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DEVELOPMENT OF TECHNOLOGY FOR THE PRODUCTION OF SEMIFINISHED PRODUCTS WITH AN EMULSION STRUCTURE BASED ON THE DECALCIFIED DAIRY RAW MATERIALS (p. 4-10)

Nataliya Grynchenko

Kharkiv State University of Food Technologies and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0002-8440-0727>

Daria Tyutyukova

Kharkiv State University of Food Technologies and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0002-2514-4639>

Pavlo Pyvovarov

Kharkiv State University of Food Technologies and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0001-9119-1225>

Oleksandr Nagorny

Kharkiv State University of Food Technologies and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0002-9069-4514>

It was determined that in a condition of meeting requirements of current normative documents, physicochemical and technological properties of the cottage cheese differ from each other which affects technological parameters of making products based on this cheese. It was proved that in order to stabilize qualitative indicators of the final product, modification of protein substances of dairy stock or the use of stabilization systems of non-protein nature is necessary. It was proposed to use decalcified dairy stock – milk and cheese – as a source of modified protein substances. Expediency of developing the technology of the target semi-finished products was proved. Influence of pH on solubility of protein substances of the cottage cheese was studied. It was determined that the change in pH of the systems based on the cottage cheese results in an increase in the content of soluble protein in the aqueous phase of dispersion which is an evidence of high functionality of proteins of the cottage cheese made from decalcified skim milk. Emulsifying capacity, kinetic and aggregate stability of the cheese and milk mixtures were studied. Based on the obtained data, rational content and the ratio of decalcified dairy and fat stocks in the composition of semi-finished products were determined. Ratios of the cottage cheese to decalcified milk in the range of (90:10) – (70:30) at fat content of 5–20 % were defined as rational. Rational parameters were experimentally substantiated and the model of the technological system for making semi-finished products with an emulsion paste-like structure was developed. Microstructure characteristics of the semi-finished products were studied. The data of electron microscopy confirmed formation of an emulsion structure in which fraction of fat particles with diameters of $0.25\text{--}0.45 \cdot 10^{-6}$ m was dominant which confirms formation of a stable homogeneous emulsion structure of semi-finished products.

Keywords: semi-finished products, decalcified dairy stock, cheese and milk mixture, emulsifying capacity, emulsion paste-like structure.

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IMPROVEMENT OF A ROTOR FILM DEVICE FOR THE PRODUCTION OF HIGHQUALITY MULTICOMPONENT NATURAL PASTES (p. 11-17)

Oleksandr Cherevko

Kharkiv State University of Food Technology and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0003-1809-5960>

Valeriy Mykhaylov

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-4335-1751>

Aleksey Zagorulko

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-1186-3832>

Andrii Zahorulko

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0001-7768-6571>

We have improved a heat exchange system of the rotor film device by using, as a heater, a flexible film resistive electric heater of the radiation type, which repeats the geometry of a working chamber of the device. Its technical properties ensure the acceptable temperature mode (50...60 °C), a decrease in resource consumption, dimensional and weight characteristics of RFD, and hence the cost of such devices.

In order to test the improved RFD, a formulation ratio of natural components in multicomponent compositions was proposed. Based on the result of blending, we have obtained 3 compositions with different content of components (55...60 % of apple, 25...40 % of cranberries, 5...10 % of hawthorn), which were compared with control. The effect of mass content of each component in the compositions on the structural-mechanical properties of the obtained products was studied. Values for the mean radii of microcapillaries in multicomponent natural compositions were established: $\bar{r} = 1,51$ nm for composition 1a, $\bar{r} = 1,69$ nm for composition 1b, and $\bar{r} = 1,7$ nm for composition 1c. It was established that at an increase in the content of cranberry from 25 to 30 % (compositions 1b and 1a), an increase in the dispersion of the obtained puree was observed. On the contrary, the dispersion decreased at an increase in the content of cranberry to 40 %.

Color patterns of apple puree, which is characterized by greenish-yellow coloration, and the puree made of cranberry and hawthorn, characterized by bright red and orange colors, were studied. Color parameters of the blended puree-like compositions were determined, specifically: puree 1a is characterized by a color tone purity of 76.4 %. Puree 1b and 1c – 70.7 % and 78.1 %, respectively; in this case, all of them are reddish-orange.

