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QUALITY ASSURANCE MANAGEMENT BASED ON THE HACCP SYSTEM IN FOOD SERVICE ENTERPRISES

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Purpose: The aim of the article is to present the theoretical and practical aspects related to the essence and functioning of the HACCP system in selected catering companies.
Design/methodology/approach: The article uses the method of analyzing the content of the HACCP book of two companies. The thematic scope relates to the research question: does the HACCP system help in appropriate production management in catering companies?
Findings: The research shows that Food monitoring and proper storage temperature control are strictly adhered to thanks to the HACCP system. All the established activities and rules in the HACCP system greatly help in the proper management of production, mainly by preventing the occurrence of a hazard. The system HACCP controls the entire production process, so you can be sure that the finished product is safe.
Research limitations/implications: The limitations encountered by the author are mainly the reluctance of companies to present the functioning of HACCP in their area. It is difficult to get a company to provide HACCP documentation.
Practical implications: The practical implications of the article are the strengthening of the importance of HACCP in the surveyed companies. The owner will change the menu – there will be a note about the functioning of the HACCP system in the restaurant. Research has strengthened the company's marketing.
Originality/value: The article has value for owners of catering businesses. Originality consists in presenting the HACCP quality manual and discussing its records.

Keywords: HACCP, health safety, food quality, food safety.

Category of the paper: Case study.

1. Introduction

In production, food service companies should follow HAACP guidelines. Compliance with these guidelines will ensure the proper safety of food used in the production process. The aim of this article is to present theoretical and practical aspects associated with the

substance and operation of the HACCP system in selected food service companies. The subject of the study was restaurants that have been in operation on the market since 2015.

Materials and Methods

The analysis concerns the impact of the HACCP system on production quality management in food service enterprises. The aim of the study was to determine based on the conducted hazard analysis designated critical temperature points and the predicted hazards, including biological, chemical and physical hazards, aid in the proper management of production in restaurants. The article uses the method of analysis of the content of the HACCP records of enterprises. The method chosen made it possible to determine whether the HACCP system aids in the proper management of production in food service enterprises based on the example of selected companies. Using the induction method, conclusions resulting from the application of the HACCP system were formulated.

2. Food safety and its health quality

Both food safety and food quality are growing in importance as areas of interest for both practice and science. This is a consequence of the globalisation of economic processes, including the food chain (Kowalczyk, 2014).

Factors contributing to food safety problems include limited consumer awareness, lack of incentives to invest in food safety throughout the entire food supply chain (from the farmer to processors, food service providers and ultimately to the consumer) and weakness of the institutions responsible for enforcement of the law (Hoffmann, Moser, Saak, 2019).

Ensuring the health quality of a product now also means ensuring its safety, because the modern consumer is looking for food that, in addition to its nutritional building blocks and qualities of flavour, will have no pathogenic microorganisms, toxins, antibiotics, etc., and thus will not have a negative effect on their health. Bacterial poisoning is the most frequent cause of food poisoning in Poland (Górna, 2007). The health quality of products comprises all the traits by which a food is characterised in terms of its nutritional value, organoleptic quality, functional properties and its safety in terms of consumer health (Górna, 2008). The organoleptic qualities are things such as flavour, aroma, colour, texture and general appearance; nutritional value is the content of vitamins and trace elements; health safety refers to microbiological purity and the absence of chemical and physical impurities; functional properties are related to preparation (speed), product shelf life and type of packaging (Górna, 2007). Food safety is an important part of the human healthcare system. The main objectives of the food safety policy in the European Union are to provide consumers with safe, high-quality food and reliable, accurate and transparent product information (Pachołek et al., 2018).

Food quality is an important criterion for assessing the standard of living of citizens of a country. Contaminated food can be not only a means of causing fear among the population, but also an instrument for triggering an economic crisis, since food production and trade produce significant income in the world economy. In this latter context, it has been shown that the treatment of diseases caused by contaminated food generates high medical care costs, and health care systems of some less developed countries of the world may turn out to be inadequate in the event of a pandemic (Szwejkowska, Truszkowski, 2016).

