ICSTI: 65.01.70
UDC: 378.048.2; 664 https://www.doi.org/10.53355/ZHU.2025.114.1.003

ISSUES OF SAFE FOOD STORAGE IN THE EDUCATION OF GRADUATE STUDENTS OF PROFILE SPECIALTIES: CONCEPT AND INFORMATION SUPPORT

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An important direction in the education of graduate students in the profile "Food Technology" is the study of the basics of safe storage of foods – both in the scientific and practical sense. To dynamically determine the shelf life of products, the following factors must be taken into account: internal (physical, chemical, biochemical and microbiological contaminants), external (climate, ecology, farming practices, storage and realization conditions, and human interaction). Hence, it is necessary to outline the scope of the required knowledge of graduate students in this area. During the research, we used a systematic approach to research factual materials, in particular scientific and scientific-practical literature, normative-legal acts, regulatory documents, etc.; abstract-logical approach to generalize the research results and formulate conclusions. According to the results of the research it can be stated that in the process of training graduate students in the educational and scientific program "Food Technologies" it is necessary to properly involve the concept of safe storage of products, in particular the definition and scientifically based prediction of spoilage, as well as preservation/loss of nutritional value, of the main groups of food products in the process of their storage in accordance with the current requirements of food safety and rational resource conservation. The scientific value and practical significance of the conducted research lies in the fact that specialists of the highest scientific qualification – PhD master the most important in their professional activity concept of safe food storage.

Keywords: *scientific institution, food industry, graduate school, safe food storage, information support, technical library.*

Introduction

Traditionally, the food industry is one of the most developed in Ukraine, which is due to the presence of highly productive agriculture, which provides a reliable raw material base, the variety and high technical level of industrial enterprises of processing direction, as well as the high professional level of those employed in the processing industry [1]. Accordingly, the system of personnel training at all levels – from workers to engineers – is also developed. Numerous universities and specialized scientific institutions also train scientific personnel capable of scientific support of technical progress in the food industry – bachelors and masters. There is also a significant interest in the training of applicants of the third (educational and scientific) level – PhDs specializing in research and innovation activities [2, 3].

PhD training course is also carried out at the Institute of Food Resources of the National Academy of Agrarian Sciences of Ukraine (IFR NAAS), which originates from the Ukrainian Research Laboratory of Dairy Butter Industry (UMIL) established in 1933. In different periods our scientific institution was called Ukrainian Research Institute of Meat and Dairy Industry and Technological Institute of Milk and Meat of the Ukrainian Academy of Agrarian Sciences. The present name of the Institute has been used since 2012 [4, 5].

In the postgraduate program of IFR NAAS training of highly qualified scientific personnel in the field of food technology as well as biotechnology and bioengineering is carried out by conducting scientific research and obtaining new and practically directed results. Directions of

scientific researches in the postgraduate course of the Institute for applicants of higher education on educational and scientific program "Food technologies" include researches of regularities and development of scientific and practical bases, methods and approaches on: processes which occur at meat and milk plants, transformation of raw material components in food; fundamental and applied problems of production of safe meat and dairy products for rational nutrition; fundamental and applied researches of bioconversion of plant raw materials; fundamental and applied research of bioconversion of plant raw materials; biotechnology and bioengineering in the field of food technologies. The introduction of educational and scientific program "Food Technologies", allowed providing qualitative positive changes in the education of specialists who demonstrate knowledge and understanding of effective food technologies and are able to apply this knowledge in their professional activities.

The peculiarity of the educational and scientific process is the formation of individual educational trajectories for each graduate student taking into account their scientific interests, the realization of the concept "Learning by doing research". Applicants directly work on the realization of scientific topics of departments, prepare parts of reports on fundamental and applied tasks of the Institute, have the opportunity to travel to enterprises for approbation and implementation of the results of their own research and research of departments. Now 19 postgraduate students are studying at the postgraduate course of IFR NAAS on educational and scientific programs "Food Technologies" and "Biotechnology and Bioengineering". The licensed volume for the training of applicants for higher education of the Institute is 10 persons per year. Educational and scientific programs of training of applicants of the third educational and scientific level of higher education includes program profiles, in particular in the field of technology of meat, dairy products and technology of sugary substances and fermentation products, namely: improvement of existing and development of new energy-saving and resource-saving technologies for the production of meat products; development of theoretical and practical foundations for the creation of effective technologies for the production of poultry products based on the integrated use of raw materials; study of biochemical, physical, chemical, rheological and functional technological properties of meat raw materials for the development of rational schemes for its use; development of scientific foundations for the greening of meat industry enterprises; development of new resource-saving technologies for processing milk and secondary milk raw materials based on modern principles of modification of protein-carbohydrate components, the use of functional-technological ingredients and bacterial preparations; study of milk raw materials as an object of technological processing into food products. Improvement of existing technological processes for the production of dairy products, including dietary products and baby food; theoretical and practical foundations for the formation of characteristics of dairy products, their composition and properties during production and storage; improvement and optimization of theoretical and practical foundations of sugary substances technologies, rational use of waste and secondary products of these industries, ensuring the microbiological purity of finished products; development of conceptual, theoretical and methodological foundations for the bioconversion of plant materials, creation of effective technologies for the production of ethyl alcohol for various purposes – fuel ethanol, alcoholic beverages, antiseptics; development of scientific foundations for the greening of food industry enterprises with the production of industrially valuable components, liquid and gaseous fuel.