We have determined the colors of paste compositions after concentration at the improved rotor film device to the content of 28...30 % of dry substances at the acceptable temperature of 50...60 °C. It was established that the tone purity of the paste composition 1a is 77.6 %, and in the compositions of pastes 1b and 1c, it is 64.0 % and 78.9 %, respectively. In this case, they are characterized by reddish-orange color. Comparison of visual characteristics of the color of puree and paste samples for the indicators of a dominating wavelength and a color frequency confirm maximal retention of colors. This allows us to draw a conclusion about the maximum retention of vitamins and medicinal-prophylactic properties of natural raw materials in the obtained compositions of multicomponent pastes through the use of the proposed technological parameters and the improved system of heating at the rotor film device.

The data obtained would allow the optimization of technological parameters when processing natural raw materials and producing high-quality multicomponent pastes with a considerable content of BAS, medicinal-prevention properties, and pleasant structural-mechanical and color characteristics.

Keywords: natural raw materials, rotor film device, intensification, structural-mechanical properties, color formation.

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EFFECT OF PLASTICIZERS ON THE QUALITATIVE INDICATORS OF FILMFORMING COATINGS FOR THE PROTECTION OF CHILLED MEAT (p. 17-22)

Andrii Kyshenia

Odessa National Academy of Food Technologies, Odessa, Ukraine
ORCID: <http://orcid.org/0000-0003-1763-0546>

Lydmila Vinnikova

Odessa National Academy of Food Technologies, Odessa, Ukraine
ORCID: <http://orcid.org/0000-0002-6106-1785>

Yevhenii Kotliar

Odessa National Academy of Food Technologies, Odessa, Ukraine
ORCID: <http://orcid.org/0000-0002-2173-8018>

Tat'yana Volovik

Odessa National Academy of Food Technologies, Odessa, Ukraine
ORCID: <http://orcid.org/0000-0002-1820-7697>

Kateryna Garbazhiy

Odessa National Academy of Food Technologies, Odessa, Ukraine
ORCID: <http://orcid.org/0000-0001-8696-8810>

The result of theoretical research into protection and prolonging the duration of meat and meat products storage has demonstrated that one of the promising directions is the application of protective coatings based on natural biopolymers. We used hydrocolloids as basic components of film-forming protective coatings. The study into mechanical and rheological properties of protective coatings was conducted; a comparative characteristic of these properties, which depend on the added plasticizer, is given.

Film-forming coatings must possess high indicators of strength, elasticity, transparency, barrier properties, capability to sorb gases, water vapor. The film is to prevent undesirable effects for meat, to improve shelf life of the product without compromising quality indicators. Adding plasticizers to the composition of film-forming coatings will make it possible to control quality indicators of coatings.

We have analyzed and theoretically substantiated the character and mechanisms of interaction between components of a film-forming coating and plasticizers.

The viscosity of the film-forming coating without adding a plasticizer has the largest value compared to other solutions.

The addition of plasticizers led to an increase in the elasticity of the film; we, however, observed a slight increase in strength.

Film-forming coatings with the addition of a plasticizer had a higher yield limit and thus they were stronger than the integrated film-forming coatings without the addition of a plasticizer. On the other hand, the values of deformation of the film-forming coatings without the addition of a plasticizer were higher than those of the integrated film-forming coatings with the addition of a plasticizer, so they were more elastic.

Studying the physical properties of the developed film-forming coatings based on hydrocolloids revealed that coatings with a plasticizer possess a larger vapor permeability.

We have analyzed and theoretically substantiated the character and mechanisms of interaction between components of a film-forming coating and plasticizers.

Based on results obtained in the course of experiments, it was established that the best mechanical, rheological, and physical indicators are demonstrated by the film-forming coating based on sodium alginate, carboxymethyl cellulose, and glycerin.

Keywords: film-forming coating, plasticizer, shelf life of meat, synergy, sodium alginate, hydrocolloids.

