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Analysis of the dangerous factors related to food products in a retail establishment

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Abstract. In accordance with the current legislation of Ukraine, retail establishments must develop, implement, and apply permanent procedures based on the principles of hazard analysis and control at critical points, and provide appropriate training on the application of permanent procedures based on the principles of HACCP; persons responsible for these procedures during the production and circulation of food products. The purpose of the study is to analyse food-related hazards in retail establishments. The study used methods of analysing internet resources, scientometric databases, in particular, Scopus and Web of Science, and regulatory documents on the food safety management system. Food safety hazards can occur at any stage of the food chain. Therefore, proper control throughout the entire food chain is essential. In the course of the study, adapted recommendations for network use were developed in the form of a HACCP book, which contains four volumes: Basic provisions, Basic programmes-prerequisites, HACCP Group, and HACCP plan (Production). Another method for determining the substantiality of hazardous factors is also proposed. In general, it is established that the implementation of HACCP principles ensures both the safety of culinary products and contributes to the development of trade enterprises. The process of production of culinary products becomes safe, the staff adheres to sanitary and hygienic standards; the confidence of visitors in the quality and safety of food consumed increases the rating of the institution; the detection of possible violations in case of inspections is practically excluded; the institution acquires a marketing advantage in the conditions of modern competition. Hazard analysis is important for an effective food safety management system because its implementation helps in streamlining the knowledge needed to establish an effective set of management measures and implement integrated quality systems

Keywords: quality, food safety management system, HACCP, risks, hazards

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Relevance

In modern conditions, the problem of food quality and safety is becoming particularly relevant. The quality and safety of food products determine the life and health of people, including the food, economic, and national security of the state.

The issues of ensuring the stability of quality and safety of products of processing enterprises of the agro-industrial complex, in particular, agricultural and food, are becoming increasingly important, which is achieved through the introduction of quality management systems at enterprises in accordance with the requirements of international standards, the development of products considering consumer preferences and the needs of the modern market.

According to the requirements of the Laws of Ukraine "On food safety and quality", "On baby food", all enterprises that are engaged in the cultivation and production of agricultural and food products must implement food safety management systems based on the principles of HACCP.

Today, food consumers demand that market operators have an effective food safety management system, in accordance with the requirements of voluntary standards and certification schemes recognised by the Global Food Safety Initiative.

In the context of European integration, it is important for Ukrainian producers to meet not only the EU requirements for food safety but also apply knowledge of quality management. This will help to correct gaps in certain phases of development of Ukrainian enterprises and, accordingly, the competence of personnel, which will contribute to the process of integration of Ukrainian producers into the European community, developing a production culture, and applying best practices of quality management.

All participants in the chain: from the farmer – carrier, food producer and retail chain – understand that today the condition for their existence is precisely the safety of products. Therefore, the market and consumer understanding have led to new requirements for food products, and therefore for the quality management systems of all participants in the food chain. Retail trade and purchasing unions were the first to put forward their demands. They were supported by major shopping centres in Europe, which began to compile their own lists, determine criteria for evaluating food producers, and conduct internal audits. Manufacturers had to adhere to the formulated requirements to be able to sell their products in certain retail chains.

Implementation of food safety management system (FSMS) is a strategic decision for an organisation that can help improve overall productivity in food safety.

In this regard, the identification and control of hazardous factors will allow for predicting the quality and safety of products according to the criteria of efficiency of technological processes, so this subject is an urgent problem and has practical importance. In addition, the analysis of food-related hazards in retail establishments deserves special attention.

Analysis of Recent Studies and Papers

In the course of research (Agnieszka Jackowska-Tracz, Michał Tracz, and Krzysztof Anusz, 2018) determined that the introduction of only the HACCP concept at the enterprise for product safety control is not enough. In addition to the concept of risk analysis, it is also necessary to introduce programmes of prerequisites and various integrated approaches. Marić Radenko and Goran Vukmirović (2018)

determined the dependence on the introduction of sustainable technologies in retail on customer satisfaction. Thus, the results of the study prove the importance of sustainable development with the introduction of international quality and safety management systems in the retail sector. These principles also serve as guidelines among buyers.

A considerable number of retail enterprises have internal capacities for the production of culinary products and semi-finished products. The study (Mrdovic *et al*., 2019) identified that out of 297 samples of semi-finished meat products from nine retail outlets, 5% (16/297) of semi-finished meat products contained Escherichia coli, and Salmonella spp. was detected in 1.6% of semi-finished meat products. Such results confirm the need for corrective actions, hazard analysis and revision of the current HACCP concept.

