



**The Hazard Analysis System and Critical Control Points as a quality tool in  
brazilian food industry**

*O Sistema de Análise de Perigos e Pontos Críticos de Controle como ferramenta de  
qualidade na indústria de alimentos brasileira*

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**Abstract.** Food safety is one of the main problems related to food production and processing. The control of food contamination hazards in relation to physical, chemical and biological risks must occur during all phases of the production process, that is, from the acquisition of the raw material to the production of the final product that arrives at the consumer's table. Food industries need an effective quality system to exercise quality control at all stages of production. The Hazard Analysis and Critical Control Points (HACCP) system stands out today as the most important quality control system in the food industry, capable of identifying the likely risks of contamination within a specific process and the measures preventive measures to control them, aiming at food safety.

**Index terms:** Food safety. Microbiology. Quality. Public health.

**Resumo.** A segurança dos alimentos é um dos principais problemas relacionados à produção e processamento de alimentos. O controle de perigos de contaminações dos alimentos em relação aos riscos físicos, químicos e biológicos deve ocorrer durante todas as fases do processo produtivo, ou seja, desde a aquisição da matéria prima até a produção do produto final que chega na mesa do consumidor. As indústrias de alimentos necessitam de um sistema de qualidade efetivo para exercer o controle de qualidade em todas as etapas da produção. O sistema Análise de Perigos e Pontos Críticos de Controle (APPCC) se destaca na atualidade por ser o sistema mais importante de controle de garantia de qualidade nas indústrias de alimentação, capaz de identificar os riscos prováveis de contaminações dentro de um processo específico e as medidas preventivas para o controle dos mesmos, objetivando a inocuidade dos alimentos.

**Termos para indexação:** Segurança alimentar, Microbiologia, Qualidade. Saúde Pública.

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## **Introduction**

Quality has been one of the most relevant points in all the segments of the industry being linked to goods, products, processes and services, a factor of great importance that assumes a standardization role and stands out among the companies. Generally, quality is seen not only as a differential between companies, but a condition for staying in an increasingly demanding and competitive consumer market. The quest for an organization's success lies in the use of methodologies that encompass quality tools (DIAS, 2014).

In the food industry, the concept of quality is closely related to product safety, as any problem throughout the production process can affect the health of the end consumer (FIGUEIREDO & COSTA NETO, 2001).

Food safety can be understood as the combination of standards that drive all the processes involved in the production, transport and storage of food, seeking to guarantee certain characteristics of the products, making adjustments to biological and physico-chemical standards so that these foods are fit for the consumption (SILVA et al., 2015). This connection of standards and guidelines is followed

internationally, so that health and commercial needs are met to satisfy every customer anywhere in the world, ensuring the quality and safety of food (FERREIRA et al., 2019).

The Hazard Analysis and Critical Control Points (HACCP) system is of great importance in the food industry, as it acts preventively to ensure a product free of physical, chemical or biological contaminants. The analysis performed in the steps during the manufacturing allows a control before the final transformation of the product, allowing the adoption of corrective and preventive measures to eliminate the contamination hazards. Rigorous control in the food manufacturing process provides greater quality, safety, reduction of losses and rework in the productive process (QUINTINO & RODOLPHO, 2018).

This paper aims to discuss and review sources found in the literature to demonstrate how the preparation of the HACCP plan in the food industry promotes the increase of process quality, reducing waste, reprocessing and eliminating the risks of food contamination.

### **Methodology**

The methodology used in this study was the exploratory-descriptive and qualitative research, with data collection, developed from research in legislation, technical standards, scientific articles, websites and electronic documents. The scientific papers were purchased from the sites: [www.pubmed.com](http://www.pubmed.com); [www.highwire.stanford.edu](http://www.highwire.stanford.edu); [www.scholar.google.com](http://www.scholar.google.com); [www.scielo.br](http://www.scielo.br).

