ASPECTS OF STANDARDIZATION AND COUNTERING FOOD TERRORISM IN THE CONDITIONS OF MARTIAL LAW

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https://doi.org/10.23939/istcmtm2023.01.054

Abstract. One of the important issues in the field of ensuring product safety at food industry enterprises is the prevention of bioterrorism. The emergence of bioterrorism is associated with the rapid development of genetic engineering and the emergence of the latest biotechnologies in the world, which contributes to a quick and easily accessible way of neutralizing the enemy. In connection with the full-scale invasion of the Russian Federation on the territory of Ukraine, the occupation and the holding of illegal referendums, and the use of all types and types of terrorism, market operators whose location is tangential to the occupied territories should strongly pay attention to food terrorism and carry out a biorisk assessment depending from the field of production.

Key words: Bioterrorism; Food terrorism; Food safety; Food safety management system; Integrated management system.

1. Introduction

Today, in Ukraine, there is a regulated requirement for the implementation of the HACCP system at facilities that manufacture, process, store, and transport food products to ensure that the food product does not pose any threat to the health of the consumer. Based on incidents, facts about food fraud, and facts of intentional contamination of food products with potentially dangerous agents, today, operating under martial law, the HACCP system at facilities seems to be insufficient.

Based on incidents in international history, and especially the facts of bioterrorism, international standards in the field of food safety, such as ISO 22000, Global Standard for Food Safety, International Food Standard, and Food Safety System Certification requires the implementation of certain series of measures to ensure and prevent acts of terrorism, sabotage and food fraud. However, the requirements are not specific enough. According to the international standard "Threat Assessment Critical Control Point" (TACCP), market operators can apply the risk assessment action algorithm.

Bioterrorism is a broad concept that involves the production, and agents of microbiological weapons in the context of military operations [1]. A narrower term is food bioterrorism, which consists of the protection of food in the process of production, transportation, preservation, and sale [9]. In the field of food such as viruses, genetically modified organisms (GMOs), pathogenic organisms, and toxins can be named, which are listed in Table 1 [2].

Table 1. Biological agents and diseases caused by them

Category	Biological agents	Disease
A	Poxvirus Variola major	smallpox
	Bacillus anthracis	Anthrax
	Yersinia pestis	Plague
	Clostridium botulinum	Botulism
	Francisella tularensis	Tularemia
	Filoviruses and arenaviruses (for example, Ebola and Lassa)	Viral hemorrhagic fevers
B	Coxiella burnetti	Coo fever
	Brucella spp.	Brucellosis
	Burkholderia mallei	Sap
	Burkholderia pseudomallei	Melioidosis
	Alphaviruses	Encephalomyelitis
	Rickettsia prowazekii	Typhus
	Toxins (e. g. ricin, staphylococcal enterotoxin B)	Toxic syndromes
	Chlamydia psittaci	Ornithosis, psittacosis
	Pathogens that threaten water safety (for example, Vibrio cholera, Cryptosporidium parvum, etc.)	Infections, the causative agents of which are transmitted by water
C	Pathogens that threaten food safety (for example, Salmonella spp., Escherichia coli O157:H7, etc.)	Food infections and toxic infections

History of the problem. Germany and France were the first countries to apply new knowledge about bacterial infections to explore the possibilities of using specific biological agents as weapons. Scientists from these countries made the greatest contribution to the development of microbiology as a science at the end of the 19th century [3, 4]. In 1899, the Hague Declaration [5] (Annex, Part II, Chapter 1, Article 23), officially

banned the use of poison and poison weapons. Until the 20th century, chemical, biological and toxic weapons were combined into the category of poisonous weapons. Thus, this treaty made biological warfare illegal. It is assumed that the General Staff of the German Army interpreted the Hague Convention as a ban on the use of biological weapons against people, but not against animals [6]. Research work was conducted on viruses, rickettsiae, or toxic agents. Thus, in the USA, in 1984, followers of the Rajneesh cult intentionally contaminated food with Salmonella typhimurium bacteria at public catering enterprises [7].

Currently considering the sustainable development of biotechnology and the war efforts of the Russian Federation, it is necessary to implement all preventive measures to ensure the complete safety of food products in Ukraine, as stated in the decision of the National Security and Defense Council of Ukraine [8]. During martial law, we do not track the recorded developments and the mechanisms of the mentioned strategy. However, with the wider dynamics of implementation of various management systems at food facilities, market operators can provide the requirements of the TACCP standard. The most likely challenges to TACCP implementation are a) malicious contamination of a food product; b) sabotage in the supply chain; c) use of food products and beverages for terrorist purposes; d) espionage; e) forgery.