3. The importance of the HACCP system

Good food practices can help protect consumers from food-borne diseases (Whited et al., 2019), and the demand for healthy and safe food has been growing in recent years (González-Gómez et al., 2014). HACCP is a key element in contemporary food safety management practices; therefore, the design, implementation, control and management of HACCP systems are crucial for the production of safe food products (Wallace et al., 2014). Implementation of the HACCP system in enterprises strengthens the food sector and prevents the transmission of diseases by food. The places where consumers are exposed to contact with contaminated food are e.g. restaurants and take-away establishments (Ababio, Lovatt, 2015).

The legal regulations regarding food make unambiguously clear that any operator who conducts business related to any stage of production, processing or distribution of and food distribution is an entity operating on the food market and is obliged to comply with the principles of the HACCP system (http://www.portalspozywczy.pl/). Every restaurant and catering company, in accordance with the law, must have an operational HACCP system in place.

Used on a mass scale to ensure food safety around the world, HACCP is a method based primarily on the elimination of potential hazards. This system is based on the prevention of food safety problems and is accepted by international authorities as the most effective way to control the transmission of disease through food (Stanley et al., 2011).

Introduction of the HACCP system in an organisation is conducive to:

- greater care for standards of hygiene in an enterprise;
- greater engagement by facility management in issues of food safety;
- reduction or elimination of the costs of defects and negligence;
- increased awareness and knowledge among persons responsible for the safety of the food produced;
- integration of the HACCP system with other systems, e.g., ISO 9001;
- elimination of waste of time, materials, energy and other resources used to correct errors;

- reduction of the risk associated with the operation of the facility;
- increased profits;
- winning consumer confidence;
- greater chances in winning new markets;
- increased constructive competition between companies;
- shaping the market for qualified suppliers;
- restoring mutual trust between different market players (Wiśniewska, 2005).

The HACCP system also has a number of shortcomings. It:

- requires investment in organising and securing the work of the HACCP team;
- requires highly qualified staff in every department;
- requires additional staff training, which entails additional costs;
- may result in additional costs for the purchase of equipment, e.g. for monitoring;
- is organisational and bureaucratic in nature, as it requires professional management of the organisation and additional documentation.

These only seem to be disadvantages, however, as the costs incurred are reimbursed in the short term due to lower costs resulting from complaints, lower processing costs for non-compliant products and lower costs related to the disposal of defective products (J. Berdowski, F.J. Berdowski, 2006).

The HACCAP system is based on the seven basic principles set out in the Codex Alimentarius. These are:

1. Hazard analysis – identification and assessment of hazards and the risk of their occurrence, as well as determination of control measures and methods of counteracting them.
2. Establishment of Critical Control Points to eliminate or minimise the occurrence of hazards.
3. Establishment of requirements (parameters) for each critical control point which should be met and defining tolerance limits (critical limits).
4. Establishment and implementation of a monitoring system for critical control points.
5. Determination of corrective action if a critical control point does not comply with the requirements established.
6. Establishment of verification procedures to confirm that the system is effective and is in accordance with the plan.
7. Developing and maintaining HACCP system documentation concerning the stages of its introduction and determining the manner of data registration and storage and archiving of the system documentation (http://www.psseradziejow.pl/).

The HACCP methodology increases awareness among major manufacturers across the entire production chain. The HACCP system can be compared to flood banks and floodplains that are built to protect against flooding. If they are badly built, it is not visible to the naked eye, but the water will find its way through, nonetheless. It is therefore necessary to lay down stringent rules for the design of protective systems. If the structure is built properly, it will still wear over time, and so regular inspection and maintenance is necessary to preserve its functionality (Toropilová, Bystrický, 2015).

The HACCP team must be an interdisciplinary team, and if this is not possible, it must be given the opportunity to consult other specialists. The team should establish a special HACCP data sheet, which should include product data, factors that cause hazards, a list of preventive measures, the location of critical control points (CCPs), tolerances, as well as monitoring and corrective or upgrading measures at a given stage of the process. It is also assumed that corrective operations can be applied at any stage of production. The key issue, however, is to identify potential threats, which requires a detailed analysis of individual processes in terms of various threats (e.g. chemical, physical, microbiological, organisational and other) and which may have an effect at a given stage of the process. This analysis consists mainly in asking "What if the respective parameters of the process were changed at a given stage?". Hazard analysis is the key to the establishment of critical control points. It should be emphasised that critical control points refer only to a given process in a specific organisation and cannot be freely transferred to other processes (Kaczmarek, Wrześniewski, 2014).

