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Food Safety

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Abstract

The provision of mankind with adequate quality and quantity of food has always been one of the most crucial issues in human history. The protection of food and potable water sources, the survival of not only individual human beings but also of mankind depends on the availability of food and potable water. Knowledge about food poisoning had been obtained empirically for a long time, which was then passed on through generations.

As a result of the social, economic and environmental changes over the past century, which often grew global, the importance of food safety has increased considerably with the rise of consumer awareness. At the same time, recent scientific advances have allowed us to learn more about the hazards that characterize food safety. The problems that arise have to be dealt with more extensely, from the field to the table of the consumer.

In addition to giving an introduction to the effects of factors influencing food safety on both the local and global levels, the present chapter also presents facts about food safety. Policy principles and debated issues concerning food safety are discussed along with the ways how food safety is achieved, including decision-making based on risk analysis.

The chapter also explains the roles of the authorities in maintaining food-chain safety and highlights the risks and dangers related to the adulteration of food as well as the deliberate contamination of food (food terrorism).

Keywords: food chain, risk, strategy, food defence, food safety, food security

Introduction

Providing people with food in adequate quantities has, throughout the history of mankind, been a vital requirement in both peacetime and war. Securing food and feed supplies has been of outstanding importance, together with the protection of potable water resources, as the survival of both the individual and, in a broader sense, humankind, has always depended on the availability of food and drinking water. Any other need may only be taken care of when these have been made available (Maslow, 1954).

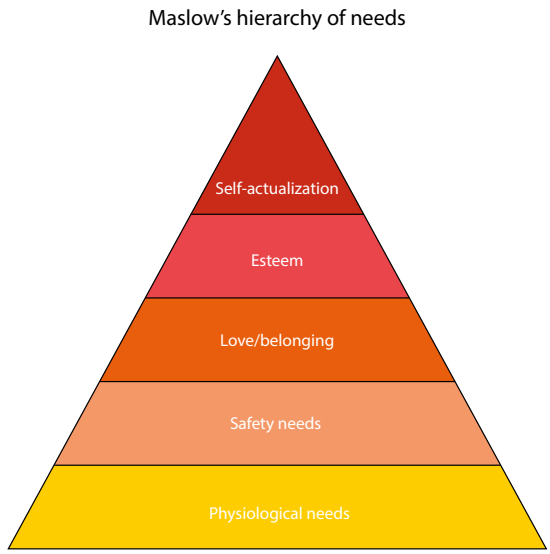

Figure 1
Maslow's pyramid

Source: Maslow, 1954

Knowledge about diseases that came to be associated with food consumption, and the phenomenon of foodstuffs deteriorating to a degree where their instincts forbade eating them, accumulated though experience, in the course of sourcing, storing and consuming food. In the case of sickness immediately or shortly after eating was easily associated with the symptoms as the factor that triggered or intermediated them, although in relation to economic and political conflicts food-borne sickness or even death was often mistaken for deliberate poisoning. In the case of conditions that were slow to develop over a long period of time, it took quite a while before the causal relationship underlying unpleasant experiences were realized.

In the absence of adequate scientific knowledge sometimes it took hundreds of years before the actual cause of a particular disease that came and went like an epidemic was discovered and the necessary actions could be taken. This was the case with deficiency diseases such as scurvy and beriberi, but also in the case of chronic led poisoning, a condition which allegedly contributed to the downfall of the Roman Empire as well, or epidemics, caused by mycotoxins produced by various microfungi, developing slowly but then affecting entire provinces and generations from time to time in history. Other examples include "Saint

Anthony's fire" or ergotism, or the so-called alimentary toxic aleukia, which brought down large numbers of people for example in the territory of the Soviet Union, primarily in the Caspian region, and caused the death of more than 100,000 people, according to estimates (Szeitzné Szabó, 2016).

Changes in social and economic conditions have always raised issues relating to the security of food supplies, highlighting, at the same time, the importance of food safety as well. In addition to adequate quantity, the quality of food was paramount (they should not be spoiled, disgusting or adulterated), and that it should be safe to consume (it should cause no sickness or death). Our predecessors accomplished incredible deeds – even by the standards of our current knowledge – when, without any knowledge about microbiology, based solely on experience and observations, they managed to take enough food for journeys of exploration taking months to complete, military campaigns to conquer distant lands, or long sea journeys. Knowledge was passed down through generations and often ended up enshrined in religious instructions or acts of law of the day. The hygiene of food production and storage has always been taken seriously and those breaking the rules were in for some tough punishment.

Food products have never been as safe as they are today in developed countries, including Hungary; however, the extent of potential risks, and the population's dependence on food supplies, has never been as great as today, as a consequence of world trade, globalization, urbanization and the food chain's energy dependence.

Concepts relating to food-related safety and security issues

Issues of safety and security regarding the food supplies of humankind, or the population in a narrower sense, are closely related to the following concepts:

- *Food security:* the continuous availability and accessibility of safe and nutritious food supplies of sufficient quantity.
- *Food safety:* assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.
- *Food chain safety:* ensuring that the food chain does not entail unacceptable health or economic risks for the individual or society.
- *Food defence:* protection of food supplies from intentionally caused damage.
- *Food terrorism:* intentional contamination or poisoning of food supplies for ideological or political purposes.
- *Food fraud:* illegal altering the composition and/or marking of food products for the purpose of economic or financial gains.

