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COMPREHENSIVE FORMATION OF LEATHER SEMI-FINISHED PRODUCTS USING ENZYMES

pages 6–11

Anatolii Danylkovych, *Doctor of Technical Sciences, Professor, Department of Biotechnology, Leather and Fur, Kyiv National University of Technologies and Design, Kyiv, Ukraine, ORCID: https://orcid.org/0000-0002-5707-0419*

Olena Okhmat, *PhD, Associate Professor, Department of Biotechnology, Leather and Fur, Kyiv National University of Technologies and Design, Kyiv, Ukraine, e-mail: oxmat.oa@knutd.edu.ua, ORCID: https://orcid.org/0000-0003-0927-8706*

The object of research is the process of complex formation of elastic leather using enzymes of proteolytic and hydrolytic action.

One of the most problematic areas is the decrease in the elasticity of the leather semi-finished product at the stage of its dehydration. Enzyme treatment increases the mobility of the microfibrillar structure of the semi-finished product due to the destruction of physical intermolecular bonds.

During the study, a proteolytic enzyme was used at the stage of bating the pelt and enzymes of hydrolytic action were used to treat the tanned chrome semi-finished product.

A semi-finished product was obtained, which is characterized by an increase in porosity compared to the original semi-finished product. The porosity of the semi-finished product increases by 22% in the case of using enzyme treatment at the bating stage and by 67% with repeated treatment of the tanned semi-finished product with enzymes. This is due to the fact that the proposed enzyme treatment promotes the removal of glycosaminoglycans from the dermis at the bating stage. Further use of enzymes after tanning of the semi-finished product contributes to the destruction of carbohydrate bonds with collagen macromolecules, which ensures an increase in its physicochemical properties. The peculiarity of this effect can be explained by the presence of an active center in enzymes, which forms enzyme-hydrocarbon-collagen complexes with carbohydrates and collagen macromolecules. Inside the formed complexes, the destruction of existing bonds occurs and the separation of carbohydrates from the collagen of the dermis.

This provides the possibility of obtaining a leather semi-finished product, which is characterized by an increase in the tensile strength and elongation at 9.8 MPa by 8.4 and 23.0%, respectively, and these indicators reach 20.7 MPa and 48.0% compared to the indicators of the tanned semi-finished product.

Keywords: enzymatic plasticization, enzymes of proteolytic and hydrolytic action, leather semi-finished product, physicochemical properties.

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FEATURES OF OBTAINING SELECTIVE METAL OXIDE LAYERS FOR CERAMIC MEMBRANES VIA SOL-GEL METHOD

pages 12–20

Liudmyla Bohdan, *PhD Student, Department of Inorganic Substances, Water Treatment and General Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, e-mail: bohdan.liudmyla@lll.kpi.ua, ORCID: https://orcid.org/0009-0006-5207-7781*

Khrystyna Hutsul, *PhD, Assistant, Department of Inorganic Substances, Water Treatment and General Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, ORCID: https://orcid.org/0000-0002-4760-3605*

Olena Yanushevska, *PhD, Associate Professor, Department of Inorganic Substances, Water Treatment and General Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, ORCID: https://orcid.org/0000-0002-3457-8965*

Yurii Fedenko, *PhD, Senior Lecturer, Department of Technology of Inorganic Substances, Water Treatment and General Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, ORCID: https://orcid.org/0000-0002-8599-1717*

Tetiana Dontsova, *Doctor of Technical Sciences, Professor, Head of Department of Technology of Inorganic Substances, Water Treatment and General Chemical Technology, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine, ORCID: https://orcid.org/0000-0001-8189-8665*