### **HACCP System**

The Hazard Analysis and Critical Control Point (HACCP) system was established in the 1960s in the United States by the Pillsburg Company together with NASA (National Aeronautics and Space Administration) to develop a quality food safety program for astronauts on space missions (Mortimore & Wallace, 2013).

HACCP is a process control system applied to prevent physical, chemical and biological hazards in food, seeking the production of innocuous foods. This principle is supported by the

application of technical and scientific principles in the processes of production, processing, manufacturing, preparation and consumption of food (ROCHA et al., 2018). The implementation of HACCP system aims to act in preventive and control actions, instead of corrections and tests in the final products (DÜRR, 2016).

Through systematic investigation, the HACCP system allows identifying potential contamination points within the process, establishes preventive measures and identifies critical points of control and acceptable limits of a critical point. In addition, the system determines the monitoring of identified critical points and corrective actions to be taken if acceptable critical process limits are exceeded (ASSIS, 2011).

The HACCP system stands out as the most important quality assurance control system in the food industry, being recognized and accepted by the most respected international organizations, such as the World Health Organization (WHO) and the Codex Alimentarius and required in Brazil by Federal Government Order 1428/93 of the Ministry of Health, as well as Portaria 368/97 of the Ministry of Agriculture, Livestock and Food Supply (MAPA) (GIORDANO & GALHARD, 2004; ROCHA et al., 2018).

In Brazil, the National Agency of Sanitary Surveillance (ANVISA) is the

representative of the Ministry of Health in the Codex Alimentarius Commission (CAC). Several programs and manuals have been prepared by the official agencies to standardize procedures for the preparation and manipulation of raw materials and finished foods (Araújo, 2010).

To verify the operation and effectiveness of HACCP, it is necessary to establish verification procedures such as

conducting audits and tests including random sampling and analysis. The most common actions involve a review of the HACCP and its records, review of the deviations and destination of the products, as well as confirmation that the Control Critical Point (CCP) are kept under control (BARRETO et al., 2013).

The seven HACCP principles and their respective purposes for food safety are described in Table 1.

**Table 1** - The 7 basic principles and objectives of the HACCP system.

<b>Principles</b>	<b>Description</b>
1. Hazard analysis and preventive measures	Hazards pertaining to the production process should be identified and preventive measures should be established. The HACCP system seeks to maintain control of various types of hazards. The main hazards in the food production process are: biological, chemical and physical.
2. Identification of critical control points	The critical control points are determined at the food production stages and must be identified as representing a real risk to the consumer's health, and therefore, the control and prevention measures are submitted.
3. Establishment of critical limits for the associated preventive measure in all CCPs	The maximum and minimum values of the biological, chemical and physical parameters should be established for each critical control point in order to keep the CCP under monitoring. These critical limits can be obtained from various sources such as guides, legislation, laboratory data, among others.
4. Establishing the need for PCC monitoring	The main control points and their related hazards should be monitored by a determined sequence of observations or

	measurements in order to assess the integrity of each step. A faithful record must be produced for use in future checks.
5. Implementation of corrective actions, when the occurrence of deviation from a critical limit of the CCP	Corrective actions are procedures that must be established with the utmost precision and efficacy to correct deviations at a given critical threshold. Rapid response to a diversion is one of the main focuses of the HACCP system, actions should be taken at the time or soon after identification of the deviation.
6. Establishment and maintenance of records of HACCP documentation procedures	Procedures to maintain control and storage of all important records or documents are critical to any management system, they should be designed to provide easy access to any document / record and be uniquely identified.
7. Establishment of procedures to verify the correct functioning of the HACCP system	These procedures are additional to the monitoring procedures that must be established to verify that the HACCP system is functioning correctly. These procedures include: technical or scientific process, plan validation process, revalidation process.

Source: Adapted from Durello (2016).

For Colleto (2012), before implementing the seven HACCP principles, it is necessary to perform some basic steps as described in Table 2.