It should be pointed out that in practice there are no clear distinctions between these concepts; they are interrelated and often overlap each other. In a narrow sense of the term, the definition of food safety applies only to the health effects of food products ready for consumption, however, in a broader sense, as in everyday use, it extends to food chain safety, it is mutually interdependent with food security and it covers all activities and effects relating to the production and consumption of foodstuffs. Definitions applying to deliberate illegal manipulation of food products may also apply to mutually interrelated activities,

be discussed in more detail below. Important concepts relating to foodstuffs such as food quality, ethical food production or fair trade will only be mentioned as and when they have to do with safety.

International and domestic situation

Humankind's food production and consumption habits have changed more during the past 50–100 years than during thousands of years before. Supply of food to the population which is constantly growing – and is increasingly exacting – involves mass production of the foodstuffs and their input materials. It does not take long for these products, together with pathogens and toxic substances, to reach virtually any part of the world through the free movement of goods, advanced transports and world trade. *Threats relating to food consumption have reached a new dimension, risks have taken on a global scale.*

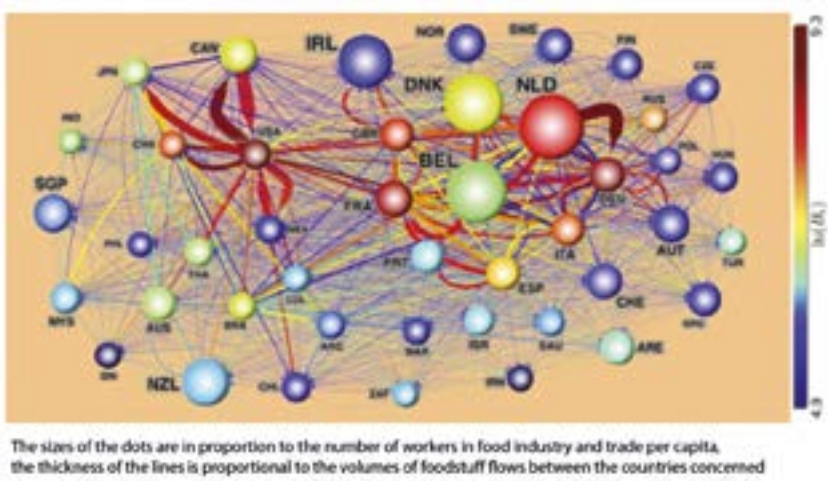

Figure 2

The most important food flows among countries as points connected in a network (USD)

Source: Ercsey–Ravasz et al., 2012

The food chain (or more precisely: the food net or food mesh) is growing increasingly complicated nowadays (Figure 2), with products becoming increasingly more difficult to keep tracks of. Food marketing and distribution is motivated by increasingly wide and complex networks of commercial and economic interests. Production is becoming increasingly concentrated and it takes less and less time for products to reach consumers all over the world. Consequently, the number of people exposed to the treats of deliberate contamination or accidental defects is constantly increasing.

Science has developed new live organisms that previously never existed in nature, and it has produced new types of food and new technologies (e.g. genetic modification, nanotechnology), whose safety is not yet corroborated by experience built up over long

periods of time. Growing environmental contamination appears in our food. On the other hand, we also contaminate our environment by food production and transport. Besides their indubitable benefits, scientific, technological and social progress may even entail new types of threats of global dimensions to our health and the safety and security of food production. New trends also include a growing consumer awareness and increasingly effective activities on the part of consumer interest groups, affecting the food chain and the related actions and developments. Quite often, however, consumers' risk perceptions are not based on scientific facts and groundless concerns can even lead – with the help of the media and the internet – to panic and boycotts of certain types of food or products, or business undertakings.

The increasing prices of growing food and feed production, the increasing food, feed and energy prices, as well as the increasing costs of food safety actions are posing a major challenge. Situations may arise in which the scarcity of food resources or considerations of maintaining food security necessitates a revision of the need for strict food safety actions, particularly decisions concerning destruction from the aspect of the frugal management of food resources.

Factors affecting the situation of food safety

Food safety is affected by a variety of factors, many of which interact with each other. Some of the most important reasons for today's situation give rise to concerns even on a global scale:

1. The pollution of the environment

Human activity today is responsible for gradualy polluting the natural environment. Pollutants may end up in our food and so affect human health. At the same time, the mass production of foodstuffs itself – cropping, livestock production, food processing, trade and the spreading of disposable packaging materials – also contributes to environmental pollution. The contamination of meat products and guar gum with dioxin and the mercury and arsenic contamination of sea fish were alarming examples of environmental/industrial pollutants finding their way into the food chain. Toxins, viruses and bacteria are incorporated in seafood as a consequence of the contamination of seawater, causing epidemics. The pollution of surface waters affects the purity of waters used for irrigation and, consequently the safety of vegetables and fruits.