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DETERMINING THE MICROELEMENT COMPOSITION OF POPPY SEEDS USING SOLIDPHASE SPECTROPHOTOMETRY METHOD (p. 23-28)

Elizaveta Kostenko

National University of Food Technologies, Kyiv, Ukraine
ORCID: <http://orcid.org/0000-0002-2451-0828>

Elena Butenko

National University of Food Technologies, Kyiv, Ukraine
ORCID: <http://orcid.org/0000-0002-8130-414X>

Maria Golubeva

National University of Food Technologies, Kyiv, Ukraine
ORCID: <http://orcid.org/0000-0001-6813-410X>

Larisa Arseneva

National University of Food Technologies, Kyiv, Ukraine
ORCID: <http://orcid.org/0000-0002-6632-090X>

Poppy seeds are one of the most important and oldest oil-bearing crops in the world. Therefore, quality control of poppy seeds and food products whose composition contains them as a food additive, is very important. To this end, we have applied procedures for solid-phase spectrophotometric and photometric determining of micro elements in food products.

It was established that in determining cadmium and zinc, the best ion exchanger for the group concentration of interfering metal ions is the ion exchanger with the immobilized KO.

CAZ made it possible to concentrate and determine in the solid phase the ions of Hg(II). Using PCV enabled selective determining of Pb(II).

Selective determining of the Fe(III) ions at pH 3 was conducted using ammonium thiocyanate. Cu(II) was determined photometrically upon masking the ions of Fe(III) employing SPADNS. Based

on the data acquired, we have developed a microelement analysis scheme for poppy seeds.

It was established that the sample contained, mg/kg: Cu(II) – 5.0; Pb(II) – 0.3, Zn(II) – 50, P(V) – 1,600, K – 550, Na – 20, Ca – 1,500, Mg(II) – 450; Fe(III) – 10; Cd(II) and Hg(II) are absent.

The proposed scheme for analysis of poppy seeds is universal and could be applied for microelement analysis of other food products.

The procedures employed are characterized by sensitivity and selectivity.

Ion exchangers with the immobilized dyes, as well as procedures for the solid-phase spectrophotometric determining, are environmentally safe. They do not require the use of toxic organic reagents.

The procedures applied are easy to use.

Relative standard deviation in the results does not exceed 0.10. This indicates good reproducibility of the results.

Keywords: spectrophotometric determining of elements, food supplements, poppy seeds, hybrid methods of analysis.

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A STUDY OF THE EFFECT OF THERMOTROPIC POLYSACCHARIDES ON THE PROPERTIES OF THE ALGINATE-CALCIUM SHELL OF AN ENCAPSULATED FATTY SEMIFINISHED FOOD PRODUCT (p. 29-38)

Olga Neklesa

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-9597-7644>

Yevgeniia Yarrantseva

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-3166-0282>

Oleg Kotlyar

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-4818-4967>

Olga Grinchenko

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-9867-5502>

Pavlo Pyvovarov

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0001-9119-1225>

Numerous tests have determined that the use of AlgNa, as a polysaccharide capable of ionotropic gelation, in the technology of capsular products is a promising direction. Owing to the ability of AlgNa to interact chemically with Ca²⁺, it loses its bond with the aquatic medium. The result is a technological possibility of forming an elastic thermostable shell of capsules with specific structural and mechanical parameters. In this case, the formation of a globular shape of capsules is achieved by using the technological principles of droplet extrusion of the recipe mixture in an air medium. Simultaneous use of several thermotropic and/or ionotropic gelators in a common solvent helps implement the chemical potentials inherent in the ionotropic gel formers. The result is the production of “chemical” gels or the creation of a system of a “physical + chemical” gel with the use of thermotropic polysaccharides. The need to correct the texture properties of alginate-calcium shells of the EFSFFP is due to the prerequisites for providing new organoleptic properties of products,

managing the extent of permeability for controlled homeostasis, and expanding the spectrum of using capsulated products in the technology of culinary and food products. It has been experimentally proved that the use of “AlgNa – agar – Ca²⁺ – water” and “AlgNa – low-esterified pectin – Ca²⁺ – water” systems can significantly influence the elastic elasticity of mixed gels in terms of increasing their density. The use of glycerol as an alcohol-solvent of an aqueous solvent results in inhibiting the process of forming the Alg₂Ca gel, thereby providing controlled capsulation with the formation of plastic gels.

