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TECHNOLOGICAL EXPERTISE, QUALITY AND SAFETY MANAGEMENT SYSTEMS OF FOOD PRODUCTS. VALIDATION OF THE TECHNOLOGICAL PROCESSES CONTROL MEASURES

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Abstract. *Technological expertise of food production is an extremely important competence for the production process. Technological expertise of food production has many points of contact with quality and safety management systems. In order to regulate the quality and safety of food products at the legislation level, it is indispensable for companies to implement quality and safety management systems that are harmonized with international standards. To implement the legal requirements, manufacturers must adhere to good hygiene and good manufacturing practices for the implementation of prerequisites for production, as well as the principles of the HACCP system. in practice, manufacturers are faced many problems that require a deep understanding, a scientific approach. One of the steps in the implementation of the HACCP system is a detailed description of the technological scheme of production and modes of technological processes. Validation of control measures is used to establish the correct technological regimes, because otherwise a hazard may arise, which will further affect the quality and safety of products. The paper provides recommendations for the selection of methods for validation of control measures of significant hazards in the production of milk and canned (fruits and vegetables) products as a necessary element of technological expertise and quality and safety management systems. It was provide a brief description of the such food groups as milk products and canned products (fruit and vegetable) from the technological expertise view of point. For both of these groups hazards have been identified in the technologies and significant hazards were detected. The validation methods of significant hazards control measures in the production of a specific group of food products were analyzed, that can improve deeper understanding of processes and, therefore, risk reduction in problem prevention and process management.*

Key words: technological expertise, quality and safety management systems, food products, hazards, critical points, control measures, validation, water holding capacity, acid number of fat and peroxide number of fat

ТЕХНОЛОГІЧНА ЕКСПЕРТИЗА, СИСТЕМИ МЕНЕДЖМЕНТУ ЯКОСТІ Й БЕЗПЕЧНОСТІ ХАРЧОВОЇ ПРОДУКЦІЇ. ВАЛІДАЦІЯ ЗАХОДІВ КЕРУВАННЯ ТЕХНОЛОГІЧНИХ ПРОЦЕСІВ

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Анотація. *Технологічна експертиза виробництва харчової продукції – надважлива компетенція для виробничого процесу, яка має багато точок дотику з системами менеджменту якості та безпечності. Для урегулювання питань якості та безпечності харчової продукції на законодавчому рівні, обов'язковим для підприємств є запровадження систем менеджменту, які гармонізовано із міжнарод-*

ними стандартами. Для реалізації законодавчих вимог, виробники повинні дотримуватись норм належної гігієнічної та виробничої практики для впровадження програм передумов на виробництві, а також принципів системи НАССР. На практиці виробники стикаються з безліччю проблем, які потребують глибокого розуміння, наукового підходу. Одним із кроків впровадження системи НАССР є детальний опис технологічної схеми виробництва та режимів технологічних процесів. Для встановлення коректних технологічних режимів застосовують валідацію заходів керування, адже в протилежному випадку можливим є виникнення небезпечного чинника, що у подальшому впливатиме на якість та безпечність продукції. У роботі надано рекомендації щодо підбору методів валідації заходів керування суттєвими небезпечними чинниками при виробництві молочної та консервованої (фрукти та овочі) продукції як необхідного елемента технологічної експертизи та систем менеджменту якості та безпечності. Надано коротку характеристику кожної групи харчової продукції; ідентифіковано небезпечні чинники та виявлено загальні суттєві небезпечні чинники, проаналізовано методи валідації заходів керування суттєвими небезпечними чинниками при виробництві конкретної групи харчової продукції.

Ключові слова: технологічна експертиза, системи управління якістю та безпечністю, харчова продукція, небезпечні чинники, критичні точки, заходи керування, валідація.

Introduction. Problem formulation. Technological expertise of food production is an extremely important competence for the production process. In a broad sense, technological expertise of food production investigates the issues of processing of raw materials, semi-finished products and products, technological modes of converting them into finished products, compliance with technological standards for quantitative and qualitative composition, raw materials and additional materials used, and the nature and sequence technological processes, methods of their implementation, selection of the necessary equipment, devices, models, working tools, placement of equipment within individual shops, etc. [1–2].

