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REALIZATION OF FOOD DEFENSE AND FOOD SECURITY STANDARDS IN POLISH MARITIME TRANSPORT

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ABSTRACT

This article touches on the issue of Food Defense and Food Security in Polish maritime transport. It seems indispensable to refer to the food defense as any action that the company must take to prevent the intentional contamination of food products by biological, chemical, physical or radiological factors which cannot be expected based on hazard analysis and which may arise in connection with human activities as a source of contamination (FDA). Temperature-controlled food transport is one of the most critical elements in today's supply chain, which is reflected in an increase in the demand for fresh and frozen products. In the case of sea transport, this will require temperature control in refrigerated containers. The effect of research on the impact of the stream of descending air and its free passage on the duration of storage of natural food products, which are presented in the article, are guidelines contained in military procedures.

Keywords: sea transport, logistics, food safety.

1. INTRODUCTION

The subject matter of the article made the authors choose specific information content. Therefore, the problems of transport safety in the food sector are presented in the effect of the analysis of Polish and foreign literature. Theoretical context of the discussed issue of the phenomenon of food defense, food safety, food transport in controlled temperature and humidity HEADING, Polish and international legal regulations is to show the practical application of the conducted research on the influence of the stream of descending air and its free flow on the period of storage of natural food products. The question was: Are the standards of food protection and food safety, as defined by the law, maintained in Polish maritime transport? The answer to this question also included naval transport carried out by the Polish Armed Forces. It is an undoubted added value in the discussion on food protection and food safety since there are no references to this form of sea transport in the subject literature. The statement to be verified through the analysis of documents, literature, legal acts, and research reports was that the standards of food defense and food safety in the Polish maritime transport are maintained.

The changes taking place in the modern world allow us to observe economic phenomena permeating across national borders, which means international integration of commodity, capital, and labor markets, and thus determines the economic dimension of globalization. Transport is a factor of great importance in this respect. There is no doubt that the development of transport technologies influences the reduction of transport costs, which therefore favors the expansion of geographical borders of markets, including the regional (semi-global) and global level.

Transport is a sector of the economy that contributes to competitiveness, social development and world integration. It is also an essential component of civilian and military logistics systems. Transport conditions space-time to be overcome by carrying out tasks related to the movement of parts, materials and finished products in supply, production, and distribution subsystems. The world population has doubled over the last 50 years. That increased the demand for all kinds of goods, which means an almost seven-time rise in the value of goods produced in the world. Some of them are intangible services transmitted using communication, while the others are goods sold at the place of production. The remaining ones are vast quantities of products that need to be transported to a recipient.

International maritime transport that serves most of the world trade in goods, both in terms of quantity and value, plays a crucial role in this process. It determines the effectiveness of global trade, ensuring the efficacy of liberalized commodity markets as well as the efficiency and flexibility of global supply chains and networks. It is, therefore, becoming one of the main pillars supporting and consolidating the processes of globalization and development of the global economy. The analyses conducted indicate that since 1970 maritime trade has been growing on average by 3.2%, and the pace of growth was ahead of the dynamics of global GDP growth and industrial production of OECD countries, but it was lower than the dynamics of global trade

growth - in the years 2000-2011 it amounted to 8.9% on average annually. If the current high growth rate of maritime trade on a worldwide scale is maintained, it means that in 2020 the volume of goods transported by sea will increase by 36-40%, reaching 12.0-12.5 billion tons, and in 2031 it will be doubled in relation to its 2010 level. As a result, the share of maritime transport in total world trade in tons may increase in 2020 to as much as 85% (in 2006 it was 75%), at the expense of reducing the share of land transport (rail, road, and pipeline) from the current 24% to 14.6%, while the share of air transport in world trade services increased from the current 0.3% to 0.4%. Grzelakowski (2012)