4. Research results

The take-away establishments studied rely on serving mainly traditional Italian dishes. The menu is diversified by a few American dishes. The owners attach great importance to the quality of ingredients used in the preparation of dishes. To preserve the true Italian taste of the dishes, most of the ingredients are imported directly from Italy. The rest come from family farms known to the owners.

The production process consists of a series of structured and intentional actions that are carried out using semi-finished products and food raw materials to change their properties. In production processes, raw materials and semi-finished products are transformed into wholesome, consumable products. Most raw materials cannot be consumed without proper processing. This process is shown in Figure 1.

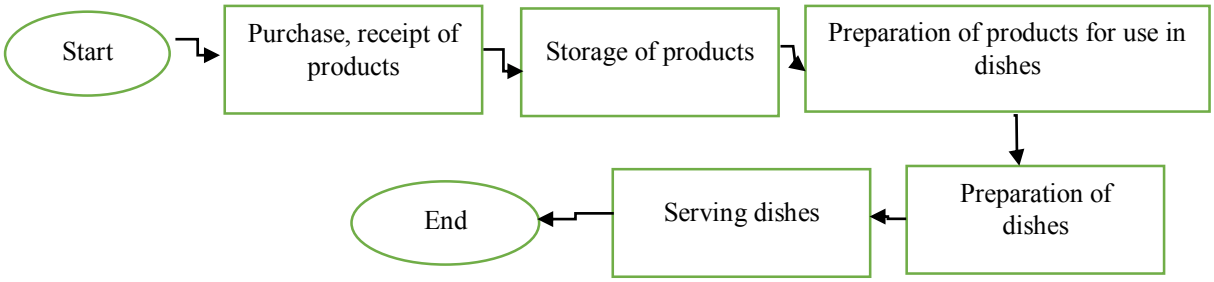

Figure 1. *General production diagram of the enterprise.* Source: own work.

Figure 1 shows a general process diagram for the surveyed enterprise. The process diagram was developed and is maintained by the team appointed to control the HACCP system. On the basis of the general diagram, additional diagrams for the processes for the production of meat dishes, salads, fish dishes, meatless dishes and desserts were constructed. These diagrams show the basic steps to be taken during the preparation of these dishes. Verification of the established schemes is carried out by a specially appointed HACCP team. It consists in a thorough review of the entire process in actual practice and a comparison with the process diagram. If, during verification, any discrepancies between the documentation and the practice are found, appropriate changes are made with the date the change was introduced. Verification takes place each time any changes are made to the diagrams. A record of these changes is also visible on the verification form.

At enterprise B, diagrams were drawn up for specific groups of dishes, such as soups, hot and cold dishes, meat and fish dishes. The workflow starts with the acceptance of the goods and their proper storage. All processing of raw materials is aimed at increasing the shelf-life of the food. All measures for the correct performance of the activity are marked on the process diagram. After the required treatment, the food can be served or refrigerated at the appropriate temperature. All storage temperatures are set by the HACCP team.

Use of the HACCP system makes it possible to minimise the hazards that may occur in food and may pose a threat to human health and even life. We may face the following threats:

- Microbiological (M) threats are caused by various types of fungi, bacteria, microorganisms, organisms similar to bacteria, viruses and protozoa. The source of these hazards may be directly human, due to inadequate food hygiene, or the animals or raw materials used in the preparation of food were contaminated.
- Physical (P) threats, broadly understood, are foreign substances and materials that are not naturally present in food and may cause physical damage to the body of the person consuming it.
- Chemical (C) agents are substances that cause chemical poisoning after being introduced into food and being consumed.

In enterprise A, the HACCP team has determined five steps at which each identified hazard can occur. All the stages and the risks identified in them are presented in Table 1.

