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Quality management and safety of food in HACCP system aspect

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Abstract

The practical implementation of hazard analysis and critical control point (HACCP) and in particular the definition of the critical control points (CCPs) in the food industry is usually a complex structured task. This is particularly the case of food enterprise, where quality/safety manager ability, knowledge of the production processes and “sensitiveness” is usually the discriminate for the proper identification and prioritization of risks. The same applies for the definition of causes which may lead to food safety hazards. This paper addresses the issues of how quality/safety managers can objectively and automatically implement the HACCP principles of hazard analysis in the application of HACCP, which is the identification of risk priorities and of the related CCPs. The proposed methodology combines decision tree analysis approach for the analytical decomposition of the relevant steps in the manufacturing process of ice cream.

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1. Introduction

The food industry in Poland and in the world is a widely developed branch of the economy, in which the quality of products is a very important element of competitiveness and the basic factor determining the degree of customer satisfaction. Mandatory quality management systems in Poland and other EU countries are: GHP Good Hygienic Practice, GMP Good Manufacturing Practice and HACCP Hazard Analysis and Critical Control Points System.

Food is an extremely a non-gradable adjective element for the survival of human beings. Everybody expects the food they eat to be clean, wholesome and safe for consumption (Pal et al., 2016; Sharma et al., 2019). The implementation of a food safety management system (Tsitsifli and Tsoukalas, 2019) is designed to monitor the entire production process, thus, contributing to the creation of a safe product for the consumer with appropriate standards with limited returns. The finished product must have an approved pathway through correct records and traceability at every stage of production, starting from the supplier of ingredients and ending with the customer.

It is intended as an introduction to HACCP, giving guidance on how to apply the principles in a stepwise fashion, and showing how HACCP links with prerequisite programs as well as safe product design, the other essential elements of food safety management systems (Wallace, 2014). HACCP has been and being mandated into law in many nations all over the world (Ziggers, 2000). Prerequisite programs such as Good Manufacturing Practices are an essential foundation for the success of a HACCP plan (NACMCF, 1997).

A major determinant for the utilization of HACCP as a food safety management tool has been the growing global concerns on food safety by various stakeholders like consumers, food processors, governments, and public health officials (Ramnauth et al., 2008; Azanza and Zamora-Luna, 2005; Panisselo and Quantick, 2001). This paper addresses the issues of how quality/safety managers can objectively and automatically implement the HACCP principles of hazard analysis in the application of HACCP, which is the identification of risk priorities and of the related CCPs.

2. Characteristic of HACCP in the tested company

HACCP is a systematic approach to identification, assessment, and control of hazard during production, processing, manufacturing, and preparation of food (Pal and Mahendra, 2015; Rosak-Szyrocka et al., 2018; Kielesińska, 2018). The research facility is an ice cream company located in the Śląskie Voivodeship. In addition to the HACCP system, the company has an ISO 22000 system and BRC. The goal of the HACCP system is to identify potential threats and identify them as Control Critical Points (CCP). By analyzing and controlling process documentation for possible emerging threats, the system develops principles that will lead to safe food guarantees. Employees are appointed in the organization who are responsible for managing the HACCP plan. Designated employees must have appropriate qualifications and in-depth knowledge of the principles of the HACCP Code (Wrońska and Piepiórka-Stepuk, 2017; Wahyuni et al., 2019). When implementing the HACCP system, the following actions should be undertaken:

- specifying the control supervision system at CCP,
- determining corrective action,
- determining and describing the checking activities and developing documentation and records.

The development of all HACCP principles is important because correctly defined critical control points and tolerance limits for each CCP can be estimated, checked and measured. The analyzed company has a list of CCP (critical control points) and CP (control points) on the ice cream line and the principles of control:

- CCP 1 - Pasteurization of ice cream mix and ice cream syrup - during pasteurization the temperature, which should be 86°C, should be controlled at the frequency of each process. Entries are made in the production report, the person responsible for this action is the chef.

- CCP 2 - Finished product storage, during which storage temperature is measured. The inspection takes place twice a day by measuring the temperature in freezers and recording them in the appropriate CCP 2 monitoring sheets. The warehouseman is responsible for the inspection.

- CCP 3 - The metal detector controls each piece of finished product, detection of contamination causes rejection of the product. Records from CCP 3 monitoring can be found in the appropriate sheet, which the operator is responsible for completing.

- CP 1 - Acceptance of raw materials, packaging, support materials, verification of compliance with the order with each delivery. Entries are made in the delivery receipt register, for which a quality specialist is responsible.

- CP 2 - Water quality is microbiologically and physico-chemically tested at least once a year. The inspection is carried out by an external laboratory.

- CP 3 - Storage of raw materials, packaging and auxiliary materials. The temperature and humidity are checked twice a day, for which the quality specialist is responsible.

- CP 4 - Preparation of ice cream mix in accordance with the recipe. The control is carried out by the chef at every stage of preparing the mixture.

- CP 5 - Filtering and cooling the mixture. During this process, the cleanliness of the filter is checked with an assessment of the type of contamination, assessment of the condition of the filter and control of the temperature of cooling the mixture with each operation. Entries are made by the chef in the production report.