It has been established that the characteristics of mixed gels, their elastic-plastic and technological properties depend on many factors. These are the choice and concentration of polysaccharide, the properties of the solvent, the stage of conversion of AlgNa into Alg₂Ca, the concentration ratio of the components, and the temperature of the medium, which determines the mobility of hydrogen bonds. On the basis of the obtained data, a technological model of producing an EFSFFP has been developed to obtain capsulated products with given organoleptic parameters.

Keywords: alginate-calcium shell, semifinished fatty food capsule, ionotropic and thermotropic gel formation.

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ELUCIDATION OF THE MECHANISM THAT FORMS BREADBAKING PROPERTIES OF THE SPELT GRAIN (p. 39-47)

Nina Osokina

Uman National University of Horticulture, Uman, Ukraine
ORCID: <http://orcid.org/0000-0002-2822-2989>

Vitalii Liubych

Uman National University of Horticulture, Uman, Ukraine
ORCID: <http://orcid.org/0000-0003-4100-9063>

Larysa Novak

Uman National University of Horticulture, Uman, Ukraine
ORCID: <http://orcid.org/0000-0002-9509-9044>

Tetiana Pushkariova-Bezdil

Uman National University of Horticulture, Uman, Ukraine
ORCID: <http://orcid.org/0000-0001-7663-4278>

Olesia Priss

Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: <http://orcid.org/0000-0002-6395-4202>

Valentyna Verkholtantseva

Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: <http://orcid.org/0000-0003-1961-2149>

Olena Hryhorenko

Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: <http://orcid.org/0000-0002-2082-5822>

Volodumir Pusik

Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
ORCID: <https://orcid.org/0000-0001-5028-9461>

Ludmila Pusik

Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
ORCID: <https://orcid.org/0000-0002-5465-2771>

The technology of making dough from spelt flour differs from that known for flour of soft wheat in which starch grains are firmly bound to the protein matrix. It has been established that the content of protein in spelt grain varied from 15.0 % to 22.5 % for varieties and from 14.0 % to 19.8 % for lines. The content of gluten does not depend on the origin of varieties and lines. It amounted to 31.6–44.9 % in the grain of varieties and 29.2–43.6 % in the grain of lines. Technological properties of grain of introgressive lines are similar to those of grain of interspecies spelt lines. Index of gluten deformation of grain of spelt varieties and lines varied from 97 to 116 points and the fall number varied from 389 to 416 s. The spelt baking properties differ from those of soft wheat since the maximum gas-holding capacity of dough prepared of spelt flour comes after 60–90 min

of fermentation and then rapidly decreases. The highest stability during fermentation had dough prepared of flour of Zoria Ukrainy variety and NSS 6/01 and NAK34/12-2 lines. Volume of the bread baked of prime flour was from 303 to 523 cm³, which corresponded to 1.0–7.6 points. The corresponding figure for dark flour was from 270 to 470 cm³ depending on spelt variety and line. Its quality was high in all samples: 7.2–8.4 points or 80–93 % of the maximum value. The bread baked of flour of Zoria Ukrainy variety and LPP 3132, NAK34/12-2 and TV 1100 lines was of the highest quality. The overall estimate of quality of the bread baked of dark flour was very high (8.3–9.0 points) while the bread baked of flour of Swedish 1 variety and LPP 3117, LPP 3122/2, P 3, LPP 3132, NAK34/12-2 lines had the highest quality (9.0 points). Glossiness of the bread surface and its overall estimate were influenced by the content of protein in grain. Gluten content affected bread quality somewhat less. Gluten deformation index also affected crust surface, pore size and the overall estimate of bread. The bread baked of flour of Zoria Ukrainy variety and LPP 3132, NAK34/12-2 and TV 1100 lines had the highest overall culinary estimate.

