ABSTRACT AND REFERENCES

TECHNOLOGY AND EQUIPMENT OF FOOD PRODUCTION

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STUDYING THE COMPLEX OF BIOLOGICALLY ACTIVE SUBSTANCES IN SPICY VEGETABLES AND DESIGNING THE NANOTECHNOLOGIES FOR CRYOSUPPLEMENTS AND NANOPRODUCTS WITH HEALTH BENEFITS (p. 6–14)

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

Oleksander Cherevko
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-1809-5960

Vadym Pavliuk
Kharkiv Trade and Economics Institute of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3947-3473

Ludmila Radchenko
Kharkiv Trade-Economic Colledge of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-2514-7549

Ekaterina Dudnyk
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-7229-7945

Anna Radchenko
Kharkiv Trade-Economic Colledge of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-0869-6607

Tatyana Kolomiets
Lipkovatovsky Agricultural College, Kharkiv region, Novovodolazhsky district, Lipkovatovka village, Ukraine
ORCID: http://orcid.org/0000-0003-4106-8530

We determined the complex of BAS of spicy vegetables (roots of ginger, celery, horseradish, and garlic), which differ from other vegetable raw materials by a high content of unsaturated reactive phyto-substances. It includes volatile aromatic substances, low-molecular and high molecular phenolic compounds. The latter are natural antioxidants, preservatives and have a bactericidal and an immunomodulating effect. We found that spicy vegetables have a high content of prebiotic substances (cellulose, pectin, and protein); they are low in sugar. The presence of the specified BAS in 100 g of spicy vegetables in the amounts that can satisfy a daily need of the human body, as argued by authors, provides fresh vegetables with direct therapeutic and prophylactic properties.

We developed the nanotechnologies for healthy frozen supplements and nanoproducts produced from spicy vegetables, which fully preserve vitamins, aromatic substances, phenolic compounds and other BAS of fresh raw materials. In addition, we found the hidden (bound) forms of BAS in the course of development of nanotechnologies and extracted them into a freely assimilable state. The mass fraction of these substances is 2.5...3.2 times higher than that in fresh vegetables, which we can control by standard chemical methods. We propose to use the cryogenic treatment of raw materials, which includes a cryogenic «shock» freezing and a finely dispersed low temperature grinding (mechanolysis), as the innovation in the development of technologies.

The advantages imply that it became possible to obtain frozen spicy vegetables, which, in terms of the content of natural aromatic substances and phytocomponents (phenolic compounds, polyphenols and other BAS), exceed fresh spicy vegetables by 2...2.5 times. We worked out the technological modes at the semi-industrial bench equipment. We developed technologies for health-improving supplements in the form of finely dispersed purees and frozen spicy vegetables.

That makes it possible to develop a wide range of health products that outperform known analogues in quality using the obtained frozen products and supplements of spicy vegetables.

Keywords: cryogenic treatment, spicy vegetables, BAS complex, health supplements, nanoproducts, mechanolysis, hidden forms of BAS.

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STUDY OF THE NEW METHOD TO INTENSIFY THE PROCESS OF EXTRACTION OF BEET PULP (p. 15–20)

Gregoriy Deynichenko
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3615-8339

Vasyl Guzenko
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-8407-2404

Dmytro Dmytrevskyi
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-1330-7514

Vitalii Chervonyi
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-9085-2260

Tatiana Kolisnichenko
Oles Honchar Dnipro National University, Dnipro, Ukraine
ORCID: http://orcid.org/0000-0003-0560-9520

Oleksandr Omelchenko
Donetsk National University of Economics and Trade named after Mikhailo Tugan-Baranovsky, Kryvyi Rih, Ukraine
ORCID: http://orcid.org/0000-0003-0704-5909

Olga Melnik
Donetsk National University of Economics and Trade named after Mikhailo Tugan-Baranovsky, Kryvyi Rih, Ukraine
ORCID: http://orcid.org/0000-0002-7270-4774

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

Radion Nykyforov
Donetsk National University of Economics and Trade named after Mikhailo Tugan-Baranovsky, Kryvyi Rih, Ukraine
ORCID: http://orcid.org/0000-0001-9823-9551

We report results of experimental research into the process of acidic extraction of pectin-containing raw material (beet pulp) using the new model of the stirring element compared with the conventional grid stirrer. We have designed the experimental installation and devised a procedure for processing the results of studying the extraction process of pectin substances from pectin-containing raw materials (beet pulp), using the new combined stirring element. Mathematical models were constructed in the form of nonlinear regression equations based on the multifactor experiment planning method that employed input parameters of temperature, duration, and hydromodule. It was established that the principal influence on a change in the output parameters is exerted by the input variables of temperature and duration of the process.

