



## CHEMICAL AND TECHNOLOGICAL SYSTEMS

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## INFLUENCE OF SILICONS OF DIFFERENT STRUCTURES ON THE HYDRATION OF COMPOSITIONAL CEMENTS

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**Sokoltsov Vladimir**, Engineer, Department of Chemical Technology of Composite Materials, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: xtkm@kpi.ua, ORCID: <http://orcid.org/0000-0003-1811-4527>

**Tokarchuk Volodymyr**, PhD, Associate Professor, Department of Chemical Technology of Composite Materials, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: tokarchuk.volodya@ukr.net, ORCID: <http://orcid.org/0000-0001-8620-954X>

**Sviderskyi Valentyn**, Doctor of Technical Sciences, Professor, Department of Chemical Technology of Composite Materials, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: xtkm@kpi.ua, ORCID: <http://orcid.org/0000-0002-2246-3896>

The object of research is cement, which contains in its composition silica of various structures. The increase in the production of composite cements leads to the need to search for new active mineral additives. At the moment, the choice of mineral additives is made without taking into account the state in which the silicate component is located, therefore, it is necessary to develop certain criteria for the targeted selection of possible materials. This will reduce the cost of labor and financial resources to conduct relevant research.

As it is known, silicates can be in a crystalline, amorphous and glassy state; therefore, the reactivity of various additives, even with the same chemical composition, can also differ significantly. It is proposed to study the effect of silica structure on hydration processes and properties of cements.

The effect of silica in a different phase state (crystalline, amorphous, and glassy) on the hardening processes and physico-mechanical properties of composite cements has been investigated. It is established that the crystallinity degree of silica significantly affects the normal density of cement paste. Thus, the introduction of crystalline silica increases the normal thickness by 0.1–1.1 %, amorphous by 12.3–136.1 %, glassy by 11.2–56.2 %, compared with non-additive cement. The setting time of cement paste varies slightly.

In the early stages of hardening, the rate of drop in strength is highest with the introduction of amorphous silica. For example, when enter 10 wt. % of crystalline silica shows a slight increase in the strength of the samples, compared with 8.2 % non-additive cement. The same amount of amorphous silica additive reduces strength by 33 %, glassy silica – by 19.2 %. This trend continues with increasing content of additives.

The obtained research results allow to conclude that it is most appropriate to use in the production of composite cements mineral additives containing in their composition silica phases in a crystalline and glassy state.

**Keywords:** silica of various structure, composite cement, setting time, normal density, hydration processes.

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## REGULATION OF RHEOLOGICAL AND MECHANICAL PROPERTIES OF POLYPROPYLENE COMPOSITIONS FOR AUTOMOTIVE PARTS

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**Saitarly Svetlana**, Postgraduate Student, Department of Applied Ecology, Technology of Polymers and Chemical Fibers, Kyiv National University of Technologies and Design, Ukraine, e-mail: svetlanasaitarly@gmail.com, ORCID: <http://orcid.org/0000-0002-1344-444X>

**Plavan Viktoriia**, Doctor of Technical Sciences, Professor, Head of the Department of Applied Ecology, Technology of Polymers and Chemical Fibers, Kyiv National University of Technologies and Design, Ukraine, e-mail: plavan.vp@kmutd.edu.ua, ORCID: <http://orcid.org/0000-0001-9559-8962>

**Rezanova Nataliia**, PhD, Associate Professor, Department of Applied Ecology, Technology of Polymers and Chemical Fibers, Kyiv National University of Technologies and Design, Ukraine, e-mail: mlfibers@ukr.net, ORCID: <http://orcid.org/0000-0002-7956-3767>

**Sova Nadiya**, PhD, Associate Professor, Department of Applied Ecology, Technology of Polymers and Chemical Fibers, Kyiv National University of Technologies and Design, Ukraine, e-mail: sova.nv@kmutd.edu.ua, ORCID: <http://orcid.org/0000-0003-3550-6135>

The object of research is the technology of producing filled impact-resistant compositions based on polypropylene for the manufacture of automotive parts. The main problem is the reduction of strength and technical characteristics with an increase in the amount of filler in the compositions. To solve this problem, the injection of a modifier in an amount of 5 mass % is proposed in filled polypropylene compositions.