Availability of a record-keeping system for documentation, hazard analysis, sanitation compliance, and other necessary programmes – support the successful development and implementation of the HACCP concept (Gehring K.B. and Kirkpatrick R., 2020). Product quality in the study (Stoyanova, 2020) is considered as a socio-economic category and is perceived as a set of properties and features that must meet the constantly growing needs of consumers and consumption requirements. Identifying opportunities for a unified approach to integrated management, which is implemented through risk-based thinking at all levels of management, is essential to ensure food safety.

Justification of the need to implement a food safety management system was also covered by the following researchers: M.T. Bilukha, F.F. Butynets, N.I. Lavrenchenko, L.A. Maiurnykova, T. Maies, S. Mortymer, V.M. Parkhomenko, Sh.A. Sfiev, I.Yu. Tymrienko, and many others. Despite the presence of a substantial number of scientific papers on this subject, problematic issues related to the implementation of the system in retail establishments remain insufficiently investigated.

Purpose of the study. The purpose of the study is to analyse food-related hazards in retail establishments.

Materials and Methods

The study uses methods of analysis, synthesis, information-search investigation, Internet resources, and regulatory-methodological documents of Ukraine.

Research Results

Food market operator (market operator):

- legal entity, individual entrepreneur, individual, agri-food market;
- activities with or without the purpose of making a profit;
- primary production, production, sale and/or turnover of food products and/or other objects of sanitary measures (except for contacting with food materials);
- responsible for meeting the requirements of the law and legislation on safety and certain indicators of food quality.

Food safety is associated with the presence of hazardous factors in the food at the time of consumption. Since the food hazard factor can appear at any link in the food chain, adequate management throughout the food chain is essential.

Information throughout the food chain is essential to ensure that all relevant food hazards are identified and adequately managed at each link in the food chain (DSTU ISO 22000:2019; Bal-Prylypko *et al*., 2020).

The tasks in the field of ensuring the quality system and food safety for a trading enterprise are continuous improvement of the food production process, ensuring the stability of

product quality at all stages of its life cycle, improving the efficiency of resource use, providing customers and regulatory authorities with confirmation of product compliance with established requirements. In accordance with the main tasks, solutions are developed, which can be expressed in the following: personal responsibility of the manager and employees, constant work with suppliers of food raw materials to improve the quality and safety of delivered products, improving the forms and methods of production organisation, the level of knowledge in the field of food safety, preventive actions and their management, regular internal audit and monitoring of the effectiveness of the system, systematic analysis of audit results, monitoring and satisfaction of customers of retail establishments, continuous improvement of the food safety management system (Nikolaenko *et al*., 2017; Silonova, 2018).

HACCP groups are responsible for compliance with and implementation of elements of the food quality and safety management system in accordance with legal requirements and proper functioning of the implemented HACCP concept in a retail establishment.

In accordance with the above, adapted recommendations in accordance with the requirements of national legislation and international practices for network use in the form of a HACCP book were developed. The HACCP book of the retail chain has an extensive structure and is generally divided into 4 books:

*The HACCP book. Main provisions – describes the architecture of the HACCP book, its main provisions, terms, principles, and defines responsibility.

*The HACCP book. Volume 1. Basic programmes-prerequisites – the basic conditions for ensuring the safety of products of a network of retail establishments are described.

*The HACCP book. Volume 2. HACCP Group – the provisions on HACCP groups and their responsibility are included, the methodology for analysing hazards (risks), determining critical control points (CCP), and key information on managing the HACCP concept are presented.

*The HACCP book. Volume 3. HACCP Plan (Production) – the application of HACCP principles on each type of production is described, which includes: conducting a risk analysis, determining the critical control points (CCP), determining critical limits for each CCP, monitoring system, corrective actions, procedures for confirming the functioning of the system, its documentation.

The HACCP plan contains information about all critical control points identified in the network's production facilities, namely: general information about the CCP (page number and CCP, stage of the technological process, intended monitoring method); object of control (name of the CCP, substantial hazard factor, critical limits for this CCP); monitoring of the CCP (subject of monitoring, monitoring methods, frequency of monitoring, ones responsible for monitoring); corrective actions (corrective actions, protocol of performing corrective actions, method of checking the effectiveness of monitoring).

According to HACCP, hazards are classified into three types: biological (B), chemical (C), and physical (P). When further identifying hazards, it is important to understand that hazards include only those that can cause health disorders, diseases, or injuries to a person. Many other conditions are also highly undesirable and must be controlled, but as long as these conditions do not directly affect food products, they are not included in the HACCP plan.

Biological hazard factors – microbiological: pathogenic and conditionally pathogenic bacteria, viruses, parasites, and single-celled

organisms, mould, etc. As a rule, there is at least one factor that can affect the degree of risk. The determination of risk may be influenced by the processing conditions to which the food product is subject. A food product that is subjected to heat treatment reduces the risk of disease (Bocharova, 2019; Bal-Prylypko *et al*., 2018).