Poland is also one of the elements of the world's maritime transport. The conducted research on processes taking place in the period 2000-2010 indicates that it is not possible to accelerate the economic growth and development of foreign trade without effective and efficient transport. Therefore, Poland needs to create a coherent and efficient transport system, integrated with the European and global networks. The prepared Transport Development Strategy until 2020 (with perspective until 2030) sets out the most important directions of activities and their coordination to achieve the strategic objective. It should be stated that on the territory of Poland there are four sea ports of fundamental importance for the national economy, which at the same time are international sea ports belonging to the trans-European transport network - i.e. Gdańsk, Gdynia, Szczecin and Świnoujście - and 57 smaller ports and harbors, 18 of which are sea border crossings). Among the most important regional ones, the ports of Gdynia, Szczecin, and Świnoujście should be mentioned: Police, Kołobrzeg, Darłowo, and Elbląg. The Polish fleet of seagoing merchant vessels increased in the years 2003-2010: by 4.3% in terms of the number of ships and by 24.6% in terms of carrying capacity. In the whole period, most of those ships (83%-90%) were operated under foreign flags. The average age for seagoing vessels in 2010 was 16.8 years, while under 10-year-old ships accounted for 34.4%, aged 11-20 years - 37.8%, and aged over 20 years - 27.8% of tonnage). Foreign trade is progressively based on containerized transportation of goods. In 2010, the Polish maritime fleet lacked in suitable ships for their transport (traditional bulk carriers dominated 83% of them). Maritime transport was not a key area of interest of the Armed Forces of the Republic of Poland since they were focused on the implementation of activities related to the defense of the territory of the state. The international community, including key allies, expected Poland to take an active part in foreign missions. The creation of Polish Military Contingents was connected to the necessity of supplying troops abroad, thereby generating an urgent need to have the required technical capabilities in the form of refrigerated containers and access to sea transport.

2. FOOD DEFENSE VS. FOOD SAFETY

When addressing the issues of food defense and food safety in maritime transport, it is necessary to point out that defending food is not the same as food safety. The term 'food defense' appeared in the United States of America after the attack on the World Trade Center and concerned the protection of food against terrorist exposure, i.e., deliberate pollution. Food defense focuses on the protection of food resources from deliberate contamination by various chemical, biological or other harmful substances by people who want to harm a facility or population. Product contaminants may contain compounds that are not naturally present in food or are not tested for use in contact with food. The aim of an attacker may be to harm a food producer, destroy a country's economy or kill people - so in the US, those who are proven to have deliberately contaminated food are charged with terrorism and tried like terrorists. Intentional actions are not usually rational and are non-foreseeable.Food safety refers to the accidental contamination of food products during their storage or processing with biological, chemical and physical agents. Those unintentional contaminants are possible to foresee. They are typical of raw materials, types of technological processes, and kinds of packaging used. Anusz and Didkowska and Blanka Orłowska (2017). Regardless of the definition categories, both deliberate and inadvertent contamination of food is of vital importance for the development of a system that is preventive, i.e. that contamination can be predicted and action can be taken to minimize or limit the occurrence.

One of the systems of fundamental importance is the Hazard Analysis and Critical Control Point (HACCP) system. It was established in the 1960s as the result of NASA's cooperation with Pillsbury and US Army laboratories. It was developed to ensure food safety for the upcoming space expeditions and was subsequently used as a standard in the food industry. HACCP became the most revolutionary innovation in food safety in the 20th century. Nowadays, the obligatory HACCP system is a fundamental element of protection of human health against threats that may occur in food. This system considers all foreseeable hazards (microbiological, physical or chemical) that appear under the production conditions or in the food itself and that may occur inadvertently in the final product. However, HACCP hazard analysis does not include the intentional introduction of an agent that may be harmful to health or life into food. It is therefore also necessary to analyze the risks in the context of food defense.

IFS is a specific standard recognized and developed for all food manufacturers, mainly for retail chains and their brands. The main objective of this system is to verify the safety and quality of the product and its compliance with applicable laws and standards. IFS unifies requirements and introduces transparency in the supply chain, from raw material to final product. BRC is a Global Standard for Storage and Distribution. The standard has been developed to ensure the highest quality of delivered products internationally. The main bene-

fits of introducing BRC include reduction of the number of improper quality products, control of both the supplier and the customer, reduction of the number of audits conducted by customers, and unification of food safety requirements: documentation confirming the durability of the expected quality product.
Food Safety and Food Defense programs are independent of each other, but may have some common procedures, e.g., SOP (Standard Operating Procedure), a HACCP plan, or other ones for crisis response.