The effect of the filler and modifier on the rheological and mechanical properties of polypropylene-based compositions has been studied. It has been established that the presence of calcite concentrate as a filler and propylene-octenoic block copolymers as a modifier in the composition helps to reduce its viscosity, which is due to the predominant effect of the emulsifying action of calcium stearate over the thickening effect of the mineral filler. An increase in the melt flow index in compositions with 5 % propylene-octenoic block polymer is shown, which is explained by its plasticizing effect and good combination with polypropylene. It is shown that the injection of the filler to 10 mass % increases the impact strength compared to the original polypropylene. A further increase in the filler content to 20 % in the compositions reduces the impact strength to almost the value for the output polypropylene with an uncritical decrease in tensile strength. It is shown that the presence of 5 mass % of the modifier in the compositions increases the value of the relative elongation.

It is determined that the developed composition with 5 mass % of the modifier and with varying the amount of filler can be used for the production of parts for cars for various purposes without significant changes in the technological cycle. The advantage of the investigated compositions is the reduction of energy consumption for the processing of highly filled compositions. The implementation of the developed technologies does not require additional capital investments for the re-equipment of the enterprise, since the developed compositions can be processed using conventional extrusion equipment.

**Keywords:** polypropylene, calcite concentrate, propylene-octenoic block copolymers, rheological properties, mechanical properties, impact strength, automotive parts.

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#### IMPROVEMENT OF WORKING PARAMETERS OF SHIPS WITH THE USE OF WATER-FUEL EMULSIONS

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**Malakhov Oleksiy**, Doctor of Physical and Mathematical Sciences, Professor, Department of Vessel's Thermal Energy, National University «Odessa Maritime Academy», Ukraine, e-mail: [a\\_malahov@yahoo.com](mailto:a_malahov@yahoo.com), ORCID: <http://orcid.org/0000-0002-5003-8715>

**Kolegaev Mikhail**, PhD, Professor of the Department of Life Safety, National University «Odessa Maritime Academy», Ukraine, e-mail: [smf@onma.edu.ua](mailto:smf@onma.edu.ua), ORCID: <http://orcid.org/0000-0002-9328-182X>

**Malakhova Diana**, Postgraduate Student, Department of Oil-Gas and Chemical Engineering, Odessa National Polytechnic University, Ukraine, e-mail: [diana.dizy.ds@gmail.com](mailto:diana.dizy.ds@gmail.com), ORCID: <http://orcid.org/0000-0003-4833-1485>

**Maslov Igor**, PhD, Associate Professor, Department of Ship Power Plants and Systems, Danube Institute of National University

«Odessa Maritime Academy», Izmail, Odessa region, Ukraine, e-mail: igormsl@ukr.net, ORCID: <http://orcid.org/0000-0003-1759-6077>

**Brazhnik Igor**, Postgraduate Student, Department of Life Safety, National University «Odessa Maritime Academy», Ukraine, e-mail: ig.brazhnik@gmail.com, ORCID: <http://orcid.org/0000-0001-9961-9759>

**Gudilko Roman**, Odessa, Ukraine, e-mail: romangudilko1973@gmail.com, ORCID: <http://orcid.org/0000-0001-6519-9258>

The object of research is the process of preparing and burning watered fuels on ships. One of the most problematic places in the use of such fuels is the complexity of the process of preparing a water-fuel emulsion and the lack of data that unequivocally indicate the maximum allowable values of water concentration in a marine diesel. As a result of research, it has been established that the presence of water in fuel under certain operating conditions of a marine ship may lead to an improvement in the combustion process. In this case, harmful emissions are reduced, flue gas temperature decreases and fuel costs are descended.

In the course of the study, a new technology of ship treatment of water-fuel emulsions was used. The proposed method of mixing water with fuel provided structural changes in the molecular composition of the emulsion in comparison with the initial structure of hydrocarbons and provided increased dispersion when it was sprayed in the combustion flame. The basis for creating a technology for preparing water-fuel emulsions was two processes – cavitation and mechanical mixing of water and fuel at high speeds.