The first stage presented is the acceptance of goods at restaurant A. At this stage, two types of hazards were identified that may infect food: physical and microbiological. All the steps to be taken when receiving goods are described in the GHP and GMP Register. The second stage is the storage of products. The hazards at this stage are that the quality of the food may deteriorate or spoil, as well as microbiological hazards. The causes of these hazards may be poor storage conditions or lack of monitoring of the goods. In order to prevent these hazards, the places in which the goods are stored should be properly monitored. The next step in which hazards are identified is when the products are prepared for use in dishes. Physical and microbiological hazards may occur at this stage. They are caused by poor protection against pests and improper performance of steps in the preparation of products. In order to avoid these hazards, it is necessary to follow the processes established by the HACCP team and which are found in the HACCP register. The fourth stage is the preparation of dishes. At this stage, only physical hazards have been identified. If in the previous stage monitoring of the products took place with appropriate attention and in accordance with the outlined process, the physical hazards were largely minimised. Dishes should be prepared following the recipes, and the manufacturer's instructions in the description of each product need to be followed. The last stage is the serving of food. At this stage, only one hazard has been identified, which is the possibility of infection of the food with pathogenic microorganisms. In order to prevent this, it is necessary to require that employees submit current sanitary and epidemiological test certification and to monitor their personal hygiene.

The production process in restaurant B begins with the initial preparation of dishes. During this stage, chemical hazards and microorganisms were identified. The causes of these hazards may be the use of inappropriate tools during operations and improper hygiene, both regarding the tools as well as the employee. Procedures to prevent such hazards from occurring in the workplace in this case should include appropriate instructions on hygiene for tools and workers, as well and purchase of appropriate tools by the owner that do not pose a hazard to the food during the production process.

Table 1.
Hazard sheet for enterprises A and B

Restaurant A						Restaurant B			
stage no. in the diagram	**stage of the process**	**hazard**		**measures to control the hazard**		**stage no. in the diagram**	**stage of the process**	**hazard**	
		type and character	**causes**	**procedures and instructions**	**preventive actions**			**type**	**causes**
1	2	3		4		1	2	3	4
1	Acceptance of goods at the restaurant	P M	Acceptance of products that do not comply with food safety	Guidelines regarding how to accept products - GHP and GMP Register	Checking received products carefully	1	Preparation of ingredients	M P	Improper hygienic conditions in the process (tools, work surface, etc.); Improper employee personal hygiene
2	Storage of products	Reduction of quality, spoilage, infestation by pests	Improper storage conditions for products, lack of control over storage conditions, improper condition of rooms and equipment	Storage and handling procedure for foodstuffs - GHP and GMP Register	Control of storage conditions	2	Heating food	C M P	Improper temperature and/or time of heat treatment, improper sanitary condition of food, etc.
3	Preparation of products for use in meals	P M	Poor protection against pests, improper performance of actions	Process control procedure and testing of ready meals - GHP and GMP Register	Due diligence during the preparation of products for production	3	Prepared food cooling down	P M	Improper temperature and/or time of the cooling process; failure to use the proper place to cool food and protect it from contamination
4	Preparing dishes	P	Meal contamination, improper temperature and time of heat treatment	Product description - recipes	Following the instructions in product descriptions	4	Storage of chilled food in a refrigerator	C P M	Improper storage conditions, lack of controls, improper means of washing and disinfecting refrigeration equipment, packaging damage
5	Serving dishes	Infection of meals with pathogenic micro-organisms	Inattention to hygiene by the employee	Employee personal hygiene procedure - GHP and GMP Register	Compliance with the rules of hygiene; monitoring	5	Heating of refrigerated food	P M	Improper heating temperature and/or time, improper personal hygiene of employee, improper hygienic conditions of the process
						6	Serving food	M	Improper disinfection of tableware; improper temperature of meals served

Source: Based on S. Machaj, Księga HACCP dla Restauracja A Wydanie 1 [HAACP Register for Restaurant A Edition 1], Kraków 2017, pp. 102-103, and own study based on Księga HACCP Restauracja B egzemplarz 1 [HAACP Register of Restaurant B copy 1], Kraków 2016, p. 23.

