SCIENTIFIC DEVELOPMENT AND ACHIEVEMENTS

volume 5

London 2018

Scientific development and achievements

Published by Sciemcee Publishing.
LP22772, 20-22 Wenlock Road
London, United Kingdom
N1 7GU
Sciemcee Publishing is part of SCIEMCEE.
It furthers the SCIEMCEE's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

First Edition: 2018
A catalogue record for this publication is available from British Library.

ISBN 978-1-9993071-0-3
Includes bibliographical references and index.

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INTRODUCTION

The monograph includes 27 sections, each of which is devoted to a specific problem of national economy's sustainable development.

The first section "POSTNATAL GROWTH RESTRICTION IN NEONATES WITH VLBW AND ELBW DURING NEONATAL HOSPITAL STAY". Postnatal growth restriction (PGR) is a worldwide problem for premature infants with very low birth weight (VLBW, 1000-1499g) and extremely low birth weight (ELBW, under 999g) which determines poor long-term forecast for the physical and intellectual development in later life. Evaluation of postnatal growth parameters – body weight (BW), body length (BL) and head circumference (HC) – was conducted at birth, admission to neonatology department and discharge. The research included 92 infants with VLBW and 34 infants with ELBW. 76.47% of infants with ELBW and 39.13% of infants with VLBW required treatment in neonatal intensive care unit before admission to neonatology department. Infants with VLBW and ELBW had severe growth restriction at discharge by BW – 40.2% vs 64.7%; by BL – 41.3% vs 67.7%; by HC – 16.3% vs 23.5%. PGR increases from birth to discharge by every parameter in both groups, which requires collective research efforts for the development of new nutritional strategies.

The second section "THE TOPICAL PHARMACEUTICAL COMPOSITION FOR TREATMENT OF DIABETIC SKIN LESIONS". Diabetes mellitus causes the increasing f number and severity of complications of different organs and systems, skin among others. Topical treatment of diabetic skin lesions is realized with using topical reparative medicines which are not always provide the achievement of the adequate therapeutical effect. The topical soft pharmaceutical composition based on succinic acid derivate has been developed in SI "Institute for endocrine pathology problems named after V. Ya. Danilevsky of the National Academy of Medical Sciences of Ukraine". As it was early determined, succinic acid derivate is able to influence the main pathogenic mechanisms development of diabetes complications. The pharmaceutical composition and manufacturing technology of the new medicine on the o/w emulsion base have been elaborated. The analytical quality control methods have been proposed. The ability of the soft pharmaceutical composition based on succinic acid derivate on exudative and alterative inflammation phases in the presence and absence of experimentally induced diabetes has been determined.

The third section "MODERN ASPECTS OF CREATING THE ALLERGENS FOR THE IMMUNODIAGNOSTICS OF CANDIDAMYCOSIS". As of today in Ukraine there are no allergens available for the candidamycosis diagnostics, and the range of imported allergens is quite limited and expensive, which conditions the research works in the creation of the national allergen for the candidamycosis

diagnostics. The Paper is aimed at the elaboration of the allergen obtainment technology for the immunodiagnostics of candida infection. The Paper provides the experimental grounding of the optimal technology of extracting the protein and polysaccharide from the biomass of *C.Albicans* fungus through the combination of physical and chemical methods: Extraction with 5.0 % solution of sodium hydroxide with ultrasound. According to the results the biochemical research the content of obtained *C. Albicans* fungus extract was determined, which contains the proteins, polysaccharides and nucleic acids. The monosaccharide composition of polysaccharides was determined, which contains mannose, glucose, and tracks of ribose. Taking into account that the low-molecular substances may influence the results of immunodiagnostics of candida infection, physical, chemical and biological researches ground the technology of purification of C.*Albicans* fungus extract from the ballast low-molecular substances using the gel chromatography on Sephadex G-100. Based on the results of biological researches on the simulated generalized candidamycosis of guinea pigs the high-molecular fraction was selected, which, in case of the intradermal administration in the amount of 0.1 ml with the protein concentration of 5 μg/ml in 24-48 hours causes the formation of erythema 18-22 mm and papula 5-10 mm, i.e. causes the delayed-type reaction.

The fourth section "ANALYSIS OF MODERN ANTI-ACNE REMEDIES FOR CREATION THE COMPLEX BIOTECHNOLOGICAL DRUG FOR ACNE TREATMENT". Modern remedies for problem skin with acne and postacne are symptomatic, such as antibiotics for treatment of inflammation, or alcoholic mixtures for sebum removal. However, skin microflora becomes resistant to antibiotic, the alcohol overdry the skin, and sebum removal accompanied by violation of lipid barrier of the skin. Insufficiently attention is given to problem of skin microflora, which is associated with infectious-inflammatory process that develops with acne, or occurs as consequence of treatment with anti-inflammatory remedies. Solution of these problems is therapeutic and prophylactic remedy of complex action, which suppress pathogenic and opportunistic microflora, treating inflammation, remove sebum, and normalize skin microflora.

The fifth section "SINGULAR INTEGRAL EQUATIONS IN MODEL BOUNDARY VALUE PROBLEMS WITH CONICAL GEOMETRY". Mathematical modeling plays an important role in the analysis of various processes. Theoretical studying and development of mathematical models that adequate to processes make possible not only to validate, but also often to predict results of experimental investigations of these processes. In the article the rigorous mathematical method of the model boundary value problems solution for acoustics and electrodynamics based on the application of Kontorovich–Lebedev integral transforms in combination with the method of the singular integral equations is proposed and developed. It is shown

that as a result of applying this method the scalar problem of waves diffraction for a semi-infinite circular slotted cone with the defined mixed (impedance) boundary conditions on the surface is equivalent to the singular integrated equation with the Cauchy integral kernel for the function containing Fourier coefficients of the required scalar potential.

The sixth section “THEORETICAL ASPECTS OF PHYSICAL IMAGES FORMATION IN SCANNING MICROWAVE MICROSCOPY”. In the paper, the methods of constructing images in SMM are numerically studied, providing visualization of profiles of the distribution of physical parameters of an object in the near-surface region. It is shown that the image of the fundamental signals of the change in the resonant frequency and quality factor of the resonator scanning probe does not always correspond to the profile of the indicated parameters. To ensure this correspondence, it is proposed to solve an inverse measurement problem. A different ways of this solution are reviewed. It is concluded that the best way is to reconstruct the image of measuring signals on the basis of an analytical approximation of the corresponding conversion characteristics of the resonator measuring transducers and the formation of an optimal signal packet.

The seventh section “THE MODELING OF OSCILLATION SUPPRESSION AT HYSTERESIS DAMPING”. The results of oscillation suppression modeling of the impact device in hysteresis damping of its oscillation which appear as the result of recoil reaction are given in the article. On condition of such damping, the damper stiffness varies depending on the direction of motion. We consider a power characteristic of this type, which is generated by a damper with the use of a new working medium - a heterogeneous lyophobic system (HLS) and all these realize a system with an engineering hysteresis. An initial-value problem, for which an analytical solution is found, is formulated for a single-mass system with a simplified power characteristic. An initial-boundary value problem is formulated for the instrument of the impact device, as a shank, which is supported by a damper with a HLS. This initial value problem was investigated by the finite difference method.

