FOOD SAFETY MANAGEMENT SYSTEMS: A COMPREHENSIVE THEORETICAL REVIEW AND CONCEPTUAL FRAMEWORK

D. M. Lăpușneanu*, M. Matei, S. I. Petrescu, C. G. Radu-Rusu, I. M. Pop

Faculty of Food and Animal Sciences, Iasi University of Life Sciences, Romania

Abstract

The objective of this paper is to analyze the fundamental concepts and tools of food safety management, as well as their role in ensuring food safety. The methodology relies on a literature review of scientific articles, databases, international standards, and official documentation from European and international food safety organizations. The analysis identifies the HACCP system as the preventive cornerstone of all safety standards, while ISO 22000 and FSSC 22000 provide an integrated management framework for systematic risk control and continuous process improvement. Furthermore, GLOBALG.A.P., BRC, and IFS Food complement this system by addressing specific requirements across different stages of the food supply chain. These internationally recognized standards do not function in isolation but are highly complementary, with organizations frequently implementing them simultaneously to meet market demands. In conclusion, the integration of food safety management systems represents the most effective strategy for protecting consumer health, enhancing organizational competitiveness, and fostering a safe and sustainable food system.

Key words: *HACCP, ISO 22000, FSSC 22000, GLOBALG.A.P., BRCGS, IFS Food*

INTRODUCTION

Food safety is an essential component of the modern food system, with the primary goal of protecting consumer health and reducing the risks associated with food consumption. The concept of food safety encompasses all the measures and conditions necessary to ensure that food does not pose a health hazard to consumers when consumed as intended [1].

In the scientific literature, food safety is defined as the set of activities and procedures implemented to prevent food contamination and to maintain food under appropriate conditions of hygiene and quality [2-4].

Food safety is also closely linked to the concept of food quality, but the two concepts are not identical. Food quality includes characteristics such as organoleptic properties, nutritional value, or the appearance of food products, while food safety refers exclusively to the absence of hazards that could affect consumers' health [5].

Food safety is one of the fundamental priorities of European Union policy and is considered essential for protecting consumer health and ensuring the proper functioning of the internal market. To this end, the European Union has developed a comprehensive legislative framework governing all stages of the food chain, from primary production to the distribution of food products to consumers [6].

A key milestone in the development of European food safety policy was the adoption of [7], which establishes the general principles of food law in the European Union which introduces the concept of risk analysis and sets out the

*Corresponding author: dragos.lapusneanu@iuls.ro

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responsibilities of food business operators regarding food safety [4].

To ensure the proper enforcement of food safety legislation and to protect consumer health, the European Union has established a comprehensive system for food safety oversight and control. This system is based on cooperation among European institutions, national authorities, and food business operators [8,9]. The European Food Safety Authority (EFSA) plays a central role in this system; it is the institution responsible for the scientific assessment of food risks [10]. Another important tool used in the European Union to monitor food safety is the Rapid Alert System for Food and Feed (RASFF); this system enables the rapid exchange of information between member states and European institutions when risks associated with food or feed products are identified [11].

This study aims to analyze the fundamental concepts and tools of food safety management, as well as their role in ensuring food safety.

MATERIAL AND METHOD

This paper analyzes the main systems and standards used in food safety management, namely HACCP, ISO 22000, FSSC 22000, GLOBALG.A.P., BRCGS, and IFS Food. These standards are important tools for controlling food hazards and improving processes within organizations in the food sector.

To conduct this research, bibliographic sources and specialized documents in the field of food safety management were consulted. The literature review was carried out by consulting books and scientific articles, as well as by accessing databases and online academic platforms. At the same time, international standards, official documents, and information published on the websites of national, European, and international organizations with responsibilities in the field of food safety were analyzed.

RESULTS AND DISCUSSIONS

A. HACCP System

The HACCP (Hazard Analysis and Critical Control Points) system is a preventive method used to identify, evaluate, and control hazards that are significant to food safety. This system is considered the modern foundation of food safety management and is widely applied in the food industry, being internationally recognized as an effective tool for preventing food risks [3,12-13].

The implementation of the HACCP system depends on the existence of appropriate preliminary programs, known as good hygiene practices. These include measures related to personnel hygiene, cleaning and disinfection, pest control, equipment maintenance, and the prevention of cross-contamination [14]. HACCP implementation begins with a series of preliminary steps, which include forming a HACCP team, describing the product, identifying its intended use, and developing a process flow diagram [15]; the principles of the HACCP system are presented in Figure 1.

