ABSTRACT AND REFERENCES

TECHNOLOGY AND EQUIPMENT OF FOOD PRODUCTION

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DEVELOPMENT OF POWEREFFICIENT AND ENVIRONMENTALLY SAFE COFFEE PRODUCT TECHNOLOGIES (p. 6-14)

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Based on the energy and environmental audit, analysis of material flows, energy conversion, emissions into atmosphere and lithosphere in the production of instant coffee was carried out.

To raise energy efficiency and reduce environmental burden, innovative flow diagrams and equipment for waste processing and production of new coffee products have been developed.

Experimental modeling was carried out: kinetics of microwave extraction of water-soluble substances and oil from coffee slurry; hydraulics of the extractant flow through cassettes of the microwave extractor. The experimental data were summarized in the form of a criterion equation.

As a result of experimental modeling of the extraction kinetics, it was found that the duration of the process in a microwave field is approximately 20 times less than in a thermostat. The microwave field affects the extraction rate to a greater extent than the process temperature. The growth of microwave power results in a more than the two-fold rise of the yield of extractives from a coffee slurry.

Specification of the microwave oil extractor was defined. The extractor sample was tested at a specific power of 180...240 W/kg in the mode of boiling extractant. Ethanol (93...96 % concentration) was used as an extractant. As a result of the tests, a high-quality coffee oil was obtained. It is characterized by a pronounced aroma, coffee taste and an intense dark brown color.

Flow diagram of pre-extraction of coffee from slurry was worked out. Additional extraction of water-soluble extractive substances from coffee slurry increased the extract yield by 10...12 %. The temperature regime of extraction was significantly reduced plus duration and energy intensity of the process were reduced.

An innovative flow diagram has been developed for the production of liquid coffee concentrate as a basis for coffee-based drinks ready for immediate use. The concentration of solids is 50...65 %.

Keywords: food concentrates, coffee oil, coffee slurry, microwave extraction, energy monitoring.

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IMPROVEMENT OF EQUIPMENT IN ORDER TO INTENSIFY THE PROCESS OF DRYING DISPERSED FOOD PRODUCTS (p. 15-21)

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One of the most common and investigated processes in the food industry is the drying process; this is the final stage of technological protocols that defines quality of a resulting product. It has been established that the drying process intensified due to the effective utilization of a dryer's volume and the increased phase contact surface, thereby bringing down the cost of the dried product. It has been determined that the increase in the relative velocity of the dispersed and gaseous phase increased in turn the driving force of the drying process and reduced the heat-carrier consumption for drying. It has been found that the use of an inert carrier increased the relative velocity of the phase contact surface.

Theoretical and experimental studies have been conducted, which made it possible to derive empirical correlations,

necessary for the engineering calculation of design features of the dryer with a pseudo-liquefied layer of inert carrier for drying the dispersed food products. The main features of the installation for drying dispersed foods are as follows: first, the upper part of the chamber hosted a device to capture the product, which prevented the release of an inert carrier along with the particles; second, the use of fluoroplastic crumbs enabled the intensification of the drying process as a result of an increase in the heat-and-mass exchange surface; third, the application of a fan and a heater made it possible to obtain a dry hot air of the required temperature, thereby preventing darkening of the product.

When designing the drying unit, we established the basic requirements for ensuring uniform drying throughout the entire volume of the drying chamber at high technical and economic indicators: minimum dimensions, as well as minimum cost of materials to construct the dryer, minimum consumption of heat and electricity to dry one kilogram of raw materials, simple maintenance, decrease in the cost of equipment repair, low cost of fabrication, simplicity and reliability of operation.

Our comparison of calculations based on an energy efficiency index has determined that the energy efficiency of the designed dryer outperformed a standard dryer model by 0.25 %.

Keywords: drying, pseudo-liquefied layer, dispersed food products, heater, technological flow chart, heat-and-mass exchange.