2. Disadvantages

Due to the lack of legal requirements for ensuring biosecurity and implementing preventive measures in the field of bioterrorism at food facilities, market operators in the field of canned meat production can apply only the requirements of international standards to ensure food safety.

3. Goal

Since the international standards in force in Ukraine during the martial law do not ensure complete food safety at production facilities, and in the field of Ukrainian legislation there are no requirements for the protection of products from intentional contamination by potentially dangerous agents, the studies of technological chains concerning quite dangerous meat products represent a scientific-applied interest, and their implementation can ensure a high level of food security.

4. Action plan to ensure safety in food production during martial law

4.1. The sequence of creating a plan to combat food terrorism at existing facilities

Each market operator must create a crisis team for the enterprise, which undertakes to include: the head of the supply department (which is directly related to the purchase of raw materials), a production technologist, and a quality director. The roles and responsibilities of the product risk assessment team must be clearly defined with the involvement of senior management. The creation of a plan to combat food terrorism for any enterprise has to consider the special indicators of each system and simply display its structure (Fig. 1).

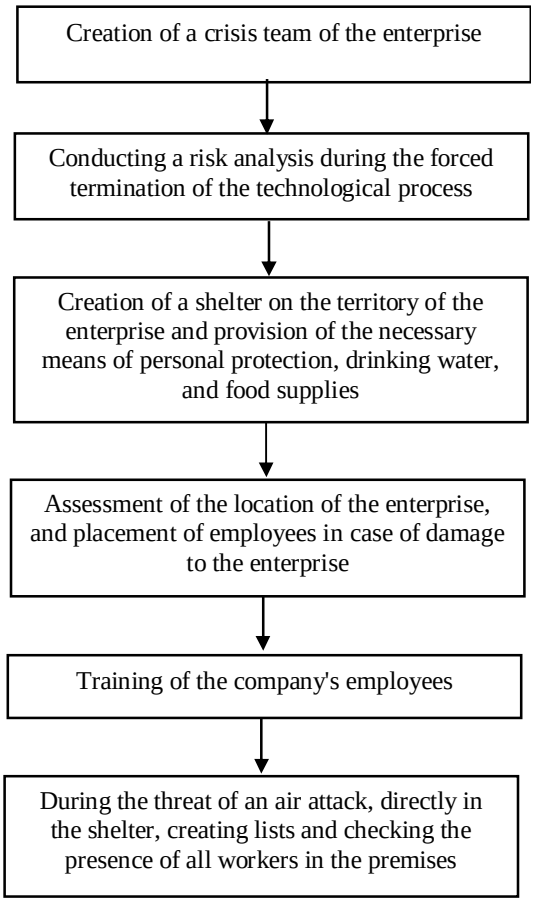

Fig. 1. Algorithm for the prevention of food terrorism in the conditions of martial law

Developing a product fraud prevention plan involves several steps, namely:

– identification of a potential threat using known and reliable data sources;

– assessment of the level of risk: both the product and the source of supply, by conducting an assessment of the vulnerability of the product to the possibility of fraud;

– analysis of the need for additional control measures;

– use of assessment results to develop a product fraud prevention plan;

– implementation of control and monitoring measures defined in the plan to combat product fraud.

An effective product counterterrorism plan should identify the measures and control means that are needed

to mitigate the risks identified during the product's vulnerability assessment to fraud. The developed Food Terrorism Countermeasures Plan is the most important document because it reflects the results of the supplier's anti-food fraud strategy. Current measures are recommended to be evaluated according to the control effectiveness rating scale by members of the crisis team. Example: high means a good level of control measures related to food terrorism; average corresponds to an average level of measures related to terrorism; low is the low level.