The eighth section “SCIENTIFIC AND THEORETICAL DEVELOPMENT OF STABILIZATION SYSTEMS FOR GRAVIMETRIC SYSTEMS AND MODERN SENSING ELEMENTS FOR MEASURING GRAVITATIONAL ACCELERATION”. In the article expediency of using aviation gravimetric systems for gravimetric measurements and receiving information about the Earth's gravitational field is proved. An analysis of existing gravimeters of aviation gravimetric systems is done, identified their strengths and weaknesses. Modern perspective developments in the area of designing a new type of aviation gravimeters with higher accuracy and speed of the known are considered. For a given specific force sensor uncertainty, the minimum system uncertainty results when the sensor is physically stabilized along the

z axis (vertical axis) of an in strumented local geographic coordinate frame. Errors in the z axis alignment of such a frame result in 1…20 mGal error for each arc minute of misalignment due to projection of horizontal Coriolis forces along the measurement axis.

The ninth section “BREAD PRODUCTS WITH MILK WHEY ENRICHED WITH BIOGENIC METALS ACCORDING TO THE INNOVATIVE TECHNOLOGY”. This paper presents technological aspects of using milk whey enriched with magnesium and manganese in wheat bread technology. The technology of enriching whey with valuable minerals, particularly magnesium and manganese, by volumetric electrical discharge dispersion of conductive metal granules directly into the medium is presented. It has been established that this treatment of milk whey enriches it with valuable metals that can form metal-ligand complexes with components of milk whey, which contributes to the increase of their biological availability. The positive effect of using enriched whey in the amount of 15% to the mass of flour on the wheat bread quality, nutritional value, and shelf life has been proven.

The tenth section “EFFICIENCY OF PROVIDING BIOLOGICAL VALUE OF COMBINED MEAT-CONTAINING PRODUCTS WITH MEAT OF WATERFOWL”. Promising species of protein-containing raw materials of animal origin in Ukraine are meat of waterfowl and fresh-water fish, whose production in various regions of Ukraine has a sustainable development. The conducted researches are devoted to the study and analysis of the biological value of the compositions of proteins of meat-containing products of boiled group with meat of freshwater fish and meat of ducks of regional origin. The use of meat of freshwater fish as an additional source of protein allows getting meat-containing products with a protein content of 15.03–17.47 g/100 g of product, which significantly exceeds the normative values for the protein content of sausage products of the boiled group, respectively to current standards. The use of non-traditional types of protein raw materials in the composition of meat-containing products of the emulsified cooked group allowed producing sausages with high content of practically all essential amino acids with the value of CDAA, characteristic for meat sausage products, which confirms the effectiveness of such use. The presented results confirmed that the compositional balancing of various sources of protein of animal and vegetable origin allows to balance the amino acid composition of formulations of protein compositions for boiled sausages using Muscovy duck meat, collagen-containing raw materials in combination with soy isolate and milk processing products, significantly increasing the content such essential amino acids as methionine, valine, threonine and the amounts of phenylalanine and tyrosine. Inclusion in the formulation of emulsified meat-containing products of freshwater fish

allows to obtain food systems with the presence of all essential amino acids, amino acid score, which is higher than close to 100%.

The eleventh section “THE EFFECT OF VARIOUS METALLIC FILLING MATERIALS ON THE PROPERTIES OF AROMATIC-POLYAMIDE-BASED COMPOSITE MATERIALS”. The chapter is devoted to the development of new thermo-resistant metal-containing polymers based on aromatic polyamide phenylone for friction units instead of highly deficient metals and known antifriction materials. It has been established that physical and chemical interactions between metal particles and phenylone significantly affect the processes of structuring of the developed metal-containing polymers. Physical interaction is manifested in an increase in the average size of crystallites with a simultaneous decrease in the shortest interatomic distance, which has been revealed by quantitative X-ray analysis. The appearance of new structures at the polymer-filler interface, which is not characteristic of the polymer matrix, has also been confirmed by electron microscopy. The effectiveness of the impact of the nature and content of metals on thermophysical, physico-mechanical and tribological properties of metal-containing polymers has been shown.

The twelfth section “EVALUATION OF ALBUMIN AND CASEIN AS POLYMERIC NANOPARTICLES FOR FLAVOR NANOENCAPSULATION IN THE BAKING”. This study aimed at evaluating the potential of combination albumin and casein with optimal ratio in the flavor nanoencapsulation by emulsification used high homogenization (20000 rpm, 5min). The research of adsorption properties of albumin and casein by gas chromatography have presented their different adsorption selectivity for monoterpenoid hydrocarbons according to the molecular weight. The rosemary essential oil was used as the aroma agent. The odor - active compounds content of rosemary essential oil and adsoption selectivity of albumin and casein has allowed to find out the mass ratio of albumin and casein 34:67. The nanoemulsion with this mass ratio of researched nanoparticles characterized for stability, viscosity and droplet size. It was investigated thermal behavior of nanoemulsion encapsulating rosemary essential oil to the typical temperatures of baking processes (200–250°C) in food industry and food preparation application. From 20 to 200°C the odor - active compounds loss was about 2%.

The thirteenth section “SYSTEM’S TECHNICAL CONDITION ASSESSMENT METHOD AND DETERMINATION OF ITS OPERATION TIMEFRAME IN UNCERTAINTY CONDITIONS”. Lifecycle of a technical system is determined by a substantial quantity of external operational factors, part of each is of detectable nature, whereas another part is of random nature. These factors include various environmental conditions, operational loads, working schedule, proficiency of servicing personnel, general manufacturing culture, etc. To date, there are multiple concepts for technical system lifecycle management, including, in particular, such aspects as maintenance and

repairs, which evolved and are now prospective. However, a process of system's technical condition assessment in a state of insufficient information remains a critical item and has not got a single unambiguous solution up till now. In this view, the presented work proposes an assessment method for a system's technical condition in incomplete data environment, which enables to assess system technical condition in a context of uncertainty with all other factors being equal. Furthermore, mathematical apparatus is developed for quantitative technical condition assessment of technical system elements throughout its lifecycle. A method is also developed enabling to determine timeframes for technical system's functioning.

The fourteenth section "STABILIZATION TECHNOLOGY OF FATS DURING STORAGE". Problems of protection of fats during storage are considered and search of its decision is carried out. The results of determinations of peroxide, benzidine, and thiobarbituric acid numbers of the fatty mixture with the addition of the powder of the dandelion are provided. It is established that the most effective is the concentration of this additive in the amount of 2 %. Also, according to the definitions the feasibility and prospects of using this additive to slow down the oxidation of the lipid fraction of a new sugar cookie were proved. The results of determining the quality indicators of cookies during storage were provided. The use of this additive allows to extend the shelf life of a new sugar cookies packed in boxes of corrugated cardboard up to 4.5 months under standard conditions.

The fifteenth section "TECHNOLOGY OF SEMI-FINISHED FISH PRODUCTS". The article deals with the results of the chemical composition, organoleptic evaluation and physical and chemical changes in semi-finished minced products with the addition of non-traditional raw materials and the establishment of their shelf life. The expediency of combining a freshwater fish with plant material to expand the range of biologically valuable food products is presented in the article. It has been found, that there are processes of hydrolytic damage in the control sample after 90 days of storage, which indicates the intensive lipid hydrolysis and the accumulation of free fatty acids in these samples. In experimental samples a hydrolytic damage gradually increases, and reaches its critical point only close to the end of the shelf life. The research has established that the use of non-traditional raw materials in a production of semi-finished minced products allows not only to improve the technology of production, but also to solve the problem of obtaining the product of a high nutritional value. The authors found that the developed technology of production of semi-finished fish products will significantly expand the range of products of functional purpose based on natural components, which will allow, to some extent, to expand the actual problem of processing raw materials from domestic reservoirs in Ukraine.