- CP 6 - Dosage of aromas according to the recipe and correctness of mixing them by the chef.

- CP 7 - Transport to a milling machine where a sanitary swab is made and tests are carried out in the company's laboratory. Entries in the work diary.

Control points CP 8 ÷ CP 18 relate to operations related to baking wafers and cooking syrups, which will not be taken into account in the analysis.

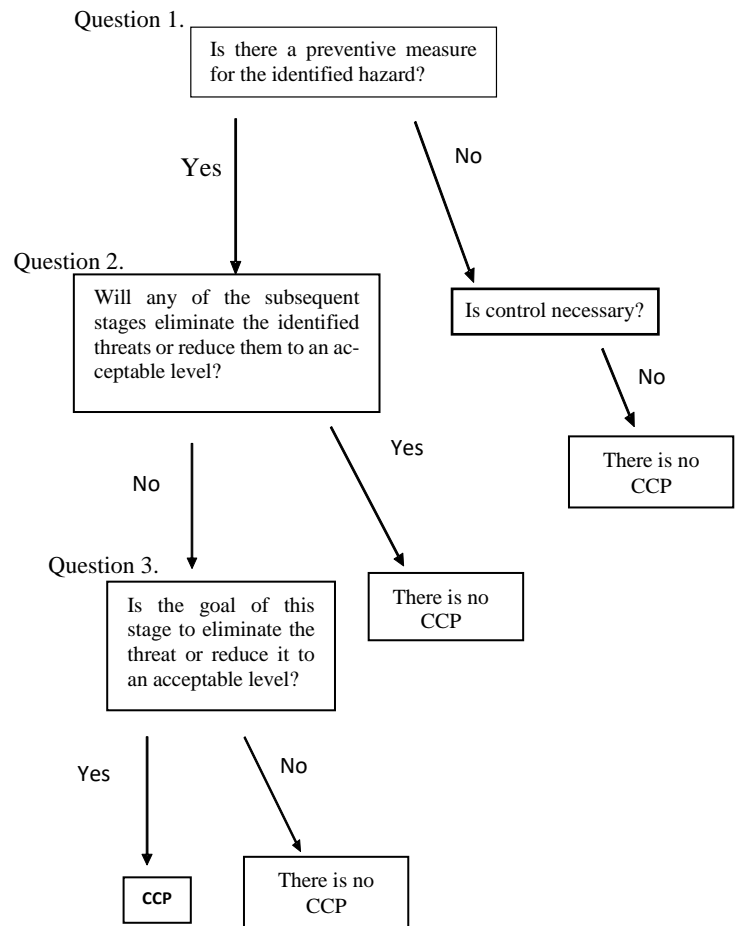


Fig. 1. Decision tree

- CP 19 - Wrapping formed ice cream in wrappers, foil or containers. The visual assessment is made by the operator and the laboratory technician at the frequency of each piece.

- CP 20 - Packaging in bulk packaging, quantity control carried out by the machine operator.

- CP 21 - Storage is controlled in terms of sanitary condition of storage rooms, records are made in control and inspection

reports for which the warehouseman, quality specialist and quality representative are responsible.

- CP 22 - Preparation for forwarding.

- CP 23 - Transport to the recipient. The inspection is carried out by the engineer and driver. The check occurs each time before loading and is subject to an assessment of the sanitary condition of the loading chamber and the temperature in the chamber.

The HACCP system in the analyzed enterprise meets all 7 principles of system implementation, and as an example the pasteurization stage is given and developed.

- Principle 1 - Hazard analysis and listing of preventive measures. Sources of physical hazards: unsealing the installation, damage to packaging and pallets with packaging, improper transport and storage conditions, inattention of the employee, improperly carried out the process of cleaning and freezing sheep (production of syrups), lack of supervision over the infrastructure and personnel, unwashed hoses and pipes, lack of control over the effectiveness of washing and disinfection processes, improper rinsing process, tearing of the collective packaging, dirt, cardboard getting wet, improper storage conditions, no maintenance of machines and devices.

Sources of chemical hazards: migration of chemical substances, chemical pollution from packaging, excessive residue of plant protection products, metals harmful to health (production of syrups), possibility of infection with residue of washing and disinfecting agents.

Sources of microbiological hazards: improper storage and transport conditions (microbiological contamination from the packaging surface), no HACCP system at suppliers, no cold chain behavior, no temperature supervision, incorrect pasteurization parameters.

- Principle 2 - Designation of critical control points.

(Pasteurization stage) The critical control point of CCP 1 was determined after analyzing the stage of the pasteurization process in which hazards were identified and the category of hazards (physical, chemical and microbiological) was determined, followed by the reasons for their occurrence. A decision tree was used to determine CCP, in which 3 questions (Figure 1) were used to determine and distinguish critical points from control points.

- Principle 3 - Setting critical limits for each CCP that cannot be exceeded because it would endanger the product. For the identified threats in each CCP, the HACCP team determined the value of critical parameters. For CCP, the first limit is pasteurisation at a temperature not lower than 86°C, for CCP 3 the limit is the presence of foreign bodies, for CCP 2 the limit is a temperature not higher than - 18°C.