We show graphical dependences for quantitative and qualitative characteristics of pectin extracts (pectic substances concentration, molecular weight, complex- and gel-forming capability) depending on the input parameters of temperature and duration of the process for extraction of pectic substances. An analysis of these characteristics allowed us to determine the rational input parameters for the process of extraction of pectin substances. The rational working parameters of the process of acidic extraction of pectin substances from sugar beet pulp with the application of the new method for intensifying the process, are: temperature is 60...70 °C, duration is 1...1.1 hours, and hydromodule is 8...10.

The purpose of this study was to intensify the extraction of pectic substances from pectin-containing raw materials, to improve technical level of the extraction process and to implement the developed method under industrial conditions. Based on the research results, the feasibility of the new method for intensification was established. Further implementation of these results in the food and processing industries would make it possible to produce a wide assortment of pectin-products (extracts, liquid and dry pectin concentrates).

Keywords: pectin-containing raw material, process of acidic extraction, pectin substances, stirring element.

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RESEARCH INTO PRESERVATION OF BROCCOLI DEPENDING ON THE TREATMENT WITH ANTIMICROBIC PREPARATIONS BEFORE STORAGE (p. 20–28)

Ludmila Pusik
Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-5465-2771

Vladimir Pusik
Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-5028-9461

Nina Lyubymova
Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-8964-7326

Veronika Bondarenko
Kharkiv National Agrarian University named after V. V. Dokuchayev, Kharkiv district, Kharkiv region, Ukraine
ORCID: http://orcid.org/0000-0002-0883-7193

Ludmila Gaevaya
Kharkiv National Agrarian University named after V. V. Dokuchayev, Kharkiv district, Kharkiv region, Ukraine
ORCID: http://orcid.org/0000-0002-8302-1776

We studied the effect of antimicrobial preparations on the preservation and quality of broccoli. We established that antimicrobial preparations such as Baikal EM-1, 0.5 % citric acid solution, 0.2 % benzoic acid solution, 0.05 % sorbic acid solution, 0.5:0.5 % solution of vitamins C and P (ascorutin) – contribute to prolonging the storage life of broccoli for 5–20 days depending on the hybrid. The treatment with preparations reduces losses per day by 1.2–3.0 times, it provides the yield of commercial products at 76.8–86.2 %.

The treatment of broccoli with antimicrobial preparations, with ascorutin especially, provides a dry matter content of 1.1–2.6 times higher than in the control variant, which contributes to a decrease in the intensity of consumption of dry soluble substances and vitamin C. At the end of storage, the content of total sugar and disaccharides is equal to the level of the control variant, or exceeds its content by 1.2 and 1.5–2.0 times, respectively. The variants with acids and ascorutin have more of them. The content of monosaccharides remains at the initial level. The loss of mass due to evaporation of water is 1.3–1.8 times higher.

Baikal EM-1 and ascorutin inhibit intensity of expansion of pathogenic microorganisms better than other drugs for 10–15 days. Ascorutin provides 0.8–2.2 % lower loss of weight due to diseases and physiological disorders and a 4.1–7.6 % larger yield of commercial products at prolonged storage. Ascorutin, citric acid, sorbic acid and benzoic acid inhibit development of pathogenic microorganisms on broccoli more actively.

The proposed method for the treatment of broccoli with antimicrobial preparations before storage makes it possible to use antiseptics, such as Baikal EM-1, 0.5 % citric acid solution, 0.2 % benzoic acid solution, 0.05 % sorbic acid solution, 0.5:0.5 % solution of vitamins C and P (ascorutin) – for the post-harvest treatment of vegetable raw materials. This is an important technique for the development of new, low-cost, environmentally friendly and affordable storage technologies.

Keywords: quality of broccoli, antiseptics, storage life, components of chemical composition, preservation.