It has been found that the improvement of the main performance indicators of ships in various load modes of the main engine can be achieved with a water concentration in the fuel of up to 15 %. This is due to the fact that the quality of fuel combustion increases due to a decrease in the deposits and in sediments on the inner surfaces of the working cylinders. The process of using water-fuel emulsions on ships has a number of features that are determined by the used equipment. A very important issue is the question of the sustainability of the combustion flame created by the injectors of the ship's main engine. Due to the quality preparation of the water-fuel emulsion, a decrease in the total fuel consumption is observed while maintaining the ship's performance at a constant level. Compared to similar ships operating on standard fuel, the reduction of thermal stress of the ship's main engine is achieved by reducing the temperature of flue gases emitted into the atmosphere.

**Keywords:** water-fuel emulsion, water concentration, temperature of the flue gases, combustion flame, main engine, fuel consumption.

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## ECOLOGY AND ENVIRONMENTAL TECHNOLOGY

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### DEVELOPMENT OF THE LANDSLIDE HAZARD CONTROL SYSTEM OF NATURAL AND MAN-MADE SLOPES

page 21–25

**Kovrov Oleksandr**, PhD, Associate Professor, Professor of the Department of Ecology and Environmental Protection Technologies, National Technical University «Dnipro Polytechnic», Ukraine, e-mail: kovralex1@gmail.com, ORCID: <http://orcid.org/0000-0003-3364-119X>

**Kolesnyk Valerii**, Doctor of Technical Sciences, Professor, Department of Ecology and Environmental Protection Technologies, National Technical University «Dnipro Polytechnic», Ukraine, e-mail: kolesnikve@yahoo.com, ORCID: <http://orcid.org/0000-0003-2349-3576>

The object of research is the landslide hazard control of natural and man-made slopes, as a factor in environmental safety and stability of geomechanical systems. One of the problematic aspects in solving this scientific problem is the lack of an integrated approach in the study of landslides and insufficient laboratory studies of the physicomaterial properties of soft loamy rocks and soils. For a possible forecasting and control of the landslide hazard, a combination of analytical and laboratory studies, methods of numerical modeling of the stability of the slopes is necessary, and is used in the study.

The 5-level evaluation landslide hazard of the natural and man-made slopes to control their stability is substantiated. Landslide hazard scale allows to reliably forecast the geomechanical state of the rock massif depending on the values of the slope stability factor in changing geoclimatic conditions and substantiate effective

engineering measures for protection against landslides. Landslide hazard classification of natural slopes according to the value of safety factors is proposed. It can be used to evaluate the sustainability of man-made slopes of solid and bulk rocks, and to forecast the environmental hazard from landslides as a result of emergency situations.

A structural-logical scheme for the landslide hazard control at the regional and local levels is based on modern methodological approaches regarding the evaluation and forecasting of the stability of natural and man-made slopes. Thanks to the use of an integrated approach for evaluating the stability and safety of the slopes, it is possible to scientifically-based monitoring of these geo-features.

The use of the proposed landslide hazard control system allows justifying the stable parameters of geotechnical objects (man-made slopes) during the open development of minerals with due regard for geometrical parameters, physical and mechanical characteristics, flooding of the rock mass and external loads. Using an integrated approach for natural slope landscapes is an effective tool for determining the conditions of landslides.

**Keywords:** landslide hazard of natural and man-made slopes, stability factor, forecasting and control system.

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## DEVELOPMENT OF NEW COMPOSITIONS FOR REDUCING THE CORROSIVE AGGRESSIVENESS OF OIL-CONTAINING WATER

page 25–30

*Shuryberko Mariia*, Postgraduate Student, Department of Ecology and Plant Polymers Technology, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: [mashashuryberko@gmail.com](mailto:mashashuryberko@gmail.com), ORCID: <http://orcid.org/0000-0001-5283-2069>

*Gomelya Mykola*, Doctor of Technical Sciences, Professor, Head of the Department of Ecology and Plant Polymers Technology, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: [m.gomelya@kpi.ua](mailto:m.gomelya@kpi.ua), ORCID: <http://orcid.org/0000-0003-1165-7545>