Control measures should include: Verification of the economic (financial stability) and legal status of the supplier; certificates of analysis, issued by accredited/nonaccredited laboratories (Certificate relating to a specific batch with a product code); quality control of products before delivery including the trial sample of products as well as availability of accompanying documents; consideration of suppliers which includes the questionnaire and evaluation of the supplier (the more reliable and detailed the questionnaire, the lower the risk); compliance with legal requirements by supply chain suppliers that is reviewing the legal compliance (presence and number of legal disputes); enhanced control of unauthorized access by third parties to the territory of the enterprise; placement and round-the-clock control of video cameras for the purpose of third parties or actions of employees that may lead to the threat of contamination by dangerous factors of products; control of the security service at the entrance to enterprises, in addition to keeping records: visual examination of persons for the presence of viral infectious diseases, temperature measurement, state of alcohol or drug intoxication, control of identity documents, inspection of personal belongings for the presence of foreign objects, vials, etc.; while controlling the entry of vehicles into the territory of the enterprise, checking for the presence of such objects as canisters, sprayers; Increasing the frequency of product traceability tests; development of a product recall and withdrawal system and periodic testing for prompt response; when hiring potential employees, checking for the presence of administrative fines, their origin and evaluation of activities.

Depending on the results of the analysis, the crisis team makes the following decisions: a) stopping or reducing the use of raw materials, ingredients, and packaging of food products; b) terminating the cooperation with the supplier(s); c) reducing the number of raw materials, ingredients, packaging or food products from a specific supplier(s); d) modification of current product and control measures, for example, increased analytical monitoring, use of accredited laboratories and methods, enhanced internal inspection, pre-shipment inspection.

4.2. Algorithm of actions of the enterprise's crisis team when the fact of contamination of products with a dangerous agent at the facilities is detected

One of the most important points is the prompt convening of a food terrorism team. Communication should be fast and efficient, which is why it is necessary to carry out a communication test with a certain frequency, evaluate the response of team members, and apply certain adjustments and corrective actions. In case of detection of contamination of products at facilities, it is necessary (Fig. 2).

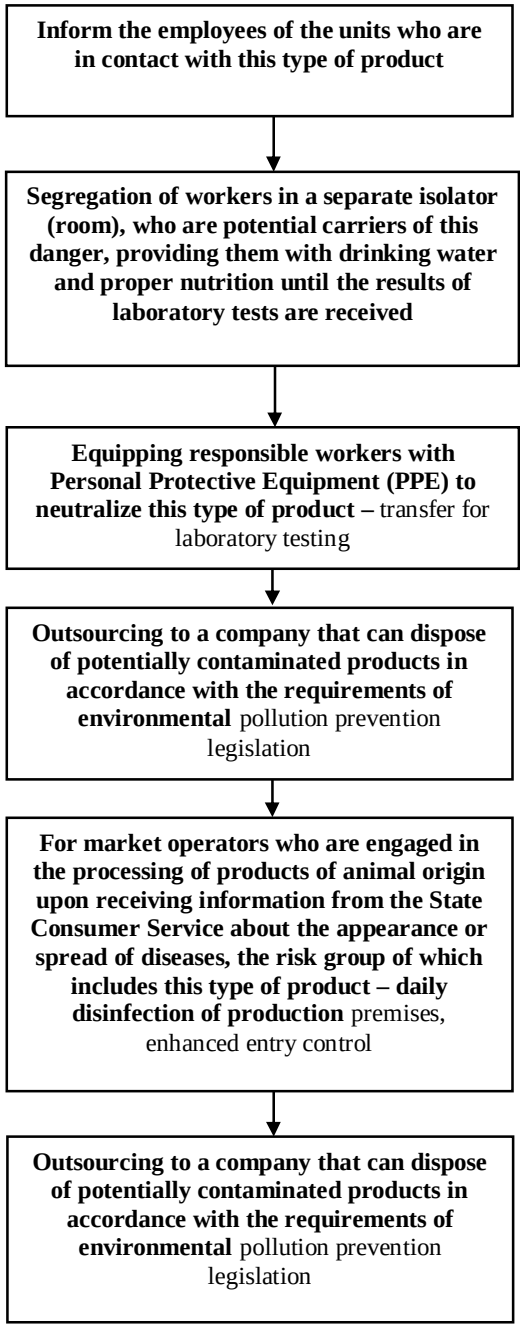

Fig. 2. Algorithm of actions when a dangerous agent is detected directly at production facilities