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INFLUENCE OF WHEAT BRAN ON QUALITY INDICATORS OF A SOUR MILK BEVERAGE (p. 28–35)

Volodimyra Nagovska
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv, Lviv, Ukraine
ORCID: http://orcid.org/0000-0003-3624-8182

Yuriy Hachak
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv, Lviv, Ukraine
ORCID: http://orcid.org/0000-0003-1028-1910

Bogdan Gutyj
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv, Lviv, Ukraine
ORCID: http://orcid.org/0000-0002-5971-8776

Oksana Bilyk
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv, Lviv, Ukraine
ORCID: http://orcid.org/0000-0003-1165-8935

Natalya Slyvka
Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv, Lviv, Ukraine
ORCID: http://orcid.org/0000-0002-1792-2082

Our experimental research revealed that in order to improve consistency during storage of sour milk beverages, it is necessary to ensure the binding of free moisture through the use of natural stabilizers, thickeners and the substances that perform a similar function. Among many tested ingredients of this group of substances, the stabilizing systems based on natural components of plant and animal origin were selected for implementation and preferred for usage. Analysis of the information sources shows lack of data on the use of wheat bran in the technologies of sour milk beverages. That is why there is an objective need to create new kinds of sour milk beverages, specifically, kefir with the use of wheat bran. Consumption of such functional products guarantees the elimination of malnutrition, replenishment of the organism with necessary components.

The influence of wheat bran on quality indicators of the sour milk beverage was studied. It was found that the sour milk drink with wheat bran with fat content of 2.5 % by physical and chemical indicators meets the requirements of standard DSTU 4417:2005. Kefir. Technical specifications.

Studying the organoleptic indicators of the beverage using wheat bran revealed its clean sour milk taste and smell. The total amount of amino acids in the drink with wheat bran increased by 15.08 %, the amount of essential amino acids – by 10.57 %, and that of nonessential amino acids – by 18.24 %. The identified changes in the amino acid composition of the drink with wheat bran indicate that the use of wheat bran in manufacturing sour milk beverages allows increasing their nutritional and biological value of the protein component.

The sour milk drink with wheat bran is a medical and prophylactic product because it contains dietary fibers, which are a valuable energy additive.

Keywords: sour milk drinks, additives, wheat bran, amino acids, organoleptic indicators, physical-chemical indicators.

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EFFECT OF BANANA POWDER AND BUTTER ON THE FORMATION OF THE CRYSTALLINE PHASE OF SUGAR FONDANT (p. 35–41)

Mariia Ianchyk
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-3675-6611

Alexandra Niemirich
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-2849-7501

Oksana Vasheka
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-4162-105X

Oksana Petrusha
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-6009-127X

Nikolay Pogozhikh
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-0835-4896

Taking into consideration modern requirements to technological characteristics of decorative semi-finished products, micronutrient composition, we developed the formulation for the innovative confectionery semi-finished product, which is based on sugar fondant with addition of the mixture of butter, banana powder and the surface-active substance (citric acid ester, monodiglycerides – SAS). It is universal and is designed for the production of a wide range of decorative semi-finished products (creams, fillings, icing, etc.).

We conducted the study of the influence of the mixture of butter, banana powder and surfactant on thermo-physical properties and the structure of the confectionery semi-finished product for confectionery decoration.

The aim of this research was to study the influence of the selected ingredients on the process of formation of the crystal phase of sugar fondant, which is the basis for the confectionery semi-finished product.

Results of the study revealed that during the formation of the crystal phase of the semi-finished product, the existence of the banana powder components leads to differentiation of carbohydrates of sugar fondant by melting temperature. This suggests that recrystallization processes flow less intensively compared to the control sample during the storage of the enriched fondant cream.

The addition of SAS helps obtain a homogeneous polyphase system, which is proved by the homogeneous elastic structure. Microstructural research showed that fondant crystals and vegetable powder particles are surrounded by fat phase of butter and swollen powder particles do not form groups.

Results of the micro-structural analysis and of the differential scanning calorimetry made it possible to propose the mechanism of interaction of banana powder particles with fat phase and the oversaturated solution of sucrose.

The obtained results explain aggregation stability and thermal stability of the universal confectionery semi-finished product at multiple thermal and mechanical influence, which is of technological importance.

Keywords: confectionery semi-finished product, banana powder, thermophysical properties, crystallization, melting endotherm, fractionation.