*Gluchenko Nikola*, Senior Lecturer, Department of Operations Management Units with Military Communications Facilities, National Academy of National Guard of Ukraine, Kharkiv, Ukraine, e-mail: [gluschenko4@ukr.net](mailto:gluschenko4@ukr.net), ORCID: <http://orcid.org/0000-0003-3448-0965>

*Chuprova Kristina*, Department of Ecology and Plant Polymers Technology, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: [istiupro@gmail.com](mailto:istiupro@gmail.com), ORCID: <http://orcid.org/0000-0002-4713-3949>

*Overchenko Tetiana*, PhD, Department of Ecology and Plant Polymers Technology, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Ukraine, e-mail: [nezvyskaya@i.ua](mailto:nezvyskaya@i.ua), ORCID: <http://orcid.org/0000-0002-5883-6228>

The object of research is environmentally friendly systems in the oil and petrochemical industry. All stages of the oil use – mining-processing-use – are accompanied by environmental pollution. Significant pollution occurs during the extraction, transportation and spill of oil, wastewater discharge, burning and storage of oil waste. Due to the presence of aggressive components in the composition of oil-containing saline water, the corrosion rate of metal structures increases, which leads to the rapid destruction of equipment and pipelines. Therefore, one of the priorities is to protect metal structures from corrosion in oil and oil-water emulsions.

The paper assesses the aggressiveness of aqueous solutions of different petro-mineral composition at a temperature of 80 °C. It is shown that mineralized aqueous solutions are more corrosively aggressive than their composition with oil. Compositions are developed to reduce the corrosivity of oil-contained water and their effectiveness is determined. Research results indicate that the alkyl imidazoline-based inhibitor provides high efficiency of protecting steel against corrosion at temperatures from 30 °C to 80 °C. Protection degree at doses of 10–50 mg/dm<sup>3</sup> reaches 82–86 %. Compounds based on alkyl imidazoline are effective in aqueous-organic emulsions based on saline water and petroleum ether only at low temperatures. At elevated temperatures, due to the high volatility of petroleum ether, the formation of a protective adsorption film on the surface of the steel does not occur.

In the case of the use of corrosion inhibitors of steel on the basis of alkyl imidazolines, it is possible to achieve high effectiveness of protection against destruction of oil pipelines, where, in addition to oil, there are always impurities of saline water, and water pipelines, where oil contains in highly mineralized waters. The advantage of alkyl imidazolines is that due to the hydrophilic and hydrophobic components of their molecules, they dissolve well in both petroleum products and in the aquatic environment.

**Keywords:** oil-contained water, metal corrosion, corrosion inhibitor, corrosion rate, alkyl imidazoline.

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## DEVELOPMENT OF TECHNOLOGY OF INDUSTRIAL WASTES TREATMENT PRODUCTS DISPOSAL BY FERRITIZATION IN THE MATRIX OF ALKALI-ACTIVATED CEMENTS

page 31–35

**Kochetov Gennadii**, Doctor of Technical Sciences, Professor, Department of Chemistry, Kyiv National University of Construction and Architecture, Ukraine, e-mail: [gkochetov@gmail.com](mailto:gkochetov@gmail.com), ORCID: <http://orcid.org/0000-0003-0041-7335>

**Samchenko Dmitriy**, PhD, Junior Researcher, Scientific Research Part, Kyiv National University of Construction and Architecture, Ukraine, e-mail: [sama30071988@gmail.com](mailto:sama30071988@gmail.com), ORCID: <http://orcid.org/0000-0003-3305-8180>

**Kolodko Anton**, Postgraduate Student, Department of Chemistry, Kyiv National University of Construction and Architecture, Ukraine, e-mail: [antoon11@ukr.net](mailto:antoon11@ukr.net), ORCID: <http://orcid.org/0000-0002-6791-7978>

**Kovalchuk Oleksandr**, PhD, Senior Researcher, Scientific-Research Institute for Binders and Materials named after V. D. Glukhovskiy, Kyiv National University of Construction and Architecture, Ukraine, e-mail: [kovalchuk.oyu@gmail.com](mailto:kovalchuk.oyu@gmail.com), ORCID: <http://orcid.org/0000-0001-6337-0488>

**Pasko Anton**, PhD, Scientific-Research Institute for Binders and Materials named after V. D. Glukhovskiy, Kyiv National University of Construction and Architecture, Ukraine, e-mail: [ua.pasko@gmail.com](mailto:ua.pasko@gmail.com), ORCID: <http://orcid.org/0000-0001-6455-9581>

The object of research is liquid and solid wastes resulting from the processing of highly concentrated wastewater from industrial enterprises using the ferritization method. It is known that galvanic

production creates large volumes of highly toxic waste requiring further processing or safe disposal. One of the most problematic places is the use of traditional reagent methods that do not provide high rates of treated water and chemical stability of a significant amount of solid-phase waste water.