Technological expertise of food production has many points of contact with quality and safety management systems, so these concepts, in our opinion, should be considered in tandem.

Professional technological expertise in food production allows to produce consistently high quality, safe and competitive products, make informed decisions in the development of technological regimes, minimize material costs for equipment, energy and raw material losses, production of substandard products, etc. But in order to regulate the quality and safety of food products at the legislation level, it is indispensable for companies to implement quality and safety management systems that are harmonized with international standards, European legislation, the provisions of the Codex Alimentarius [3–6].

The most recognized today are the international quality management systems of the ISO 9000 and the safety management systems of the ISO 22000, BRC, IFS, FSSC 22000, Global GAP, SQF, which implement the principles of HACCP. The structure of the requirements of international standards is an interconnected set of rules, systematically structured processes for the purposeful prevention of risks of danger at certain stages or in food industries. Standards have the same purposes, so their requirements are similar and have a certain level of identity. The main differences between the standards are the modification of approaches to the implementation of the principles of HACCP, the interpretation of basic concepts and definitions, detailing the requirements [7–17].

In Ukraine, the basic food legislation is represented by the following standards [18–22]:

– Law of Ukraine № 771 “On basic principles and requirements for food safety and quality”;

– Law of Ukraine № 2042 “On state control over compliance with legislation on food, feed, by-products of animal origin, animal health and welfare”;

– Order of the Ministry of Agrarian Policy and Food of Ukraine № 590 “On approval of the Requirements for the development, implementation and application of permanent procedures based on the principles of the Food Safety Management System (HACCP)”;

– Law of Ukraine № 2639 “On information for consumers about food products”.

To implement the legal requirements, manufacturers must adhere to good hygiene (GHP) and good manufacturing practices (GMP) for the implementation of prerequisites for production, as well as the principles of the HACCP system. Today, there are a sufficient number of foreign and domestic methodical instructions, handbooks that explain the details, features of quality management systems and food safety, recommendations for their implementation. But in practice, manufacturers are faced many problems that require a deep understanding, a scientific approach. One of the steps in the implementation of the HACCP system is a detailed description of the technological scheme of production and modes of technological processes. Validation of control measures is used to establish the correct technological regimes, because otherwise a hazard may arise, which will further affect the quality and safety of products [3; 4].

Validation is an evidence obtaining that a control measure (or combination of control measures) will be able to effectively manage a significant dangerous factor of food product (ISO 22000: 2018) [16; 21]. Effective

validation requires the use of a risk management approach, a full understanding of production processes and increasing their resilience, through the introduction of new technologies. Thus, validation is a dynamic process.
From the point of view of food developers and manufacturers, validation can provide the following benefits:
– deeper understanding of processes and, therefore, risk reduction in problem prevention and process management;
– reduction of the cost of eliminating non-compliance;
– reducing the risk of non-compliance with regulatory requirements.
The following approaches can be used to validate management measures:
– use of references to scientific or technical literature;
– for preliminary studies of the validation process or historical data on the application of the management measure;
– reliable examples from the practice of other organizations;
– scientifically substantiated experimental data;
– data collection under certain conditions of operations in the entire food production chain;
– mathematical modeling;
– data reconciliation;
– survey research.

The purpose of the work is to systematize the methods of validation of control measures to manage significant hazard in the production of certain groups of food products as a necessary element of technological expertise and quality and safety management systems.

Tasks of work:
– provide a brief description of the food group;
– identify hazards in the technology of a specific group and identify significant hazards;
– analyze the methods of validation of measures to manage significant hazards in the production of a specific group of food products.

Milk products. Milk is an unique natural product that is used directly for food, as well as a raw material for processing. Milk products include cream, sour milk products, ice cream, canned milk, cow butter and cheese.