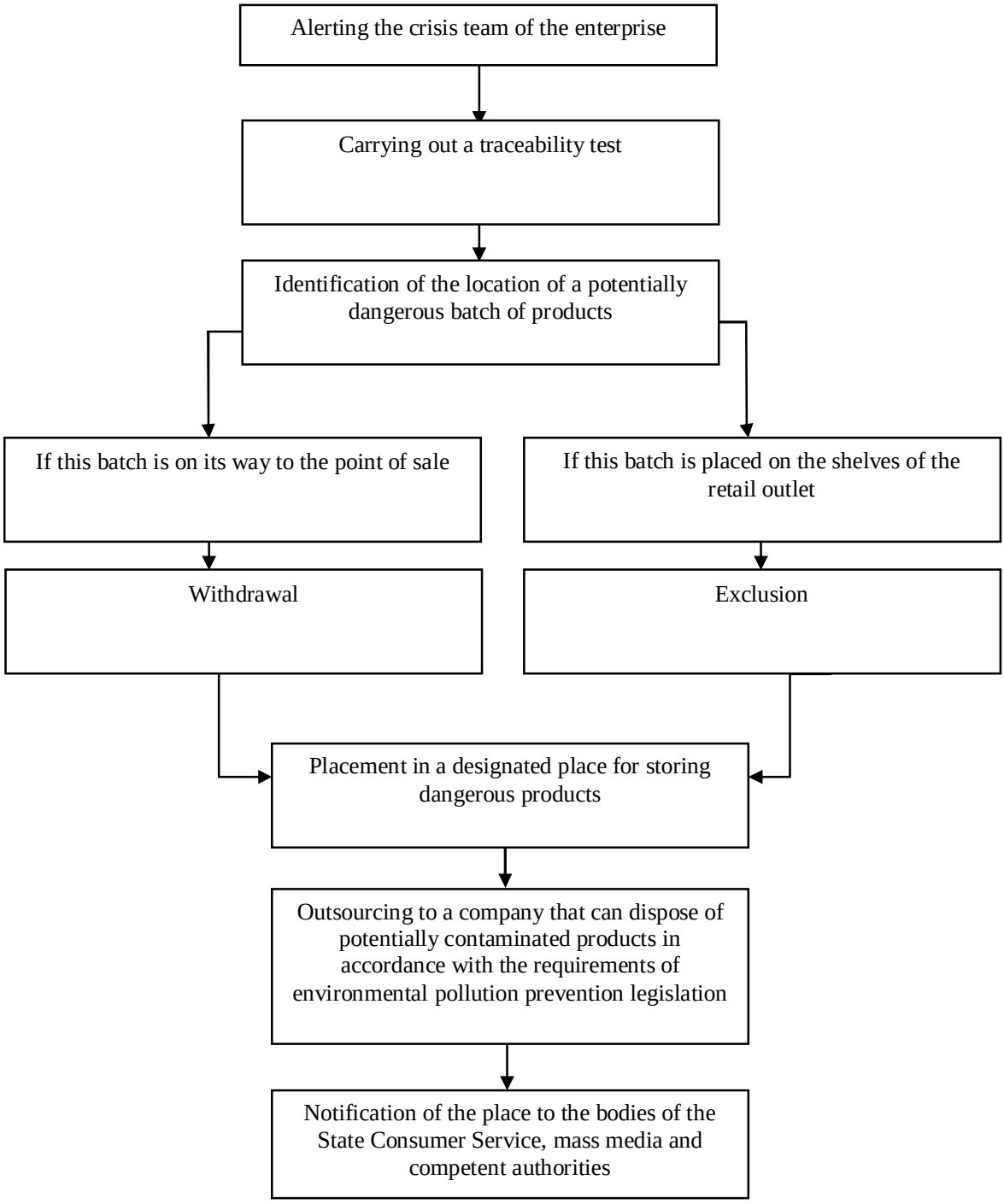

Fig. 3. Algorithm of actions upon detection of a shipped batch of dangerous products

In the case of receiving information from local health authorities about the spread of viral and infectious diseases, the risk group of which are people, it is necessary to implement time corridors for lunches, changes to minimize the contact of employees, establish control of body temperature measurement before the start of the work shift, change the schedules of corporate transportation of employees, provide employees of the enterprise with means of personal protection.

4.3. Algorithm of actions of the crisis team upon detection of the fact of shipment of products contaminated with a dangerous agent to retail outlets

According to the established requirements under Regulation (EC) No. 178/2002 [10] on the implementation of the traceability system at production facilities, this system must be used in hypothetical situations to

detect the fact of contamination of a product that is already on the way or the counter to the consumer. The person responsible for traceability at the enterprise must conduct a traceability test as soon as possible and trace the supply chain of a potentially dangerous product, including the addresses of partner stores. Actions of the company's crisis team upon detection of the fact of shipment of a dangerous product are shown in Fig. 3.