The use of ferritization technology allows eliminating the indicated disadvantages and increasing the efficiency of the industrial wastewater treatment process. In the course of the study, improved ferritization method with electromagnetic activation of the process is used, which can significantly increase its energy efficiency. However, dense and stable ferritization sediments that contain toxic compounds of heavy metals need reliable disposal. But even with proper treatment of wastewater from heavy metal compounds, they contain a large amount of other pollutants, making it impossible to discharge such water into natural water bodies, in particular, because of its increased alkalinity. Environmentally safe use of such substandard products in solid and liquid state as components of building materials is developed. The most effective cementing materials with reliable immobilization of industrial waste compounds are alkaline binders. The performance properties of such modified alkaline cements and concretes based on them are obtained. The leaching of heavy metal ions from the matrix of the material is investigated and their reliable fixation in the structure of alkaline cements is proved. Due to this, immobilization of water treatment products in alkaline cements and concretes based on them does not degrade the performance of their properties and at the same time provides the advantages of such waste disposal.

Compared with similar known technologies, a completely waste-free complex treatment of industrial wastes of electroplating plants of industrial enterprises is developed.

**Keywords:** industrial waste treatment, ferritization technology, ferritic sediments, alkaline cement, leaching of heavy metal ions.

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## FOOD PRODUCTION TECHNOLOGY

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### INVESTIGATION OF THERMAL AND TECHNOLOGICAL CHARACTERISTICS OF NEW MEAT PASTES PRODUCTION

page 36–41

**Moskalyuk Oksana**, Assistant, Department of Technology of Meat and Meat Products, National University of Food Technologies, Kyiv, Ukraine, e-mail: [MoskalyukOE@i.ua](mailto:MoskalyukOE@i.ua), ORCID: <http://orcid.org/0000-0001-7090-6834>

**Chernyushok Olga**, PhD, Associate Professor, Department of Technology of Meat and Meat Products, National University of Food Technologies, Kyiv, Ukraine, e-mail: [chernyushokolga@ukr.net](mailto:chernyushokolga@ukr.net), ORCID: <http://orcid.org/0000-0001-7384-3170>

**Fedorov Volodumer**, Doctor of Technical Sciences, Professor, Department of Applied Engineering and Labour Safety, Uman National University of Horticulture, Ukraine, ORCID: <http://orcid.org/0000-0002-4453-4122>

**Kepko Oleg**, PhD, Associate Professor, Department of Applied Engineering and Labour Safety, Uman National University of Horticulture, Ukraine, e-mail: [kepko@meta.ua](mailto:kepko@meta.ua), ORCID: <http://orcid.org/0000-0003-1443-307X>

**Zhurilo Svitlana**, Lecturer, Department of Applied Engineering and Labour Safety, Uman National University of Horticulture, Ukraine, e-mail: [kvnsv555@ukr.net](mailto:kvnsv555@ukr.net), ORCID: <http://orcid.org/0000-0002-0533-0485>

The object of research is the thermal and technological characteristics of the production of meat pastes, namely, chicken meat and liver patties, as a delicious, nutritious (assimilated by 94–96 %) and at the same time low-calorie product. One of the most problematic places is the quality management of the process of designing functional food products, taking into account their intended purpose. The creation of meat products on the basis of the combination of meat and vegetable raw materials is one of the effective ways of solving the problem of balanced nutrition, regulation of properties and optimization of biological value of the finished product.

The article presents the research of developed pest recipes for the naturally-appropriate health and prophylactic nutrition of high biological value. This gives an opportunity to expand the range of meat products, to enrich the daily ration with useful infusions and food fibers, which promote the health, efficiency and active creative longevity of man.