In Poland, several years ago, companies selling their products in the United States had to take certain actions in this area. The turning point was the publication of the sixth edition of the IFS Food Standard at the beginning of 2012.

3. POLAND IN THE FOOD DEFENSE AND FOOD SAFETY SYSTEM

Food and packaging, like any other product, should meet the needs of producers, logisticians and consumers by fulfilling certain characteristics: physical (e.g. dimensions, weight facilitating transport and storage), chemical (e.g. the composition of raw materials and their impact on the body, environment), technological (e.g. ease of manufacture and storage), organoleptic (e.g. pleasant to touch, taste, and smell), functional (e.g. easy to open, prepare for consumption, utilization, and convenient to track), economical (price, cost of preparation, utilization, transport), aesthetic (e.g. color, shapes), safe (e.g. harmfulness, healthiness, ease of monitoring the product quality, protection against thieves or destruction). Despite the awareness that all entities involved in the supply chain should have in this respect. The above is not always the case. Unfortunately, Poland is an example of that:

1. It was near Kalisz (Poland) that irregularities and negligence in the production of dried eggs were detected in two companies there. For many years, the produced powdered eggs were questionable in terms of their quality and impurities they contained (among others, heavy metals and bacteria from the Coli group). Irregularities were found only in 2012, while the dried eggs had been produced since 2008. About 26 tons of egg powder intended for sale to over 100 producers of pâtés, sweets, and pasta in Poland was secured. There was also an international issue concerning the powdered eggs. The trope leads to the Czech Republic and the Netherlands. It turns out that one of the entrepreneurs suspected in this case bought goods from a resident of the Łódzkie Voivodeship, who in turn imported dried egg mixtures from abroad.
2. In 2012, illicit trade in food grade salt was detected in Poland. The so-called 'road salt', which in its appearance resembles edible salt, was introduced on the food market instead of the latter. The chemical composition of the salt can be hazardous for human health since it can contain potassium or potassium nitrate, which can affect the heart rate and even lead to cardiac arrest. It is a technological waste in the manufacture of calcium chloride, which is suitable for road maintenance. The road salt was used instead of food grade salt in 646 confectioneries, restaurants, bakeries, including bakeries in Tesco and Auchan hypermarkets Szymonik (2017).
3. In 2011, 20 tons of chicken breast packaging imported from Poland by Slovakia turned out to be contaminated with salmonella. As the then Minister of Agriculture stated, 'Poultry meat with a taste of salmonella' went to several hundred supermarkets in the country. A few years earlier, a dispute arose over Polish vegetables and potatoes, which, according to Slovaks, did not meet the quality standards. On 23 January 2013, the Slovak Ministry of Agriculture applied to the European Commission for an analysis of the mechanisms of control of Polish agricultural and food products supplied to the EU market. The direct cause of the European Commission's intervention was the case of contaminated milk powder from the regional dairy cooperative 'Rokitnianka' in Szczekociny used to produce sweets in the company 'Magnolia'.

Poland takes active part in shaping the system of both food defense and food safety. That is reflected in the provisions of one of the most important documents, i.e., the National Security Strategy of the Republic of Poland. In the individual chapters we read:

- *Chapter I 'Poland as a subject of security*' – '... the above arrangement of interests gives rise to corresponding strategic objectives in the field of security: ensuring food safety'
- *Chapter III*, '*Concept of strategic actions. Operational strategy'*, point 104 *Strengthening food safety*: 'It is necessary to implement the agricultural policy which will increase the resistance of agricultural production to unfavorable phenomena and maintain control over food economy divisions important for the state security and guarantee an appropriate level of food self-sufficiency'
- *Chapter IV 'Concept of strategic preparations. Preparation strategy'*, point 4.5 *Economic subsystems* and further in point 149 *Food safety*: 'In order to properly protect the health and interests of consumers of agri-food products, it is vital to strengthen food control so that state actions ensure uniform and efficient supervision of its production and distribution'.