Technological properties of grain of 16 spelt varieties and lines have been theoretically substantiated and experimentally confirmed. Differences between quality of the bread baked of prime and dark flour were analyzed. Relevance of the differentiated approach to the technological properties of flour for its production was shown. Based on the study of physical-chemical and organoleptic characteristics of bread, promising possibility of its use in the baking technology has been confirmed for expanding assortment of products and improving their quality.

Keywords: spelt, baking properties, bread quality, hydrocarbon-amylase complex.

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THE STUDY OF BAS COMPLEX IN CHLOROPHYLL-CONTAINING VEGETABLES AND DEVELOPMENT OF HEALTHIMPROVING NANOPRODUCTS BY A DEEP PROCESSING METHOD (p. 48-56)

Raisa Pavlyuk

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-3440-0451>

Viktoriya Pogarskaya

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0001-8031-5210>

Valeriy Mykhaylov

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-4335-1751>

Olexandr Bessarab

National University of Food Technologies, Kyiv, Ukraine

ORCID: <http://orcid.org/0000-0001-8620-8694>

Ludmila Radchenko

National University of Trade and Economics, Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0002-2514-7549>

Aleksey Pogarskiy

Kharkiv State University of Food Technology and Trade,
Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0001-8714-9518>

Oleksandr Telenkov

Putivl College of Sumy National Agrarian University,
Putivl, Ukraine

ORCID: <http://orcid.org/0000-0002-9743-386X>

Anna Radchenko

National University of Trade and Economics, Kharkiv, Ukraine

ORCID: <http://orcid.org/0000-0003-0869-6607>

The BAS complex was determined in chlorophyll-containing vegetables (broccoli, spinach, Brussels sprouts, green beans). Presence of the BAS complex (chlorophyll, phenolic compounds, L-ascorbic acid, β -carotene) in 100 grams of fresh CCV in a quantity capable of satisfying the daily demand of the human body was established.

It was found that in comparison with boiling in conventional equipment, steam thermal treatment of CCV in an automatic steam convection oven proceeds at a more intensive inactivation of oxidative enzymes. It was shown that a complete inactivation of enzymes occurs after 10 minutes of steam thermal treatment of CCV.

Health-improving nanoproducts with a high content of chlorophyll were developed. A combined action on the raw materials of the processes of steam thermal treatment and mechanolysis with the use of a new generation of equipment for heat treatment and fine-dispersed shredding was used for the first time. Conditions of steam thermal treatment of CCV were established in which not only preservation of a and b chlorophylls and β -carotene but also thermal destruction and extraction from hidden forms take place. In comparison with fresh CCV, a 1.33...1.4 times larger mass fraction of chlorophyll and a 2-fold increase in β -carotene were observed. The mechanism of this process involves inactivation of oxidative enzymes and thermal destruction of hydrogen and other bonds between hidden forms of chlorophylls in nanocomplexes and proteins and polysaccharides.

It has been established that significantly greater effect of extraction of hidden BAS forms occurred when using fine shredding of thermally treated chlorophyll-containing vegetables. Increase in chlorophyll and β -carotene content was 2.0...2.1 and 2.0...3.3 times, respectively, in the case of production of fine-dispersed CCV purees. With the help of the innovations used, it was possible to establish existence of hidden forms of chlorophylls and carotenoids and transform the product into an easily digestible nanoform.

It has been shown that quality of fine-dispersed purees prepared from CCV with the use of these innovations exceeds quality of the starting raw material. Based on fine-dispersed CCV purees, a wide range of health-improving food products were developed. The

products are in an easily digestible nanosized form. Thick soups, nanodrinks, nanosorbets, dressings sauces have been developed, their quality was studied and a comparison with counterparts made. It has been established that new types of products made from chlorophyll-containing vegetables exceed existing counterparts in the content of the BAS complex (chlorophyll, ascorbic acid, β -carotene, phenolic compounds, etc.). One portion of the product contains from 1/3 to the daily person's demand of BAS. The BAS content in the obtained nanoproducts can be included to the health-improving products and recommended for immunizing people.

Keywords: chlorophyll-containing vegetables, BAS complex, health-improving nanoproducts, steam thermal treatment, mechanolysis, hidden forms of chlorophylls.

