

## Food safety / security - biological risk (review)

Paul Moldovan<sup>1</sup>, Cristina Liliana Mitroi<sup>1,2\*</sup>, Gabriel Bujancă<sup>1,2</sup>

<sup>1</sup>Faculty of Food Engineering, Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Calea Aradului No. 119, 300645, Timisoara, Romania.

<sup>2</sup>Research Center for "Food Science", Faculty of Food Engineering, Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" – Timișoara, Calea Aradului 119, 300645 – Timișoara, Romania

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### Background

Human society as a whole is facing a major problem, namely food security/safety, due to its profound implications worldwide. For our country, the acquisition of food security must be a joint action of competent organizations. For more than 20 years, worldwide, but also in our country, significant progress has been made in food security and production. However, there are situations in which the progress of food security is hampered by political and social conditions [1]. Biological hazards are organisms or substances produced by organisms that represent a menace to human health. These are an important concern in food processing, as they cause many outbreaks of foodborne illness. These organisms can affect human health, by infection, intoxication, and even death [5].

**Keywords:** food safety, food security, biological risk, HACCP

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### 1.Introduction

Consumer needs, but also their requirements for food safety, security, and quality, have changed rapidly as a result of globalization and trade liberalization, changes taking place within the global economy, in the structure and authority of government, in the food industries, in the structure of local and global agriculture and trade. In recent years, it has become increasingly important to guarantee food security, which can be done by discovering new solutions that are practically feasible and which, with the help of biotechnology, result in foods with high nutritional value, but also the efficiency of natural resources existing, by realizing the full potential of their goals. The importance of food security and agriculture is an essential area of the Romanian economy necessary to ensure the main public resources and which supports the tracing and finalization of the main elements of the impact, with the idea of promoting agriculture and creating a national, regional and global place among others [1].

The food with nutritional value, from the perspective of food safety, must correspond mainly to three important characteristics, namely:

- be harmless i.e. do not contain toxic ingredients, antinutrients, abuse of additives, do not contain

radioactive substances, pathogenic microorganisms;

- have nutritional quality, given the quantity and quality of the most important macronutrients (carbohydrates, proteins, lipids) and micronutrients (biominerals, vitamins, biologically active substances)
- to have energetic quality [2].
- Food security has several essential characteristics, such as: availability, use and stability of food, versatility of price, population access to food availability.

### 2.Biological risk

A food product is defined as a substance or a product that can be processed, semi-processed, or noprocesed and is used to meet the nutritional needs of consumers. Gum, the water which is absorbed during the manufacturing of products, are considered food. Food safety represent the assurance of quality parameters (chemistry, physics, and microbiology) in foods from the raw material to the final consumer.

The concept of safe food has emerged, and it has been implemented using a variety of technical methods, both modern and traditional, to prevent the

spread of microbiological or physical-chemical pollutants. All steps must be planned for, beginning with the production of the food and ending with the storage and transportation of the food. If the measures are followed, we can assume that (preparation or consumption) a food product for a consumer is not hazardous.

The active production system encourages manufacturing processing of some raw materials and their transformation into foods, as well as international integration of food products and the expansion of current packing and storage techniques, all of which contribute to lower food prices and ensure the availability of sufficient food in countries with a thriving economy, in countries from Europe.

Furthermore, these new technological methods, as well as the evolution of the food system, have not resulted in the creation of more reliable foods in a consistent manner.

The process modernization that allows for the storage and preservation of products at low temperatures, including the use of methods such as lyophilization, sterilization, pasteurization, or UHT (ultra-high temperature), use of preservatives, and exposure of foods to certain radiations, the freezing used since the 1950s, extend the shelf life of foods significantly. Despite these findings, foods can still be contaminated by natural pollutants, including those that are unintentionally added, or by manipulating and transforming raw materials into food [3].

Foodstuff have a quality based on their quality characteristics and are influenced by a large number of factors, demonstrating that a fundamental characteristic, product sterility (sterility), is influenced (unfortunately negatively and frequently) by a number of factors that may be harmful to consumers' health.

To promote a higher level of public health, the European Commission proposes a perspective in which food-safety regulations include the responsibility of producers and responsible authorities, as well as a unique setting for dealing with animal welfare issues.

A new method for ensuring food safety is based on recognition, evaluation, and control of food contamination risks (physical, chemical, and biological) at every stage of the food supply chain [3].

The hazards need to be warned, excluded, or reduced up to a limit that is accepted through unquestionable implementation previously decided measures in order for the product to be fit for consumption. The European Commission has proposed legislation that based on new methods of food safety, such as Regulation (CE) nr. 178/2002 on the establishment of general food requirements and the determination of food safety methods, which has been recognized as a general law on food safety. In Romania, the provisions of Regulation No. 178 have undergone a transformation to ensure that they comply with the requirements of Legislation No. 150/2004, which includes changes to the regulations governing food safety. According to law nr. 150/2004, "operators in the food and feed industry, as well as those in the animal nutrition industry, must take all necessary measures to ensure that food and feed for animals meet the requirements of the law in the areas of food and animal nutrition that are relevant to their operations, to verify that these requirements are met, and to ensure the implementation of a system of food safety management."