Consequently, the activities of the postgraduate program of the Institute of Food Science and Technology of the National Academy of Agrarian Sciences aim at high-quality fundamental training of specialists in the volumes necessary for the effective functioning and development of society; a combination of traditions and innovations to form a personality capable of competent and responsible professional activity in the field of food technology, in particular such a socially and technologically important concept as safe storage of food products.

Materials and methods

During the research, a systematic approach was used to study factual materials, in particular, scientific and scientific-practical literature, regulatory legal acts, normative documents, etc.; an abstract-logical approach to generalizing the research results and formulating conclusions.

Results and discussion

As part of the training of postgraduate students in the educational and scientific program "Food Technology", it is necessary to ensure a proper understanding of the fact that the process of storing food products is aimed at extending their shelf life and delivering safe products to consumers using various materials and technologies [6-8]. The problem is that during storage, a very sharp loss in weight and a change in the content of pigments or dyes in tissues can occur. In food products, for example, due to a decrease in chlorophyll content, the content of other pigments can also increase or decrease depending on the storage temperature, packaging and other factors. Expiry date is an important and essential characteristic of the food storage process, and information on the expiration date is necessary for consumers [6, 9, 10]. The expiration date of food products has a direct impact on their quality.

In their professional activities, food industry specialists should proceed from the fact that scientific substantiation of methods for forecasting the storage of food products should be carried out based on food safety criteria, minimization of losses of nutritional value, optimization of production programs, supply logistics, etc. This contributes to the further improvement of the technical and technological foundations for minimizing spoilage of food products during their storage and losses of nutritional value, and is an important contribution to achieving the proper level of food security and resource conservation in the agro-industrial complex. The results of the analysis of the theory and practice of determining and scientifically substantiated forecasting of spoilage, as well as preservation/loss of nutritional value, of food products during their storage in accordance with modern requirements of food safety and resource conservation allow considering the presence of a number of factors that do not ensure proper compliance with the specified requirements. These are, in particular:

• prevalence of empirical approaches to determining and predicting the safe storage periods of food products;

• insufficient understanding of the importance of preserving the nutritional value of food products as an important factor in resource conservation and one of the technical criteria for ensuring food security;

• lack of scientific and scientific-technical information on absolute indicators and dynamics of the nutritional value of the main groups of food products;

• lack of scientifically sound and acceptable for practical use methods for determining and predicting the safe storage periods of food products [11].

It is necessary to achieve a full understanding among postgraduate students that the following factors must be taken into account for the dynamic determination of the shelf life of products: internal (physical, chemical, biochemical and microbiological contaminants), external (climate, ecology, agricultural practices, storage and distribution conditions, and interaction with people). The information necessary to determine the actual shelf life is difficult to obtain in advance by laboratory assessment, so it is necessary to determine the influence of external factors. The concept of kinetics of property loss was introduced as a number of factors acting during storage and distribution. These include:

• models of growth, recovery and death of microorganisms (microbiological prognosis);

• physical characteristics (e.g. texture and color);

• chemical and biochemical parameters influencing nutritional characteristics, toxicological factors [12].

The main processes of food spoilage can be divided into

• physical (rheological);

• chemical;

• microbiological.

Postgraduate students should learn that there is a correlation between the above processes as in most cases, all three types of spoilage are present to some extent. They are usually interconnected by nonlinear laws and influence each other. During the storage of food products,

there are several main factors that affect the storage period and determine the types of spoilage: temperature, pH, water activity, oxygen availability, light intensity, variety and properties of ingredients, as well as their decomposition products [13].