The object of research is metal oxide layers based on SiO_2, TiO_2, ZrO_2 for creating intermediate and selective layers on ceramic matrices. One of the most problematic areas is the difficulty of obtaining a uniform, dense, and stable selective layer determines the operational characteristics of the membrane – selectivity, productivity, and fouling resistance. The sol-gel method was used for synthesizing colloidal solutions of SiO_2, TiO_2, ZrO_2 and the spin-coating method for applying the resulting suspensions to ceramic matrices. The sizes of SiO_2, TiO_2, ZrO_2 particles were determined by turbidimetry, with diameters of 159 nm, 79 nm, and 99 nm, respectively. The results of IR spectroscopy show that the application of TiO_2 selective layer by spin-coating allows for complete coverage of the membrane surface, while the application of ZrO_2 layer results in incomplete coverage with confirmation of the formation of a hydrated precipitate. Studies of morphology by scanning electron microscopy indicate a coarse-grained matrix structure and a more homogeneous medium-grained structure after applying an intermediate SiO_2 layer. The transport properties of ceramic matrices and membranes were determined by their permeability to pure water indicates high permeability of both matrices and membranes. Thus, the sol-gel method in combination with spin-coating has several features, in particular, controlled hydrolysis of precursors and the possibility of step-by-step formation of uniform layers makes it possible to obtain membranes with high water permeability (over 560 cm^3/min) and a stable microfiltration structure after applying only 5 layers. Compared to similar methods, the proposed approach provides uniform coverage, less particle agglomeration, increased process reproducibility, enabling the creation of ceramic microfiltration membranes for water purification processes.

Keywords: selective layers, metal oxides, spin-coating, ceramic membranes, sol-gel method, water permeability.

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DETERMINATION OF THE LARGEST LYAPUNOV EXPONENT OF CHAOS IN THE DYNAMICS OF HAZARDOUS PARAMETERS OF A GAS ENVIRONMENT FOR THE RAPID IGNITION DETECTION

pages 21–26

Igor Tolok, *PhD, Associate Professor, Rector, National University of Civil Protection of Ukraine, Cherkasy, Ukraine, ORCID: https://orcid.org/0000-0001-6309-9608*

Boris Pospelov, *Doctor of Technical Sciences, Professor, Independent Researcher, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0002-0957-3839*

Evgeniy Rybka, *Doctor of Technical Sciences, Professor, Science and Innovation Center, National University of Civil Protection of Ukraine, Cherkasy, Ukraine, e-mail: e.a.ribka@gmail.com, ORCID: https://orcid.org/0000-0002-5396-5151*

Serhii Savchenko, *Vice-Rector, National University of Civil Protection of Ukraine, Cherkasy, Ukraine, ORCID: https://orcid.org/0009-0005-6506-4552*

Yurii Kozar, *Doctor of Legal Sciences, Professor, Department of Theory and History of State and Law, Uzhhorod National University, Uzhhorod, Ukraine, ORCID: https://orcid.org/0000-0002-6424-6419*

Olekcii Krainiukov, *Doctor of Geographical Sciences, Professor, Department of Ecology and Environmental Management, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0002-5264-3118*

Konstantin Sporyshev, *Doctor of Science in Public Administration, Educational and Scientific Institute for Management Training, National Academy of the National Guard of Ukraine, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0003-4737-9698*

Larysa Maladyka, *PhD, Associate Professor, Department of Fire Prevention in Populated Areas, National University of Civil Protection of Ukraine, Cherkasy, Ukraine, ORCID: https://orcid.org/0000-0003-1644-0812*

Vyacheslav Surianinov, *PhD, Department of Reinforced Concrete Constructions and Transport Constructions, Odesa State Academy of Civil Engineering and Architecture, Odesa, Ukraine, ORCID: https://orcid.org/0009-0006-9620-4287*

Maksym Harifullin, *PhD, Research Center, Lviv State University of Internal Affairs, Lviv, Ukraine, ORCID: https://orcid.org/0000-0002-6469-4924*