Since milk is the main raw material for the production of drinking milk and processed products, its quality and safety will determine the levels of these indicators for the final product.

Milk that enters the dairy plant must meet the requirements of State Ukrainian standart DSTU 3662-2018 “Whole cow’s milk. Procurement requirements”. The standard regulates the physical, chemical and biological characteristics related to safety: milk purity groups, content of dangerous substances (toxic elements), antibiotics and hormones, radionuclides, etc., general bacterial contamination. The methods of delivery, packaging, labeling, as well as the conditions and terms of storage of milk from the producer must meet the requirements of the standard.

Before processing, milk must undergo several operations: determination of qualitative and quantitative characteristics, cooling, purification, normalization, homogenization, pasteurization and cooling to the required temperature.

The first principle of the HACCP system [3; 21] provides for the compilation of a list of potentially hazards, their analysis and review of control (precautionary) measures.

At the stage of preparation of milk for further technological processing there are the following hazards:
1. physical (foreign objects, animal wool, mineral impurities);
2. chemical (presence of excessive amounts of mercury, arsenic, lead, cadmium, zinc, copper, mycotoxins, pesticides, antibiotics and hormones, nitrates, radionuclides)
3. biological (presence of pathogenic microorganisms: *Salmonella spp., S. aureus, E. coli, Campylobacter spp., Yersinia spp., Streptococcus spp.,*
L. monocytogenes, etc.) [23].

Physical and chemical dangerous factors at the stage of raw material acceptance can be fully controlled using the current procedures of the General Principles of Food Hygiene *Codex Alimentarius*, Good Manufacturing Practice (GMP) and Good Hygienic Practice (GHP) [2–4].

Control measures for physical and chemical dangerous factors are control of sources of supply: establishment of technical conditions for raw materials and ingredients and certification of suppliers, which is a confirmation of the absence of dangerous biological, physical and chemical factors or their permissible values in products;

For physical hazards control it is necessary the constant technological control (eg use of magnets, metal detectors, sieves) and environmental control, ie ensuring that good manufacturing practices are followed and that the food product is not exposed to any physical contamination from buildings, production equipment or work surfaces.

For the control of chemical hazards the technological control of recipes, proper use and control of food additives and levels of their contentare are also used. It is nassesary to follow the rules:proper isolation of non-food chemicals during storage and handling; control of accidental contamination from chemicals (for example, lubricants, chemicals for water and steam treatment, paints); labeling control, ie certifying that the final product has the correct label in terms of the list of ingredients and known allergens [23].

Each batch of milk is subject to incoming control. The test is performed on organoleptic parameters, temperature, purity group, acidity, mass fraction of fat and protein. The freshness of milk is determined by the titrated acidity. Fresh milk has an index of 16–18 °T. The value of the titrated acidity can be used in the first approximation to assess the sanitary and hygienic condition of the animals from which the milk was obtained.

Bacterial contamination and the presence of inhibitory substances are checked at least once every 10 days. If the enterprise (small capacity) does not have a bacteriological laboratory, samples of raw materials are sent for analysis to a specialized accredited laboratory.

Milk with high bacterial contamination and the presence of harmful and pathogenic microflora is not suitable for the production of high quality dairy products, especially cheese [24.].

The most significant hazard in the production of drinking milk and dairy products is biological. Milk has an indicator of water activity in the range of 0.99–0.95, which determines the possibility of growth of all types of microorganisms, including pathogens [25].

Raw milk contains many groups of substances with antimicrobial activity that protect it from spoilage and pathogenic growth of bacteria: lactoperoxidase system, lactoferrin and other proteins. The period during which the bactericidal properties of milk (bactericidal phase) are detected depends on the time elapsed from milking to cooling, the cooling temperature and the initial number of microorganisms. To extend the bactericidal phase up to 24 hours, the milk should be cooled immediately after milking to 8 °C, and up to 48 hours milk should be cooled to 0 °C. When heated to 60 °C milk loses bactericidal properties [24].