It is necessary to understand that mathematical modeling tools allow predicting the state of a certain food product during storage under standard conditions, using the results obtained during storage under extreme conditions. This concept is based on studying the mechanism and kinetics of processes that determine the deterioration of the quality of the test object during storage. Consequently, for various food products, it is possible to use mathematical modeling methods, in particular, the construction and evaluation of the quality of a regression model based on mathematical planning and processing of the results of an active experiment [11].

The mathematical models used to predict food storage processes are often integrated into general food quality models [14-16]. The quality indicator models aim to understand, predict and control processes during storage and sale of food products [17]. The difference in the models lies in the systems they define – in this case, it is assumed that the boundary conditions, transfer mechanisms and physical properties will change during storage [16, 18]. In this sense, it should be understood that kinetic modeling implies that changes can be described in mathematical models using kinetic parameters such as activation energy and rate constants [16, 17].

In their future professional activities, postgraduate students will recognize that shelf life determination should be scientifically based and supported by available data. Shelf life limits can be established using scientifically accepted methods [19]. The development of new technologies to extend the shelf life of foods includes improvements in raw material collection, processing speed and technology, packaging technology, food composition, and the integrity of the cold/freeze chain. Extending shelf life has become a goal for many food manufacturers to alleviate some of the previously discussed problems of food production and distribution. Scientists and R&D specialists must study these food systems and subject them to testing under the worst conditions of processing, packaging, storage, and use, proving that food products will retain their shelf life, they can use traditional culinary and scientific methods to create products that meet market demand. The shelf life must be sufficient to allow production planners to meet supply demand and logistics specialists to deliver the product to the customer in a timely manner. Therefore, the development methods and technology used must be consistent with business interests and marketing objectives in terms of production costs, as well as nutritional labeling and the use of ingredients that meet consumer expectations. Scientists and subject matter experts develop appropriate formulas and define target processing parameters to achieve the desired shelf life. Product quality personnel are responsible for monitoring the product and may perform continuous shelf life testing on representative product samples [19].

Computational methods use modeling techniques that link experimental data on multiple quality and safety characteristics, allowing for multi-scale scenario analysis and interpretation to better understand the complex dynamics of food quality and shelf life. Of course, the scientific process of collecting experimental data on a product, combined with real-world distribution information, can be a means of accurately predicting shelf life and indicating accurate dates on packaging [19]. In particular, a full factorial two-level experiment is used for the purpose of mathematical modeling of the shelf life of food products [20].

It is also worth noting the role of information support for the training of postgraduate students, in particular the effective functioning of the scientific and technical library of the IFR NAAS based on a systems approach, which provides for a comprehensive organization of all processes and the integration of various resources, in particular: the latest information technologies and the Internet; modern electronic resources and databases; scientific and technical educational programs; scientific communications and connections. The Scientific and Technical Library of the IPR NAAS actively interacts and cooperates with other information platforms to expand the boundaries of databases, exchange archives and repositories. This will allow scientists, postgraduates and students to access a wide range of information. Thanks to the digitalization of

funds, postgraduate students can access information on safe food storage in a convenient format. Using special software for managing databases, searching for information and serving readers, interactive systems allow you to quickly and clearly find the necessary materials, reserve books online, and receive electronic recommendations based on preliminary requests. In particular, the integration of artificial intelligence and automation of the search system of a scientific library allows you to quickly and accurately find relevant information and receive personalized recommendations for scientific literature.

Conclusion

In the process of training postgraduate students in the educational and scientific programs "Food Technology" and "Biotechnology and Bioengineering" it is necessary to properly involve the concept of safe storage of food products, in particular the definition and scientifically based prediction of spoilage, as well as the preservation/loss of nutritional value, of the main groups of food products during their storage in accordance with the current requirements of food safety.

Determining the shelf life of food products requires taking into account internal factors such as physical, chemical, biochemical and microbiological contamination and external factors such as climate, ecology, agricultural practices, storage and distribution conditions, interaction with people, etc. Since the actual shelf life is difficult to determine by preliminary laboratory assessment, it is necessary to determine the influence of external factors.

Mathematical models for predicting the shelf life of food products are often integrated into more general food quality models. Quality indicator models allow understanding, predicting and controlling processes during the storage and marketing period of food products.

Current and retrospective scientific and technical information remains an indispensable resource for training postgraduate students in conceptual and practical issues of safe food storage, therefore the role of the scientific and technical library of the IFR NAAS, which, thanks to digital technologies and automated search systems, is significant in this information capacity.