During the study methods of organoleptic, physico-chemical, functional-technological and structural-mechanical research were used. To determine the optimal amount of the proposed ingredients, a study was made of their effect on the organoleptic and functional and technological parameters of the model combined systems.

Components of new pastes and finished products undergo a different thermal (heat or refrigeration) treatment. The individual components of the minced meat are pre-cooled or frozen, others are cooked or blanched, the prepared minced meat is sterilized in tins, roasted in metallic forms or cooked in a vapor mixture or hot water. The finished product is cooled. The paper presents the results

of the study of thermal load changes during the heat treatment of pieces of meat products. These data are obtained by direct measurement of the heat flux density by means of small-scale inertial heat measurements that do not interfere with the flow of the technological process.

The results of the organoleptic evaluation of model products show their pleasant taste and aroma, uniform, delicate, greasy consistency. This makes it possible to recommend for mass production three developed formulations of the «Mushroom», «Spicy» and «Special» pastes.

**Keywords:** health-preventive nutrition, meat pastes, nutritional and biological value, physical and chemical indices.

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### INVESTIGATION OF THE EFFECT OF A MIXTURE OF SPROUTED GRAINS ON THE QUALITY AND NUTRITIONAL VALUE OF BAKERY PRODUCTS

page 42–47

**Burchenko Liudmyla**, Assistant, Department of Bakery and Confectionary Goods Technology, National University of Food Technologies, Kyiv, Ukraine, e-mail: [L27\\_burchenko@ukr.net](mailto:L27_burchenko@ukr.net), ORCID: <http://orcid.org/0000-0002-5413-961X>

**Bilyk Olena**, PhD, Associate Professor, Department of Bakery and Confectionary Goods Technology, National University of Food

Technologies, Kyiv, Ukraine, e-mail: bilyklena@gmail.com, ORCID: <http://orcid.org/0000-0003-3606-1254>

**Bondarenko Yulia**, PhD, Associate Professor, Department of Bakery and Confectionary Goods Technology, National University of Food Technologies, Kyiv, Ukraine, e-mail: bjuly@ukr.net, ORCID: <http://orcid.org/0000-0002-3781-5604>

**Perederii Inna**, Department of Bakery and Confectionary Goods Technology, National University of Food Technologies, Kyiv, Ukraine, e-mail: innakleo12@gmail.com, ORCID: <http://orcid.org/0000-0002-0662-5920>

**Kochubei-Lyutyencko Oksana**, PhD, Associate Professor, Director of Institute, Educational and Scientific Institute of Food Technologies, National University of Food Technologies, Kyiv, Ukraine, e-mail: okolit@email.ua, ORCID: <http://orcid.org/0000-0003-0712-448X>

The object of research in the work is wheat bread, enriched with a mixture of sprouted grains. In sprouted grains due to the technology of soaking, the process of sprouting and drying, natural properties are preserved and multiplied. The protein contained in the sprouted grain of wheat, oats, barley and maize contains all the essential amino acids, which in percentage are up to 30 % of the total protein content. 5...10 times more vitamins of group B, H, E, PP and others. All high molecular weight compounds with high nutritional value are split into sprouted grains and are easily digested. A possible lack of use of sprouted grain in bread technology is high autolytic activity and acidity. This must be considered when improving the process.

During the research, a mixture of sprouted grains of the Ukrainian producer LLC «Choice» (Kyiv) was used, which has the appearance of a powder that has a slightly sweet taste.

It is established that the use of a mixture of sprouted grains in the technology of wheat bread activates the fermentation activity of the dough microflora, promotes the use of accelerated technology. The introduction of a mixture of sprouted grains increases the shelf life of fresh products. The obtained results are related to the improvement of the nutrition of the yeast microflora of the dough due to the content of sugars introduced with a mixture of sprouted grains. Intense coloring of the products crust is a consequence of the fact that the products of starch hydrolysis more actively react to melanoid formation. The slowing down of the staling of products with a mixture of sprouted grains, apparently, is due to the slowing down in them of the retrogradation of starch and the accumulation of low molecular weight dextrans due to active  $\alpha$ -amylase.