2. Global environmental and climate changes

Agriculture is profoundly affected by the current global environment and climate change processes. Changes in the global climate may trigger the appearance and drive the spreading of new pests, weeds and mycotoxin-producing microfungi (the amount of mycotoxins produced by mould fungi increases in response to environmental stress and in dry conditions). Floods and droughts reduce crop yields and lower their quality, if not entirely destroying them, potentially causing food scarcity. Due to their genetic variability and short reproductive cycles, pathogens are quick to respond to environmental stress – they adapt to changed circumstances through the evolution of resilient, stress tolerant strains and variants, or ones with changed virulence, or even altogether new forms may appear (Farkas et al., 2013).

Infectious diseases carried by vectors appear to be spreading to new areas (such as the spreading in Europe of the viruses causing the blue tongue disease or the West Nile fever).

Weather extremes have been growing in frequency in many places all over the world as a result of changes in environmental impacts, and this may enhance the loss of soil fertility (erosion). Moreover, improper land use practices trigger soil degradation processes in many places, undermining the security of food supplies, together with food safety itself. Rising atmospheric CO_2 levels on the other hand are causing difficulties in the uptake of certain nutrient elements in various crop categories (papilionaceous plants, cereals) which may lead to symptoms of under-nourishment in billions of people (Myers et al., 2014).

3. Changes in agricultural and food industry technologies

Feeding the growing population with its demand for more and better food is no longer feasible by conventional agricultural production. Rising living standards in developing countries are accompanied by growing demand for foodstuffs of animal origin. Both livestock and crop production have adopted techniques of mass production in the course of which the use of agricultural chemicals, yield enhancers and veterinary medicines entails risks of contamination of both the environment and raw materials of food products and of the consumption of chemical residues together with food. To satisfy changed consumer demand and as automatically entailed by technical development, processes applied by the food industry are changing continuously, new techniques or ones not widely applied hitherto, are being introduced. Technological changes may have sometimes unpredictable consequences as regards food safety. The complexity of the situation is indicated by the fact that changes may appear in the following areas (Győri, 2012):

- increase in average yields in field crop production and horticulture (fertilizers, plant protection products, new varieties, machines, expertise)
- production rate increases in livestock production (feed mixes, new breeds, fisheries)
- concentration of production,
- concentration of processing,
- concentration of the product distribution,
- accelerating urbanization, creation of megacities,
- growing rule of public catering,
- growing importance of logistics.

4. Effects of world trade, free trade and globalization

The food chain is growing increasingly complicated, products are becoming ever more difficult to keep tracks of. Food marketing and distribution is motivated by increasingly wide and complex networks of commercial and economic interests. Production is becoming increasingly concentrated and it takes less and less time for products to reach consumers all over the world. It has been found in numerous cases that the authorities' investigations following the detection of a contamination reveal that the goods had been reloaded, distributed, carried here and there from country to country, repackaged, mixed into other products, processed etc. In this way, clarifying where the goods concerned started out and where they ended up may take so long that in the end it is no longer possible to take timely action (withdrawal, destruction). This is why there is a growing demand for transparency and traceability (Figure 3) in the food chain.

Figure 3
Linkages in the food chain

Source: Raspor, 2008

5. Evolution of gigantic cities, supply centres, commercial hubs and food concerns
Populations worldwide have been growing increasingly reliant on larger and larger factories and food industry enterprises for food supplies, while catering is being provided for by industrial-sized food factories producing an ever increasing numbers of portions. So a contaminated product may bring down large numbers of consumers at the same time. Junctions and hubs, ports, distribution and warehousing centres of immense proportions have come about in the network of international trade and if any of them is terminated or disabled by a targeted attack or a disaster the whole network and supply chain may be incapacitated or collapse.

Supplying gigantic metropolises of tens of millions of inhabitants with food and pure drinking water is becoming increasingly difficult. Mention must also be made of the disposal of waste and wastewater produced in such gigantic cities, along with the threat of epidemics and the extensive distribution – even in other countries' markets – of contaminated produce grown around cities, often irrigated with wastewater. These processes have also been playing a role in the development of the so-called *"urban agriculture*" involving primarily the production of horticultural products as well as the keeping of certain animals (like fish, bees etc.).

6. The food chain's energy dependence
There is now practically no process in the food chain that does not depend on energy supply, that can do without energy. Cropping and livestock production have both become dependent on energy supply. This applies even to reproduction, as artificial insemination and the incubation of eggs also require energy. The transport of raw materials and food products

requires fuel, food production and storage requires electricity. Even retail units cannot continue operating during a power outage. We cannot even imagine our world without refrigerators. Computers, other IT devices, programs, telecommunication networks as well as the world wide net; they all require energy for functioning. Energy supply is, by all means, critical infrastructure; when it is cut, in war, by an act of terrorism or natural disaster, the result is disruption of the food supply and other vital consequences.

7. Changing ways of life

In the wake of efforts made to avoid contaminated food products and endeavours towards healthy nutrition, demand is on the increase among the population for fresh and less processed food products. In some cases this demand leads to a conflict between nutritional advantages and food safety risks. The growing consumption of raw plant parts (seeds, germinated seeds, leaves) creates a new medium for the spreading of infectious microbes. Ecological farming may entail a growth of mycotoxin contamination and the bypassing of food preserving technologies leads to increased microbial exposure. Growth in tourism entails an increase in imported infections. Less and less food is prepared and consumed by people at home, while more and more people eat ready meals and other convenience products supplied by the food industry, eat out or order food deliveries, whereby they are growing increasingly exposed. Exposure is also increased by the fact that less and less food is produced by people for themselves. Household gardens and farmyards are no longer cultivated, pigsties and poultry pens are empty now – even people in villages go to the store for their daily food requirements. Practically nobody is keeping food reserves at home – in towns and in rural areas alike – which would make it possible for families to survive longer periods of time. This is why the protection of infrastructure required for stockpiling food raw materials and food products is a strategic issue.