Implementing the HACCP system in practice requires the involvement of a multidisciplinary team and the use of specific tools for process analysis. Developing the flow chart and verifying it on-site are essential steps for correctly identifying hazards and critical control points [14].Another important aspect is the integration of HACCP with other food safety management systems, such as ISO 22000 or FSSC 22000; this integration allows for a more comprehensive and effective approach to food risk management [16-17].

The main advantage of the HACCP system is its ability to prevent food safety risks before they affect the final product. Furthermore, implementing this system helps improve process control, reduce costs associated with nonconformities, and increase consumer confidence [15].

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Figure 1.1. Principles of the HACCP system [18]

B. FSSC 22000

The FSSC 22000 (Food Safety System Certification 22000) system is an internationally recognized food safety certification scheme developed to ensure that organizations in the food chain comply with food safety requirements. This system is based on the ISO 22000 standard and the technical specifications for prerequisite programs, and is recognized by the Global Food Safety Initiative (GFSI) as a benchmark standard for food safety certification [19].

FSSC 22000 was developed in response to the need for a unified certification system that would be accepted globally by retailers and manufacturers. Prior to the introduction of this standard, organizations were subject to different requirements depending on their business partners, which created difficulties in implementing food safety systems. By standardizing requirements and gaining international recognition, FSSC 22000 has helped simplify the certification process and increase confidence in the food chain [19].

The structure of the FSSC 22000 system is based on three main components: the ISO 22000 standard, prerequisite programs (PRPs), and additional requirements specific to the scheme (Figure 1.2.). The ISO 22000 standard provides the general framework for food safety management, while the Prerequisite Programs ensure the basic conditions for a hygienic production environment. The additional requirements include aspects such as food fraud prevention, food defense, and food safety culture [19].

Prerequisite programs are an essential component of the system and include measures related to personnel hygiene, cleaning and disinfection, pest control, equipment maintenance, waste management, and cross-contamination prevention. These programs are tailored to the specific sector and are defined by specific standards, such as ISO/TS 22002, which provide detailed guidance for various areas of the food industry [14].

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Figure 1.2. Structure of FSSC 22000 [19]

A central element of this system is the integration of HACCP principles into a management system. This integration allows organizations to combine the preventive approach of HACCP with requirements for planning, implementing, monitoring, and improving processes. Thus, FSSC 22000 provides a comprehensive and systematic approach to food safety [1].

Implementing the FSSC 22000 system involves several stages, beginning with an analysis of the organization's context and the identification of risks associated with its activities. The organization must establish clear food safety objectives, define staff responsibilities, and develop procedures for risk control. It is also necessary to implement a performance monitoring and evaluation system that allows for the identification of nonconformities and the application of corrective actions.

Traceability is another fundamental requirement of the FSSC 22000 system. Organizations must be able to quickly identify the origin of raw materials and track products throughout the entire production and distribution chain. This capability is essential in the event of nonconformities or incidents, as it allows for the rapid recall of affected products and minimizes the impact on consumers [19].

A major advantage of this standard is its international recognition, which facilitates organizations' access to global markets. Certification under this standard is accepted by numerous retailers and business partners, providing assurance of compliance with food safety requirements. Furthermore, implementing the system helps improve process efficiency and reduce costs associated with nonconformities. At the same time, the system promotes the concept of continuous improvement through the application of the PDCA (Plan-Do-Check-Act) cycle. Organizations must continuously monitor the system's performance, analyze the results obtained, and implement measures to optimize processes. This approach allows the system to adapt to changes in the external environment and to new requirements in the food industry [1].

C. ISO 22000

The ISO 22000 standard is an international food safety management system developed by the International Organization for Standardization that establishes requirements for organizations involved in the food chain. The primary objective of this standard is to ensure the control of food safety risks and to guarantee that food products are safe for consumption,

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regardless of the stage of the food chain at which the organization operates [20].

ISO 22000 was designed to integrate HACCP principles with the general requirements of management systems, thereby providing a unified framework for food safety management. Through this integration, the standard enables organizations to apply a systematic and structured approach based on risk identification, the implementation of control measures, and the continuous monitoring of processes [14].