HACCP is a system for assessing risks and establishing control systems that focuses on warnings instead of relying solely on finished products inspection.

Food security is a complex and difficulty aspect. Policy makers and food safety authorities need to address many food security issues, usually at once, and resources are automatically scarce to control all issues at one time. Risk classification has been identified as an appropriate starting point for deciding on risk-based priorities and resource allocation, as it would allow policy makers to focus on the most significant public health issues and develop tactics for accessing them. In a science and risk-based structure, food safety provisions should be used in a way that maximizes public health benefits achieved by reducing hazards [4].

The main sources of biological contaminants in food are: fecal infection; soil and water infected with unprocessed manure; cross-contamination (human contamination due to unsafe personal hygiene).

Factors affecting the development of microorganisms in food:

- Temperature values for microbial development belong to the type of microorganism, as well as

psychotrophs including *Listeria monocytogenes* increases at refrigeration temperature (4 °C), simultaneously thermotrophs can increase at higher temperatures (45 °C).

- The pH of a product is determined by the acidity or alkalinity of the product. The pH of the products influences the growth of bacteria. In general, bacteria grow in a pH range of 5 to 9.
- Water activity (*a<sub>w</sub>*) refers to the water accessible in the product. The more water available, the better the bacteria will grow.

Any of these factors is necessary to check microbial development. The development or inspection of microorganisms is caused by the contact between these factors. The most useful way to manage biological hazards is to warn. The introduction of Good Manufacturing Practices guide (GMP), hazard research and implementation of HACCP (Hazard analysis and critical control points) that supports the avoidance of biological hazards and provides an assessment of personnel and environmental hazards during food production. HACCP monitors the hazards that may exist in ingredients and packaging materials, as well as those that occur when processing, packaging and storing food.

Processing tactics for biological hazard verification:

- the thermal processing and her use as destroying phase (eg cooking, pasteurization)
- use of the appropriate process check: processing parameters (eg: temperature and cooking time, the action of water at the time of dehydration); storage temperatures (eg cooler, freezer); suitable cooling mechanism
- useful cleaning and sanitation processes (ex: SSOP)
- operation of food technologies to prevent the growth of bacteria or other biological hazards: packaging methods (such as: use of vacuum packaging, packaging in a modified environment), preservatives; processing methods (eg dehydration) [5].

Biological hazards of food origin include bacterial, viral and parasitic organisms. The food unit includes these organisms that are normally allied with raw products and humans. Many naturally occurring pathogens enter the environment in which food is produced. Many of them are eliminated or diminished by proper cooking, and during

distribution and storage the number is kept to a minimum by proper cooling.

Bacterial pathogens generally include cases and outbreaks of foodborne illness. Excessive temperatures, such as inadequate temperatures to keep warm or cold, may increase this number of pathogens considerably. Cooked foods that have undergone cross-contamination with pathogens frequently present a fertile environment for their agile and progressive growth. An enteric virus can be from food, water or from a person or animals [6].

Biological hazard can occur from the environment or from inappropriate sanitary practices, respectively through contamination during transport, handling, processing and storage of food.

*Microbial toxins* are pathogenic bacteria, fungi, parasites and viruses, which lead to infections and poisoning. The former are caused by the pathogenic microorganism, and the intoxications are due to the toxic compounds (metabolites) generated by these microorganisms.

*Bacteria* are single-celled organisms and are the main cause of infectious diseases caused by eating contaminated food. This is due to the environment in which they can exist, such as milk, eggshell, chicken, fish and seafood. On the other hand, metabolic toxins are composed of relatively high molar masses, especially of the classes of proteins, peptides or lipopolysaccharides.

*Bacillus cereus* is a Gram-positive bacterium that produces two different types of toxins. One is a high-temperature, temperature-sensitive molar protein that causes diarrhea syndrome, and the other is a low-mass, heat-stable peptide that causes heat, which causes stomach pain. It occurs mainly in meat, fish, vegetables and dairy products [7,8].

*Staphylococcus aureus* is a Gram-positive bacterium that is transmitted through foods such as dairy products, meat, chicken, salads. The symptoms are severe but not fatal. Five enterotoxins encoded as follows were identified: SEA, SEB, SEC, SED and SEE. These are actually cytolisines that hydrolyze membrane phospholipids. Enterotoxins A and D cause diarrhea syndrome, vomiting, and enterotoxin B causes colitis [7,8].

*Salmonella* are anaerobic, Gram-negative species transmitted by wild and domestic animals, reptiles, birds and insects. The disease is aggravated by salmonellosis and involves the appearance of sepsis,

enteric syndrome and typhoid fever, the most dangerous form of the disease. It is transmitted through foods such as lightly treated or untreated eggs and meat, dairy products, cheeses, salads [8].