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DETERMINING THE RATIONAL CONCENTRATION OF DRY DEMINERALIZED WHEY IN A FORMULATIONFOR MARZIPAN PASTES (p. 22-33)

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Results obtained in the studies of rheological, surface and sensory characteristics of marzipan paste containing dry demineralized whey (DDW) are presented in this paper. Positive effect of DDW on sensory characteristics of model compositions of marzipan pastes was established. Component compatibility of DDW and almond nut has been confirmed. It has been established experimentally that DDW brings about changes in structural state of marzipan pastes by changing quantitative values of rheological and surface characteristics. It was established that an increase in DDW concentration entails growth of strain and plasticity indices and a decrease in elasticity and resilience indices of marzipan pastes which generally improves formability. As it was confirmed by the results from comprehensive studies, there is a possibility of partial replacement of import-dependent raw materials in composition of marzipan paste and, respectively, cut of cost of final product.

Technological feasibility of using glycerin in compositions of DDW-containing marzipan pastes to improve their plasticity and compliance while maintaining high formability was substantiated. The rational content of glycerin in compositions of marzipan pastes was established which makes it possible to adjust surface properties within specified limits for pasty dressing semi-finished products from marzipan pastes.

Lines of differentiated use of marzipan pastes with various weight fractions of DDW in confectionery production as dressing semi-finished products were offered: TICP marzipan paste with DDW mass fraction of 20 % for topping and spreading interlayers in wads and confectionery products. Corresponding figure of 30 % was recommended for making sweets and molding figured confectionary products.

Keywords: dressing semi-finished products, dry demineralized whey, rheological properties, surface properties, sensory properties.

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INFLUENCE OF PRELIMINARY PROCESSING OF VEGETABLES ON INCREASING THE CONTENT OF γ-AMINOBUTYRIC ACID IN JUICES (p. 34-43)

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Relevant issues have been considered regarding a method for increasing the biological value of vegetable carrot juice. The expediency of treatment of carrots with electrochemically activated (ECHA) water during storage has been substantiated. We investigated influence of acid-base conditions of vegetable juice on the activity of glutamate decarboxylase enzyme. It was found that pH values in the range of 5.4...6.0 contribute to the release of the enzyme with maximum activity. Studies showed that one can increase the amount of γ-aminobutyric acid in plant tissues by changing the metabolism in raw materials.

We studied influence of temperature and exposure time of raw materials on the rate of conversion of glutamic acid to γ-aminobutyric acid (GABA). A pattern was revealed in an increase in the activity of glutamate decarboxylase at changes in aerobic and anaerobic conditions of exposure of raw materials for 24 hours. It was found that exposure of vegetables for 10...60 min in a rarefied atmosphere at the relative humidity of 95 % does not affect changes in dry matter.

We substantiated a choice of the pressure supply mode for conversion of glutamic acid of plant materials to γ-aminobutyric acid (GABA). It was proven that the method of exposure of raw materials at multiple changes in cycles of increase and decrease of pressure makes it possible to obtain finished products (juices, drinks, etc.) with the increased content of γ-aminobutyric acid.

We proposed a method of treating raw materials for production of vegetable juices and beverages with the increased content of γ-aminobutyric acid based on a set of analytical studies, experimental studies, and mathematical calculations. The study indicated the expediency of producing vegetable juices and functional drinks. One can implement it at canning processing enterprises.

Keywords: γ-aminobutyric acid, glutamic acid, glutamate decarboxylase, anaerobiosis, aerobiosis, enzymatic conversion, metabolism.

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EXPLORING A POSSIBILITY OF USING ULTRASOUND IN THE TECHNOLOGY OF CONFECTIONERY PRODUCTS (p. 43-49)

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The unconventional methods of processing raw materials and semi-finished products have been widely used in various sectors of food industry over recent time. This contributes to intensification of production, prolonging the period during which new products retain freshness, thereby making it possible to implement resource- and energy saving technologies.

It is a relevant task to explore a possibility to use ultrasound in the technology of flour-based confectionery products, specifically sponge cakes.

Here we propose a technology for whipping up mélange with sugar using a mixer whose bowl is installed in an ultrasonic tub filled with water.