The sixteenth section “BASIC PRINCIPLES OF THE NEW TECHNOLOGY PROJECT OF MANUFACTURING STEEL PRODUCTS HARDENED BY THE COLD DEFORMATION”. Comparative analysis of the known technologies for manufacturing hardened steel products using the methods of heat hardening and the methods of thermomechanical hardening shows that the developed technology favourably differs from the others by using only one type of hardening – deformation, which gives better logistics and ecology due to exclusion of the technological operations of high-temperature heating and rapid cooling; reduces the price of the billet, since the cold deformation does not require alloying; we may speak of the universal billet used for manufacturing many types of the cold-worked products.

The seventeenth section “RESEARCH OF THE EFFECTS OF SUGARS ON THE PROCESS OF FOAMING OF CONFECTIONERY SYSTEMS”. Recipes of foam confectionery products include many raw ingredients that form taste, aroma and consistency of finished products. Foam structure of confectionery products is achieved due to the mechanical saturation and distribution of air in a solution of food proteins - egg albumin, gelatin or milk protein. The main role in the formation of such disperse systems is delegated to the structure-maker, but the role of sugar is not limited only to the formation of the sweet taste of products. In complex foamy structures, the concentration of sugars is 50 ... 60% and sugar is actively involved in the formation of structural and mechanical characteristics of foam. Physical and chemical properties of sugars are different, so each type of sugar will have different effect on the mechanism of foam formation. The section presents the results of experimental studies of the effects of saccharose, glucose, fructose, lactulose, tagatose on the patterns of egg albumin and milk protein foam formation. The characteristics of the state of water in complex structures have been firstly determined according to the complex dielectric permeability as well as the estimation of the hydration of sugars in complex media.

The eighteenth section “DEVELOPING OF MANUFACTURING TECHNOLOGY FOR HOT ROLLING COILS (STEEL GRADE S355MC) AT THE WIDE-STRIP ROLLING MILL 1700”. Developing of manufacturing technology for hot rolling coils (steel grade S355MC) using thermo-mechanical controlled process (TMCP) in accordance with EN 10149-2 for wide-strip rolling mill 1700 and producing pilot batch. The technology has been developed in accordance with the general requirements for manufacturing of rolled products using thermo-mechanical controlled process (TMCP) and based on the mathematical model of the rolling process. There has been developed technology, and pilot batch of hot rolling coils (6×1500 mm, steel grade S355MC) has been produced using thermo-mechanical controlled process (TMCP) for the wide-strip rolling mill 1700. The integrated technology for TMCP coil production (steel grade S355MC) has been firstly developed for the rolling mill 1700 in accordance with EN 10149-2. Air cooling for coils to 450°C after coiling has been

firstly used in the developed technology, which provides for decrease in air scale and improvement of surface quality for the customers. It is possible to manufacture rolled products up to 6×1500 mm (steel grade S355MC) in accordance with EN 10149-2 using the existing equipment without exceeding the existing process constraints during its operation and without upgrading. It is possible to further master the rolled products, which are manufactured according to the TMCP technology.

The nineteenth section "THE CONCEPT OF SOFTWARE UPGRADE FOR GOVERNMENT BODIES BASED ON THE DURATION OF SOFTWARE'S LIFE CYCLE". The study showed that, in the current context, the problem of timely software upgrades is critical in providing the sufficient level of information security of the critical infrastructure, which primary consists of government bodies and other public institutions. Developed the concept of budgetary planning, key elements of which are software life-cycle modeling and centralized procurement bidding. Implementation of the proposed concept will help to make process of software upgrades more manageable and predictable, as well as more efficient and reasonable use of budgetary funds. It allows to reduce the software piracy and ensure an adequate level of efficiency and security of the software in public sector.

The twentieth section "FIRE SAFETY IN THE WINE INDUSTRY". The article presents the results of studies of the risk of fires in wine-making companies. The issues of fire safety provision for security organization of the territory, buildings and facilities, technological processes, automation systems are consecrated. The information on changes in the legislative base on fire safety is provided.

The twenty-first section "ECOLOGICAL MONITORING AND DETERMINATION OF PHOTOSYNTHESIS PARAMETERS IN EQUATIONS OF WOODY PLANTS". Based on the proposed structures of consortive protective ecotone (CPE), there was developed a mathematical model of tree diameter growth taking into account the effect of photosynthesis, which will allow predicting the index of CPE condition. The CPE condition index is one of the important parameters of the quality of the forest plantation functioning. The advantage of the nonuniform quality scale is that it more accurately reflects the peculiarities of response to impact, the disadvantage is that it closes the possibility of adequate generalization of multiple responses to different actions in a comprehensive assessment of the state. Thus, before the output of the status indicator function, the solution to the quality scale problem was seen in the use of coded responces, in particular, on the basis of the desirability function, and displaying the received coded values on a single uniform quality scale. The parameters of photosynthesis have been determined; to do this, programmes were developed based on the least-squares method and the Leuvenberg-Marquard optimization method.

The twenty-two section “PROCESS PARAMETERS OF AEROBIC SYNTHESIS OF MICROORGANISMS”. This monograph deals with the features of equipment and technologies for the synthesis of bakery yeast in sugar-containing media in anaerobic conditions. The presence of dissolved oxygen (25–30% to the saturation volume) causes the yeast to irreversibly enter aerobic state with accelerated biomass synthesis. The oxygen delivery is accompanied by the need to overcome technical problems, mostly determined by the properties of oxygen, namely its low solubility. This study analyzes the peculiarities of mass exchange processes in gas-liquid media based on the ratios of matter flows, taking into account the requirements for dissolved oxygen and simulating aeration regimes. Nitrogen as an effective component of the air phase in aerated conditions of culture media and methods of intensifying mass transfer processes are considered. The mathematical formalizations point to the presence of interconnections in the dynamics of transformation and synthesis of substances according to the matter balances. This means the ability to create a control system for synthesis processes based on tracking changes in concentrations of sugar, microorganisms, dissolved oxygen, ambient temperature, etc. It has been proven that the effective factors of influencing mass exchange processes on the boundary between the liquid and dispersed gas phase include variable pressures in the volume of the gas phase above the liquid and the restriction of velocity in gas-liquid circuits.

The twenty-third section “COMPLEX LOW-WASTE TECHNOLOGIES FOR WATER PURIFICATION FROM IRON COMPOUNDS”. Nowadays, the problems of salinization of surface and groundwater are quite urgent. The paper is aimed to present the rational use of materials, energy and resource-saving technologies for the protection of the environment. Sorption technologies are effective in purification of wastewater, but most sorbents are quite expensive and their regeneration connected with the problem of utilization of regeneration solutions. Due to the cheapness and availability, sorbents based on the plant materials are attractive to wastewater treatment. To improve the efficiency of the process, the use of the simplified aeration method to reduce the iron ions content in water was proved. The regularities of iron ions oxidation in electrolysis and the optimal conditions of the process and the development of recommendations for the practical application of the obtained results were given. The application of "green", complex technologies allows to achieve significant technical, economic and ecological effect for ensuring ecological safety.