Control measures to prevent biological hazards are supplier control over compliance with the HACCP program; proper control of cooling and storage time of milk to minimize the growth of microorganisms before processing operations; cleaning and disinfection, which can eliminate or reduce the levels of microbiological contamination; rules and regulations of personal and industrial hygiene that can reduce the levels of microbiological contamination.

The control point for controlling a biohazard is the stage of pasteurization or sterilization of milk to kill microorganisms. At the same time the duration and temperature of processing of raw materials are controlled.

Different approaches are used to validate control measures [3,4]. For milk products, there are large arrays of research data and practical experience on the development of microflora under different conditions. Therefore, the validation of control measures for biological hazards will include references to regulations, scientific and technical literature, scientifically validated experimental data and reliable examples from the practice of using pre-cooling, pasteurization and sterilization of milk and milk products.

It is known that the efficiency of pasteurization, or the degree of destruction of microorganisms, depends on the qualitative and quantitative composition of their raw materials. If there are many heat-resistant bacteria in milk, the efficiency of pasteurization decreases, and with the predominance of psychrophilic races – increases. The reason for the high content of heat-resistant lactic acid bacteria in milk is a violation of sanitary and hygienic rules during milking and cooling on farms, as well as during transportation. The effectiveness of pasteurization on bacteria contained in milk depends on its duration and temperature, type of pasteurizer.

In practice, the following pasteurization modes are used: *short-term* – heating to 72–76 °C with holding at this temperature in the current holder for 15–20 s; *long*, or *low-temperature* – heating to 63–65 °C with holding for 25–30 min; *instantaneous* – 85 °C and above without endurance. These modes of pasteurization provide a fairly complete destruction of the vegetative forms of bacteria in milk. In the dairy industry, two types of sterilization are used: long-term in containers at a temperature of 103–125 °C with a holding time of 15–20 min in devices of periodic, semi-periodic and continuous action; short-term in the flow at a temperature of 135–150 °C with a holding time of 2–4 s and aseptic bottling [24].

Tasks of processes validation of heat treatment of milk are confirmation of correctness of development of technological regulations and the established parameters of process, confirmation of possibility of the equipment to provide maintenance of necessary values of parameters. Execution of tasks is confirmed by laboratory researches of quality and safety indicators which should correspond to State Ukrainian standart values, absence of morbidity of consumers owing to consumption of dairy products, the analysis of results of checks of Derzhspozhyvstandart and complaints from the population on this type of production.

In the further processing of milk to obtain fermented milk products, cheeses, butter, etc. to prevent secondary contamination, measures are required to comply with sanitary and hygienic requirements and GMP and GHP, as well as appropriate conditions for packaging and storage of finished products.

Canned fruit and vegetable products. Vegetables, fruits, berries are an important source of vital and essential substances: digestible (sugars, starch) and indigestible carbohydrates (pectin substances, hemicelluloses, cellulose, which play the role of dietary fiber), vitamins, minerals, organic acids, polyphenols, antioxidants, phytoncides. Therefore, fruits and vegetables are an integral part of the daily human diet [26–27].