Ensuring food safety is related to the implementation of food safety management systems such as the Good Hygiene Practice (GHP), Good Manufacturing Practice (GMP) and the HACCP system. It is a

requirement of the law specified, among others, in the Act on Health and Safety at Work:

- Act of 25 August 2006 on Food and Nutrition Safety;
- Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures regarding that issue;
- Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs

In the light of the latter regulation, all food operators, regardless of the size and profile of their activity, are obliged to have the HACCP system implemented and functioning as of 1 January 2006:

- IFS (International Food Standard) - an international food safety standard developed in 2002 by the German retail trade. In 2012, an updated version of 'IFS Food Version 6' was published and came into force on 1 July 2012;
- BRC is an international standard (Global Standard) developed by the British Retail Consortium and required by a growing group of hyper- and supermarkets across Europe.

In January 2015, Version 7 of the Standard was published and it has been effective from 1 July 2015. The implementation of provisions contained in normative and legal acts and other standards and norms would not be possible without:

- a warning system for notifying of any direct or indirect threat to human health deriving from food or feed;
- risk assessment (means a scientifically supported process consisting of four stages: hazard identification and characterization, risk assessment and characterization) and their management;
- management of a crisis caused by hazards, which is defined as a biological, chemical or physical agent in or on food or feed, or a condition of food or feed likely to cause adverse health effects. Szymonik (2017).

The first Polish Food Act was issued on 22 March 1928. It was a Presidential Decree with the force of law (Journal of Laws No. 36, item 343), regulating the provisions governing: 'the manufacture, sale and other introduction into circulation of food products, their raw materials and those everyday items whose use, in accordance with their intended purpose, may prove harmful to human health'. This Regulation, as amended later, was in force until 1971. On 2 November 1970, the Act on Health Conditions of Food and Nutrition (Journal of Laws No. 29, item 245) was passed and amended on 6 November 1992 (Journal of Laws No. 91, item 456 of 1992). The act governed 'the production conditions of foodstuffs and tobacco products and the marketing of those products to the extent necessary to protect the health of the population...'. It also regulated, to the extent necessary for the protection of the health of the population, the requirements concerning devices, apparatus, equipment, tools, packaging, and other materials which are brought into contact with foodstuffs and substances in production or trade. The Polish legal act obligating enterprises to implement the HACCP system is currently the Act of 11 May 2001 'on health conditions of food and nutrition'. Under the current law, large and medium-sized companies involved in the production and marketing of food, that is, not only production plants but also wholesalers, shops and restaurants, shall implement the HACCP system.

One should not lose sight of the importance of the international standards in the field of food safety and food defense adopted by Poland for the national law. The Directive 89/397/EEC of 14 June 1989 on the official control of foodstuffs is one of the significant horizontal directives concerning the supervision of food health quality. The document recommends the protection of citizens' health in all EU member states and introduces official control over food additives, vitamins, minerals, trace elements, and food contact materials. It was repealed by Regulation (EC) No 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law as well as animal health and animal welfare rules.

Subsequent acts include Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official acts performed to ensure the application of feed and food law, rules governing animal health and welfare as well as plant health and plant protection products, amending existing regulations on official controls and amending Regulations (EC) No 999/2001, (EC) No 396/2005, (EC) No 1069/2009, (EC) No 1107/2009, (EU) No 1151/2012, (EU) No 652/2014, (EU) 2016/429 and (EU) 2016/2031 of the European Parliament and of the Council, Council Regulations (EC) No 1/2005 and (EC) No 1099/2009 and Council Directives 98/58/EC, 1999/74/EC, 2007/43/EC, 2008/119/EC and 2008/120/EC, and repealing Regulations (EC) No 854/2004 and (EC) No 882/2004 of the European Parliament and of the Council, Council Directives 89/608/EEC, 89/662/EEC, 90/425/EEC, 91/496/EEC, 96/23/EC, 96/93/EC and 97/78/EC and Council Decision 92/438/EEC (Official Control Regulation).

In Poland, as part of the adaptation to the requirements of the European Union, Directive 93/43/EEC has been transposed into Polish law. The afore-mentioned Act of 11 May 2001 on Health Conditions of Food and Nutrition [Journal of Laws of 2001, No. 63, item 634, as amended], the wording of reference No. 1 entered into force on 17 October 2005 (Journal of Laws of 2005, No. 178, item 1480)] defines the concepts of Good Hygiene Practice and Good Manufacturing Practice (Article 3, points 33 and 34). The Act on Health Conditions of Food and Nutrition stipulated the obligation to implement the HACCP system in establishments conducting business activity within the scope of food production

and trade. Article 3(1) (12) of the Act defines the HACCP system itself, whereas Articles 28 – 32 specify the obligation to apply it and the principles of the system.