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STUDY OF MICROELEMENT DISTRIBUTION UNIFORMITY IN A BULK OF DOUGH ENRICHED WITH DIETARY SUPPLEMENTS (p. 42–48)

Tatyana Golovko
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-7059-3620

Micola Pogozhikh
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-0835-4896

Andrey Pak
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0003-3140-3657

Nicolay Golovko
Kharkiv State University of Food Technology and Trade, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-1778-4847

Alina Pak
Kharkiv Institute of Trade and Economics of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-0311-9731

Myushfik Bakirov
Kharkiv College of Trade and Economics of Kyiv National University of Trade and Economics, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0001-9723-9808

The expediency of introduction of dietary supplements based on the chelate complex in food systems and ensuring uniformity of their distribution was substantiated. The objective was to elucidate uniformity of distribution of microelements sorbed on carrier macromolecules and the effect of supplements on functional and technological properties of the dough preparations. Preparations from yeast, puff pastry and unleavened dough with introduced supplements based on the chelate complex were the study subjects. Distribution of the dietary supplement based on the chelate complex in the food system volume and its influence on functional and technological properties of the food systems under study was elucidated. Nuclear magnetic resonance and electron paramagnetic resonance methods, low-temperature calorimetric method and rheological study methods were used.

It has been established that powdered supplements based on the stabilized chelate affect mobility and interaction of water molecules with environment of the test dough preparations. It was proved that introduction of metal chelate in the form of a powdered food supplement makes it possible to ensure uniformity of metal distribution in the volume of the preparations under study. It was determined that an increase in amount of chilled water takes place in the dough

samples with an introduced dietary supplement based on the chelate complex in comparison with the control samples. The established data indicate growth of amount of bound water provided that a supplement was added. It was noted that the stabilized chelate was mainly in a saturated state since water of the dough preparations was in a «bound» state. A change of elastic properties was established in the test dough preparations with a dietary supplement based on the chelate complex. The obtained results are explained by the change of free to bound water ratio in the food systems under study.

The prospects of using powdered supplements with stabilized metal chelates in technologies of food enrichment were proved. It was pointed out that the task of further studies consists in determination of distribution of other microelements of the chelates forming the basis of dietary supplements in the volume of food systems.

Keywords: dough preparations, supplement based on chelate complex, volume distribution of microelement.

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DEVELOPMENT OF MEAT-CONTAINING MINCED SEMI-FINISHED PRODUCTS BASED ON THE LOCALLY PRODUCED RAW MATERIALS (p. 49–54)

Nataliia Bozhko
Sumy National Agrarian University, Sumy, Ukraine
ORCID: http://orcid.org/0000-0001-6440-0175

Vasyl Tischenko
Sumy National Agrarian University, Sumy, Ukraine
ORCID: http://orcid.org/0000-0001-8149-4919

Vasil Pasichnyi
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-3219-1564

Manyefa Polumbryk
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-2333-8595

Oleksandra Haschuk
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-2726-5271

We report results of studying the developed meat-containing semi-finished products; an analysis of the results was performed, which confirm the possibility to combine the meat of duck and freshwater fish meat in the formulation for meat-containing semi-finished products by completely replacing pork and beef in the formulations. Combining in the formulations of meat-containing semi-finished products of duck meat and freshwater fish meat made it possible to obtain model minced meat with high functional-technological properties: the value of moisture-binding capacity is up to 81.54 %,

moisture-retaining capacity is up to 76.47 %, emulsifying capacity is up to 98.0 %, stability of the emulsion is up to 69.49 %, which are higher in comparison with semi-finished products based on traditional kinds of meat.

A sensory quality assessment of the developed semi-finished products has confirmed the high quality of organoleptic indicators and compliance with the requirements regulated by standards for traditional minced semi-finished products, based on the specifications for a given segment of products. The introduction to the composition of formulations of duck meat and freshwater fish meat did not impact negatively on the microbiological safety of the combined products, which is confirmed by the indicators of NMAFAM and the lack of BGEC in the finished products. Based on the set of indicators, we selected sample 2 that contained the meat of duck and the meat of silver Prussian carp for further research.

The combination of different kinds of raw materials of local origin in the formulation for meat-containing minced semi-finished products makes it possible to receive a product with a high content of essential amino acids. The minced semi-finished products that combine duck meat and silver Prussian carp demonstrate values of the amino acid score, which, by the content of threonine, tryptophan, phenylalanine+tyrosine, leucine, and isoleucine, exceeds the «reference» protein and is in the range of 115.75–156.01 %.

The lipids of meat-containing combined semi-finished products are characterized by the high biological effectiveness of fat acid composition due to the high content of PUFA and MUFA, and by the optimal ratio of ω-3 and ω-6 of PUFA (1:7).