The twenty-fours section “PHASE COMPOSITION, STRUCTURE AND MECHANICAL PROPERTIES OF INDUSTRIAL BRONZE BrA9Zh3L ADDITIONALLY DOPED WITH ZINC”. Based on Cu-Al, Al-Fe, Cu-Fe, Cu-Al-Fe phase diagrams analysis, structure and phase composition of bronze BrA9Zh3L have been observed. It has been established that bronze structures with $Zn \leq 1\%$ contents consist of structure-free α-Cu solid solution crystals and eutectoid component, which

basis forms on $\gamma_2 + \alpha$ eutectoid of Cu-Al system. In addition, in bronze structure branched star-like small crystals of iron-containing phase have been discovered. These star-like iron-containing crystals with 81,20 ... 82,79 wt. % Fe and 9,86 ... 10,39 wt. % Al have been identified as β_1-phase, i.e. Fe_3Al.

The twenty-fifths section "DEVELOPMENT OF COMPOSITION OF BALANCED EXTRUDED GRAIN PRODUCT WITH LINEAR PROGRAMMING APPLICATION". Extruded grain products relate to a segment of dry breakfasts that are in high demand among various segments of the population, including children, adolescents and the elderly. Therefore, the improvement of the composition of these products is an urgent task of the present. The aim of the study was to develop a composition of an extruded grain product enriched with milled grain of millet using a standard program from the Microsoft Exel table processor package. The balance and biological value of extruded grain products is solved by the development of multi-component composite mixtures. It has been shown that the introduction into the composition of the extruded grain product of whole grain millet grain promotes the increase of the biological value of the finished product, improves the technological parameters. It is shown that with partial replacement of cereals on whole grain millet, the mass fraction of protein increases to 11.03%. The organoleptic parameters and safety indicators of developed products that meet the normative documentation are investigated.

The twenty-sixths section "USING E-LEARNING TOOLS DURING THE "DECISION MAKING THEORY" COURSE. SMPR SYSTEM". Due to the development of Internet technologies, it has become necessary to extend the course of the Decision-Making Theory through the e-learning application. In the process of research and solution of this problem, modern e-learning systems were considered and SMPR application was created. During the creation of the evaluation module, algorithms of methods for adjusting and adapting the complexity level used for the seven types of questions were used: binary questions (yes-no); one correct answer from many options; many answers from many options; number as a reply; range as a response; array as an answer; one or more words as a reply. These algorithms help determine the correctness of real-time ratings when assessing knowledge at universities or schools. The software was developed by the students of the Faculty of Cybernetics and tested during the winter sessions.

The twenty-seventh section "THERMODYNAMIC CONCEPT OF OPERATION OF SYSTEMS OF THERMAL POWER OBJECTS OF THE BUILDING INDUSTRY". Theoretical and practical studies of the possibility of using a non-reagent water preparation method are given. They represent a strategic significance in terms of creating resource-saving technologies in the feasibility study of the construction industry. Ecological problems and mechanisms of resource and

energy saving are shown due to optimization of production processes. It is solved by three sciences (3E): ecology (saving of natural resources) - economics (management of natural resources) - energy (physical basis of thermal energy processes). The paper considers the thermodynamic concept of the state of material flows in the feasibility study. The emergence of potentially possible conflict situations in the preparation of technical water for the critical operating conditions of the TEO systems. The introduction of modern nanotechnologies in the use of non-reagent water preparation techniques for TEO raises technogenically safe conditions for their exploitation, competitiveness and energy conservation. This is the main instrument of the actions of ecological and economic management in the production.

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EFFICIENCY OF PROVIDING BIOLOGICAL VALUE OF COMBINED MEAT-CONTAINING PRODUCTS WITH MEAT OF WATERFOWL

Introduction. One of the global challenges of humanity, identified at the special meeting of FAO/WHO by leading world experts, is the deficiency of dietary protein and its rational use.

The statistical data indicate that the need for a complete protein can be met at the expense of dietary variability not only in a particular country, but also at the regional level [1].

A wide range of meat products in the traditional segment of consumption is provided by the use of meat and offal from pork, beef, poultry, milk and egg processing products as sources of animal protein, which allow the richness of the diet to be balanced with water and soluble proteins and ensure the stability of functional and technological parameters meat products [2, 3, 4].

With the growth of the population and the need for protein in meat products, the use of new sources of protein is expanding. By introducing new technologies for the use of non-traditional protein sources, new meat and meat-containing products may be developed that may differ from traditional more sustainable use of energy, water and land resources [5].

For this reason, one of the solutions to the problem of protein deficiency is the involvement in the process of production of meat products of non-traditional protein-containing raw materials, or by-products of production from adjacent to the meat industry. The combination of meat and protein-rich ingredients with high nutritional value in order to rationalize the use of protein resources can significantly increase the volume of products based on regional raw materials.

The combination of animal raw materials of different species has a multifunctional character, which allows to expand the range of products, rationally use raw materials, produce products of high nutritional and biological value.

Promising types of protein-containing raw materials of animal origin in Ukraine are meat of waterfowl and fresh-water fish, whose production in various regions of Ukraine has a sustainable development [6].

The analysis of scientific researches of Ukrainian and foreign authors, as well as literary data, suggests that one of the most promising sources of valuable protein as raw material for the production of complete food value of meat products is meat of landfowl and waterfowl, chicken broilers, turkeys, ducks [7–11].

A matrix for the development of new food products can be the widespread use of hydrobionts, namely, various types of fish of pond and lacustrine breeding [12–13]. The production of food products with fish raw materials of local origin is connected with the solution of the problem of raw materials rational use, as well as the creation of products with high consumer characteristics, food and biological value, which contain high-quality proteins balanced by the composition of essential amino acids. Protein of fish contains all essential amino acids, which explains the special value of fish as one of the most important sources of high-quality proteins in human nutrition [14, 15, 16].

The development of combined meat and meat-containing products using waterfowl and freshwater fish in recent years was undertaken by various research teams. However, there is practically no generalized material on the purposeful and comprehensive use of these sources of valuable protein and the evaluation of the biological value of the products obtained in the production of various groups of meat and meat-containing products.

The aim of this study is researching and analyzing the biological value of proteins of meat-containing products of the boiled group with freshwater fish and duck meat of regional origin.

Materials and methods. To accomplish the aim, the products of the boiled group were used as models for the study of biological value of meat-containing products with waterfowl and fresh-water fish, namely: sausages with Muscovy duck meat, boiled sausage with Muscovy duck meat and Silver Prussian carp, meat loaf with Muscovy duck meat (Cairina moschata) and white carp (Hypophthalmichthys molitrix).

Muscovy duck meat was used in the technology of meat-containing sausages, also introduced into the formulation of soy isolate, emulsion of pork skins, milk powder and functional additive XB Fiber (Germany). The recipes of the control sample of the sausages included duck meat, bacon, first grade beef, potato starch, salt, spices, sodium nitrite [17]. The recipes of the sausages are presented in Table 1.

We also researched the indicators of meat-containing sausage boiled from Muscovy duck meat and silver Prussian carp, which included ingredients in the recipe in the following ratio: Muscovy duck meat 35%, fish (silver Prussian carp) 45%, pork fat 10%, dry demineralized milk whey 5%, wheat flour 1%, eggs chicken 4%, spices.

As analogy, boiled sausages "Otdelnaya" [18] were taken, which according to the formulation contains: 60% of first grade beef, 23% of pork, 15% of pork fat.