The effect of ultrasound on quality indicators of egg-sugar mixture (foaming ability, foam stability, its microstructure), as well as on sponge-cake semi-finished products, has been investigated.

It was established that the foaming capacity of examined samples exposed to ultrasound increased by 35 %. In addition, the maximum value of foaming capacity in a sample exposed to ultrasound required an almost twice shorter time than that in the control sample. Our comparative analysis of foam stability after 60 minutes of aging has shown that the mélange–sugar mixture exposed to ultrasound had proven to be the most stable, 90 %. It was determined that exposing an egg-sugar mixture to ultrasound resulted in obtaining foam with almost uniform bubbles of small size, located close to each other.

We have established the optimum parameters for whipping the egg-sugar mixture of sponge cake dough in an ultrasound field: ultrasound power is 0.6 kW, water temperature in an ultrasonic tub is 26 °C, the time to whip up mélange with sugar is 6.5 min.

It has been proven that the use of ultrasound in the technology of sponge-cake semi-finished products promotes the intensification of foaming process of egg-sugar mixture; makes it possible to whip all the components simultaneously, which greatly simplifies the process of making sponge cakes; and improves porosity of finished products, as well as contributes to a more uniform pore distribution.

Keywords: ultrasound, egg-sugar mixture, foaming capacity, foam stability, sponge-cake semi-finished products.

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DEVISING A TECHNOLOGY FOR MAKING FLOUR FROM CHICKPEA ENRICHED WITH SELENIUM (p. 50-58)

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The paper reports results from developing a technology of chickpea flour enriched with selenium. The devised technology would allow the intake of the organic forms of the microelement whose deficiency is suffered by 17 % of the global population.

The study has found that the degree of selenium accumulation is affected by the protein content in the native grain. It is rational to use solutions for germination, which are the carriers of 75 μg of selenium. 95...99 % of selenium in sprouted grains are accumulated in the cotyledon, in the protein fraction. During the germination of grains, the amino acid composition increases considerably. The content of leucine, lysine, arginine, and tryptophan increases by 87, 76, 80 %, and 55 %, respectively. The base of the substituted amino acids are aspartic and glutamic acids and their amides, whose share in the non-sprouted grains of chickpea accounts for 67 %, and in the sprouted grains – 70 %.

The devised technological protocol of chickpea flour production differs from the control one by that the washing and disinfection of chickpea grains are performed in an aqueous solution of citric acid (pH 3.5...4.0). Afterward, the grains germinate in a solution of $NaHSeO_3$ for 48 hours.

As regards the organoleptic indicators, the proposed flour has a light-yellow color, a smell that is peculiar to chickpea flour, its taste has no bitterness and sour flavors. In terms of its physical-chemical indicators, the differences from control are observed in the mass share of moisture, by 1 % less than that of the control sample, and the mass fraction of fat, which decreases by 2 %. There is a 0.5 % increase in the mass fraction of total ash and the mass fraction of fiber. Regarding the content of mercury, arsenic, lead, the proposed chickpea flour's levels are not higher than those permissible for human consumption; it does not contain cadmium, and its content of copper is less than the permissible level by 1 mg/g. As regards the number of mesophilic aerobic and facultative anaerobic microorganisms, mold fungi, and yeast, the developed chickpea flour is safe for

use. It includes neither bacteria from the group of Escherichia coli nor pathogens of bacteria from the genus Salmonella.

Our study has allowed us to argue that the developed chickpea flour is a carrier of 52 μg of selenium in the bioavailable organic form that provides 65 % of daily requirement in selenium for an adult healthy person.

Keywords: chickpea flour, amino acid composition, selenium, germination, micro-elements, grain, chickpea, inversion voltammetry method.

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STUDYING THE INFLUENCE OF MEATS FROM WHEAT AND OAT GERMS, AND ROSE HIPS, ON THE FORMATION OF QUALITY OF RYEW HEAT DOUGH AND BREAD (p. 59-65)

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The results of studies of the influence of wheat germ meal (WGM) and oats (OM) in the amount of 10...20 % and meal of rosehips (RHM) in the amount of 2...6 % by weight of flour on the ripening of rye-wheat dough and on the quality of bread are presented.