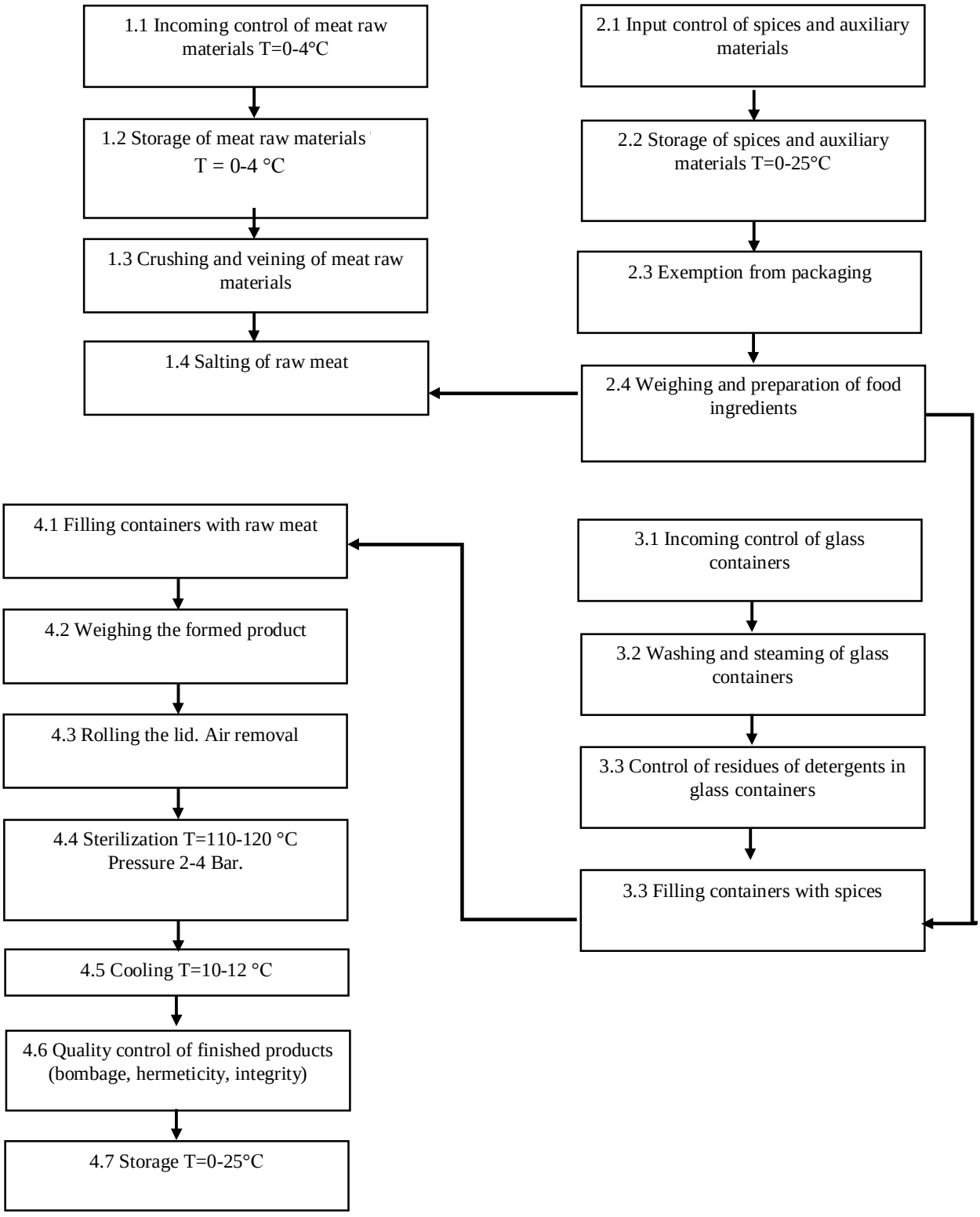

Fig. 4. Stages of the technology for the production of canned meat

4.4. Assessing dangerous factors of the technological process of canned meat production

In connection with the introduction of martial law on the territory of Ukraine, the preparation of products for the armed forces of Ukraine becomes an important task; here canned meat is the most common food product. The advantage of this product is long-term storage and minimization of manufacturing processes. Due to the great demand and the critical need for the production of canned meat, private manufacturers of meat products have implemented the technology for their production. However, due to the lack of legal requirements in the field of bioterrorism prevention, not all market operators are acquainted with specifics and knowledge about the probable food threat to the consumer.