The Act provided for the issuance of an executive regulation defining detailed hygienic requirements for the production and distribution of food. The version of the Regulation of the Minister of Health of 26 April 2004 on hygiene and sanitary requirements in establishments manufacturing or marketing food (Journal of Laws of 2004 No. 104, item 1096) replaced the Regulation of 19 December 2002 (Journal of Laws of 2002, No. 234, item 1979). It was repealed by the Act of 25 August 2006 on Food and Nutrition Safety [Journal of Laws of 2006 No. 171, item 1225 (i.e. Journal of Laws of 2018, item 1541, 1669, 2136, 2227, 2242, 2244, 2 245)]

Article 1.1. The Act specifies the requirements and procedures necessary to ensure food safety in accordance with the provisions of Regulation 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (OJ L 31 of 01 February 2002, p. 1; OJ EU Official Journal Polish Special Edition, Chapter 15, Volume 6, p. 463), hereinafter referred to as 'Regulation No 1788/2000'.

The adopted legal regulations mentioned above apply to maritime transport. Regardless of them, the provisions specific to this form of transportation shall apply. These include but are not limited to:

- Commission Regulation (EU) No 579/2014 of 28 May 2014 granting a derogation from certain provisions of Annex II to Regulation (EC) No 852/2004 of the European Parliament and of the Council regarding the transport of liquid oils and fats by sea;
- Commission Regulation (EU) 2016/238 of 19 February 2016 amending the Annex to Commission Regulation (EU) No 579/2014 granting a derogation from certain provisions of Annex II to Regulation (EC) No 852/2004 of the European Parliament and of the Council regarding the maritime transport of liquid oils and fats;
- Regulation of the Minister of Health of 23 February 2017 on specific hygienic requirements for the transport of bulk raw sugar by sea (Journal of Laws, item 451);
- Commission Regulation (EU) No 16/2011 of 10 January 2011 laying down implementing measures for the Rapid alert system for food and feed.

4. SELECTED FOOD SAFETY STANDARDS IN MARITIME TRANSPORT

A well-functioning food chain offers, among other things, high-quality foodstuffs at affordable prices while ensuring safety as well as traceability of food products to consumers Fajczak-Kowalska.and Motowidlam (2010) In line with the ISO 28000 standard, which is believed to be widely applicable to food products, the security of the supply chain in maritime transport will be seen from the perspective of its resistance to intentional and unauthorized action aimed at causing damage or destruction. The specific nature of competition in the market for maritime transport services makes it particularly notable for its participants to gain a competitive advantage over their rivals. Therefore, competitiveness in free market conditions is a central issue, and appropriate formulation of a competitive strategy becomes essential for the survival and development of an organization. Kisiel (2005). The main consequence of such a character is the necessity of observing the activity of competitors and predicting their reaction to individual actions. Forlicz (1996).

Due to the number of such negative phenomena connected with cases of security threats concerning food products, various examples of such practices can be found in the field of maritime transport or customs procedures. The programs implemented in the United States deserve special attention from in the light of the experience acquired in international trade.

The Customs - Trade Partnership Against Terrorism (C–TPAT) is a voluntary program that developed procedures for importers, maritime carriers, maritime transport intermediaries, multimodal transport operators without their own vessels, American ports and sea terminals, as well as requirements for seals and sealing.

Another program is the Container Security Initiative (CSI) aimed at pre-shipment security checks of containers so that the US border is the last and not the first line of defense. The program has implemented cooperation with various ports where containers with a US port of destination are loaded.

This initiative includes the Szczecin port as the only one in Poland. The implementation of the CSI scheme for maritime transport, while not specifically aimed at benefiting operators, has had plenty of unintended positive effects on international trade, notably the development of operational systems, improved control over transport and other processes, as well as reduced losses due to theft.