A key element of the ISO 22000 standard is its structure based on the PDCA (Plan-Do-Check-Act) cycle, which ensures the continuous improvement of the management system. During the planning stage, risks are identified and food safety objectives are established; during the implementation stage, control measures are applied; and during the check and act stages, results are analyzed and corrective and improvement measures are implemented [20]. Another important aspect of ISO 22000 is interactive communication throughout the food chain. The standard requires organizations to ensure the exchange of relevant information among suppliers, producers, distributors, and other stakeholders to prevent risks and ensure a rapid response in the event of food incidents. This communication helps increase transparency and improve control over processes [21].

ISO 22000 places particular emphasis on Prerequisite Programs (PRPs), which are the basic conditions necessary to ensure a hygienic production environment. These programs include measures related to personnel hygiene, cleaning and disinfection, pest control, waste management, and equipment maintenance. Proper implementation of PRPs is essential for preventing food contamination and for the effective operation of the HACCP system [20].

The defining feature of the ISO 22000 standard is the integration of the HACCP plan into the management system. Organizations must conduct a hazard analysis, establish critical control points, and implement monitoring and control measures. This integration enables consistent and effective risk management within an organized and documented system. ISO 22000 is flexible and can be applied in organizations of various sizes and across different sectors of the food chain. From raw material producers to distributors and food service operators, all organizations can implement this standard to ensure food safety [22].

ISO 22000 also allows for integration with other management standards, such as ISO 9001 (quality management) or ISO 14001 (environmental management). This compatibility facilitates the development of an integrated management system that covers multiple aspects of the organization's operations and contributes to improving overall performance [14]. Implementing the ISO 22000 standard helps improve process control and reduce food safety risks. By continuously monitoring critical parameters and applying preventive measures, organizations can prevent contamination and ensure safe products for consumers [20].

Accountability at the highest level of management is an important aspect, as it must demonstrate active involvement in the implementation and maintenance of the system. The organization's leadership must establish clear policies and objectives, ensure the necessary resources are available, and promote an organizational culture focused on food safety [1].

D. GlobalG.A.P

The European GAP (Good Agricultural Practices) system serves as a benchmark for implementing good agricultural practices during the primary production stage, with the primary goal of ensuring food safety from the very beginning of the food chain.

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This system was initially developed under the name EUREPGAP by a consortium of European retailers, in response to rising demands for food quality and the need to more effectively manage risks associated with agricultural production [23]. The context in which this standard emerged is closely linked to the evolution of the European food market, characterized by the globalization of supply chains and the intensification of trade. In this context, retailers have been compelled to take an active role in ensuring the safety of the products they sell by imposing clear and standardized requirements on suppliers. Thus, EUREPGAP emerged as a tool for harmonizing agricultural practices and reducing uncertainties regarding product quality [24].

The subsequent evolution of this standard into GLOBALG.A.P. reflects its international expansion and adaptation to the requirements of a global market. Currently, the standard is used in numerous countries and covers a wide range of agricultural products, becoming an important benchmark in the certification of primary production [25].

A fundamental aspect of the European GAP system is its integrated approach to food safety, which includes not only control of the final product but also the management of all factors that may influence its quality. Thus, the standard emphasizes control over the entire production process, from the selection of raw materials to the handling of products prior to delivery [15].

The European GAP system can be analyzed from several perspectives, which highlight its complexity and importance within the food chain: 1. Food safety—the standard sets strict requirements for preventing contamination of agricultural products, including controls on the use of pesticides and fertilizers. These measures aim to reduce chemical and biological risks that may affect consumer health; 2. Environment—a defining element of the system is the promotion of sustainable agriculture. The standard encourages the responsible use of natural resources, soil protection, and the reduction of environmental impact. This approach reflects modern trends in agriculture, which are oriented toward sustainable development (European Commission, 2020); 3. Economic—Certification under the GLOBALG.A.P. standard provides producers with a competitive advantage by facilitating access to international markets. At the same time, the standard helps increase production efficiency and reduce losses through the implementation of well-structured agricultural practices; 4. Social-the system includes requirements regarding working conditions and the safety of agricultural workers [23]. These requirements cover the use of protective equipment, staff training, and compliance with occupational health and safety standards [6].