Keywords: combining, freshwater fish, duck meat, meat-containing semi-finished product, functional-technological indicators.

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COMBINATION OF VEGETABLE-FRUIT FORMULATION COMPOSITION FOR OBTAINING HIGH QUALITY PRODUCTS (p. 55–60)

Anastasiia Tokar
Uman National University of Horticulture, Uman, Ukraine
ORCID: http://orcid.org/0000-0003-0865-5725

Liudmyla Matenchuk
Uman National University of Horticulture, Uman, Ukraine
ORCID: http://orcid.org/0000-0002-4051-4546

Zinaida Kharchenko
Uman National University of Horticulture, Uman, Ukraine
ORCID: http://orcid.org/0000-0003-3083-7971

Iryna Haidai
Uman National University of Horticulture, Uman, Ukraine
ORCID: http://orcid.org/0000-0002-9202-0062

Nadiia Zahorko
Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: http://orcid.org/0000-0003-4828-5343

Vira Tarasenko
Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: http://orcid.org/0000-0002-0275-0281

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

Nadiia Palianychka
Tavria State Agrotechnological University, Melitopol, Ukraine
ORCID: http://orcid.org/0000-0001-8510-7146

Inna Povorozniuk
Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine
ORCID: http://orcid.org/0000-0002-2575-5114

Lesia Kravchenko
PhD, Associate Professor
Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine
ORCID: http://orcid.org/0000-0001-7012-3709

We have investigated a change in the active acidity of blended products made from vegetable and fruit raw materials. A possibility has been proven to control active acidity through the introduction to formulations of canned foods fruits with a high content of titrated acidity. Apricot, gooseberry, cherry plum, black currant are characterized by a high content of titratable acidity, thus they could replace in the formulations of canned products the organic acids obtained artificially.

It is possible to use zucchini, pumpkin, carrot and beet to produce natural organic purees, juices, compotes, sauces, natural canned vegetable food with a regulated active acidity not higher than 3.9 pH units. To achieve this level of active acidity in canned products, the mass share of titratable acidity should be brought to 0.55–0.60 %. The canned food products manufactured using a given technique are microbiologically stable and safe when employing the sterilization temperature of 100 °C for 20–25 minutes; they have a high organic estimate; they efficiently preserve ascorbic acid. The pumpkin puree demonstrated active acidity of 5.6 pH units. In the blended pumpkin and apricot puree, gooseberry and cherry plum puree, the active acidity decreased to 3.80–3.84 pH units following the introduction of the calculated formulation amount of a fruit part into compositions, from 11.3 to 28.1 %, the content of ascorbic acid increased by 1.6–2.6 times. The content of ascorbic acid in a pumpkin and black currant puree, at the regulated active acidity of 3.86 pH units, increased to 30.6 mg/100 g, by 7.6 times. A similar trend was observed for the blended purees made from carrot and table beet.

The vegetable-fruit purees and sauces, manufactured in line with a given technique, are characterized by excellent organoleptic quality estimation, 26.3–29.3 points. Canned foods from vegetable raw materials with a controlled level of active acidity, due to their fruit part, are natural products with an elevated content of ascorbic acid. The combination could be used for the manufacture of organic products from the appropriate raw materials, thereby retaining their high quality.

Keywords: puree, sauces, titratable acidity, active acidity, ascorbic acid, organic products.

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SUBSTANTIATION OF THE INTERACTION MECHANISM BETWEEN THE LIPO- AND GLUCOPROTEIDS OF RYE-WHEAT FLOUR AND NANOPARTICLES OF THE FOOD ADDITIVE «MAGNETOFOOD» (p. 61–68)

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

Oksana Bryzytska
National University of Pharmacy, Kharkiv, Ukraine
ORCID: http://orcid.org/0000-0002-7728-2275

The mechanism of interaction between nanoparticles (NP) from the polyfunctional food additive «Magnetofood» and functional groups of complex proteins of rye-wheat flour is established. NP of the food additive «Magnetofood» mostly interact with complex proteins at the expense of coordination bonds. Structural changes occur in the structure of complex proteins under the influence of NP from the food additive «Magnetofood»: there are formations of the «cluster» type and the electrostatic complexes of biopolymer with NP of «Magnetofood».