When recognizing the importance of risk in logistic processes, which result from internal conditions and above all from external dependence on business partners or random events, organizations are beginning to look for a methodology that would enable them to limit its level. Żabiński (2000).

All over the world, as regards the broadly understood defense of organizations against threats of intent leading to destabilization of the position of organizations in maritime transport, it can be concluded that programs and proposals in the area of food defense developed by organizations and government agencies in the United States are particularly valuable. It stems from the fact the country is extremely experienced in this respect due to terrorist attacks, as well as the num-

ber of programs aimed at counteracting threats in the field of food hazards.

To sum up, it is noticeable that various food safety and security agendas in the United States and the European Union are doing a great deal to prepare producers, processors and transport links of food chains to defend food.

Threats related to the above should be sought in terrorist activity and in a wide area of gaining competitive advantage. From the point of view of an organization, a competitive advantage is its unique position in the sector in relation to its competitors, enabling it to achieve above-average profits and get ahead of the competition. Żabiński (2000).

The modern concept of creating a competitive advantage places particular emphasis on the need to use the acquired knowledge and resources skillfully. Competitiveness does not arise spontaneously and automatically in the effect of changes in the macro and microenvironment, nor is it the sole result of entrepreneurship, but is the result of the actions of many actors of social and economic development. Staszewska (2007).

Furthermore, profit in the form of financial resources or the ability to handle as many personnel losses as possible is the overriding factor here. Is increasing income the primary goal of an enterprise? Is the aim of our work to earn money? The answer 'yes' to these questions is often described as evident. In 2012, alcohols from the Czech Republic were secured and then withdrawn from the market in the whole of Europe because they contained methanol, which is dangerous for human health and life. It is evident that the reasons for food contamination can be purely material and profit-driven. The activities undertaken as part of the Food Defense Program are intended primarily to reduce the likelihood of a malicious attack and to assure the public that the organization is taking adequate action as regards food defense. When analyzing the security mentioned above programs, it can be seen that it leaves a lot of freedom for organizations to create appropriate conditions for them in favor of food security. Such a situation has both positive and negative aspects. It is good to see that no unilateral, ready-made solutions are imposed due to the diversity of processes taking place in maritime transport. Besides, the general approach prevents a too single-sided view of the problem, in the context of existing risks, which in turn may limit the creativity of workers in proposing remedies appropriate to a given shipowner. The generality of the formulations contained in these programs, the requirements of the market, the rush to implement food defense systems and plans, and short deadlines imposed may lead to a situation in which certain essential aspects are overlooked and may contribute to mistakes being made, the occurrence of which is undoubtedly prevented by requirements or guidelines.

5. FOOD TRANSPORTATION AT MONITORED TEMPERATURE AND HUMIDITY

Progressive globalization and internationalization of food trade and the multiple relationships and interdependencies between actors in the maritime transport chain make defending a food product in the food supply chain an extremely complex process. An example of this type of chain in a simplified form was presented by E.R. Choffnes, D.A. Relman, L.A. Olsen, R. Hutton and concerned the USA. The time-consuming transport of foodstuffs (fresh products such as fruit, vegetables, meat, fish, dairy products, juices, and crustaceans) by sea requires extensive and specialized knowledge due to the sensitivity of food to transport conditions. When exposed to too high or too low temperature, too high or too low humidity, they wilt, die or rot, thereby losing their quality conditions, making them unfit for consumption. It is therefore imperative that those responsible for this process can adjust the temperature, humidity, and transport time to the requirements of the individual foodstuffs. Bieńczak and Starkowski and Zwierzycki (2012).

At this point, special attention should be paid to the flow of information, which is essential and accompanies a transport process from the very beginning of the product to its destination. Szymański (2018).

According to the authors, not only is today's food chain increasingly complex but it is also becoming anonymous.

When referring to the concepts of food protection and safety in this area, attention should be paid to the relationship between the actors and their interest groups. That makes the risks associated with the transport of food products by sea more complex and unpredictable. The threats related to maritime transport are, on the one hand, very diverse, but, above all, the implications of their possible existence and impact could be severe. In terms of economic theory, the consequences that arise from the effects of threats accompanying and generated by transport (including maritime transport) can be divided into those whose effects influence the entity that caused them and those that affect other objects (the victims). If negative consequences occur and affect the aggrieved bodies, and at the same time are not compensated by the entity or entities generating (causing) them, they should be understood as classic negative externalities. Droździecki (2014).