Table 1 Formulations of examined sausages samples with Muscovy duck meat

Ingredients	Control	Sample 1
Duck meat	40	-
Muscovy duck meat	-	40
Pork fat	10	10
Soya isolated protein	-	10
First grade beef	47	10
Milk powder	-	3
XB Fiber	-	2
Pork skin	-	25
Potato starch	3	-
Total	100	100
Salt	2.5	2.5
Sodium nitrite ($NaNO_{2)}$	0.005	0.005
Sugar	0.1	0.1
Black pepper	0.1	0.1
Coriander	0.05	0.05
Fresh garlic	0.2	0.2

For the production of meat bread meat bread "Chainiy" was selected as a formulation analogue (DSTU 4436:2005) [18]. Muscovy duck meat was used for the production of experimental samples [19]. Muscovy duck meat was prepared according to standard technological scheme. Duck meat was separated from bones, degreased and shredded in a chopper with grid holes of 2–3 mm in diameter. Also, meat of white carp was added to the formulations of experimental samples of meat loaf. The recipes are given in Table 2.

Table 2 Recipes of experimental samples of meat-containing loaves

Ingredients	Control	Sample 2
Second grade beef	70	-
Half fat pork	20	-
Muscovy duck meat	-	30
Ground white carp	-	45
Dry demineralized milk whey	-	5
Pork fat	8	10
Wheat flour	2	2
Aprored	-	3
XB Fiber	-	2
Melange chicken	-	3
Salt	1.5	1.5
Sodium nitrite ($NaNO_{2)}$	0.0075	0.0075
Sugar	0.1	0.1
Black pepper	0.1	0.1
Coriander	0.05	0.05
Fresh garlic	0.2	0.2

In products, the definition of nutritional value and biological value [20], in experimental samples, determined the content of amino acids and calculated the amino acid score, the imbalance of the amino acid score CDAA (coefficient of difference of amino acid score) [20].

Determination of the content of amino acids in products was realized by the method of ion-changing column chromatography using the amino acid analyzer «BIOTRONIK» (Germany). The content of bound irreplaceable and replaceable amino acids is calculated in g for 100 g of the product [21]. For preparing samples, the batch with mass 0.1 g was put in the test-tube with the closed cork, poured with 10 cm^3 of distilled water and 10 cm^3 of concentrated saline acid. The test tube was hermetically corked up and put in a drying-frying chamber with temperature 130 ºC for 8 hours. The obtained hydrolysate was filtered through a wadding filter and poured by 3 volumes of distilled water. The obtained solution was transferred in a porcelain dish and evaporated on an electric stove to volume 0.5…1.0 ml. The obtained sample was diluted by distilled water and filtered through a paper filter in 50 ml test-tube and a filter was washed till a test-tube was filled with 35–40 ml. The quantitative determination of amino acids was made by taking 1 ml and adding 1 ml of a buffer solution with pH=2,2. The obtained sample was passed through a membrane filter with pores diameter being 0.45 mcm. 50 mcl of the cleaned sample were taken and put in a chromatographic ion-exchanging column of the analyzer. After finishing the analysis, the obtained chromatogram was deciphered and areas of peaks of each amino acid were calculated by the method of external standard.

The amino acid score (%) was calculated by (7) [24]:

$$AS=AA_x/AA_s\times100, \quad (1)$$

where AS – amino acid score; AA_x – amino acid in the studied protein AA_s – the same amino acid in the standard protein or by the scale. The amino acid scale of FAO/WHO was used as a standard for calculating the amino acid score [22]. The absolute error of measurements was determined using Student criterion, reliable interval P=0,95, number of repeats in determinations 3–4, number of parallel tests of experimental samples – 3. [23]

Results and discussion. According to the calculations of the nutritional value of meat-containing sausages with Muscovy duck meat protein content in the formulation analogue was 16.25 g/100 g of product, while in the developed formulation, this figure increased by an average of 47% and was at the level of 23.7–24.1%. Despite the replacement of first grade beef in the formulations, the protein content not only did not decrease, but also increased, due to the introduction of high protein raw materials of animal and vegetable origin: dry milk powder, soybean isolate and protein from pork skins. The mass fraction of fat in model sausages was 20.1–21.2%, which ensured a

dietary ratio of 1:1 protein to fat. In contrast to the control sample, sample 1 contained 2% fiber by using XB Fiber (Germany) soluble vegetable fiber.

The results of a chromatographic study of the content of essential amino acids of meat-containing sausages with Muscovy duck meat are presented in Figure 1 and in Table 3.

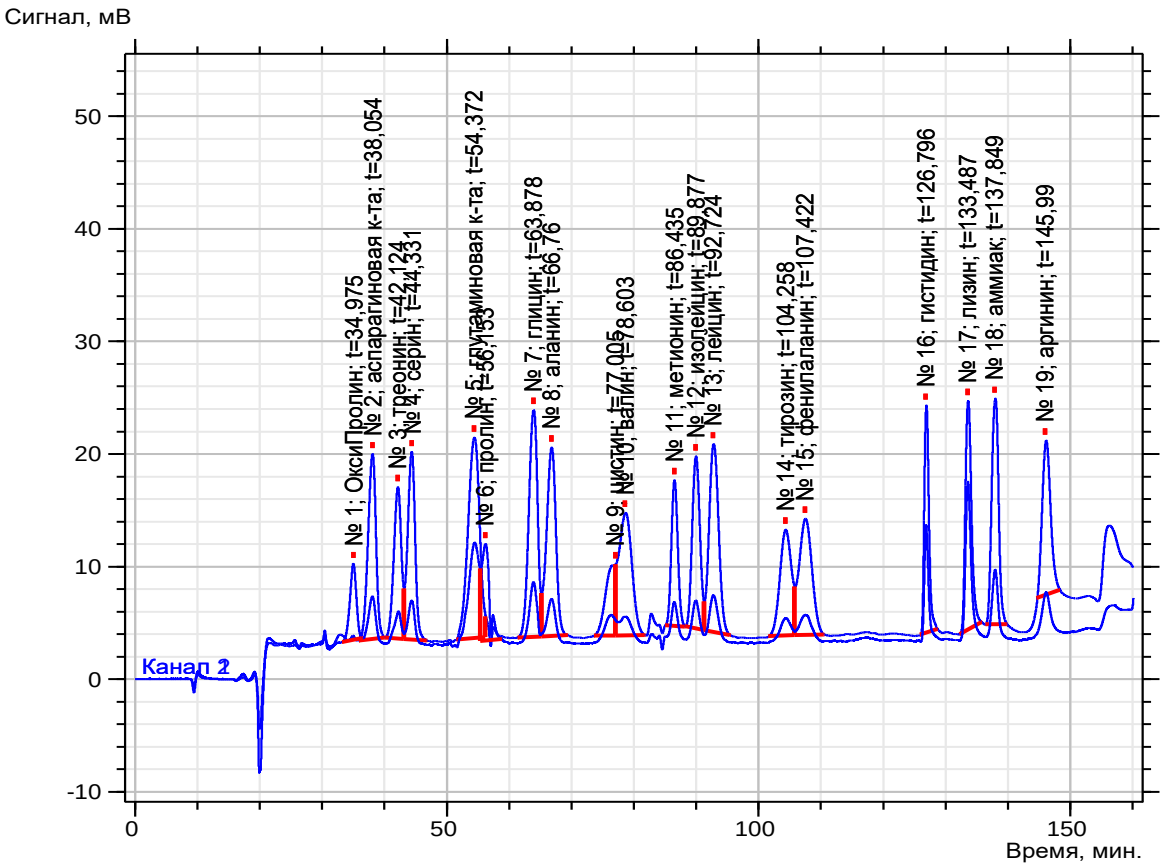

Figure 1. Chromatogram of the amino acids of meat-containing sausages with Muscovy duck meat.