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EXAMINING A POSSIBILITY OF USING PURPLE AMARANTH IN THE TECHNOLOGY FOR PRODUCTS MADE OF YEAST DOUGH (p. 57-64)

Olga Simakova

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky Kryvyi Rih, Ukraine
ORCID: <http://orcid.org/0000-0002-4432-8337>

Yurii Korenets

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky Kryvyi Rih, Ukraine
ORCID: <http://orcid.org/0000-0002-5873-7908>

Tatiana Yudina

Kyiv National University of Trade and Economics, Kyiv, Ukraine
ORCID: <http://orcid.org/0000-0001-9863-878X>

Iryna Nazarenko

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky Kryvyi Rih, Ukraine
ORCID: <http://orcid.org/0000-0002-8602-549X>

Iuliia Goriainova

Donetsk National University of Economics and Trade named after Mykhailo Tugan-Baranovsky Kryvyi Rih, Ukraine
ORCID: <http://orcid.org/0000-0003-1228-7793>

It was experimentally found that additives of purple amaranth (APA) have high enzyme activity, which is proved by high activity of the amylase complex: maltose number of 5 % water extract from dry foliage of purple amaranth is 12.31 ± 0.36 %, with addition of CaCl_2 ($\text{Ca}^{2+} = 0.01$ g/l), it is 16.0 ± 0.35 %. The obtained results indicate the prospects of using APA for enhancing baking properties of wheat flour.

We determined the required concentration of the additive of flour from dry foliage of purple amaranth to wheat flour (1 %) for the fortification with biologically active substances, enhancing baking properties of flour and retaining organoleptic parameters. The impact of different concentrations of APA on the content of the basic biologically active substances in wheat flour, gluten running, the indicators of whiteness and a color shade of wheat flour was explored.

It was experimentally found that APA enhance baking properties of top grade wheat flour. High amyolytic activity of flour with APA was established: maltose number of 5 % water extract (tap water) from dry PA foliage is 9.42 ± 0.34 %, from amaranth malt, it is 10.53 ± 0.38 %. There is an increase of sugar forming, and, as a consequence, gas forming capability of wheat flour. APA demonstrates considerable proteolytic activity: flour from dry PA foliage – ($\eta_{\text{rel}} = 1.09$), from amaranth malt – ($\eta_{\text{rel}} = 1.13$), comparable with the activity of barley malt. Application of the enzyme preparation accelerates the process of hydration of gluten proteins of wheat flour (one-hour lying of dough is not required), gluten elasticity is also improved. Thus, the expedience of the use of APA in the technology of products from yeast dough was substantiated.

Keywords: wheat flour, yeast dough, quality, gluten, purple amaranth, enzyme activity.

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CRYOSCOPIC AND MICROBIOLOGICAL STUDY OF THE SEMIFINISHED PRODUCT FOR MAKING A SMOOTHIE DRINK (p. 65-69)

Dmytro Odarchenko

Kharkiv State University of Food Technology and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0002-4792-3465>

Andrey Odarchenko

Kharkiv State University of Food Technology and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0003-4205-7286>

Evgenia Sokolova

Kharkiv State University of Food Technology and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0002-6246-6012>

Vladimir Mikhailik

Kharkiv State University of Food Technology and Trade,
Kharkiv, UkraineORCID: <http://orcid.org/0000-0003-3444-9693>

The dynamics of freezing a semi-finished product for making a smoothie drink was investigated. We have chosen, as the subject of present study, a semi-finished product whose production technology included strawberry, dried apple, and oat flakes.

By using a low temperature calorimeter, crystallization ranges for the examined semi-finished product, as well as the amount of frozen moisture, which was 68.6 %, were identified. It is established that freezing at -20 ± 2 °C contributes to the complete preservation of the sample, and its further storing at the temperature within such limits ensures its storage over a long period of time. It was also experimentally established that the curves of freezing and defrosting of the sample do not coincide, that is, the character of temperature dependence during freezing and defrosting is different. This testifies to the irreversibility of plant tissue during ice formation and thawing.