The mechanism of the influence of NP from the food additive «Magnetofood» on the binding of H_2O by lipo- and glucoproteids of rye-wheat dough is established. Nanoparticles (NP) of «Magnetofood» modify lipo- and glucoproteids, change the spatial structure, promoting the strengthening of hydration and water retention processes. In particular, under the influence of NP from «Magnetofood», glucoproteids are structurally altered, activated, they acquire additional reactive centers, specifically hydrophilic. As a result, the activated protein fragments of rye-wheat flour, when swelling, wrap around the carbohydrate fragments and form stable glucoprotein complexes. In lipoproteids, due to the presence of the polarized NP of «Magnetofood» and «clusters», as well as the system of hydrogen bonds between dipoles of H_2O, the accumulation of water is observed around NP of «Magnetofood» and in the «clusters» of the lipoproteid chain. That increases the moisture-retaining ability (MRA) of rye-wheat dough.

The mechanism of interaction between the «Magnetofood» nanoparticles and complex proteins and H_2O molecules in the rye-wheat dough system is proposed. The accumulation of water around NP of «Magnetofood» and in the «clusters» of the lipo- and glucoproteids chains is observed as a result of:

– the presence of polarized NP of «Magnetofood»;
– the emergence of «clusters» in the matrices of biopolymers;
– the system of hydrogen bonds between the dipoles of H_2O.

All this contributes to the improvement of MRA of rye-wheat dough.

It was experimentally established that the food additive «Magnetofood» has a comprehensive effect: water-retaining, fat-retaining, and stabilizing. That leads to the improvement of consumer characteristics of bakery products.

From this point of view, the results of research are of interest not only for Ukraine but also for the scientific community in other countries.

Keywords: food additive, protein-carbohydrate complex of flour, lipo- and glucoproteids, mechanism, moisture-retaining ability.

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RESEARCH INTO EFFECTIVENESS OF USING THE INTEGRATED BREAD BAKING IMPROVER «MINERAL FRESHNESS +» TO SLOW DOWN THE STALING OF BAKERY PRODUCTS (p. 69–78)

Olena Bilyk
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0003-3606-1254

Yulia Bondarenko
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-3781-5604

Mykola Desyk
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0001-8016-466X

Anatoliy Sokolenko
National University of Food Technologies, Kyiv, Ukraine
ORCID: https://orcid.org/0000-0002-1360-9945

Volodymyr Kovbasa
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-0350-6109

Volodymyr Bondar
National University of Food Technologies, Kyiv, Ukraine
ORCID: http://orcid.org/0000-0002-8106-4174

Nutritionists recommend elderly people to eat bakery products that were baked on the previous day and enriched with mineral substances. That is why the relevant problem of the baking industry is extension of freshness retention by bakery products for gerodietary purposes. To solve the stated problem, it is recommended to use food additives and ingredients with the GRAS status and integrated bakery improvers. To prolong freshness of bakery products, we developed the integrated bakery improver «Mineral Freshness +», composed of white pharmacopoeian clay, carboxymethylcellulose, emulsifier, amylolytic enzyme preparation, ascorbic acid, maltodextrin and apple pectin. The technological effectiveness of using the integrated bakery improver «Mineral Freshness +» in order to slow down products' staling was proved. The optimal dosage of the improver was found to be 1.5 % of the weight of flour.

The regularities of the influence of the integrated bakery improver «Mineral Freshness +» on the formation of the structural-mechanical properties of dough were determined. It was established that its introduction in dough leads to an increase in the amount of gluten in it and its elastic properties, improves plastic properties of dough, resulting in shorter kneading. Given the intensification of the dough fermentation process at the use of the improver, we recommend applying it in the accelerated technologies, specifically, the fermentation process must be replaced with the process of resting that lasts 30 minutes.

It was found that the products with addition of the integrated bakery improver «Mineral Freshness +» retain freshness better, which is proved by a decrease in friability of crumb, as well as by in increase in its overall deformation and hydrophilic properties. A positive impact of using the integrated bakery improver «Mineral Freshness +» on microbiological indicators was observed, which testifies to its impact on inhibition of the processes of microbiological spoilage of products.

The results of the comprehensive research prove the usefulness of the integrated bakery improver «Mineral Freshness +» in the technology in bakery products to increase their freshness retention up to 72 h of storage without being packaged.

Keywords: integrated bakery improver, wheat loaf, staling, gluten, structural and mechanical properties of dough.

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