One of the important stages of the technology for the production of canned meat is the sterilization of the formed product (Fig. 4). Clostridium botulinum bacteria secrete the toxin that causes botulism as part of their natural anaerobic process, meaning they multiply in an oxygen-free environment in a sealed jar. Failure to comply with the requirements described in the analysis of the dangerous risks of manufacturing canned meat (Table 2) could affect the occurrence of bombaxes. The latter means that the spores were not killed, and bacteria could multiply in a sealed container and produce a toxin.

Botulism is a serious and rare disease caused by toxins produced mainly by the bacterium Clostridium botulinum, as well as strains of the bacteria Clostridium baratii and Clostridium butyricum. Foodborne botulism is the most common cause of this disease, from mild to severe symptoms, depending on the amount of toxin exposure. Difficulty swallowing, headache, abdominal pain, respiratory failure, and possible death can occur if the disease is not treated. According to the international classification of dangerous agents, Clostridium botulinum belongs to category A, which is a significant threat to the health of the consumer. Deliberate use and supply of meat products with a bombage defect is considered a fact of bioterrorism, which can have a critical impact on the health of soldiers and civilians during hostilities. Improper disposal of canned meat, which is probably infected with botulism, can cause pollution of the environment, groundwater, and soil.

Table 2. Analysis of dangerous factors of manufacturing canned meat

No.	The stage of the technological process	Risk (microbiological, physical, chemical)	Management measure
1	Incoming control of meat raw materials	Microbiological (pathogenic microorganisms; bacteria of the Escherichia coli group; mesophilic aerobic and facultatively anaerobic microorganisms)	Confirmation from suppliers that the product meets the specified requirements (declaration, laboratory test report)
2	Storage of meat raw materials	Microbiological (Growth of Bacteria of the Escherichia coli group, pathogenic microorganisms)	Monitoring and provision of appropriate temperature regimes in cooling chambers
3	Incoming control of glass containers	Physical (glass)	Integrity control of incoming batches
4	Sterilization of cans	Microbiological (development of microorganisms: C. botulinum; C.perfringens; spore-forming microorganisms)	Setting the sterilization temperature control
5	Refrigeration	Microbiological (development of pathogenic microorganisms)	Control of the cooling temperature regime
6	Quality control of finished products	Microbiological (C. botulinum, C. perfringens, spore-forming microorganisms, thermophilic spore aerobic microorganisms (Bac. stearothermophilus, Bac. Aerothermophilus, Bac. panis viscosus, facultatively aerobic thermophilic microorganisms from the genus Bacillus)	Organoleptic control for packaging, tightness, and integrity of canned meat

5. Conclusions

1. General principles of biosecurity and prevention of food terrorism have not been developed and established in Ukraine. However, in connection with the spread of trends in the implementation and certification of international food safety systems at production facilities, the market operator must act in advance, taking appropriate measures, and contribute to the provision of a product that does not pose a health threat to the participants of the manufacturing process and the consumer. Adhering to the requirements of the Ukrainian legislation regarding the introduction of the traceability system at facilities, and implementing the requirements of international standards, market operators need to develop a plan to counter food terrorism proposed in the article.

The latter enables food industry enterprises to supply commodity markets with high-quality and safe products.

2. Due to the implementation of food safety procedures, outbreaks of botulism during the canning of meat products are eliminated. The technology for canned meat production is subject to increased risks, especially in wartime when energy resources are limited. At the same time, Ukrainian market operators are not always able to monitor and adequately assess food safety, which creates potential threats.

3. Algorithms for risk estimation and a plan to combat food terrorism are proposed for enterprises in the industry, where the process of sterilization, cooling, detection of bombage and sulfite spoilage (while assessing risks during the manufacture of canned meat), as well as the disposal of an inappropriate product, were previously subject to assessment and monitoring.

6. Gratitude

The authors express their gratitude to the staff of the Department of Information-Measuring Technologies of Lviv National Polytechnic University for valuable feedback and discussions.

7. Conflict of interest

The authors declare that there is no financial or other potential conflict related to this work.

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