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## INTERNATIONAL REGULATION, CONTROL AND MANAGEMENT OF FOOD QUALITY AND SAFETY

### МІЖНАРОДНЕ РЕГУЛЮВАННЯ, КОНТРОЛЬ І УПРАВЛІННЯ ЯКІСТЮ ТА БЕЗПЕЧНІСТЮ ХАРЧОВИХ ПРОДУКТІВ

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*The article deals with one of the current trends in the science of nutrition and food hygiene, which concerns the study of the toxicological safety of food products and the presence of chemical contaminants in them. Under the conditions of insufficient control of the use of persistent chemical compounds, they can accumulate in food products, be included in food chains and have a potentially dangerous effect on the human body. The results showed that pesticides were mostly found in vegetable raw materials - vegetables, fruits and cereals, as well as in fatty products of animal origin. Pollution of water resources by mercury organic compounds that can enter water ecosystems as a result of industrial emissions, in particular in the pulp and paper and chemical industry, is particularly significant. The obtained values of lead content in vegetable products can be generally compared with the approximate maximum permissible levels recommended by the international standards of FAO/WHO and Codex Alimentarius ( $\approx 0.1$  mg/kg for vegetables and fruits), however, individual measured concentrations slightly exceeded this limit. In cooked sausages and sausages, dimethylnitrosamine was detected in 25–54% of the tested samples, while the average level of its content did not exceed  $3.3 \mu\text{g/kg}$ . The detection frequency and concentrations of diethylnitrosamine and nitrosopiperidine were significantly lower.*

**Key words:** concentration, samples, food products, fruits, meat products, fish, nitrosamines

The science of nutrition studies the processes of transformation, exchange and assimilation of nutrients in the body - proteins, fats, carbohydrates, vitamins, minerals and other components. These studies use the principles and methods of various theoretical disciplines - biochemistry, physiology, molecular biology [7].

The complex process of assimilation includes digestion in the cavity of the gastrointestinal tract, absorption of digestion products into the internal environment of



the body, cellular nutrition as a result of biochemical reactions in intracellular structures. Summarizing data from theoretical studies on the transformation of nutrients serves as a starting point for determining the needs of different population groups in nutrients and energy and recommending dietary norms. The obtained results of theoretical studies also serve as a basis for the development of preventive rations and therapeutic diets, products of increased biological value and the creation of specialized products [3].

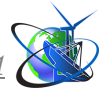
The science of nutrition studies in detail the chemical composition of food products, their taste, nutritional and technological value. Special attention is paid to the study of the toxicological properties of food [4].

Therefore, the modern concept of nutrition includes the entire chain of biological phenomena related to the entry, transformation of food nutrients in the body and provision of energy and structural components for all physiological functions that ensure the vital activity of the body [4, 6].

The harmful effect of food on humans is due to the presence in it of two groups of foreign substances - substances of natural origin and substances that enter the external environment as a result of human activity. Contamination of food products with numerous chemical substances used in agriculture and industry, in the absence of the necessary means of protection, can quickly become widespread [5].

Among the toxic food factors that occur in food products in natural conditions, there are such groups of compounds as mycotoxins, allergens, hemagglutinins, enzyme inhibitors, and demineralizing substances. The manifestation of the action of mycotoxins includes a wide range of symptoms - from skin irritations and carcinogenic effects to an acute toxic effect with a fatal outcome. Allergic reactions associated with the use of common food products (milk, eggs, fish, nuts, chocolate) are characterized by rashes, angioedema, gastrointestinal disorders, asthma, anaphylactic shock. It should be noted that some artificial substances used in the food industry, for example, dyes, are allergens [3, 6].

A possible danger to human health is also associated with such substances that are formed in food products, such as biogenic (pressor) amines, which have a hypertensive



effect in the conditions of treatment of patients with monoamine oxidase inhibitor drugs. A number of psychotropic substances, which are contained, for example, in nutmeg, can cause hallucinations [2]. Formation as a result of the interaction of nitrites with secondary amines, which are potential carcinogens, is an example of foreign and health-threatening compounds in food products. Hemagglutinins and enzyme inhibitors in active form have a toxic effect on humans, which, however, is almost completely removed by heat treatment of food [4,].

Therefore, in our country, a wide system of measures aimed at the prevention of diseases and the safe use of various chemicals in agriculture is carried out. For this purpose, numerous scientific studies of their toxicological characteristics are being conducted and safe levels of possible entry into the body with food products are being developed. [1, 2].

Among the pesticides entering food products, special attention is drawn to organochlorines, which are characterized by high lipophilicity and resistance to degradation, which, having significant stability, do not break down in the external environment. Moreover, when entering the human body with food, they accumulate in his tissues, since the rate of transformation and elimination from the body is not high enough [6].

Research into the toxicological safety of food products and the presence of chemical contaminants in them is an actual area of nutrition science and food hygiene. Studies of the presence of residual pesticides in food products were conducted using standardized methods. The objects of analysis were both raw and cooked foods, as well as ready-made diets made from these products.

The results showed that pesticides were mostly found in vegetable raw materials - vegetables, fruits and cereals, as well as in fatty products of animal origin. In most cases, the concentration of residual substances did not exceed the established hygienic norms, but they were detected regularly. In vegetables and fruits, organophosphate insecticides and pyrethroids were mainly detected, with concentrations of 0.01-0.2 mg/kg, sometimes up to 0.5 mg/kg. In grain crops and products of their processing, residual amounts of herbicides and fungicides were usually 0.02-0.3 mg/kg.



