickener and foam stabilizer. This effect is confirmed by studying the spin-spin relaxation time T2 by nuclear magnetic resonance.

The obtained results allow to create food products enriched with iodine in a concentration of 42–52 µg per 100 g of product. These products can correct the iodine content in the human body in quantities that correspond to the current trends in the norms of rational nutrition. Thus, with the use of the recommended product rate (100 g), the human body is provided with 42–52 µg of iodine, which corresponds to 28–35 % of the daily iodine requirement for an adult and 56–69 % for school-age children.

**Keywords:** foam structure, nuclear magnetic resonance, elamin, polydisperse systems, spin-spin relaxation, kelp.

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