8. Weakening immune condition

Improvements in living conditions have been accompanied by an increase in the number of people with altered immune conditions, whose resistance to infections has decreased wither because of their age, condition (children, elderly people, pregnant women) or being on medication. The population's resilience is also being eroded by chemicals, alien to the human body, that are present in very small amounts in the environment. The negative impacts of mycotoxins, dioxins and certain plant protection products, are all too well known. By contrast, the immune system may respond to growing exposure to alien substances by excessive activity, allergy and inflammation.

9. Growth in faking and fraud, threat of terrorism

These types of criminal activities have increased in scale, they have taken on international dimensions, causing serious threats. Faking, fraud and intentional food contamination have become a major health hazard that conventional national food control systems find more and more difficult to counter. Chinese import feed and food products adulterated with melanin, have caused the deaths of thousands of livestock and made hundreds of thousands of children sick, as such feeds and food products were exported all over the world. There is a realistic threat of terrorist groups poisoning or infesting feed or food products, to draw attention to their causes or in retaliation.

Food safety facts

It was in 2015 that the *World Health Organization, (WHO)* updated its factual information concerning the situation regarding food safety (WHO, 2015), highlighting the following:

- Access to sufficient quantities of safe and nourishing food is key to life and good health.
- Unsafe foodstuffs containing harmful bacteria, viruses, parasites or chemicals may cause more than 200 different diseases, ranging from diarrhoea to tumours.
- About 600 million people, that is, about a tenth of the total human population get sick each year and about 420,000 people die as a consequence of consuming contaminated food. This means 33 million healthy life-years lost (Sassy, 2006; Phillips–Thompson, 2009) to societies.
- Some 40% of food-borne diseases affect children below 5 years of age, taking the lives of 125,000 each year.
- Diarrhoea is the most frequent symptom of illnesses relating to food consumption, affecting 550,000-1,000,000 people a year, causing the deaths of 230,000.
- Food safety and the safety of nutrition and food supply are inseparably interrelated with each other. Through the interaction between disease and under-nourishment unsafe food threatens the lives primarily of children, the ailing and the elderly (Angulo et al., 1998).
- Food-borne diseases impede society's social-economic development by overstretching the health care system, reducing economic performance and jeopardising tourism and trade.
- The food supply chain has come to be extended over and across national borders many times over. Only close cooperation involving governments, producers and consumers may facilitate a positive shift in the food safety situation.

Strategic considerations

Food safety involves the widest possible range of scientific fields, social groups and societal aspects. A wide range of environmental and agricultural sciences, plant and animal health, veterinary research are related directly to agricultural production, food science and food technology, consumer perception are related to food supply and distribution, along with – in interaction with each of these – chemistry, analytical sciences, microbiology and human health. Also related are nearly all facets of state administration and government, economics, financial policy, social policy, education, industry, as well as governmental and non-governmental organizations protecting consumers' health and interests. *There is practically no scientific discipline or field that would not be directly or indirectly involved in or related to food safety (4. figure).*

Food safety must be examined in a complex way, in its environment, social, economic and nutrition-related contexts. Efficient, coordinated and effective activities and improvements in food safety require a food safety policy backed by the government's commitment and support, and the development and implementation of a single, harmonized national food safety programme based on established, clearly expressed national goals and priori-

ties, taking into account the entire process of foodstuff production, the whole of the food chain, from farm to fork.

Figure 4

Linkages between elements and factors of food safety

Source: Szeitzné Szabó, 2011

International background

Both the World Health Organization and the European Union are strongly urging and promoting the development of national food safety programmes. Consumers are also placing a growing pressure on the governments of their countries for effective actions to ensure food safety.

It was with a view to high level protection of consumers' health, as the primary goal, that the European Union released in January 2000 the document entitled *White Paper on Food Safety*, laying down the basic principles of the Union's food safety and nutrition policy, together with a detailed action plan, broken down into milestones. Its most important content elements – including the basic principles, the establishment of the European Food Safety Authority, the tasks relating quick response to threats and the related communications and actions – were also integrated in Regulation (EC) No 178/2002 laying down the general principles and requirements of food law (that is, the Union's food law), in the form of mandatory requirements. It was in 2002 that the European Union established the *European Food Safety Authority (EFSA),* primarily for working out estimates of health risks relating to the consumption of foodstuffs. The European Union's research projects under framework programmes also lay particular emphasis on food safety.

The new national food safety programme of the USA was launched in 1997 under the title of *(Food Safety from Farm to Table: a New Strategy for the 21st Century).* With the growing threat of terrorist acts, based on the framework constituted by the *Food Terrorism Act*, a variety of major, strict regulations were introduced concerning the controls over imported and domestic products (2007), while year 2008 saw the release of the *Food Protection Plan,* which contains additional strategic elements (US–FDA, 2008).