**Table 2** - HACCP system pre-requirements.

<b>HACCP Pre-requirements</b>	<b>Description</b>
Step 1. HACCP Team Formation	Depending on the size of the organization, one or more teams, which will collaborate in the management of the HACCP system, must be formed. The established team should be multidisciplinary and hierarchical, including people who encompass all the activities involved in the company, such as: production, purchasing, finance and quality, in order to facilitate

	the resolution of possible conflicting situations.
Step 2. Product description	A complete description involving the pertinent information such as composition, distribution system and method of manufacture should be made.
Step 3. Identifying the intended use of the product	Specific groups of consumers or customers should be identified in general, seeking information about allergy to the product.
Step 4. Elaboration of a product flowchart	The HACCP team should develop a detailed flowchart to identify possible sources of contamination. All steps should be considered, including ingredients, distribution and sale.
Step 5. On-site confirmation of flowchart	The elaborated flowchart must be confirmed in loco by the formed HACCP team, ensuring an exact representation of the operation linked with each product.
Step 6. Hazard Analysis	The flowchart should be applied, including technical data as a guide, to identify all physical and chemical biological hazards that may occur at each step, and also describe the control measures that must be introduced into the system to reduce or eliminate such hazards.
Step 7. CCP's determination	A decision tree or other equivalent tool should be used to determine the critical points at each stage of the production process. All recordings of steps 6 and 7 must be recorded.
Step 8. Establish critical limits and tolerances for each CCP	A critical value and the tolerance values of some parameters for each CCP must be established, from which the raw material will be considered inadequate in different values (eg temperature and cooking time).
Step 9. Establish a monitoring system for	The HACCP team must present a documented monitoring system with control measures for each CCP, ensuring that the production process is developing within the established critical

each CCP	limits.
Step 10. Establish corrective actions	Documented procedures for making corrections should be established when monitoring the critical limits indicates deviations from the determined values in order to avoid recurrence.
Step 11. Establish validation, verification and review procedures	An appropriate system for checking and reviewing (in accordance with a fixed schedule) of all hazard control measures identified and all procedures established for the operation of HACCP should be established, ensuring the effectiveness and continuous improvement of the system. Periodic internal checks such as audits and inspections should be performed to ensure that the monitoring system and corrective action plans are being applied correctly.
Step 12. Establish recordkeeping and documentation procedures	The organization shall establish procedures to ensure the existence, storage and authorized access of documents and records, which shall have accurate information on all phases of the system.

Source: Adapted from DURELLO (2016).

Thus, the implementation of HACCP in the food industry allows a series of benefits such as increased product quality, higher productivity with lower rework rate and reduced number of consumer complaints (QUINTINO & RODOLPHO, 2018).

#### **HACCP pre-requirement programs**

The HACCP system is not an independent program, but part of a larger system of control procedures. In order for

the HACCP system to work effectively, it must be preceded by the PPHO (Standard Operating Procedures) and GMP (Good Manufacturing Practices) programs (PERETTI & ARAÚJO, 2010).

The purpose of the Standardized Operating Hygiene Program (PPHOs) is to establish standardized sanitation and sanitation procedures to prevent food contamination (Forsythe, 2013), ensuring

through standards and procedures the hygiene of facilities, equipment and utensils before, during and after food processing (FIGUEIREDO & COSTA NETO, 2001).

In Brazil, the concept of GMP was introduced in the 1970s for human food companies (Peretti & Araújo, 2010) and in February 2007 by MAPA, through Normative Instruction No. 4, which established the technical regulation on the conditions hygienic and GMP standards for establishments manufacturing products for animal feed and the inspection roadmap. GMP are hygienic, sanitary and operational procedures applied throughout the production process, from the acquisition of raw materials to the distribution of the final product, in order to guarantee the quality, conformity and safety of products destined for animal feed (Brazil, 2007).

### **HACCP System advantages**

Among the main advantages or benefits of the HACCP system, Durello (2016) emphasizes: guaranteeing the safety of food or beverages; cost reduction due to reduction of losses; increase the credibility of the customer towards the products and / or services; increased competitiveness of the product; compliance with international legislation (USA, European Community, among others) and legal requirements of

the Ministry of Health and Ministry of Agriculture, Livestock and Supply.