The object of research is the largest Lyapunov exponent of the dynamics of hazardous gas environment parameters in premises at intervals of reliable absence and presence of ignition of materials in premises. The problem is to determine and develop a strategy for using the largest Lyapunov exponent on a one-dimensional sample of real contaminated measurements of hazardous gas environment parameters in premises for the prompt detection of material ignitions. An experimental verification of the determination of the largest Lyapunov exponent of the dynamics of the main hazardous gas environment parameters during ignition of materials in a laboratory chamber at intervals of reliable absence and occurrence of ignition was performed. It was established that during ignition of materials, the values of the largest Lyapunov exponent indicate a decrease in stability and a transition to chaos in the dynamics of temperature and carbon monoxide concentration for all the test materials under study. This indicates a loss of the degree of "order" in the dynamics of temperature and carbon monoxide concentration. At the same time, the value of the largest Lyapunov exponent of the dynamics of the specific optical density of smoke does not change significantly and remains stable with some decrease in stability during ignition of the material. It was found that the use of such a parameter for detecting the ignition of materials has significant advantages in the case of using the dynamics of temperature and carbon monoxide concentration of the gas environment of the premises. The results obtained are useful from a theoretical point of view for determining the largest Lyapunov exponent for a one-dimensional sample of real contaminated measurements for an arbitrary dangerous parameter of the gas environment at an arbitrary observation interval. The practical significance lies in the possibility of further improving existing fire protection systems of objects in order to prevent fires.

Keywords: largest Lyapunov exponent, operational detection of ignition, dangerous parameters of the gas environment, premises.

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FOOD PRODUCTION TECHNOLOGY

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IMPROVEMENT OF A MOBILE VACUUM EVAPORATOR FOR THE PRODUCTION OF MULTICOMPONENT VEGETABLE SEMI-FINISHED PRODUCTS WITH ADJUSTABLE THICKENING FOR NEW PRODUCT FORMULATIONS

pages 27–33

Lyudmila Chuiko, *PhD, Head of Research Department, State Biotechnological University, Kharkiv, Ukraine, e-mail: chuiko.lyudmila8@gmail.com, ORCID: https://orcid.org/0000-0003-2377-7501*

Nataliia Tytarenko, *Department of Equipment and Engineering of Processing and Food Production, State Biotechnological University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0002-9745-883X*

Andrii Milenin, *PhD, Associate Professor, Department of Equipment and Engineering of Processing and Food Production, State Biotechnological University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0003-3521-1652*

Hanna Chmil, *Doctor of Economic Sciences, Professor, Department of Marketing, Reputation Management and Customer Experience, State Biotechnological University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0002-3703-9940*

Sergei Sabadash, *PhD, Associate Professor, Department Technology and Food Safety, Sumy National Agrarian University, Sumy, Ukraine, ORCID: https://orcid.org/0000-0002-0371-8208*

Eldar Ibaiev, *Independent Researcher, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0003-3090-3553*

The object of research is the process of manufacturing multicomponent vegetable semi-finished products with adjustable thickening of the mass from Jerusalem artichoke, carrot and pumpkin on an improved mobile vacuum evaporator. Traditional evaporators are characterized by high energy and metal consumption, the presence of a steam jacket with complex temperature range regulation, which leads to an increase in the cycle duration and losses of natural ingredients. The lack of mobility of traditional equipment does not allow it to be used in mobile lines of agricultural complexes and craft production, which is relevant for decentralized use of the device, for example, in front-line regions. In the course of improving the mobile vacuum evaporator, classical methods were used to analyze heat and mass transfer, determine the content and degree of preservation of useful natural ingredients in the conditions of mobile production of multicomponent semi-finished products with adjustable thickening. The design improvement is based on the use of a film-like electric heater of the radiant type, additional increase in the useful heat exchange surface due to the use of a mixer with a heating circuit and Peltier elements for secondary air recovery. Such actions contributed to increasing the resource efficiency of the technological cycle and stabilizing the temperature effect during the controlled thickening of natural masses.