Implementing GlobalG.A.P. requires the adoption of clear procedures and a rigorous documentation system. Producers must maintain detailed records of their activities, including the use of chemicals, production conditions, and the control measures applied. The system involves conducting periodic audits to verify compliance with the standard's requirements; these audits help maintain a high level of control and contribute to the continuous improvement of agricultural processes. GlobalG.A.P. helps ensure product safety starting from the primary production stage, but additional standards are required in later stages of the food chain. In this regard, standards geared toward the processing and retail industries, such as BRC, ensure continuity of food safety controls [25].

E. BRCGS

The BRCGS Standard (British Retail Consortium Global Standard for Food Safety) is one of the best-known private

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standards used internationally for the assessment and certification of food safety. It was developed by the British Retail Consortium to establish a uniform set of requirements applicable to suppliers in the food industry, particularly those that supply products to major retail chains. This standard aims to ensure that food products are produced, processed, and marketed under conditions that meet safety, quality, and legality requirements [26].

The BRC standard was developed in response to retailers' need for a common tool to evaluate suppliers, one that would help reduce food safety risks and increase confidence in the supply chain. Prior to the development of this standard, many companies were subject to different audits, depending on each client's requirements, which led to additional costs and a lack of consistency in assessment. The BRC standard has helped harmonize requirements and simplify audit processes in the food industry [23].

The BRC system is based on a structured approach to food safety and includes clear requirements regarding the implementation of the HACCP system, quality management, control of the production environment, product traceability, and documentation management. By integrating these components, the standard provides organizations with a comprehensive framework for controlling food risks and demonstrating compliance with the requirements of trading partners and competent authorities [14].

An essential element of the BRC standard is management responsibility; the organization's leadership must demonstrate commitment to implementing and maintaining the system, establish clear policies regarding food safety and quality, and ensure the necessary resources are available to meet the standard's requirements. In this regard, the BRC is not limited to the strictly technical aspects of production but also aims to foster an organizational culture focused on food safety [26].

The standard also requires the existence of robust prerequisite programs to ensure the basic conditions for a hygienic and safe production environment. These programs include measures related to personnel hygiene, cleaning and disinfection, pest control, equipment maintenance, and waste management. Without these fundamental conditions, the effectiveness of food risk control measures would be significantly reduced [21].

Another important aspect of the BRC standard is the emphasis on process control and continuous monitoring. Organizations must define clear procedures for each stage of production, establish the critical parameters to be monitored, and document the results obtained. Through this approach, it is possible to quickly identify nonconformities and implement corrective actions before the final product is affected [14].

The BRC certification audit is a central component of the system and serves to assess the organization's level of compliance with the standard's requirements. During the audit, documents, processes, production conditions, and the level of implementation of control measures are analyzed; the audit results provide business partners with a clear picture of how the organization manages food safety and quality [26].

The BRC Standard is an important tool for food safety and quality management, and is particularly valuable for organizations that work with the retail sector. By implementing this standard, companies can improve process control, reduce food safety risks, and credibly demonstrate compliance with international food safety requirements [26-28].

F. IFS FOOD

The IFS Food (International Featured Standards Food) standard is an international system for assessing and certifying the safety and quality of food products, developed by European retailer

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organizations. This standard is primarily used to assess suppliers of private-label food products, with the aim of ensuring their compliance with food safety and product quality requirements [29].

The emergence of the IFS Food standard is closely linked to retailers' need for a unified tool to assess suppliers, given the increasing complexity of supply chains. The implementation of this standard aims to reduce food safety risks and increase control over production processes, thereby helping to protect consumers and build confidence in food products [23].

Unlike other general standards, IFS Food is directly geared toward the food processing industry, with detailed requirements regarding process control and the evaluation of organizational performance. The standard integrates HACCP principles and combines them with requirements for quality management, management responsibility, and operational control, thereby providing a comprehensive and well-structured framework [14].

A key element of this standard is its emphasis on evaluating an organization's performance through detailed audits. These audits are conducted by independent bodies and are designed to assess the extent to which the standard's requirements have been implemented, as well as the effectiveness of the food safety management system [29].