Table 3 Results of the study of the biological value of proteins of meat-containing sausages with Muscovy duck meat.

No.	Title	Reference (FAO/WHO)	Concentration, mg/1 g of product	Amino acid score, %
Essential amino acids				
1	Valine	4.0	5.21	130.25
2	Methionine	3.3	3.96	120.00
3	Isoleucine	4.0	5.02	125.50
4	Leucine	6.1	6.21	101.80
5	Phenylalanine + Tyrosine	8.0	11.01	137.63
6	Lysine	5.0	5.17	103.40
7	Threonine	3.0	5.32	177.33
8	CDAA	0	-	26.19

The study of amino acid composition of meat-containing sausages has allowed to identify all EAC (Essential amino acids). These tables indicate that methionine, isoleucine, valine, threonine and phenylalanine + tyrosine have a high content. The evaluation of protein quality by amino acid (AS) has shown that the sulfur-containing amino acid methionine has an amino acid score of 120%, and may be the source of this amino acid in the diet. The value of CDAS of model sausages is characteristic for boiled sausages of the highest grade, which makes it possible to assert about the full biological value of meat-containing sausages with Muscovy duck meat with appropriate combination of animal and vegetable protein-raw material.

Thus, the replacement of beef in the formulation of duck meat in combination with protein preparations does not result in a decrease in biological value of products of the boiled group and allows providing high consumer and nutritional value of sausage products with this type of raw material.

The results of a study of nutritional value of boiled meat-containing sausages with duck meat and silver carp showed that the protein content in the experimental sample was 15.03 g /100 g, and so the replacement of meat raw material with fish and meat of waterfowl practically did not reduce the mass fraction of proteins in boiled sausage. At the same time, the mass fraction of fat in model sausage, compared to control, decreased by 17.6% and amounted to 21.5% fat. Reducing the fat content of boiled sausages with Muscovy duck meat and freshwater fish has led to a decrease in the energy value of the product. Thereby, in the prototype, the amount of energy per 100 grams of sausage was 257 kcal, which is related to the ratio of fish and meat raw materials. The energy value of the control sample was 318.14 kcal/100 g of the product, which is 24% higher than in the experimental boiled sausage. However, there was an improvement in the ratio of protein to fat, which was better for the model 0.7:1 than the control sample, which was only 0.55:1. The results of a chromatographic study of the content of amino acids of meat-containing boiled sausage with Muscovy duck meat and silver Prussian carp, are shown in Figure 2 and in Table 4.

Study of the amino acids of meat-containing boiled sausages have shown that all essential amino acids are present in the product. The greatest amount of threonine differed, the AS of which was 173.00%. In the experimental sausage, the amount of phenylalanine and tyrosine was limited — a score of 90.63%. The rest of essential amino acids were higher than 100% and ranged from 106.06% by methionine to 168.40% for lysine. That is, the addition of silver Prussian carp meat, taking into the account a high biological value of the protein of fish meat [24-25], allows to get a biologically valuable product of the boiled group and a value close to 100% on sulfuric and aromatic amino acids.

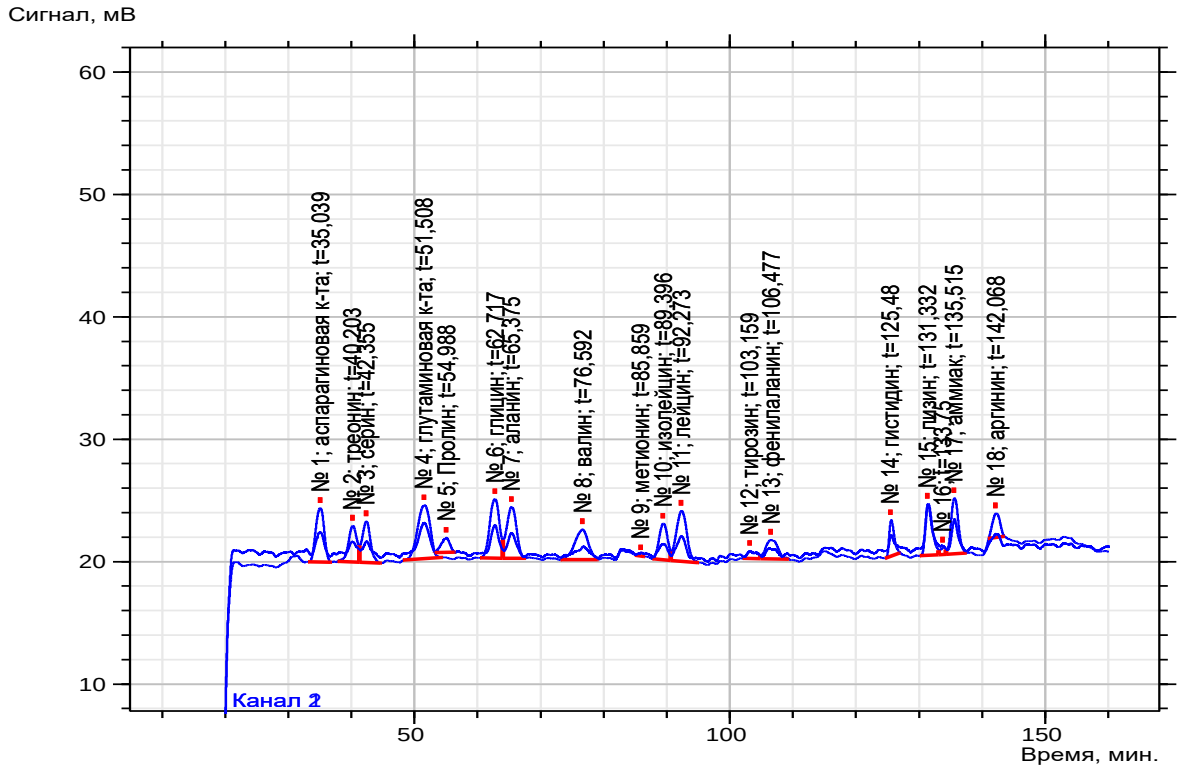

Figure 2. Chromatogram of amino acids of meat-containing boiled sausage with Muscovy duck meat and silver Prussian carp.

Table 4 The biological value of proteins of meat-containing boiled sausage with Muscovy duck meat and silver Prussian carp

No.	Title	Reference (FAO/WHO)	Concentration, mg/1 g of product	Amino acid score, %
Essential amino acids				
1	Valine	4.0	5.40	135.00
2	Methionine+ cysteine	3.3	3.50	106.06
3	Isoleucine	4.0	5.60	140.00
4	Leucine	6.1	8.68	142.30
5	Phenylalanine + Tyrosine	8.0	7.25	90.63
6	Lysine	5.0	8.42	168.40
7	Threonine	3.0	5.19	173.00
8	CDAA	0	-	45.81

The results of studies on the nutritional value of meat-containing loaf with duck meat and white carp meat showed that the protein content in the experimental sample of meat-containing loaf varied within 17.4–17.55% and the fat within 18.30–20.02%, which also allows reaching the recommended values for the ratio of protein to fat. The energy value of the prototype was almost 264 kcal/100 g, which is 11.4% less compared to the analogue formulation. This fact allows to recommend this type of meat and fish loaf for dietary nutrition.