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БЕЙІНДІ МАМАНДЫҚТАРДЫҢ АСПИРАНТТАРЫН ДАЙЫНДАУДА ТАМАҚ ӨНІМДЕРІН ҚАУІПСІЗ САҚТАУ МӘСЕЛЕЛЕРІ: ТҰЖЫРЫМДАМА ЖӘНЕ АҚПАРАТТЫҚ ҚАМТАМАСЫЗ ЕТУ

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«Азық-түлік технологиясы» мамандығы бойынша аспиранттарды дайындаудың маңызды бағыты – ғылыми және практикалық мағынада тамақ өнімдерін қауіпсіз сақтау негіздерін зерттеу. Өнімдердің сақтау мерзімін динамикалық түрде анықтау үшін келесі факторларды ескеру қажет: ішкі (физикалық, химиялық, биохимиялық және микробиологиялық ластану), сыртқы (климат, экология, ауылшаруашылығын жүргізу әдістері, сақтау және өткізу жағдайлары, сонымен қатар адамдармен өзара әрекеттесу). Сондықтан аспиранттардың осы бағыттағы қажетті білім көлемін белгілеу қажет. Зерттеу барысында фактілік материалдарды, атап айтқанда ғылыми және ғылыми-тәжірибелік әдебиеттерді, нормативтік құқықтық актілерді, нормативтік құжаттарды және т.б. зерделеудің жүйелі тәсілі, зерттеу нәтижелерін жалпылауға және қорытындыларды тұжырымдауға абстрактілі логикалық тәсіл қолданылды. Зерттеу нәтижелеріне сүйене отырып, «Азық-түлік технологиялары» оқу-ғылыми бағдарламасы бойынша аспиранттарды дайындау процесінде өнімдерді қауіпсіз сақтау тұжырымдамасын дұрыс тарту қажет, атап айтқанда атап айтқанда, азық-түлік қауіпсіздігінің және ұтымды ресурс үнемдеудің қолданыстағы талаптарына сәйкес оларды сақтау процесінде тамақ өнімдерінің негізгі топтарының тағамдық құндылықтардың бұзылуын, сондай-ақ сақталуын/жоғалуын анықтау және ғылыми негізделген болжау. Жүргізілген зерттеулердің ғылыми құндылығы мен практикалық маңыздылығы жоғары білікті ғылыми мамандар – философия докторлары өздерінің кәсіби қызметінде азық-түлік өнімдерін қауіпсіз сақтаудың ең маңызды тұжырымдамасын толық меңгеруінде.

Кілт сөздер: *ғылыми мекеме, тамақ өнеркәсібі, аспирантура, өнімді қауіпсіз сақтау, ақпараттық қамтамасыз ету, техникалық кітапхана.*

ВОПРОСЫ БЕЗОПАСНОГО ХРАНЕНИЯ ПИЩЕВЫХ ПРОДУКТОВ В ОБУЧЕНИИ АСПИРАНТОВ ПРОФИЛЬНЫХ СПЕЦИАЛЬНОСТЕЙ: КОНЦЕПЦИЯ И ИНФОРМАЦИОННОЕ ОБЕСПЕЧЕНИЕ

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Важным направлением в обучении аспирантов по профилю «Пищевые технологии» является изучение основ безопасного хранения пищевых продуктов – как в научном, так и в практическом смысле. Для динамического определения срока годности продуктов

необходимо учитывать следующие факторы: внутренние (физические, химические, биохимические и микробиологические загрязнения), внешние (климат, экология, методы ведения сельского хозяйства, условия хранения и реализации, а также взаимодействие с людьми). Следовательно, необходимо очертить рамки необходимых знаний аспирантов в этой области. Во время исследований использовали системный подход к исследованиям фактологических материалов, в частности научной и научно-практической литературы, нормативно-правовых актов, нормативных документов и т.д.; абстрактно-логический подход к обобщению результатов исследования и формулированию выводов. По результатам исследований можно констатировать, что в процессе обучения аспирантов по образовательно-научной программе «Пищевые технологии» необходимо должным образом привлекать концепт безопасного хранения продуктов, в частности определения и научно обоснованного прогнозирования порчи, а также сохранения/потери питательной ценности, основных групп пищевых продуктов в процессе их хранения в соответствии с действующими требованиями пищевой безопасности и рационального ресурсосбережения. Научная ценность и практическое значение проведенного исследования заключается в том, что специалисты высшей научной квалификации – доктора философии в полном объеме овладевают важнейшим в их профессиональной деятельности концептом безопасного хранения пищевых продуктов.

Ключевые слова: *научное учреждение, пищевая промышленность, аспирантура, безопасное хранение продуктов, информационное обеспечение, техническая библиотека*.