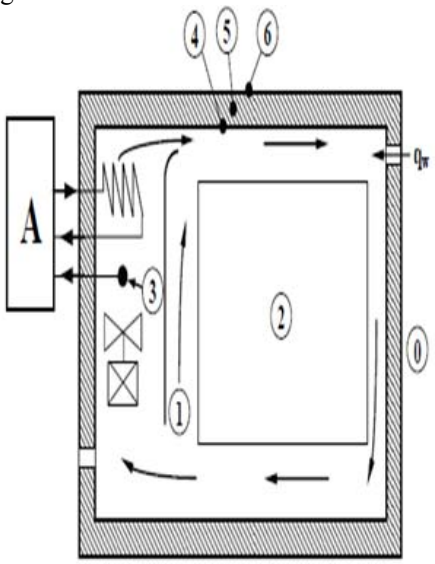
Temperature-controlled food transport is one of the crucial elements in today's supply chain, which is reflected in an increase in the demand for fresh and frozen products. In the case of sea transport, this will require temperature control in refrigerated containers.

It is during the transport service that food is exposed to damage resulting from the movement of goods - i.e., trans-shipment work, the transport itself, as well as climatic conditions. According to M. Jazdżewska - Gutta, international supply chains and maritime trans port are connected by many cooperation, production and transport links. For this reason, the consequences of unforeseen events in one place have adverse effects on other links. Jażdżewska–Gutta (2011).

Therefore, it is vital to carry out numerous activities carefully, starting from the principles of hygiene, through the selection of a proper container, adequate safeguards, uninterrupted operation of the unit in the appropriate temperature range, ending with the proper location of the container on the container vessel. That is why because it will affect the image of the manufacturer and supplier, as well as consumer confidence.

The range of own transport possibilities in the food sector was enriched when the decision was made to introduce a refrigerated container into the equipment of the Polish Armed Forces under the order No. 47 of the Head of the Inspectorate of Armed Forces Support. The tank underwent tests in the military center where the influence of the stream of descending air and its free flow on the period of storage of natural food products was investigated.

During refrigerated storage, considerable amounts of carbon dioxide are accumulated in the refrigeration chamber in the result of breathing food. The accumulation of carbon dioxide in the air, up to a content exceeding the oxygen content, causes enzymatic changes. Changing the direction of the breathing reaction causes the so-called intermolecular breathing, which is characterized by the release of carbon dioxide without absorbing oxygen from the air. Accumulating products of anaerobic respiration in the form of an acetaldehyde or ethyl alcohol leads to irreversible changes in taste and smell and loss of resistance of food products through its spoilage. That was the reason for the loss of foodstuffs



0 - external weather conditions
1 - internal air
2 - load
3 - temperature sensor inside the container
4 - internal container sheathing
5 - thermal insulation
6 - external container sheathing
A - cooling unit
q_w - heat flow exchanged due to ventilation.

Figure 1 Refrigerated container model

sent to soldiers stationed in Iraq, Bosnia, and Afghanistan on the occasion of the Polish Army Day. The model described in the paper "Refrigeration and Air Conditioning" was used in the research, and the container was divided into the following components – Figure 1 (Grajnert and Kwaśniewski 1998).

The tested 20-foot container with its power generator.

Figure 2: Refrigerated container with integrated refrigeration and power supply generator 2

The research shows that the proper capacity of a refrigerating unit is only possible if the cold air stream can move freely around the stored foodstuffs.

The arrangement of the load conditions the above. The smaller the ducts or the too narrow arrangement of the pallet units between the adjacent rows and walls of the container, the more air flow is reduced, which translates into an increase in temperature, by reducing the heat transfer intensity in the entire refrigeration space. The result of the investigations are guidelines contained in military procedures related to the distribution of food products in the refrigeration chamber and the proper selection of refrigerant recommended by the equipment providers in the form of, for example, R 134A. It is one of the varieties of purified freon with a purity level of 99.97%. As a cooling medium, it is characterized by better heat transferability than liquid nitrogen. In its gaseous state, it is heavier than air, non-flammable and non-explosive. What is more, it is economical in use as its vapors can be largely recovered and replenished. Concerning food products, proper selection of a refrigerant determines its chemical indifference to stored food products since it does not dissolve edible fats and has no influence on the change of taste and aroma of food products.