The next stage in the process is the heating of dishes; at this stage, all the hazards have been identified. In order to counteract the hazards at this stage, it is necessary to follow the recipes for the dishes and use only the appropriate tools. Cooling of ready meals is the third stage of the production process, during which microorganisms may multiply and foreign bodies may be present in the food. The causes of these hazards may be inappropriate cooling of food and its storage in unsuitable containers. Storage of food in refrigeration equipment is stage four. Actions at this stage may be performed only at specific temperatures, which are determined by the HACCP team. All set temperatures of the cooling equipment must be monitored on an ongoing basis. The fifth stage is the heating of refrigerated dishes. The success of this stage is determined by prior storage in appropriate conditions. All dishes should be heated at the appropriate temperatures given in the recipes. The last stage of the production process is the serving of dishes. Foods at this stage are threatened by microorganisms that may be present on containers or employees. The steps that need to be taken to counteract these risks are to maintain proper hygiene of serving containers and employee compliance with the rules of hygiene.

Preventive action for critical control points – Company A has identified four types of CCPs, which, successively, are:

1. CCP1 good accepted for storage,
2. CCP2 storage of raw ingredients in refrigerators and freezers,
3. CCP3 heat treatment of meat,
4. CCP4 cooling of meat.

Ad. 1. Acceptance of goods and corrective action for CCP1. Each delivery to restaurant A must comply with the parameters established by the HACCP team on the "Control Sheet". The person responsible for this is the chef, who accepts the deliveries. He is also obliged to check the hygiene of the driver and the delivery van. All goods received and accepted must have an expiry date. All products that do not meet the appropriate requirements are returned to the suppliers.

The proper temperatures for CCP1 are:

- dairy products in accordance with the manufacturer's instructions ±1°C,
- cured meats in accordance with the manufacturer's instructions ±1°C,
- prepared fish in accordance with the manufacturer's instructions ±1°C,
- meat not over 4°C,
- frozen goods not over –18°C,
- other goods under +20°C.

Ad. 2. The next type is CCP2, which defines temperature ranges for stored products/raw materials in refrigerators and freezers and corrective actions. These are shown in Table 2.

Table 2.
CCP2 temperature ranges in enterprise A

No.	Type of product	Critical limit	Temperature range	
			from	to
1.	Frozen goods	-18^0 C	- 23^0 C	-21^0 C
2.	Dairy	7^0 C	2^0 C	6^0 C
3.	Cured meats	5^0 C	2^0 C	4^0 C
4.	Meat /cold store/, Fish	5^0 C	2^0 C	4^0 C
5.	Meat /frozen/	-18^0 C	-22^0 C	-18^0 C
6.	Semi-prepared foods	5^0 C	2^0 C	4^0 C
7.	Salads	5^{0}C	2^0 C	4^0

Source: own work on the basis of Księga HACCP Restauracja A egzemplarz 1 1 [HAACP Register of Restaurant A copy 1], Kraków 2016, p. 40.

Fixed storage temperature ranges for raw materials and perishable products in freezers orefrigerators. The temperatures must be monitored twice a day by the responsible employee and recorded on the "Temperature Control Sheet". The times for inspection specified in the restaurant are 11.00 and 18.00. The temperatures must not exceed the critical point. In the event of any unit exceeding this, the thermostat is to be adjusted.

Ad. 3 CCP3 concerns the heat treatment of meat, with the aim of reducing microorganisms in meat to a level that does not endanger the health or life of consumers. To achieve this level, the meat must be heated to a temperature of 63-74°C in the centre of the product. Restaurant A uses the following types of heat treatment: grilling, cooking, stewing, frying and baking.

Minimum temperatures during heat treatment are foreseen, depending on the type of meat. Beef should be not less than 63°C for 2 minutes, poultry and pig meat not less than 74°C for 2 minutes, measured at the centre of the product. Temperature control is checked during each heat treatment using a needle thermometer or probe. The chef is responsible for this. The results of all checks must be entered in the "Temperature control sheet for meat during heat treatment".