It is proved that the high content of nutrients for lactic acid bacteria in WGM, OM and RHM contributes to an increase in titratable acidity of dough samples studied by 12.1...25.8 %, 6.1...21.2 % and 9.1...22.9 % respectively. Due to the activation of yeast, alcohol fermentation is also accelerated. In the dough with the addition of WGM, OM and RHM, the amount of carbon dioxide released is greater than that of the control sample by 23.7...49.2, 16.9...33.9 and 20.0...40.0 %, respectively. However, the studied additives differently affect the change in the volume of the dough. With the addition of meal of oat embryos and rosehips, the dough volume after ripening increases by 7.3...21.9 % and 7.8...22.3 % in comparison with the control sample, which is associated with an increase in its gas-retaining ability. At the same time, when introducing wheat germ meal, the dough volume, on the contrary, decreases by 9.8...31.7% due to its high enzymatic activity.

It is noted that the influence of the studied meal on the ripening of rye-wheat dough plays an important role in shaping the quality of finished products. Based on the results of studies of physical and chemical indicators of the quality of rye-wheat bread with the addition of WGM and RHM, it is found that their porosity, specific volume and shape stability increase in comparison with the control sample by 5.0...11.7, 10.0...25, 0, 6.7...15.6 % with the introduction of WGM, and by 10.0...13.0 %, 10.0...30.0 %, 9.0...33.0 % – with the introduction of RHM. Whereas the OM introduction leads to a decrease in these indicators relative to the control sample. The negative effect increases as the amount of additive in the system increases.

It has been established that when introducing the maximum amount of meal of oat embryos (20 %) and rosehips (6 %), an overly pronounced flavor of additives appears in the bread. Therefore, to ensure high organoleptic quality indicators of rye-wheat bread, it is advisable to use meal of wheat or oat germ in an amount of not more than 15 %, and meal of rosehips – not more than 4 % of the total weight of flour.

Keywords: rye-wheat bread, meal of wheat and oat embryos, meal of rosehips, microbiological processes, quality indicators.

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MANAGING SAFETY OF THE DEVELOPED CAKES MADE FROM ORGANIC RAW MATERIALS WITH IMPROVED FATTYACID COMPOSITION (p. 66-74)

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This paper reports two cake formulations, "Kosmyk" and "Lunik", created by using the principles of the HACCP system, which make it possible to control the safety of devised flour-based products prepared from organic raw materials. The "Kosmyk" cake formulation includes such organic raw materials as rice flour, milled ginger, lemongrass powder, coconut sugar, butter, and sea buckthorn oil, chicken egg mélange, chokeberry jam. The "Lunik" cake formulation includes rice flour in combination with spelt flour, lemongrass powder, coconut sugar, butter, and sea buckthorn oil, chicken egg mélange, organic blackberry jam. The devised products have high organoleptic properties, confirmed by the relevant research. The microbiological and toxicological indicators of the finished products safety have been defined. They do not exceed permissible limits. Since the fat base has been replaced in the developed samples compared to the control formulation, the fatty acid composition of the products has been investigated. The content of saturated fatty acids in both samples decreased by almost twice, whereas the content of monounsaturated fatty acids increased by 1.78 times in the "Kosmyk" sample, and by 1.8 times in the "Lunik" sample. The content of polyunsaturated fatty acids increased by 2.08 times in both samples. The products' fatty acid composition was compared to the composition of "perfect lipid". A block-diagram of production has been constructed, which serves the basis for analysis of hazardous factors. The hazardous factors in the production of flour confectionery products have been analyzed. It has been proposed to use daily safety sheets. The ranking system has been developed to select suppliers.

These results indicate that the use of organic raw materials in the production of cakes makes it possible to expand the existing range of flour-based confectionery products. Adding unconventional oils to the lipid base of a product allows the improvement in the fat-acid composition. The obtained results could be applied by the confectionery industry to manufacture new products and to implement a food safety management system.

Keywords: safety management system, fat-acid composition, flour confectionery, content of toxic elements.

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