Of the relevant international organizations both WHO and FAO keeps issuing warnings on a regular basis concerning the importance of food safety. In 1983 the FAO–WHO *Expert Committee on Food Safety* came to the conclusion that the consumption of contaminated food leads to most sickness and diseases all over the world, and that this is the primary factor hindering the economic performance of nations. In year 2000, the WHO *Executive Board* announced, at its 105th meeting, the strengthening and extension of its food safety programme, under the title of *New Food Safety Programme.* The programme urges countries to view food safety as the most essential public health function and allocate the necessary funds to national food safety programmes. It also calls on countries to work out their single, harmonized monitoring and surveillance systems and that they should carry out risk analyses as a basis for their actions, integrate food safety in their ongoing education and nutrition-health programmes and make sure to develop coordinated cooperation with the involvement of different participants of food safety. It was on the basis of the above programme that the WHO worked out and released its food safety strategy in 2002 *(WHO Global Strategy for Food Safety: Safer Food for Better Health).* For the implementation of the food and nutrition policy to be applied across the European Union the WHO worked out a new action plan (WHO, 2008).

Amidst global threats, there was an increasingly urgent demand for an immediate and extensive alarm mechanism and information exchange in relation to threats as they occur. By transforming its earlier systems the European Union put in place its *Rapid Alert System for Food and Feed (RASFF),* with a contact point in every single member state. The WHO also created its global food safety information and alarm system, called *INFOSAN Emergency*, which has been growing more and more intensively over time.

New mandatory *International Health Regulation* has been adopted, covering food safety as well. International strategic activities were also launched to make it possible to produce projections of climate change effects and to enable preparations (with the involvement of FAO, WHO and EFSA) (FAO, 2008). Based on the above international proposals and experience work has been started in a number of countries on developing and implementing national food safety programmes, in some cases in combination with nutrition-related programmes.

Strategic preparations in Hungary

The Working Committee on Nutrition Science of the Complex Committee for Food Science Hungarian Academy of Sciences started working, as early as in 1993, on a study entitled *Recommendations for developing a domestic food and nutrition policy*, which was submitted in 1999 to the Prime Minister's Office and to the ministers involved directly or indirectly in matters of food and nutrition.

Having recognized the importance of food safety, based on similar international a new organization called Food Safety Consulting Body was set up examples in the autumn of 1997 based on a joint initiative of the Ministry of Public Welfare and the Ministry of Agriculture. The members of the body included representatives of the ministries dealing with matters relating to food safety, authorities involved in food controlling activities, bodies of nationwide competencies, scientific institutes, associations, interest organizations and consumers.

Contributing to the elaboration of the national food safety programme was considered to be the new body's first and most important task. To this end, it carried out an assessment of the domestic food safety situation with the involvement of a variety of experts. The assessment under the title of Magyarország élelmiszer-biztonsági helyzete az ezredfordulón (Hungary's food safety situation at the turn of the millennium) was published in 2000 (Szeitzné Szabó, 2000). It was submitted to the Prime Minister's Office and the ministries concerned, in order to enable the development and implementation – based on the assessment – of a *National Food Safety Programme (NFSP)* (Szeitzné Szabó, 2004)

The NFSP was completed – with the active participation of the Food Safety Consulting Body and renowned Hungarian experts – in early 2004, before Hungary's accession to the European Union, and it prescribed the following:

- the basic principles of the national food safety policy,
- the main goals and national priorities.

Sub-programmes were worked out for the various priorities, discussing the domestic and international situation regarding the subjects concerned, together with the relevant issues and tasks, in more detail. The programme was closely coordinated with the objectives specified by UN's world organizations dealing with matters of food safety (FAO, WHO, OIE) and the EU's food safety policy. It conveyed a single, harmonized attitude relating to food safety and it provided an overview, laid down fundamental perspectives, directions and objectives, on the basis of which every governmental and non-governmental participant having to do with food safety could work out its own action plan for its own specific technical/professional area. The programme found its way to the World Health Organization and the European Union, and came to be quoted more than once in strategic documents concerning Hungary. However, it never got to be submitted to Parliament, it received no political support. In this sense it never became official, it was never provided with financial support and did not have to be implemented on a mandatory basis. It fulfilled its mission however, in the sense that it was taken into account by decision makers and other experts in their work and could make good use of its content.

Food safety has undergone changes since the issuance of the NFSP. Hungary joined the EU in 2004, which entailed profound changes in its legal regulation, institution system and the requirements that must be met by businesses. The freedom of movement of goods meant that the earlier system of official authorization (permission) of products had to be dumped. National regulations were replaced by EU rules.

The Hungarian Food Safety Office (HFSO) was launched as the domestic partner organization of the European Food Safety Authority. Primary responsibility was assigned to businesses – they must operate internal food safety systems, however, they are not fully up to such a responsibility yet. The roles of media and communication have grown stronger and more important than ever before and they have assumed an opinion leader function. An

increasing number of food safety incidents made front page news, spreading uncertainty among consumers. The majority of the cases concerned involved deliberate fraud or reckless "money-saving" efforts.