Due to the dosing of the mixture of sprouted grains in the amount of 5, 10 and 15 % by weight of the flour, the energy value of wheat bread increases in accordance with 252.7, 262.9 and 273.1 kcal, compared with the control – 232.3 kcal. The introduction of bread with a mixture of sprouted grains in the production will contribute to the expansion of the range of bakery products gerodietary destination.

**Keywords:** wheat bread, sprouting grain mixture, microflora activity of dough, bread freshness.

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#### DEVELOPMENT OF TECHNOLOGY OF AYURVEDIC CULINARY PRODUCTS WITH NATURAL PLANT COMPONENTS

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**Frolova Nataliia**, Doctor of Technical Sciences, Associate Professor, Professor of the Department of Technology of Restaurant and Ayurvedic Production, National University of Food Technologies, Kyiv, Ukraine, e-mail: frolovan809@gmail.com, ORCID: <http://orcid.org/0000-0001-9248-3262>

**Yushchenko Nataliia**, PhD, Associate Professor, Department of Technology of Restaurant and Ayurvedic Production, National University

of Food Technologies, Kyiv, Ukraine, e-mail: YuNM\_NUFT@ukr.net, ORCID: <http://orcid.org/0000-0002-4277-5782>

**Shiurenko Viktoriya**, Department of Technology of Restaurant and Ayurvedic Production, National University of Food Technologies, Kyiv, Ukraine, e-mail: vikusya.cucusya@gmail.com, ORCID: <http://orcid.org/0000-0002-2896-5686>

**Avramenko Maxym**, Department of Technology of Restaurant and Ayurvedic Production, National University of Food Technologies, Kyiv, Ukraine, e-mail: avram\_and\_ko@ukr.net, ORCID: <http://orcid.org/0000-0001-8677-0142>

**Luka Andrey**, Department of Technology of Restaurant and Ayurvedic Production, National University of Food Technologies, Kyiv, Ukraine, e-mail: manofsteel@meta.ua, ORCID: <http://orcid.org/0000-0003-3345-9638>

**Piatyhorets Anton**, Department of Technology of Restaurant and Ayurvedic Production, National University of Food Technologies, Kyiv, Ukraine, e-mail: mafokeanton@gmail.com, ORCID: <http://orcid.org/0000-0002-2440-3336>

Among the main factors preventing the growing number of non-communicable diseases is ensuring a healthy diet, increases the body's resistance to adverse exogenous and endogenous factors, helps to maintain proper homeostasis and restore health. Promising for creating new products is the use of the Ayurveda principles, which provides for nutrition in accordance with the constitutional features of the human body and takes into account the influence of environmental factors. To this end, it is proposed to use the plant materials – dried fruit, dried vegetable raw materials and spices, which is a source of biologically active substances – vitamins, phenolic compounds, and also contains essential oils and a complex of mineral substances. The object of research is the technology of drinks based on tea, olive oil and candies in fruit cases.

On the basis of the Ayurvedic principles of nutrition, formulations of new types of tea-based drinks have been developed with a composition of spices, which includes cinnamon, ginger and cloves in a 1:2:0.5 ratio.

The composition of a combination mixture of vegetable oil-sesame, soybean and hemp in a ratio of 1:2.5:1.5 and an extract of an aromatic mixture based on it (dill: marigold: oak bark in a ratio of 1:3:2) has been developed. The efficiency of obtaining oil extracts from the use of a Profi Cook1080 (vacuum sealer) is proven.

Formulations of Ayurvedic candies in fruit cases have been developed, in which honey, dry kelp and a combination of spices are added. The carbohydrate composition of candies based on dried cranberries has been investigated: the total content of certain carbohydrates is 53.2 %, including sucrose – only 12.3 %. The use of such candies will reduce the intake of easily digestible carbohydrates, and the use of natural honey as a carbohydrate component will relieve the product of refined sugars.

The use of Ayurvedic nutrition principles in the technology of culinary products will harmonize all body systems, improving the well-being, physical and emotional state of a person.

**Keywords:** Ayurveda, tea-based Ayurvedic drinks, vegetable oil extracts, spice compositions.

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