The conditions discussed above are confirmed by tests during the transport process and are subject to exceptional protection. Food is an extraordinary commodity because of its fundamental role as a source of energy and nutrients, having a direct impact on human health. A soldier is not only the final recipient of food, which he chooses and pays for but also the one who bears all the risk of health consequences associated with its consumption.

Intentional interference in this process will have an impact on the broadly understood safety and reliability of the logistics operator since it has been assumed that the cargo entrusted to it will arrive intact at their destination while preserving the highest safety standards. The safety of food products in the transport process with the controlled temperature kept and humidity is based on maintaining the suitability of food products for consumption. Most importantly, their use must not endanger human health and life.

Such assumptions initiated numerous legal regulations concerning the selection of the means of transportation, the most suitable mode of transport, the temperature of transport, loading, and unloading of food products requiring controlled temperature and humidity.

The main reasons for the organization's interest in increasing the safety of its food flow process include the necessity of strengthening the entrepreneur's position on the market and, most importantly, the need to protect the brand. It seems that the statement by T.T. Kaczmarek and G. Ćwiek is justified. They are convinced that apart from easy to measure direct financial losses resulting from a decrease in turnover, the necessity of incurring additional expenses related to restoration of technical equipment, or the payment of monetary penalties imposed on the company or logistics operator, there can be more challenging to measure losses related to the reputational risk of the organization. Ćwiek and Kaczmarek (2009).

Safety in the food supply chain with controlled temperature and humidity can be understood as a set of procedures to protect chain links from voluntary activities. Although it seems much less likely than theft or smuggling, it is much more acute in its effects due to its possible size or scope, and it will affect human life and health.

A producer who can supervise his supply chain and locate the location of his food products on an ongoing basis is a guarantee of safety of what arrives on our plates.

In conclusion, it should be stressed that the procedure will be effective only if it is possible to locate and withdraw food products that are likely to be contaminated. One of the ways how these measures can be effective and above all efficient is to apply standard solutions for the identification of marketed food products.

6. CONCLUSIONS

Household food expenditure in Poland is quite high compared to Western European countries and amounts to 16.9%, while it is worth noting that from year to year these quotas are decreasing (in 2017 they amounted to 17.2%, and in 2016 - 18%). In 2016, Poland was ranked 29th among 113 countries in the Global Food Security Index. The presence of food security systems (100 points) and food safety (99.7 points) was very highly rated, while Poland's position has been steadily growing in the GFSI ranking for several years. In 2018, Poland was promoted to 26th place (from 27 in 2017), with an overall result of 75.4 (in 2017 it was 74.2, and in 2016 - 74.1). Poland was particularly appreciated for its food standards, the presence of food security systems, farmers' access to financing, and food security. When it comes to the high level of food security systems in Poland, the legal obligation to implement the HACCP system, as well as numerous training actions and co-financing for implementation and certification costs, along with Poland's accession to the European Union, are indeed thought to play a significant role. Subsequently, new norms and standards, such as ISO 22000, BRC, and IFS, which indicated new opportunities for improvement of safety management systems in food production and trade, contributed significantly to the development of the systems in question. Moreover, it is believed that the standards functioning in agricultural production and in the feed industry, such as GLOBALG.A.P., QS, GMP+, which raise the quality and safety of raw materials and unprocessed products at the very beginning of the chain, are essential. The standards implemented in Polish maritime transport complement the food safety and defense chain. The article certainly does not exhaust all aspects related to the intentional contamination of food in maritime transport and does not cover all the issues connected with this phenomenon. The authors aimed to create a fundamental basis for further theoretical considerations and in-depth research in this field. Due to the broadly understood security threats in the context of the use of food for terrorist purposes, the subject matter raised is topical, developing and dynamic, and the suggestions put forward should be treated as pilot issues.

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