A reduction in the total microbial contamination over a long refrigeration storing is established, which indicates a negative effect of cold on the viability of microorganisms. The amount of mesophilic-aerobic and optionally anaerobic microorganisms in 30, 60, 90, 180, and 270 days of refrigeration at -18 ± 2 °C is significantly reduced compared to freshly prepared. The amount of yeast and mild fungi also decreases during storage. It is important to comply with sanitary and hygienic standards during production, packaging, storing, and selling, since the complete extinction of the microflora does not occur.

The development and active introduction of effective freezing technologies, low temperature storage, and processing of fruits and berries would contribute to solving a task on the balanced nutrition of people, reducing the level of diseases, improving quality of life. In addition, the introduction of such technologies would significantly enlarge the base of local processing industry whose development, in turn, would contribute to the development of agricultural production in a given region.

The data obtained data could be applied to determine the rational freezing and defrosting modes for a semi-finished product and would make it possible to extend the assortment of frozen products.

Keywords: frozen moisture, microflora, frozen products, crystallization temperature, kinetics of freezing, defrosting.

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SUBSTANTIATION OF THE MECHANISM OF INTERACTION BETWEEN BIOPOLYMERS OF RYE-ANDWHEAT FLOUR AND THE NANOPARTICLES OF THE MAGNETOFOOD FOOD ADDITIVE IN ORDER TO IMPROVE MOISTURERETAINING CAPACITY OF DOUGH (p. 70-80)

Iryna Tsykhanovska

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0002-9713-9257>

Victoria Evlash

Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0001-7479-1288>

Alexandr Alexandrov

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0003-3592-285X>

Tetiana Lazarieva

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0003-4435-3345>

Karina Svidlo

Kharkiv institute of trade and economics of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0002-0175-7756>

Tatyana Gontar

Ukrainian Engineering Pedagogics Academy, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0003-0758-1752>

Liubov Yurchenko

National University of Civil Protection of Ukraine, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0003-4957-338X>

Larisa Pavlotska

Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: <http://orcid.org/0000-0002-6069-9218>

The mechanism of influence of the Magnetofood additive on the moisture retaining in rye-and-wheat dough of various acidities was established. In a neutral medium, solvated Magnetofood nanoparticles are formed from polarized Magnetofood nanoparticles. Their surface acquires hydrophily and ability to interact with ionogenic groups of biopolymers and water dipoles. Interaction of solvated Magnetofood nanoparticles with water molecules results in solvate complexes. In an acidic medium, the protonated Magnetofood nanoparticles interacting with water form solvated Magnetofood nanoparticles. Interaction of the latter through hydrogen bonds with water dipoles results in formation of solvate complexes. In an alkaline medium, hydroxylated Magnetofood nanoparticles interact

with dipoles of water by an ion-dipole mechanism forming solvated Magnetofood nanoparticles which interact with water dipoles through hydrogen bonds with formation of solvate complexes. In an alkaline medium, hydroxylated Magnetofood nanoparticles interact with dipoles of water by an ion-dipole mechanism forming solvated Magnetofood nanoparticles. Their interaction with water dipoles through hydrogen bonds leads to formation of solvate complexes.

The mechanism of interaction of the Magnetofood nanoparticles with ionogenic groups of biopolymers of dough systems was shown. The Magnetofood nanoparticles enter ionic, ion-dipole, dipole-dipole and coordination interactions. Solvated Magnetofood nanoparticles form hydrogen bonds with water dipoles and with molecules of biopolymers.

A “cluster-loop-chain” model of the moisture-retaining power of gluten and flour enriched with the Magnetofood additive was proposed. The Magnetofood nanoparticles contribute to the emergence of structural formations such as “clusters”, “clathrates”, “cavities” and “loops” in which both intermicellar and intramicellar water is retained.

It has been experimentally established that the Magnetofood polyfunctional food additive has a beneficial effect on the body and has a complex sorption, complexing, moisture- and fat-retaining and bacteriostatic action. This results in yield increase, quality improvement, preservation of freshness and extension of shelf life of bakery products.

From this point of view, the study results are of interest not only for Ukraine but also for the international scientific community.

Keywords: polyfunctional food additive, rye-and-wheat flour, interaction mechanism, “cluster-loop-chain” model.

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