Lipophilic organochlorine pesticides were the most common among products of animal origin (milk, meat, fish). The content of these compounds in meat and fish ranged from 0.005 to 0.05 mg/kg, in milk from 0.002 to 0.02 mg/kg, while these indicators were much higher for the fat phase. Culinary processing (washing, cleaning, heat treatment) helped reduce pesticide levels by 30-70%, especially for organophosphorus and carbamate compounds. For organochlorine pesticides, the decrease in concentration was less significant due to their persistence and ability to accumulate in adipose tissue.

Along with pesticides, food products may contain other chemical contaminants that pose a potential threat to human health. Such compounds include heavy metals, which can accumulate in the body and have a toxic effect even in small concentrations. Lead (Pb), cadmium (Cd), mercury (Hg) and arsenic (As) are among the heavy metals most often found in food products. They are able to accumulate in various human organs and tissues: lead and cadmium in the kidneys and bone tissue, mercury in the nervous system and liver, arsenic in the liver and skin. Sources of heavy metals entering food products are pollution of soil, water, atmospheric air, as well as industrial and agricultural activities. Unlike many pesticides, they do not break down during cooking and can be stored in human tissues for a long time.

Pollution of water resources by mercury organic compounds that can enter water ecosystems as a result of industrial emissions, in particular in the pulp and paper and chemical industry, is particularly significant. From the water, these compounds pass through the plankton into the body of fish and marine animals. Analysis of fish samples showed frequent detection of methylmercury, although residual concentrations were low and averaged 0.02 mg/kg for fish and less for other seafood. It is worth noting that these values are below the maximum permissible levels recommended by FAO/WHO, which indicates their relative safety for consumption, provided that moderate consumption norms are observed.

Determination of lead in some types of food products (fruits, berries) was carried out using the atomic absorption method. As can be seen from Table 2, lead was detected in all the studied products, and its content is 0.07-0.13 mg/kg. The obtained values of



lead content in vegetable products can be generally compared with the approximate maximum permissible levels recommended by the international standards of FAO/WHO and Codex Alimentarius ( $\approx 0.1$  mg/kg for vegetables and fruits), however, individual measured concentrations slightly exceeded this limit.

The development of highly sensitive analytical methods has significantly expanded the possibilities of identification and quantification of nitrosamines, in particular in food products. Nitrosamines belong to a group of chemical compounds that pose a potential carcinogenic danger to humans and are the subject of research in many countries. According to the results of experimental studies, it was established that a significant part of known nitroso compounds exhibits carcinogenic activity, and their intake with food products in concentrations of 0.5–1.0 mg/kg leads to the development of malignant neoplasms in laboratory animals. Determination of N-nitrosamines in meat products was performed by gas chromatography after preliminary extraction and purification of samples. The method enables the quantification of major compounds, including N-nitrosodimethylamine (NDMA), N-nitrosodiethylamine (NDEA) and N-nitrosopiperidine (NPIP) at levels typical of food products.

In cooked sausages and sausages, dimethylnitrosamine was detected in 25–54% of the tested samples, while the average level of its content did not exceed 3.3  $\mu\text{g}/\text{kg}$ . The detection frequency and concentrations of diethylnitrosamine and nitrosopiperidine were significantly lower. Significantly higher levels of nitrosamines were recorded in smoked and semi-smoked sausage products, with the highest values observed in "Homemade Sausage" sausage. It is known that the presence of nitrosamines in food products in concentrations of 500  $\mu\text{g}/\text{kg}$  and more is associated with the development of malignant neoplasms in laboratory animals, which indicates the potential danger of the increased content of these compounds in meat products.

### **Conclusions.**

Therefore, food products contain residual pesticides in small quantities, which usually do not exceed the recommended FAO/WHO MRLs, but with long-term exposure may have hygienic significance and require constant monitoring by sanitary and hygienic services.



## References:

1. Prylipko T.M., Kostash V. B., Pidlisnyj V.V., Semenov A. M. Improvement of methods of identification of meat types. *The International Scientific Periodical Journal "Modern engineering and innovative technologies"* Karlsruhe, Germany Issue. № 26. Part 1. April 2023. P.72-77.
2. Prylipko T.M., Koval T.V. Method of operational quality control of meat raw materials and meat products. *The International Scientific Periodical Journal "Modern engineering and innovative technologies"* Karlsruhe, Germany Issue. № 26. Part 1. April 2023. P.78-83.
3. Tetiana Prylipko, Volodymyr Kostash, Viktor Fedoriv, Svitlana Lishchuk, Volodymyr Tkachuk. Control and Identification of Food Products Under EC Regulations and Standards. *International Journal of Agricultural Extension*. Special Issue (02). 2021. P.83-91.
4. Prylipko T.M., Koval T.V. Carcinogenic N-nitrosamines in food products. *Taurian Scientific Bulletin. Series: Technical sciences*. Kherson State Agrarian and Economic University. Kherson: "Helvetika" publishing house. 2024. Issue 4. P. 271-277.
5. Prylipko T.M., Fedoriv V.M. Methods of modern types of quality examination, identification of falsification of food raw materials of animal origin Visnyk of Lviv University of Trade and Economics, Technical Sciences. *Food technologies*. 2023. No. 35. P.43-48
6. Tolchynskyi O.V. The origin and consequences of nitrate intoxication for humans and animals. *Science zap Ternopil national ped. university Ser. Biol*. 2013, No. 2 (55). P. 122-125.
7. Hitska O.A. Risk-based food safety system: analysis of international and national legislation. *Collection of scientific works of the Kharkiv State Zooveterinary Academy. Problems of animal engineering and veterinary medicine. Veterinary sciences*. Kharkiv. Vol. 35. Part 2, Volume 3. 2018. P. 102–106