Strategic goals and priorities changed in the new situation. All of these changes necessitated a revision, review and updating of the National Food Safety Programme. This task was undertaken by the Subcommittee on Food Safety of the President's Committee on Environmental Sciences, a committee set up on the basis of a decision taken by the President of the Hungarian Academy of Sciences, in cooperation with the Hungarian Food Safety Office (HFSO). The draft was prepared by staff members and the scientific committees of the Hungarian Food Safety Office as well as representatives of the specific field concerned. It was then discussed by the Subcommittee on Subcommittee on Food Safety of the President's Committee in several rounds. Finally, the draft, supplemented and modified in accordance with the subcommittee's proposals and opinion, got to be accepted. Thereafter the Scientific Advisory Board of the HFSO – its members including representatives of the ministries, authorities and institutions concerned, sciences, interest organizations, civil society organizations and consumers – evaluated and made comments on the draft. In this way, it was based on broad agreement and consensus.

The revised new food safety programme came out with the title *Élelmiszer-biztonság: tények, tendenciák, teendők* (Food safety: facts, trends, tasks to do) (Szeitzné Szabó, 2011), and it comprised the basic principles the food safety policy, the main strategic goals, priorities and the subprogrammes for their implementation. (Table 1).

Table 1

Elements of the food safety programme

The basic principles underlying the food safety policy
1. Comprehensive approach, from farm to fork
2. Consumer orientation
3. Transparency
4. Underlying scientific fundamentals
5. Integrated approach
6. Everybody has a role
Key strategic goals
1. Alleviated negative impact from the environment
2. Reduced contamination resulting from the food chain
3. Transparent and simpler food chain
4. Responsible, well-prepared and fair businesses
5. Effective and efficient, unified, quickly responding officialfood control
6. Coordinated fight against fraud and counterfeiting
7. Wide-spread knowledge about food safety adoption and requirement of high standards
8. Support for scientific research and application of its results and achievements

Subprogrammes towards achieving strategic goals

1. Taking into account all of the complex relationships and mechanisms of food safety
2. *Enhancing and improving microbiological food safety*
3. Enhancing and improving chemical food safety
4. Assumption of responsibility, and review of tasks, of the government and its authorities
5. Enforcement of food industry businesses to live up to their responsibilities
6. Protection of the food chain
7. Affording special protection to vulnerable consumer groups
8. Facilitating the safety of unconventional foodstuffs
9. Improvement of training, education and communication
10. Promotion of research and development in relation to food safety

Source: Szeitzné Szabó, 2011

Each subprogrammes discusses the situation of the given priority theme, together with changes that have occurred since the preparation of the previous food safety programme (2004), the main problems/issues and the proposed tasks, highlighting the ones that need to be implemented with the highest urgency.

In the framework of its strategic programmes launched in its capacity as a public body the Hungarian Academy of Sciences identified the establishment and creation of the domestic conditions and requisites of achieving food security and food safety in Hungary as being one of the dominant issues determining Hungary's future. It was to this end that it decided on the publication of the paper entitled *Élelmezésbiztonság* (Food Security) (Csáki, 2010), discussing its subject based on strategic aspects of Hungary's food economy, rural development and food safety. The chapter on food safety relies primarily on the aforementioned new national food safety programme, in fact, practically citing it word by word.

These were the forward looking scientific papers that constituted the foundations for the governmental strategy which was released in 2013, under the title of *Élelmiszerlánc-biztonsági stratégia 2013–2022* (Food Chain Safety Strategy 2013–2011) (VM–NÉBIH, 2013), adopted by Government Resolution 1703/2013. (X. 8.). The strategy laid down the key objectives and tasks relating to food chain safety for a 10-year period, with guidance on how the objectives should be achieved.

Two key target areas are identified in the strategy. The first is food chain safety knowledge management, aiming at the creation and operation of a knowledge centre, the development of a knowledge network, as well as innovation. The second target area is that of food chain risk management, distinguishing between the surveillance of known risks and the management of unknown threats and risks of unacceptably high levels. In the latter field the strategy lays particular emphasis on the fight against infringements (specifically, against the black and grey economy) and the protection of critical infrastructure systems.

Relationship between food security and food safety

The 1996 FAO–WHO *World Food Summit* defined food security as follows: "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996).

Access in this case means, on the one hand, a physical access – the availability of adequate quantities of food – and, on the other hand, the financial safety that enables actual access to, and the purchase of, foodstuffs. According to the latest FAO report (FAO, 2015) there are still 795 million undernourished or starving people in the world.

Food security is based on three pillars:

- continuous availability of safe and nourishing food in adequate quantities;
- financial background, for accessing food products enabling adequate nutrition;
- availability of basic knowledge concerning proper nutrition, food storage and preparation, availability of hygienic conditions, including safe water supply.

Achieving and maintaining food security is such a complex task for society which is related to health, social security, order across society, under- and over-nourishment, sustainable production and adequate distribution of food and, as such, and in a broader sense, to all other areas discussed in the previous chapter.

Food security is closely and inseparably related to food safety, as is already indicated in its definition: an adequate supply of *safe* food is required. Otherwise an under-nourished body will suffer even more harm as a consequence of the consumption of contaminated food. This is said because in circumstances of food scarcity people will eat contaminated food, bread baked from mouldy grains and the meat of animals weakened by disease, as proven by countless sad examples in the history of epidemics. On the other hand, excessively strict food safety regulations may lead to the disposal and/or destruction of foodstuffs that are still suitable for human consumption. Exporting produce would be vital for developing countries but developed countries are sometimes unwilling to permit such products to enter their markets, with reference to their high standards of and strict regulations on hygiene.