The duration of controlled thickening of multicomponent masses was reduced by 37%, the specific heat consumption by 15.5%, the loss of vitamin C by 21%, the preservation of inulin (94%), β-carotene (87%) and 88% preservation of polyphenols. It is the introduction of electric heating of the working chamber of the apparatus and the artificial increase in the useful heat exchange surface actually due to the mixer circuit, which is heated by 27%, which contributes to the stabilization of the temperature field. And the use of an air thermal insulation jacket allows for the recovery of secondary warm air, further increasing the resource efficiency of the technological cycle. The improvement of the apparatus contributes to the resource-saving processing of plant raw materials into polycomponent semi-finished products of high readiness with adjustable thickening, in particular within 25–45% of dry matter for further introduction into the formulations of new products. A polycomponent semi-finished product of high readiness with adjustable thickening can be used in functional drinks, baby food, confectionery fillings

and meat and vegetable products. A comparison of the improved design with basic evaporators is characterized by resource efficiency, mobility for agricultural sectors in conditions of decentralized processing, for example in front-line regions.

Keywords: vacuum evaporator, film-like electric heater, polycomponent semi-finished products, heat recovery, polycomponent vegetable mass.

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DETERMINING THE INFLUENCE OF SOME FACTORS ON IMPROVING THE QUALITY OF SHERRY WINE MATERIAL

pages 34–43

Hasil Fataliyev, *Doctor of Technical Sciences, Professor, Department of Food Engineering and Expertise, Azerbaijan State Agricultral University (ASAU), Ganja, Azerbaijan, ORCID: https://orcid.org/0000-0002-5310-4263*

Natavan Gadimova, *Candidate of Technical Sciences, Associate Professor, Department of Engineering and Applied Sciences, Department of Food Engineering, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan, ORCID: https://orcid.org/0000-0003-1939-1796*

Azer Taghiyev, *Doctor of Philosophy in Engineering, Senior Lecturer, Department of Winery and Technology, Azerbaijan Cooperative University, Baku, Azerbaijan, ORCID: https://orcid.org/0009-0004-2008-2258*

Konul Baloghlanova, *Doctor of Philosophy of Technical Science, Department of Technology of Organic Substances and Complete Molecular Compounds, Azerbaijan State Oil and Industry University (ASOIU), Baku, Azerbaijan, ORCID: https://orcid.org/0009-0008-6902-4293*

Alakbar Alakbarov, *Department of Food Engineering and Expertise, Azerbaijan State Agricultural University (ASAU), Ganja, Azerbaijan, ORCID: https://orcid.org/0009-0002-0657-1595*

The object of research is the production of Sherry must and wine materials, as well as the processes that occur during this production.

Factors affecting the quality of Sherry wine material – particularly the amount of juice yield, different combinations of fining agents, the duration and course of fermentation, and the role of the grape variety – have not been sufficiently studied. It was found that increasing the juice yield per ton of grapes from 50 to 75 decaliters led to an increase in aldehydes from 61.2 mg/dm^3 to 86.1 mg/dm^3, esters from 67.3 mg/dm^3 to 86.7 mg/dm^3, higher alcohols by 40 mg/dm^3, and terpenes by up to 100 mg/dm^3 in the resulting wine material. An increase in phenolic compounds and oxidation-reduction potential (ORP) caused oxidation uncharacteristic of Sherry wine material, leading to a decrease in quality. Sensory analysis showed a decline in quality scores by 0.02–0.10 points. The effect of fining agents reduced the content of phenolic compounds and titratable acids, while color values shifted positively. Juice samples were fermented both with (experimental) and without (control) the addition of nutrient supplements. Compared with the control, fermentation in the experimental samples was completed 2 days earlier. Increasing the dose of sulfur dioxide added to the juice from 50 mg/dm^3 to 120 mg/dm^3 resulted in a decrease in alcohol content and an increase in titratable acidity in the fermented samples. Wine materials prepared from Bayan, Fetyaska, and Rkatsiteli grape varieties are suitable for Sherry production; however, in terms of optimal composition, Fetyaska wine material was considered superior.

The obtained results can be applied in family-owned vineyards and wine-making enterprises.

Keywords: juice, Sherry wine material, phenolic compounds, nitrogenous substances, ethyl alcohol, yeast solution.