- Principle 4 - Establish a monitoring system. During the pasteurization process the temperature is monitored and records of this activity are kept in the production report, for which the chef performing the process is responsible. The work of the metal detector is recorded in the CCP 3 monitoring sheet, the operator is responsible for this. CCP 2 controls are performed by a warehouseman in CCP 2 monitoring worksheet twice a day. – Ice cream production report - CCP1 temperature control – Temperature control in freezers - CCP2 monitoring sheet CCP3 monitoring sheet - metal detector.

- Principle 5 - Determination of preventive measures and control measures. In the case of the pasteurization process, the preventive action is compliance with hygiene programs and ice cream production instructions, monitoring process parameters and verification of measuring equipment. When using a metal detector, follow the instructions for use to eliminate metallic contaminants in unit packets of the finished product. If the detector indicates contamination in unit packets, stop the production line, put the packaging back into a properly labelled container with non-compliant product, and then perform the following actions: Check again that the detector works correctly, which should be noted in the CCP 3 monitoring report - corrective actions. Check again that the detector (all diodes) responds correctly to the standard reference probes. If the detector responds correctly to the probes - reconnect the production line. – Pass the previously rejected packaging through the metal detector. If the detector does not respond correctly to the probes - report the detector failure to your supervisor, foreman, production manager or lab technician. – Record the number of rejected unit packets in the "Metal detector work card" (CCP monitoring form 3). In the case of CCP 2, the temperature in the finished goods warehouse should be monitored constantly, sanitary and hygienic conditions should be monitored, and the procedure of storage and supervision of devices and infrastructure should be followed.

- Rule 6 - Establish enrolment procedures. All records are kept in the appropriate forms, approved by the Quality Representative, they are strictly controlled and stored.

- Rule 7 - System verification. Verification is carried out by conducting planned internal audits, market analysis, research results on finished products, raw materials and semi-finished products in accredited external laboratories. Any comments and observations from individual customers, traders and wholesalers are also considered verification.

3. Results and conclusion

All countries need adequate food control programmes to ensure that national food supplies are safe, of good quality, and available in adequate amounts at affordable prices to ensure an acceptable nutritional, and health status for all population groups. Food control includes all activities to ensure the quality, safety and honest presentation of the food, from primary production, through processing and storage, to marketing and consumption (Pal et al., 2016). The benefit for the organization of implementing the HACCP system is the reduction of costs associated with the production of non-compliant product, the next benefit is to increase the company's reputation and gain a customer's trust. HACCP also permits more efficient and effective government oversight (FDA, 2001; Wamukota, 2020.).

The task of the system is also to increase work efficiency through clearly defined obligations of employees. HACCP is said to be a combination of performance and process standards (Antle, 1999; Unnevehr and Jensen, 1999). The elements on which the food safety management system operates to which attention should be paid are the following:

- a) interactive communication,
- b) quality system management,
- c) a prerequisite program,
- d) HACCP principles,
- e) human resources management (Dolatowski and Kożen - Krajewska, 2008),

Only experience and knowledge of production processes and their specificity guarantee the correct development of critical control points (Przystupa, 2013).

The implementation of the HACCP system provides many economic benefits, i.e.:

- increasing the competitiveness of products,
- increasing demand,
- fewer complaints,
- employment rationalization,
- expansion of sales abroad,
- acquiring customers in the country,
- staying on the market,
- shapes the supplier market,
- reduces raw material losses,
- corrects the number of corrective actions,
- shortens unproductive working time (Trafiałek and Kołożyn-Krajewska, 2008).

HACCP system became internationally prompted as one of the most effective and efficient ways to enhance food safety. Today, many countries have integrated or are in the process of integrating HACCP system into their regulatory mechanisms, as a way of reducing the incidence of foodborne disease as well as ensuring a safe food supply for the population; promote and facilitate trade in food products (Pal et al., 2016).

HACCP brings benefits to society by reducing costs associated with food safety risks. Moreover HACCP imposes additional costs on the food industry as well as could also function as a business management tool and has a positive influence on firm export performance.

It was showed that HACCP system is very helpful tool for managers who are able to automatically implement the HACCP principles in the company.

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HACCP体系方面的食品质量管理与安全

關鍵詞

质量
HACCP系统
食品安全
质量体系
竞争

摘要

危害分析和关键控制点 (HACCP) 的实际实施, 尤其是食品行业中关键控制点 (CCPs) 的定义通常是一个复杂的结构化任务。食品企业尤其如此, 在这里, 质量/安全管理人员的能力, 生产过程的知识 and “敏感性” 通常是正确识别和确定风险优先级的区别。对于可能导致食品安全危害的原因的定义也是如此。本文讨论了质量/安全经理如何在应用HACCP时客观, 自动地实施危害分析的HACCP原则的问题, 该原则是确定风险优先级和相关CCP。所提出的方法结合了决策树分析方法, 用于冰淇淋制造过程中相关步骤的分析分解。