In a broader sense the concepts of nutrition and food security may include food *aid* and food *wastage* indeed, more indirectly, the matter of a *fair trade* as well. Unfortunately, there still are situations, armed conflicts, natural disasters and political upheavals – indeed, the number of such incidents may even be on the increase – where survival can only be ensured by means of aids. The questions to be faced include how to deliver surpluses to those in need, what quality of/how safe food may be donated as aid, how can these be distributed/allocated, how to store such supplies and how can it be ensured that they actually reach those in need. Should they be delivered directly to the needy or to the governments of the recipient countries? Should help be provided in the form of donations or by assisting local farmers/purchasing their produce? And if their produce is purchased, does it qualify as exploitation or what is taking place in such cases qualifies as fair trade promoting sustainability? Another valid question from the aspect of the developed countries and the European Union is whether food prices would remain affordable without agricultural production being subsidize with huge amounts making up a considerable proportion of the entire annual budget.

Issues in dispute

On many issues, even the experts disagree. Opposite positions are held concerning – inter alia – the following:

- is there a real food shortage or there is a sufficient quantity of food but it is poorly distributed;
- can food production keep abreast with population growth in the future;
- is the current forms and level of food production sustainable and can its development be continued;
- should food security to be guaranteed at a national level or is it no longer necessary in the age of global trade;
- is globalization a source or solution of the problem for less affluent areas and underdeveloped economies.

The most heated debates and disputes have evolved perhaps in regard to genetic modification, affecting the security of food supplies, the sustainability of environmental diversity and food safety.

Genetically modified food

As regards genetic modification, particular attention must be paid to assessing the possible effects of genetically modified plants and animals, and the food produced from them, on food security and safety. This is a double-edged achievement of modern technology and whether the benefits or the risks are laid more of an emphasis on depends to a large extent on whether one sides with the arguments of those in favour or those against this technique. This is said because many of the modifications have been developed in pursuit of food safety and security objectives. The development of drought tolerant or pest resistant varieties may contribute to increasing yields and cutting losses. On the other hand, GM organisms may find their way into the environment, alter biodiversity and irrevocably contaminate hitherto GMO-free areas. By contrast, where genetic modification is used for developing produce with seeds that do not germinate complications of a different nature are bound to be faced, also affecting food supplies. This is because farmers cannot reserve seeds for sowing next year, instead, they have to purchase sowing seeds from the large GM concerns again and again, making them heavily dependent on the latter.

The area under GM crops is continuously increasing all over the world, primarily in the US, Argentina, Canada and China. The countries growing GM crops in Europe are said to include Bulgaria, Romania and Spain. The most important genetically modified plant species include soya, cotton, maize and sugar beet, along with, to a lesser extent, tomato and potato. Experimental breeding of genetically modified animals is in progress – the products may appear in practice within a few years' time. GM salmon will soon be on the tables of consumers in the US. Microorganisms with modified traits have long been used for the production of human and animal medicines and enzymes. The latter are widely used all over the world in the production of beverages and in breweries, in the baking industry and in detergents.

First generation GM plants have advantageous characteristics primarily from the aspect of crop production (insect resistance, chemical tolerance, drought tolerance etc.). Second generation GM food products are, on the other hand, created with the aim of satisfying consumers' needs (e.g. increasing vitamin content, removal of allergenic genes). Issues like genetically modified organisms, GMO sowing seeds, cereals and food products, are subject to heated debates across societies today. Environmental and consumer protection groups and organizations oppose the production, processing and integration in the food chain of genetically modified organisms, GMO plants and cereals, because we have no adequate knowledge yet of their impacts on the environment and human health.

Extensive public opinion surveys, carried out in numerous countries, have clearly established that most people are against, and unwilling to accept, GMO food. Those opposing the technology argue that GMOs may pollinate/fertilize related species and thus make organic farming impossible, carry risks of evolution of "super weeds' and jeopardize biodiversity. Research and studies into the impacts of GMO technologies on the ecosystem are being carried out. The agro-biotechnology business and multinational enterprises promote the technological and economic benefits and advantages offered by GMO cropping. Indeed, they even employ an economic pressure to have GMO production and marketing licensed as quickly as possible. Science is not yet in a position where it could take a clear stance concerning negative effects on human health or the environment that could be attributed to GMOs. Therefore – emphasising the so-called precautionary principle – the European Union applies a strict case-by-case licensing process in regard to such products.

It was relatively early, back in 1988, that Hungary adopted an act of law on activities involving genetic technologies and the adoption of the act was quickly followed by that of its implementing decree. The legislation was in line with the effective EU regulations and as a result of its amendments introduced in 2002 Hungary's accession to the European Union was a smooth process in regard to these regulations. The bone of contention today is whether a country has a right to prohibit the production of any GM crop or livestock. Since recombinant DNA technology itself only dates back to a few decades (and its products have not been present in the environment even that long), studies of its complex and extensive interactions have only just begun, and perhaps we cannot even see the whole extent of the area to be explored.