The most fruits and vegetables spoil quickly due to the presence of microorganisms and enzymes. It is possible to slow down or stop the vital activity of microorganisms and inactivate enzymes through the use of different canning methods which makes it possible to obtain fruits and vegetables with long-term storage of their nutritional and taste properties. Conservation methods based on the principle of suspended animation are effective. Among them the restraining the vital activity of microorganisms under the influence of physical or chemical factors (storage of food products at low temperatures or in a controlled gas atmosphere, adding preservatives or an increased concentration of soluble substances), cessation of their vital activity under the influence of high temperatures, electric current, ionizing radiation, ultrasound, adding substances with antimicrobial action, mechanical removal of microorganisms from the product (sterilizing filtration). Depending on the implementation methods, the methods of canning fruits and vegetables are divided into physical (heat treatment, ionizing radiation, cooling and freezing, drying), chemical (adding sugar until its concentration in the product reaches 60–65%, sorbic acid and sodium benzoate up to 0,1%, antibiotic substances, for example nisin), microbiological (lactic acid and alcoholic fermentation) and a combination in various variants of the previous canning methods. When canning fruits and vegetables, the organoleptic properties and nutritional value of the finished product change due to the transformation of raw materials, the formation of new compounds, used food components and additives. As a result of the use of various canning methods, a wide range of products is produced: canned vegetables and fruits and berries (sealed in an airtight container, sterilized, pasteurized, aseptically canned, prepared by a combination, microwave, radiation method, etc.), fermented (pickled, salted, pickled), dried and frozen fruits and vegetables. Most canned fruits and vegetables are sterilized (at a temperature of 110–120 °C), and pasteurized (at a temperature below 100 °C) are vegetable marinades, tomato sauce, fruit soups, etc. Aseptic canning involves short-term heat treatment of the product and its packaging in sterile containers under sterile conditions. This makes it possible to obtain high quality products and preserve the natural properties of raw materials [26–27].

According to the methods of preparation and purpose, vegetable and fruit canned food is divided into natural and pickled canned food, juices, drinks, puree, pastes, sauces, creams, condiment, semimanufactures, canned food for baby and diet food. Vegetables are also used to produce snacks and canned food, concentrated tomato products, and fruit and berries are used to produce compotes, syrups, extracts, fruit and berry confectionery, jellies, cocktails, fruits and berries that are mashed or crushed with sugar.

The formation of the quality and safety of canned fruits and vegetables is influenced by such factors: type and quality of the primary (basic) and additional materials and also supplements, their intended purpose (target use), method of canning, production technology, type and quality of the packaging, especially one. Dangerous chemicals, physical and biological factors in the composition of canned foods can cause (make) disease or injury.

Practical experience and literary sources show that hazards of biological origin in the processing (conversion) fruits and vegetables are mainly microorganisms that can be source cause food poisoning. *Bacilis subtilis* and *Staphilococcus* can grow in fruits and *Bacillus Aerobacter*, *Ervinia*, *Flavobacterium*, *Achromobacter*, *Cellulomonas*, *Chromobacterium*, *Streptococcus*, *Lactobacillus*, *Micrococcus*, *Pseudomonas*, *Micobacterium*, *Phytomonas*, *Sarcina*, *Staphilococcus*, *Serratia*, *Vibrio*, *Esherechia* can multiply in vegetables. Dangerous non-spore-forming bacteria *Salmonella*, *Listeria* and pathogenic strains *E. coli* can get to vegetable raw materials (crude) on stage of its cultivation through water and natural fertilizers. Non-safe microorganisms can enter the finished canned fruit and vegetable products at any stage of processing as a result of cross contamination, and their source can be workers, equipment, and packaging materials. The spore-forming bacterium *Clostridium botulinum* is especially dangerous for canning factories as it can produce a deadly toxin in an anaerobic environment. The vegetative forms and spores of C. botulinum are widespread in the environment (soil, water). Any materials can be contaminated by them. The spore-forming ability of C. botulinum allows it to survive in the harsh conditions of heat and chemical treatments [28–29].

The toxin of this bacterium can be inactivated at a temperature of 100 °C. Due to inadequate personal hygiene of the staff, products can be contaminated with viruses such as hepatitis A virus, rotavirus, parasitic protozoa and worms If heat treatment is disturbed, molds can develop in low acid foods as *Byssochlamys fulva*, *Talaromyces flavus*, *Neosartorya fischeri* etc. They are able to form spores and therefore can withstand heat treatment. Non-observance of heat treatment or violation of the tightness of the container can spoil canned food due to the presence of yeast. Yeast growth is accompanied by the formation of alcohol and a large amount of carbon dioxide, which leads to ballooning.. In general, yeast and molds are not biohazardous in finished products. The potential danger of molds and yeasts is that as a result of their vital activity they are able to utilize acids and thereby change the pH of the product environment. This can promote the development and reproduction of *C. botulinum*. However, some types of molds can produce toxic metabolic products (mycotoxins), which are classified as chemical hazards [26].