Chemical hazard factors — detergents, migration of plasticisers from packaging, pesticides, heavy metals, nitrates, nitrites, nitro compounds, mycotoxins, food additives, veterinary drugs (antibiotics, hormones), etc. Chemical hazards can also cause foodborne illnesses, although they tend to affect fewer people. Chemical contamination can occur at any stage of production and processing. The potential risk to consumers increases when the chemical content is not controlled, or when recommended standards are exceeded (Bocharova, 2019).

Physical hazard factors – foreign objects: glass, metal, stones, wood, plastic, etc. As a rule, physical hazards create problems only for individual consumers or a small number of them. It is because of physical factors that injury occurs immediately or shortly after eating and the source of danger is easy to identify (Petrovskaya *et al*., 2020; Bal-Prylypko *et al*., 2017). In a retail establishment, the method of determining the degree of dangerous factors is used, which is presented in the table. The substantiality of hazardous factors is calculated using the following formula:

Substantiality = probability of occurrence multiplied by the severity of the consequences.

Table 1. *Method for determining the substantiality of hazardous factors*

Probability of occurrence of a dangerous factor in humans	**Severity of the consequences of exposure to a dangerous factor on humans**		
	Mild lesion Short-term malaise for a time up to 1 day – 1 point	Average lesion Temporary loss of ability to work up to 1 week - 2 points	Severe damage Temporary loss of ability to work up to 1 month – 3 points
Almost impossible 1 time per 5 years 1 point	1 Can be neglected	2 Acceptable	3 Moderate
Unlikely 1 time per 3 years 2 points	2 Acceptable	4 Moderate	6 Substantial
Probable 1 time per year 3 points	3 Moderate	6 Substantial	9 Unacceptable

All hazards the substantiality of which was 3 or higher were further analysed to rank the management measures that will be applied to manage the relevant hazards.

Hazard analysis is conducted sequentially, entering data in a special form. If at any stage there is a dangerous factor that is not controlled during the production process, it is marked as a potential critical control point. This form includes: localisation of danger: technological stage of the production process; description of the danger: a type of dangerous factor, its possible source; hazard assessment: evaluated by the method of determining the substantiality of dangerous factors; explanation of the presence or absence of danger. Management and recording measures for insubstantial hazards (Slyva, 2021; Pivets *et al*., 2018).

Conclusions and Prospects

The introduction of a food safety management system and Ukrainian legislation based

on HACCP principles is particularly useful for organisations seeking to have a more focused, consistent and integrated food safety management system.

Hazard analysis is key to an effective food safety management system, as it helps to streamline the knowledge needed to establish an effective set of management measures.

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Аналіз небезпечних чинників, пов'язаних із харчовими продуктами в закладі роздрібної торгівлі

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Анотація. Відповідно до чинного законодавства України заклади роздрібної торгівлі мають розробляти, вводити в дію та застосовувати постійно діючі процедури, що ґрунтуються на принципах аналізу небезпечних чинників та контролю в критичних точках, а також забезпечувати належну підготовку з питань застосування постійно діючих процедур, що базуються на принципах НАССР; осіб, які є відповідальними за ці процедури, під час виробництва та обігу харчових продуктів. Метою дослідження є проведення аналізу небезпечних чинників пов'язаних з харчовими продуктами в закладі роздрібної торгівлі. Під час дослідження використовували методи аналізу Інтернет-ресурсів, наукометричних баз даних, зокрема Scopus та Web of Science та нормативно-правові документи щодо системи управління безпечністю харчових продуктів. Поява небезпечних чинників для безпечності харчової продукції може статися на будь-якому етапі харчового ланцюга. Тому необхідним є належний контроль упродовж усього харчового ланцюга. В ході дослідження було розроблено адаптовані рекомендації для мережевого використання у вигляді «Книга НАССР», яка містить чотири томи: Основні положення, Базові програми-передумови, Група НАССР, План НАССР (Виробництво). Також запропоновано ще один метод визначення значущості небезпечних чинників. Загалом встановлено, що впровадження принципів НАССР забезпечує, як безпеку продукції і кулінарних виробів, так і сприяє розвитку підприємств торгівлі. Процес виробництва кулінарної продукції стає безпечним, персонал дотримується санітарно-гігієнічних норм; впевненість відвідувачів в якості та безпечності їжі, яку споживають, підвищується рейтинг закладу; практично виключається виявлення можливих порушень у разі перевірок; заклад набуває маркетингову перевагу в умовах сучасної конкуренції. Аналіз небезпечних чинників, має важливе значення для ефективної системи управління безпечністю харчових продуктів, адже його проведення допомагає в упорядкуванні знань, необхідних для встановлення ефективного комплексу заходів керування та впровадження інтегрованих систем якості

Ключові слова: якість, система управління безпечністю харчових продуктів, НАССР, ризики, небезпечні чинники