Use in the formulation of meat-containing products of dry milk whey and milk powder results in the presence of lactose in carbohydrates in an amount up to 6% of the total content of carbohydrates in the product. In addition, to increase the technological and functional characteristics of the product data, available fiber in quantities of up to 3%, due to flour and the preparation of soluble fibers XB Fiber (Germany).

The results of a chromatographic study of the content of amino acids of meat-and-bone bread with Muscovy duck meat and white carp, are shown in Figure 3 and in Table 5.

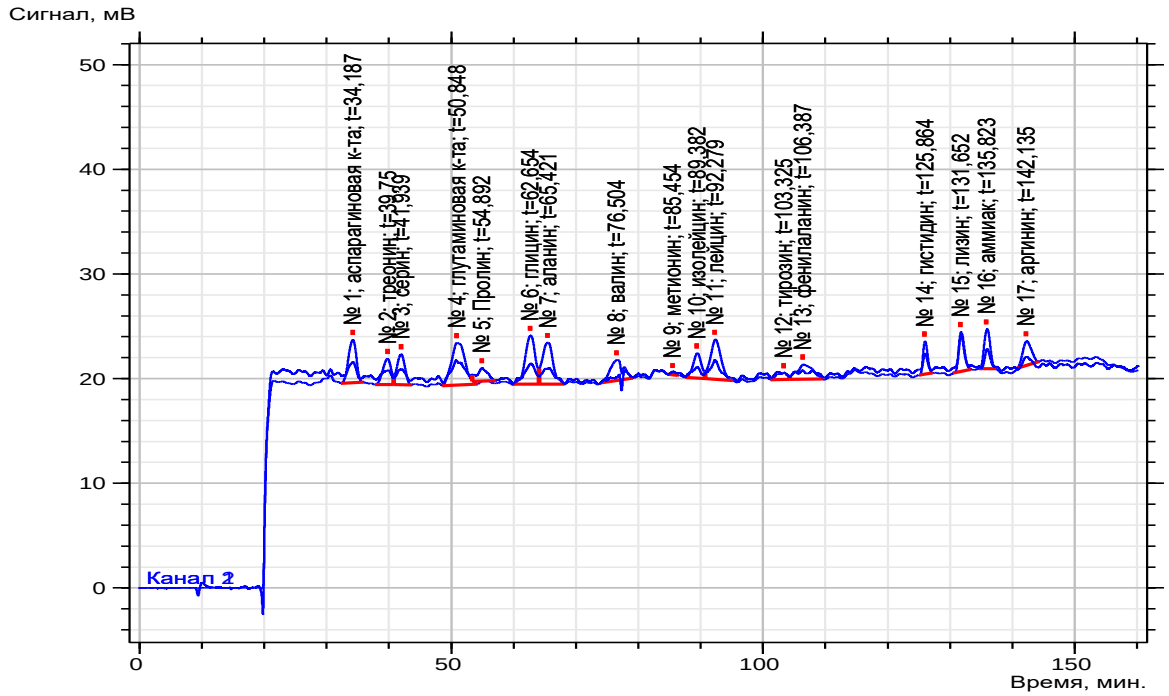

Figure 3. Chromatogram of amino acids of meat-containing loaf with Muscovy duck meat and white carp

Table 5 Biological value of proteins of meat-containing loaf with Muscovy duck meat and white carp

No.	Title	Reference (FAO/WHO)	Concentration, mg/1 g of product	Amino acid score, %
Essential amino acids				
1	Valine	4.0	6.73	168.25
2	Methionine	3.3	2.50	75.76
3	Isoleucine	4.0	4.64	116.00
4	Leucine	6.1	8.50	139.34
5	Phenylalanine + Tyrosine	8.0	7.60	95.50
6	Lysine	5.0	6.45	129.00
7	Threonine	3.0	4.61	153.67
	CDAA	0	-	49.60

The amino acid composition of meat-containing loaf with Muscovy duck meat and white carp proves that this product is a valuable source for almost all EACs, Methionine, phenylalanine+tyrosine were limiting.

Meat-containing loaf contains a significant proportion of threonine, valine, leucine and lysine. Threonine positively affects the functioning of digestive system and intestinal tract, as well as metabolic processes in the body, contributes to the work of nervous system [26]. Phenylalanine is involved in the transfer of electrochemical pulse from neurons to glandular cells or muscle tissues, which increases a person's ability to perceive information, improves memory [27].

The analysis of integrated balance of meat-containing products using duck meat and freshwater low-value fish makes it possible to obtain indicators of CDAA at the level of traditional meat products of the first and second grade, and with the optimization of selection of protein-rich improvers, meat- containing products will be accorded to the biological value of traditional meat products of the boiled group.

According to results of the research on combining meat of waterfowl and freshwater fish of regional origin, the possibility of expanding the use of various sources of protein for the development of meat-containing boiled sausages with a high balance of amino acid composition has been confirmed.

When selecting protein-containing ingredients in recipes for sausage products based on duck meat and freshwater fish, it is necessary to introduce protein-containing ingredients with high content of sulfur-containing amino acids, as well as phenylalanine and tyrosine into the composition, depending on the type of fish added.

CONCLUSION

1. It is confirmed the possibility of combining regional sources of aquaculture, waterfowl with traditional types of meat and vegetable raw materials to provide the biological value of meat-containing products. The conducted studies confirmed the high nutritional value of meat-containing products using duck meat and freshwater fish.

2. The use of minced meat products of the boiled group of Muscovy duck meat with protein-containing ingredients of animal and plant origin can improve the balance of amino acid composition, as well as provide the recommended fraction of protein and fat, in accordance with the recommendations of dietary nutrition.

3. The use of meat of freshwater fish as an additional source of protein allows getting meat-containing products with a protein content of 15.03-17.47 g/100 g of product, which significantly exceeds the normative values for the protein content of sausage products of the boiled group, respectively to current standards.

4. The use of non-traditional types of protein raw materials in the composition of meat-containing products of the emulsified cooked group allowed producing sausages

with high content of practically all essential amino acids with the value of CDAA, characteristic for meat sausage products, which confirms the effectiveness of such use.

5. The presented results confirmed that the compositional balancing of various sources of protein of animal and vegetable origin allows to balance the amino acid composition of formulations of protein compositions for boiled sausages using Muscovy duck meat, collagen-containing raw materials in combination with soy isolate and milk processing products, significantly increasing the content such essential amino acids as methionine, valine, threonine and the amounts of phenylalanine and tyrosine.

6. Inclusion in the formulation of emulsified meat-containing products of freshwater fish allows to obtain food systems with the presence of all essential amino acids, amino acid score, which is higher than close to 100%.

7. The obtained results allow confirming the prospect of further research and development of technologies and recipes of high biological value products with protein-containing raw materials of regional aquaculture for solving optimization problems of rational use of meat and fish resources.

BIBLIOGRAPHICAL REFERENCES

1. Protein and Amino Acid Requirements in Human Nutrition Report of a Joint WHO/FAO/UNU, 2007. Expert Consultation Technical Report Series, № 935, WHO, Geneva.