In this way, the commitment to quality in all stages of the production process guarantees the credibility of the customers and strengthens the company's image in the consumer market (QUINTINO & RODOLPHO, 2018).

### **HACCP implementation difficulties**

As with any implementation process in the various segments, HACCP presents some barriers during execution. Figueiredo (2006) describes the main complicating factors: lack of financial resources for modifications; low level of education of employees; lack of motivation to implement HACCP; difficulty in completing records; difficulty in raising employee awareness and over-registration. In addition, there are other complicating factors such as investments in qualified technicians, training of employees and functional equipment, as well as difficulties in complying with requirements and inaccuracies during the process (FREITAS, 2011).

According to Berthier (2007) and Dias (2014) the most difficult step for HACCP implementation in the industry is undoubtedly the time to introduce the plan. Moreover, the authors consider that the changes must be introduced gradually and in the most objective way possible. The resistance and the lack of knowledge of the



collaborators are also pointed out in the literature as complicating factors for the implementation of HACCP (SILVA JUNIOR, 2013).

### **HACCP and ISO 22000**

The International Organization for Standardization 22000 (ISO - International experts from international organizations, with the collaboration of the Codex Alimentarius Commission and Global and Drink Industries of European Union. This standard is further complemented with ISO / TS 22004 which provides guidelines for the implementation of the standard and ISO / TS 22003 which establishes certification requirements for external entities (DIAS, 2010; MARQUES, 2011).

ISO 22000: 2005 refers to the food safety management system. It is intended for manufacturers of food products, distributors, transporters, transport operators, packaging suppliers, equipment manufacturers, packaging materials, additives and ingredients, raw materials, among others that aims to effectively manage their packaging system ensure that consumer health hazards are eliminated or reduced to acceptable levels (NET, 2014).

This standard aims to ensure that food is safe for final consumption from the food chain and allows HACCP principles to be combined with other control measures such as prerequisite programs and other relevant food sector documents.

Organization for Standardization) was created on September 1, 2005, with official translation into Portuguese in June 2006 - ABNT NBR 22000: 2006. Developed by food industry professionals along with

It is important to note that ISO 22000 focuses on the product and its safety, unlike ISO 9001 that is focused on the company, services and processes (MARQUES, 2011).

The rules and regulations of ISO 22000 cover: Higher quality jobs in the food industry; Increased company profits; Insurance of safer food; Reduction in rates of foodborne disease and more efficient documentation of techniques, methods and procedures. The benefits derived from the implementation of this ISO involve scientific and technological knowledge, development of health, safety and environmental legislation, factors that are interesting to the governmental policy of a country (BEECH, 2017).

The standard supports companies in managing secure processes and encourages interactive communication from the producer to the end consumer. Other benefits resulting from its implementation were greater customer and consumer confidence, resource optimization, documentation improvements, and, finally,

greater assurance of food safety. (PINHEIRO & SÁ, 2005).

ISO 22000 specifies five elements adopted as essential for a food safety system: system management (food safety system is most effective when grouped into

a prerequisite program (good manufacturing practices), traceability, application of HACCP principles and prerequisite program (ABNT, 2006).

Such requirements allow the food-producing organization to demonstrate the ability to find hazards to ensure that food is safe until consumption (DIAS, 2010).

### Final considerations

The HACCP system, when deployed, enables the company to consider productive processes in a strategic way, optimizing production, reducing costs with analysis, discarding and reprocessing of products, since it is a preventive and non-corrective system. In addition, the HACCP adds value to the company brand and consolidates the credibility of the product in the national and international markets, as it refers to a methodology recognized and accepted worldwide, thus ensuring food safety at all stages of the process, from the acquisition of raw materials to the production of the final product that reaches the consumer.

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the overall administrative activities of the organization), interactive communication (communication between all organization of the production chain, essential to ensure control of all relevant hazards), adoption of

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