Chemical hazards of processed fruits and vegetables are represented by substances that can occur naturally (mycotoxins and toxins, allergens, cyanogenic glycosides, highly toxic alkaloids), on purpose (pesticides, nitrate fertilizers, plant growth regulators, food additives), not on purpose or by mistake (toxic elements and their mixtures, radionuclides, dioxins and dioxin-like compounds, polycyclic aromatic hydrocarbons, disinfectants and detergents, polychlorinated biphenyls, lubricants, glue, paint, prohibited substances) are incorporated into the product, as well as appear in it during the production process (furfural, hydroxymethylfurfural, nitrosamines). They can cause disease or damage due to immediate or long-term effects. Specially added chemicals do not pose a hazard if used in the recommended safe doses. Substances that enter the product accidentally do not pose a significant threat to human health, since their control at factories is carried out according to the supplier's guarantees for each batch of raw materials (their content must not exceed permissible levels), the use of permitted packaging materials and industrial chemicals. The formation of substances with carcinogenic properties in products (furfural, hydroxymethylfurfural and N-nitrosamines) is prevented by the modes of heat treatment and duration of storage. Patulin is the most widespread mold mycotoxin in fruit and vegetable raw materials but aflatoxin B1 can be found in canned cereals. Special attention is paid to the control of especially dangerous patulin. Its main producers are rot pathogens of the genus *Penicillium, Aspergillus* and *Byssochlamys. P. expansum* is the most important producer of patulin. Rotten, moldy, bruised or damaged apples are most often contaminated with patulin. It is found in high concentrations in fruit and vegetable juices (especially apple juice), compotes, purees and jams. *P. expansum* toxin causes poisoning, often fatal [29].

Hazardous factors of physical origin in canned food include any potentially dangerous foreign objects and materials that are naturally not in food, for example, glass, metal, wood fragments, small pebbles. Accidental consumption causes physical injury (cuts, bleeding, broken teeth) or suffocation [26–27].

Due to the control of agricultural technologies, traceability, implementation and effective functioning of the program, prerequisites, most hazards are not a threat to human health. Vegetative and protozoan pathogenic microorganisms (for example, *E. coli, Salmonella, C. botulinum, Cryptosporidium parvum*), mycotoxins (patulin), metal and glass fragments should be considered as significant hazards in the production of fruits and vegetables.

The plant raw material supplied for processing is microbiologically seeded. Pathogenic microorganisms have specific needs for life and growth. In the absence of the elements necessary for their life, moisture, temperature, air oxygen or its absence, they stop growing and reproduce, and in some cases they die off.