2. Pasichnyj, V. N., Zakhandrevych, O., 2008. Kharakterystyka osnovnoji myasnoyi syrovyny ta subproduktiv dlya vyrobnyctva kovbasnykh vyrobiv varenoyi ghrupy. Myasnoe delo, 1, p. 39–42.

3. Pasichnyj, V. M., Sabadash, P.M., Zhuk, I.Z., Kremeshna, I.V. Bilkovo-zhyrova emuljsija z krov'ju. Ukrajiny pat. 70714.

4. Pasychnyj V. N., 2011. Tekhnologhycheskye vozmozhnosty kombynyrovanyja ne mjasnogho syrjja dlja proyzvodstva kolbasnikh yzdelyj. Mjasnoj biznes, 12, p. 96–97.

5. Nohr, D. and H. K. Biesalski, `Mealthy` food: meat as a healthy and valuable source of micronutrients. *Animal*, 2007. 1(02): p. 309–316. doi: 10.1017/S1751731107657796.

6. Bozhko, N., Tischenko, V., Pasichnyi, V., Polumbryk, M, Haschuk O., 2018. Development of meat-containing minced semi-finished products based on the locally produced raw materials. *Eastern-European Journal of Enterprise Technologies*, 4, 11 (94). DOI: 10.15587/1729-4061.2018.140052.

7. Aronal, A.P., 2012. Amino Acid and Fatty Acid Profiles of Peking and Muscovy Duck Meat. *Int. Journal of Poultry Science*, 11 (3), 229–236.

8. Bozhko, N.V., Pasichnyj, V.M., Bordunova, V.V., 2016. Myjaso-mistki vareni kovbasy z vykorystannjam myjasa kachky. *Naukovyj visnyk LNUVMBT imeni S.Z. Gzhycjkogho,* t. 18, 2 (68). s.143-146. doi:10.15421/nvlvet6829.

9. Bozhko, N.V., Tyshhenko, V. I., Pasichnyj, V. M., Vertelecjka, N. P., 2018. Rozrobka receptury napivkopchenoji kovbasy z myjasa pekinsjkoji kachky. V: O. I. Cherevko, red., *Proghresyvni tekhnika ta tekhnologhiji kharchovykh vyrobnyctv restorannogho ghospodarstva i torghivli: zb. nauk. pr.*, 1(27). p. 112–122.

10. Pasichnyj, V. M., Moroz, O. O., Mitjajeva, S. M., 2017. Stabilizacija pokaznykiv napivkopchenykh kovbas z myjasom ptyci. *Naukovyj visnyk LNUVMiB im. S. Z. Ghzhycjkogho*, 10, 2 (37), Ch. 5, p. 101–104.

11. Ivanov, S. V., Pasichnyj, V. M., Strashynsjkyj, I. M., 2014. Reghuljuvannja strukturno-mekhanichnykh pokaznykiv nyzjkokalorijnykh myjasnykh sichenykh napivfabrykativ z vykorystannjam nanokompozytiv. *Naukovi praci Nacionaljnogho universytetu kharchovykh tekhnologhij,* 20, 6. p. 227–233.

12. Bozhko, N. V., Tyshhenko, V. I., Pasichnyj, V. M., 2017. Optymizacija receptury myjasnykh khlibiv z vykorystannjam ghidro biontiv. *Naukovyj visnyk LNUVMBT imeni S. Z. Gzhycjkogho*. T. 19, 80. p. 38–42.

13. Tyshhenko, V. I., Bozhko, N. V., Pasichnyj V.M., 2017. Rozrobka receptury polikomponentnykh myjasnykh khlibiv na osnovi farshu prisnovodnoji ryby. *Naukovi praci NUKhT.* T. 23, 3. p. 172–178.

14. Bozhko, N. V., Pasichnyi, V. M., Bordunova, V. V., 2016. Miasovmistki vareni kovbasy z vykorystanniam miasa kachky. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies.* 18, 2(68), p. 143–147.

15. Matsuk, Yu. A., Pasichnyi, V. M., Ishchenko, N. V., Suprun, E. M., 2016. The theoretical and applied aspects production of the meat and fish products. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies* 18, 2(68), c. 171–173.

16. Tyshhenko, V. I., Bozhko, N. V., Pasichnyj, V. M. 2016. Rybnyj farsh jak syrovyna dlja vyrobnyctva polikomponentnykh produktiv kharchuvannja. *Zbirnyk naukovykh pracj «Visnyk Kharkivsjkogho nac. tekhn. univ. s.gh. im. Petra Vasylenka*. p. 100–108.

17. Nykytyn, B. Y., Nykytyna, N. B., 1983. *Pererabotka ptycy, krolykov y proyzvodstvo ptyceproduktov*. M.: Leghkaja promyshlennostj.

18. Derzhspozhyvstandart Ukrajiny, 2005. DSTU 4436:2005. *Kovbasy vareni, sosysky, sardeljky, khliby myjasni*. Kyjiv, Derzhspozhyvstandart Ukrajiny.

19. Derzhspozhyvstandart Ukrajiny, 2012. DSTU 3143:2009. *Myjaso ptyci (tushky). Zaghaljni tekhnichni umovy*. Kyjiv, Derzhspozhyvstandart Ukrajiny.

20. Pasichnyj, V. M., 2002. Ranghove ocinjuvannja kombinovanykh m'jasoproduktiv. *Naukovi praci UDUKhT,* 11, p. 77-80.

21. Derzhspozhyvstandart Ukrajiny, 2009. DSTU ISO 13903:2009. Vydannja. *Kormy dlja tvaryn. Metod vyznachennja vmistu aminokyslot*. Kyjiv, Derzhspozhyvstandart Ukrajiny.

22. *Dietary protein quality evaluation in human nutrition: Report of an FAO Expert Consultation*. 2013.Rome: FAO.

23. Pasichnyj, V. M., Chernjushok, O. A., Moskaljuk, O. Je., Ghashhuk, O. I., uklad., 2018. *Modeljuvannja ta stvorennja innovacijnykh produktiv kharchovoji promyslovosti: laboratornyj praktykum dlja studentiv osvitnjogho stupenja «bakalavr» specialjnosti «Kharchovi tekhnologhiji» dennoji ta zaochnoji form navchannja.* K.: NUKhT.

24. Mohanty, B., Mahanty, A., Mitra, T., Karunakaran, D., Anandan, R., 2017.Nutritional composition of food fishes and their importance in providing food and nutritional security. *Food chemistry,* 12.

25. Lebsjka, T., Gholembovsjka, N., 2014. Kharchova cinnistj koropa Cyprinus Carpio i tovstolobyka Hypophtalmichthys spp osinnjogho vylovu. *Tekhnika i tekhnologhiji APK*, 5, p. 12–15.

26. Amino Acid Compositions of 27 Food Fishes and Their Importance in Clinical Nutrition, Edd. Mohanty B. and other, 2014. *Journal of Amino Acids,* 1, p. 7–14.

27. Parthasarathy, A., Cross, PJ., Dobson, RCJ. Three-Ring Circus: Metabolism of the Three Proteogenic Aromatic Amino Acids and Their Role in the Health of Plants and Animals, 2018. *Front. Mol. Biosci*., 6.

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Published by Sciemcee Publishing.
LP22772, 20-22 Wenlock Road
London, United Kingdom
N1 7GU
Sciemcee Publishing is part of SCIEMCEE.
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First Edition: 2018
A catalogue record for this publication is available from British Library.

ISBN 978-1-9993071-0-3
Includes bibliographical references and index.