*Escherichia coli* is a Gram-negative bacterium found in the intestinal tract of humans and warm-blooded animals. It causes gastroenteritis and is classified into four groups, with the following characteristics: EPEC enteropathogenic *E. coli* (gastroenteritis and infantile diarrheal syndrome); EIEC enteroinvasive *E. coli* (bacillary dysentery); ETEC enterotoxigenic (diarrhea syndrome) and EHEC enterohemorrhagic *E. coli* (*E. coli* O157: H7 and *E. coli* O26: H11 being the most severe- uremic hemolytic syndrome). Symptoms include abdominal pain, diarrhea, vomiting, fever, dehydration and general discomfort, and contamination is caused by raw meat (beef, pork, chicken), milk, vegetables and fruits, food or water contaminated with feces [1,7-15].

*Clostridium botulinum* causes severe paralytic syndrome. Botulism occurs when eating foods containing botulinum toxin generated by *C. botulinum* (Gram-positive bacteria). It is found mainly in products from fruits, vegetables, sausages, fish and meat, which are not heat treated. Metabolic toxin is a protein with a high molar mass that is sensitive to heat and is lethal (only a few nanograms of such a toxin causes it to improve). There are also seven types of A-G toxins, with enterotoxic, hemotoxic and neurotoxic properties. Toxin F is responsible for human botulism. These toxins can be destroyed at 80 °C for 30 minutes [7,16].

*Vibrio cholerae* belongs to the genus *Vibrio*, which are Gram-negative bacteria that cause cholera. It is transmitted through unheated or improperly treated food (for example, seafood), but also through food and water contaminated with feces. Symptoms include diarrhea, vomiting, abdominal cramps [7,8].

*Shigella* are anaerobic Gram-negative bacteria. The main species are *S. dysenteriae*, *S. flexneri*, *S. boydii* and *S. sonnei*, which generate Shiga toxin, enterotoxic, neurotoxic and cytotoxic. Shigellosis or bacterial dysentery occurs as a result of contact with infected people, flies or contaminated water and food (eg fresh vegetables, salads, melons, raw meat, eggs, milk) [7,8].

*Fungous* or molds are important in producing a wide variety of metabolites. Some of these are useful (for example, in making assortments of

cheese or antibiotics), but they are fungi that produce toxic metabolites known as mycotoxins. Mycotoxins are secondary metabolites of fungi with various structures and various toxicities, and if consumed cause mycotoxicosis. They are generally very toxic and can have carcinogenic, mutagenic and teratogenic effects.

*Viruses* are intracellular parasites, which can also be present in food, but without multiplication. When they reach the human body, they begin to multiply and cause various diseases, some quite serious. The following viruses are worth mentioning [7,8]: Hepatitis A virus (milk, fruit, meat, eggs, vegetables), Hepatitis E virus (contaminated drinking water, contaminated food), Rotaviruses (family Reoviridae), especially affect newborns through contaminated food.

*Parasites* are organisms that need a host to grow. They are transmitted by contact with lightly treated foods (meat and meat products, freshwater fish, snails). It is worth mentioning: *Toxoplasma gondii*, *Cryptosporidium*, *Cyclospora cayentanensis*, *Trichinella spiralis* and *Cestodes* (*Taenia solium* or *Diphyllobothrium latum*) [7,8].

In plants, in addition to the major and minor useful components (proteins, fats, carbohydrates, fiber, vitamins and minerals), there are some toxic components or anti-nutrient compounds, which can lead to various more or less important diseases. They are compounds of secondary metabolism whose consumption can cause adverse effects in humans and animals. It causes mainly gastroenteritis, but also diseases of the central nervous system, some of which can even be fatal. It is worth mentioning: Canavanine, Cyanogenic glycosides, Pyrrolizidine alkaloids, Solanaceae glycaloalkaloids [7,8,15,17,18].

### 3. Conclusion

- HACCP monitors the hazards that may exist in ingredients and packaging materials, as well as those that occur when processing, packaging and storing food [3].
- The factors which lead to the creation of outbreaks, include a lack of quality raw materials, improper handling of food, lack of personal hygiene, storage and transportation of food at inadequate temperatures throughout the food chain.



- Pathogenic microorganisms such as viral bacteria, parasites and fungi can contaminate water and food, which once consumed by humans can cause diseases, some of which are very serious. Humans can also be carriers of pathogenic microorganisms that they can spread on raw or processed foods [19,20].
- Biological hazards are organisms or substances produced by organisms that represent a big menace to human health. These are an important concern in food processing, as they cause many outbreaks of foodborne illness. These organisms can affect human health, such as infection, intoxication and even death. Infection occurs when organisms contaminate the host and reproduce in the body. Intoxication is shown when bacteria produce toxins that damage the body. Infection can be prevented by proper processing and handling of food, because pathogens are easier to destroy by heat. However, some bacteria that produce spores can withstand cooking temperatures.
- Steam cooking can be an example that greatly decreases pathogens that do not form spores, only deactivate spores. Examples of spore-producing bacteria include *Bacillus cereus*, *Clostridium botulinum* and *Clostridium perfringens*. Toxins are created when toxin-producing bacteria exist in fairly large numbers. These toxins are very difficult to remove. Withstands normal cooking temperatures and even temperatures above 80 °C [5].

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