Ad. 4. The last type of established temperature range is CCP4, which refers to the cooling of foods that have already undergone heat treatment and are not intended for immediate consumption. They must be chilled immediately. The specified temperatures for CCP4 are:

- 5-63°C – this is the range of dangerous temperatures for food, and they may not remain in this range for more than two hours;
- 10°C – the temperature to which a dish must be cooled within 90 minutes;
- 4°C – the temperature of the refrigerator in which the food is kept after chilling until it is served, for a maximum of 48 hours.

The person responsible for control of cooling temperatures is the chef. The observed temperatures are to be recorded in the "Cooling control sheet".

In enterprise B, an HACCP team was set up to identify two types of CCP, as shown in Table 2. In each CCP, the HACCP team set critical parameters and tolerances. Consequently, one CCP was established at the reception stage, where the appropriate parameters are recorded in the "Control sheet for the acceptance of goods in the restaurant" (CCP1), and another at the

storage stage, where the values are the parameters for storage products are recorded in the "Temperature monitoring sheet for refrigeration appliances" (CCP2).

The HACCP team used the following information to determine the critical temperature values using their own knowledge and experience and the information contained in the appropriate documentation.

Table 3.
CCP control sheet in enterprise B

Stage	CCP No.	Critical limits
Acceptance of goods at the restaurant	CCP1	temperature of accepted goods – from +2°C to +3°C, hygienic condition of the vehicle, personal hygiene of the delivery workers, condition of packaging, use by date, expiration date, quality certificate
Storage of products, in particular storage of goods in refrigerators and freezers	CCP2	temperature in refrigerators – max. +4°C; in freezers – min. -18°C

Source: own work based on S. Machaj, Księga HACCP dla Restauracja B Wydanie 1 [HACCP Register for Restaurant B Edition 1], Kraków 2017, p. 107.

CCP1 and CCP2 concern two stages, i.e. the acceptance of goods and raw materials and their storage. Storage of both takes place mainly in refrigerators and freezers.

At this stage, the HACCP team has set a critical temperature limit of 2-3°C, which applies to all incoming goods. Monitoring of goods is carried out at each delivery. This concerns not only the goods, but also the means of transport and the supplier through visual inspection. The person responsible for monitoring is the employee who accepts the delivery. All temperature controls are recorded in the "Control sheet for the acceptance of goods in the restaurant". In case of non-compliance with the set temperature, the goods are returned to the supplier, and every return is saved in the "Complaint sheet regarding goods".

The second stage is the storage of all goods. Storage temperatures are 4°C (refrigerator temperature), -18°C (freezer temperature). Monitoring at this stage is carried out by controlling temperatures in cooling devices by means of built-in thermostats and recording them in the "Sheet for monitoring temperature in cooling devices". The devices are controlled twice a day by a restaurant employee.

In case of non-compliance with the established guidelines, the thermostat should be corrected; if this does not improve the situation, the restaurant owner should be informed immediately.

Summary

Consumer awareness of food safety has increased significantly in recent years. In order to meet the rising expectations, the FSMS (Food Safety Management Systems) system should also

be introduced in food-related activities. FSMS (described in ISO 22000:2018) combines the elements of the HACCP system and Good Practices and can be applied by any company in the food chain.

Appropriate food safety in food-service enterprises is essential for proper operation. Mandatory in Poland, the HACCP system is a tool for this purpose. Its main assumption is the principle of zero defects; it does not allow for deviations from the established guidelines, which makes it highly effective. During the implementation of the system in an enterprise, strictly defined stages of operation must be observed. This system is quite accurate and identifies all sensitive locations in the production process where hazards may occur. Proper HACCP record keeping is quite time-consuming and can be daunting, but when all the rules are followed, one can be sure that the food is properly protected. Through identified hazards and remedial actions taken in case of their occurrence, they ensure that the food that reaches the consumer is neither contaminated nor pathogenic. Food monitoring and appropriate control of storage temperatures is strictly observed thanks to the system. All the established activities and rules in the HACCP system aid in the proper management of production, mainly by preventing the occurrence of hazards. Preventive actions are distinct from classic quality management, in which the finished products are randomly controlled. This system controls the entire production process, so one can be certain that the finished product is safe.

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