The IFS Food standard can be analyzed from several perspectives that highlight its complexity and role in the food industry, such as: 1. Food safety—the standard includes strict requirements regarding the identification and control of hazards, based on HACCP principles, which helps prevent food contamination and ensure compliance with safety requirements; 2. Operational control—IFS Food places particular emphasis on the control of production processes, requiring organizations to define clear procedures and monitor critical parameters, thereby helping to maintain process stability and reduce risks; 3. Management-requires active management involvement in implementing and maintaining the system by setting clear objectives, allocating resources, and monitoring system performance, while promoting an organizational culture focused on food safety; 4. Commercial-IFS Food is closely linked to retailers' requirements, serving as a tool for supplier evaluation; certification under this standard facilitates access to international markets and helps strengthen commercial relationships [14,23,29].

The IFS Food standard contains highly detailed requirements, which allow for a precise assessment of processes and help improve food safety controls; furthermore, the international recognition of this standard facilitates organizations' access to foreign markets and increases the confidence of trading partners. However, implementing the standard can present difficulties, particularly for small organizations or those lacking sufficient resources. The complexity of the requirements and the need for detailed documentation can pose challenges, and the costs associated with certification may limit some producers' access to this standard [14,21].

The IFS Food standard is an essential tool for assessing and certifying food safety in the food processing industry. Through its comprehensive approach and the integration of HACCP principles, the standard helps control food risks and improve organizational performance. At the same time, its role in the relationship between producers and retailers makes it a central element of the modern food safety system [30].

The systems analyzed exhibit both similarities and significant differences, which are determined by their purpose and scope of application (Table 1). A comparative analysis shows that HACCP (the basic methodology) is a technical approach limited to the identification and

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control of hazards at the production line level. ISO 22000 & FSSC 22000 extend HACCP by integrating the HLS (high-level structure), which is common to all ISO standards, and focus on leadership, business-level risk analysis (SWOT), communication, and the PDCA cycle (Plan-Do-Check-Act). BRCGS & IFS Food (prescriptive trade standards) are created directly by retailer associations; they not only specify what must be achieved but also impose very strict requirements on how the facility must be configured (layout design, lighting, metal detectors, pest control).

Table 1 Comparative analysis of food safety management systems

Criteria	HACCP	ISO 22000	FSSC 22000	GLOBALG.A.P	BRCGS / IFS Food
Nature/Type	Technical hazard analysis methodology	International management standard (ISO)	Certification scheme based on ISO	Good Agricultural Practices (GAP) standard	Retailers' commercial standards
Issuing body	Codex Alimentarius (FAO/WHO)	International Organization for Standardization (ISO)	Foundation FSSC	FoodPLUS GmbH	BRCGS (UK) / IFS Management (Germany/France)
Target segment	Any operator in the food chain	Entire supply chain ("farm to fork")	Industrial processing, packaging, logistics	Primary agricultural production (farms, orchards, aquaculture)	Food processors (especially private labels)
GFSI Recognition	No *(tool/ methodology)*	No *(PRP requirements too general)*	Yes	Yes	Yes
Primary focus	Critical Control Points (CCP) management	Process management & continuous improvement	Integrated management + GFSI specific requirements	Environment, traceability, worker health & farm safety	Prescriptive compliance & product specifications
Evaluation system	Pass / Fail (Legal compliance)	Compliance audit (No scoring)	Compliance audit (No scoring)	Compliance checklist (Major/Minor)	**Scoring grid** (Grades A–D / percentage score)

CONCLUSIONS

Food safety is a critical area within the food industry, having a direct impact on consumer health and the efficient functioning of the food chain. In the context of market development and increasing demands for food quality, the implementation of effective food safety management systems is essential for all organizations involved in this field.

The HACCP system has been identified as the foundation of all these standards, due to its preventive nature and effectiveness in risk control. The ISO 22000 and FSSC 22000 standards provide an integrated management framework that enables organizations to manage risks systematically and continuously improve their processes. In addition, the GlobalGAP, BRCGS, and IFS Food standards complement this system by addressing specific requirements for different stages of the food chain. These standards are internationally recognized and help build trust among consumers and business partners.

The analysis highlights that these systems do not operate in isolation but are complementary. In practice, organizations simultaneously implement multiple

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standards, depending on market requirements and the specific nature of their operations, to ensure effective control of food risks.

In conclusion, the integration of food safety management systems is the most effective approach to ensuring the quality and safety of food products. The implementation of these systems helps protect consumer health, increase the competitiveness of organizations, and foster a safe and sustainable food system.

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