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EVALUATION OF pH-MODIFIED CHICKPEA PROTEIN ISOLATE AS A FUNCTIONAL FAT REPLACER IN GERMAN-STYLE COOKED SAUSAGES

pages 44–49

Iryna Kurmakova, *Doctor of Technical Sciences, Professor, Department of Chemistry, Technology and Pharmacy, T. H. Shevchenko National University "Chernihiv Colehium", Chernihiv, Ukraine, ORCID: https://orcid.org/0000-0002-8916-6546*

Nadiia Lapytska, *PhD, Senior Lecturer, Department of Chemistry, Technology and Pharmacy, T. H. Shevchenko National University "Chernihiv Colehium", Chernihiv, Ukraine, ORCID: https://orcid.org/0000-0003-2431-4373*

Hanna Novik, *PhD, Associate Professor, Department of Food Technologies, Oles Honchar Dnipro National University, Dnipro, Ukraine, ORCID: https://orcid.org/0000-0003-4045-4878*

Olena Bondar, *PhD, Senior Lecturer, Department of Chemistry, Technology and Pharmacy, T. H. Shevchenko National University "Chernihiv Colehium", Chernihiv, Ukraine, ORCID: https://orcid.org/0000-0002-9612-0546*

Olha Vasylenko, *PhD, Associate Professor, Department of Higher Mathematics and Physics, Sumy National Agrarian University, Sumy, Ukraine, e-mail: vasylenko.sumy@gmail.com, ORCID: https://orcid.org/0000-0003-1643-0702*

Tetiana Holovko, *Doctor of Technical Science, Professor, Department of Meat Technology, State Biotechnological University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0001-7059-3620*

Maksym Zherebkin, *PhD, Senior Lecturer, Department of Meat Technology, State Biotechnological University, Kharkiv, Ukraine, ORCID: https://orcid.org/0000-0001-8365-0495*

Iryna Levchenko, *PhD, Associate Professor, Department of Fodder Technology and Animal Feeding, Sumy National Agrarian University, Sumy, Ukraine, ORCID: https://orcid.org/0009-0003-9117-4005*

Oleh Starynskyi, *PhD Student, Department of Food Technologies, Sumy National Agrarian University, Sumy, Ukraine, ORCID: https://orcid.org/0009-0001-1789-1669*

The object of research is boiled German-type sausages with reduced fat content. The technological complexity of fat reduction in traditional meat emulsions is a major problem, which inevitably leads to a deterioration in both physicochemical parameters (emulsion stability) and sensory characteristics, such as texture and juiciness. This study was aimed at assessing the ability of chickpea protein isolate (CPI), modified using the pH-adjustment method, to act as a functional fat substitute. At the first stage, a comparison of the techno-functional properties of the modified isolate (solubility, *WHC*, *OHC*, *EAI* and *ESI*) with those of the native protein was carried out. All functional parameters of CPI were significantly improved by pH-treatment ($p < 0.05$). The solubility increased from 24.33% to 82.67%, and the emulsifying activity index (*EAI*) from 27.33 to 48.33 $m1^2/g$, which are significant changes for meat systems. For the experiment, modified CPI was introduced at concentrations of 1% (sample CPI1) and 2% (sample CPI2) for partial fat replacement. This was compared with the results of the high-fat control (23%). This combination allowed to significantly ($p < 0.05$) reduce the mass fraction of fat in the finished products. Sample CPI1 showed a decrease of 26.1%, and sample CPI2 showed a decrease of 40.6%. At the same time, the technological yield showed a clear trend towards growth (from 90.67% to 99.00%). Sensory analysis (on a 9-point scale) showed that sample CPI1 (1% CPI) had a sensory profile that was statistically indistinguishable ($p > 0.05$) from the control in all parameters, including taste (8.05 vs. 8.07) and aroma (7.63 vs. 7.78). However, sample CPI2 showed a significant deterioration in organoleptic properties ($p < 0.05$). Thus, pH-modified CPI proved its effectiveness as a fat substitute, and the 1% dosage was identified as the best method for preparing healthy cooked sausages without compromising on taste.

Keywords: chickpea protein isolate, pH adjustment, fat substitute, meat products, traditional sausages, vegetable protein.

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