The most common causes of microbiological spoilage are canned food that has not undergone proper heat treatment at certain pH values of the product. The characteristic signs of the bombing caused by the bacteria *C. botulinum* are the formation of large amounts of gases in canned food. In this case, the tightness of the cans may be disturbed, the appearance of the product may change, and turbidity may appear. *C. Botulinum* toxins are destroyed by boiling for more than 10 minutes. The pH of the environment plays an important role in the life of *C. botulinum*. Its spores do not germinate or develop in foods with a pH of less than 4.8 (the Codex Alimentarius has chosen pH 4.6 as the boundary between acidic and low acid foods). The use of moderate temperatures ensures the destruction of all non-spore-forming bacteria or all vegetative cells in low-acid and acidic foods. In the production of low-acid canned food, it is necessary to apply high-temperature heating above 100 °C under pressure to destroy *C. botulinum* spores or spores of other spore-forming microorganisms. *C. botulinum* spores are not hazardous in acidic cans. Since only vegetative cells need to be destroyed in acidic foods, boiling or hot pouring is used for this. Controlling the content of microorganisms in processed fruits and vegetables is possible by the indicator of water activity (a_w), this water is available to microorganisms vital activity. A common method for determining this indicator is the use of electronic hydrometers with a touch sensor. Most food products have $a_w > 0.95$. Most bacteria, yeasts and molds grow in these conditions. *C. botulinum* spores are suppressed at $a_w \leq 0.93$, while $a_w = 0.85$ provides a wider safety margin. For example, the indicator a_w can be reduced by adding water-binding dry substances such as sugars (mass fraction 60–65%) or salt (mass fraction 7–10). The growth of some *C. botulinum* strains is inhibited at a salt concentration of 10% (equivalent to $a_w \sim 0.93$), and at a salt content of 7%, their growth is possible, but there is no data on the creation of toxins by them. The recipe must be developed in advance and very precisely followed during the production process of the product to ensure that the required a_w is achieved. $a_w = 0.93$ with the simultaneous application of pasteurization, when vegetative cells are destroyed, provide industrial *C. botulinum* sterility. The critical moment of control is the insertion of ingredients and the achievement of the required temperature in the thickness of the final product. Such products include syrups, jams and preserves, fruit and berry toppings, and so on. If the latter option is used to control industrial sterility, then it is necessary to record the received data and keep records. They will prove that this regime does indeed achieve industrial sterility. Determination of microbiological safety indicators by classical methods is a long process. An alternative to them can be convenient to use ready-made commercial test systems for the rapid determination of microorganisms (petrifilms with various chromogenic substrates for the determination of *E. coli*, *S. aureus*, molds and yeasts and a luminometer, whose operation is based on the principle of bioluminescence) [26].

Patulin control in plant raw materials (mainly apples) at the acceptance stage is carried out according to the supplier's guarantees for each batch (only apples harvested from trees are accepted). Patulin levels can increase during storage. Therefore, after the stage of storage of raw materials, it is necessary to reject damaged and battered apples or cut off rotten and moldy apples. The mass fraction of patulin is determined in the finished products of processing fruits and vegetables (mainly in juice products). The optimum temperature for patulin formation is in the range of 21–30 °C. The toxin is heat resistant and can be stored during technological processing. Patulin is quite stable in an acidic environment at pH = 3.5–5.5 even at elevated temperatures and labile in an alkaline environment. During industrial processing of vegetable raw materials, for example, apples, by vacuum concentration and short-term pasteurization (90 °C for 10 minutes), the concentration of patulin in the juice is reduced by only 18.4–18.8%. Its level decreases slightly during the storage of packed juice. The Codex Alimentarius Commission has approved apple products containing patulin residues up to 50 μg/kg. Various types of chromatography are used to detect, identify and quantify mycotoxin patulin: one- and two-dimensional thin layer chromatography for serial studies; high performance liquid chromatography with UV photometric and fluorimetric detection for serial and arbitration analyzes. Currently, the main means of monitoring this mycotoxin is liquid chromatography with mass spectroscopy. However, the future in the field of analysis of patulin, as well as mycotoxins in general, lies in more accurate and specific immunochemical methods, which are based on antigen-antibody interaction. Aflatoxin is determined by immunosensory analysis thanks to optical immune biosensors, which also make it possible to determine other low molecular weight compounds (heavy metals, pesticides, some toxins) [29].

Physical hazards and their source are easy to identify. For this, the product is passed through metal detectors to detect metal particles (metal debris can get into the product at the stage of grinding the raw materials and in case of damage to the filter), through X-ray equipment or another defect detection system to identify fragments of glass containers. A visual inspection of the equipment for broken or missing metal parts is also used. The production line is inspected for broken glass if the container is mechanically processed. Before packaging the product, the container is inspected to detect broken glass if the container is handled manually. The liquid product, which contains physical hazards, is directed to pass through filtering devices or is separated, passed through magnetic traps [26–27].

Conclusions:

1. It was provide a brief description of the such food groups as milk products and canned products (fruit and vegetable) from the technological expertise view of point.
2. For both of these groups hazards have been identified in the technologies and significant hazards were detected.
3. The validation methods of significant hazards control measures in the production of a specific group of food products were analyzed, that can improve deeper understanding of processes and, therefore, risk reduction in problem prevention and process management.

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