The consumption of genetically modified plants and food products made from them may, theoretically, have a variety of negative impacts on human health – similarly to plants not genetically modified, among which one also finds poisonous and allergenic ones. While however, it has taken centuries for mankind to choose those of the conventional plants that are safe to eat, we have precious little experience in relation to GMO crops. Theoretically, their consumption may, in the long run, be adverse to health: it may cause allergic responses, promote the propagation of bacteria that are resistant to antibiotics, or lead to other health impairment.

As regards the GM plants currently licensed to be produced and marketed in the European Union the institutions issuing the licences found that no such risks are to be faced in the case of the plants and product concerned and no health issues have been encountered in practice in association with the consumption of such licensed products. However, in the case of radical interventions such as changing the genome, consequences not expected even by scientists specialising in the given field may occur, or whose effects take a long time to

appear. Consequently, licences for GMOs must be renewed from time to time (once every ten years, under the current regulation).

It is not possible to make general statements concerning the safety of GM products; it varies from case to case, depending on the specific GM food product concerned. GM food products on the international markets have undergone risk assessment and been found to be unlikely to carry any risk to human health. Judgements of the safety of GM food products must be based on continuous risk assessments as in line with the principles laid down in the FAO–WHO *Codex Alimentarius* and be based on traceability, once on the market.

In addition to possible health effects a variety of *environmental concerns of economic importance* need to be discussed in relation to GMO-containing products. The key argument of countries calling for the banning of the production of genetically modified plants is that GM plants carry a major environmental risk to their natural values. Concerns that have been identified include, among other things, gene flow (escape), the transgene's potential integration in wild populations, the gene's retaining its activity after the GM plant's harvest, vulnerability of non-target organizations to the gene product (e.g. insects that are not categorized as pests), gene stability, the decrease of other plants' habitats, including loss of biodiversity and the increased use of chemicals in agriculture. GM plants' environmental safety considerations vary considerably depending on local conditions. Research projects currently in progress are aimed at possible negative effects on useful insects, on the accelerated evolution of resistant insects, the possible development of new phytopathogens, possible negative consequences affecting plant diversity and wildlife, or, in some cases the reduced frequency of the application of crop rotation and the transfer of genes carrying chemical resistance to other plants. Economic, social and legal aspects of GMO-related issues also need to be discussed.

With a view to the above concerns and uncertainties, in line with the precautionary principle, Article XX of Hungary's Fundamental Law provides as follows:

> *"(1) Everyone shall have the right to physical and mental health.*
>
> *(2) Hungary shall promote the effective application of the right referred to in Paragraph (1) **by an agriculture free of genetically modified organisms**, by ensuring access to healthy food and drinking water, by organising safety at work and healthcare provision, by supporting sports and regular physical exercise, as well as by ensuring the protection of the environment."*

Food-safety

In a narrow sense, food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. (CAC, 1969). In a broader sense, the concept covers the entire process, from farm to fork, who's adequate and closely monitored operation results in safe products landing on the consumer's dinner table. Food safety is not merely a strategic issue affecting only our health; it also affects our economy, the marketability of our products, the international perception of our country, the welfare of all of us and the future of our children. The existing food safety situation may only be maintained and improved through extensive domestic and international cooperation, based on strategic principles and goals, with strong governmental commitment.

Food production and marketing are important economic activities, the primary aim of which is – besides profit making – to supply the population with sufficient quantities of safe food products of a quality accepted by consumers. Food consumption – taking meals – is an important part of the lives of both the individual and the society as a whole. Through the continuous supply of the necessary energy and the body's building blocks, basic nutrients, minerals and other essential components of foodstuffs are the source of a sustainable good physical condition and health. In addition to this, eating is one of the primary sources of joy, one of the pillars of family ties and social relations. For these to be true, there needs to be a supply of high quality, healthy and safe food of adequate quantity for both the individual and the society as a whole, together with social customs and traditions promoting the consumption of healthy food in adequate quantities and of suitable compositions, as required by the human body.

Foodstuffs, may, however, have negative impacts on the health of both individuals or entire populations. The following main types of adverse health effects may be distinguished:

- Problems developing in the short or long term as a consequence of the contamination of foodstuffs (infections, poisoning, late inflammatory diseases and tumours that can be traced back to food consumption).
- Ailments developing as a consequence of the body's individual responsiveness and/or health status (allergy, intolerance, chronic gastrointestinal diseases).
- Nutritional problems that can be traced back to the consumption of too little or too much of various food components or to the inadequacy of the quantity of the food-intake.

This is a complex issue: food security mutually interrelated with responses and lack of trust among people, which necessitates both national and international actions, together with raising awareness of the fact that the safety and the nutritional aspects of food consumption are often mutually, sometimes inseparably, linked to one another. Although health issues and chronic illnesses resulting from inadequate nutrition are likely to be placing a significantly heavier burden on the society as a whole in developed countries than diseases caused by inadequate food safety, the latter, however, may lead to acute, disastrous health situations and economic crises a lot more quickly, in some cases in just a matter of hours. However the European Union has, quite rightly, adopted regulations not only for the prevention of food induced epidemics, infections and poisoning but also the management issues such as the production of foodstuffs for people suffering from food allergies and people in need of special nutrition or diets, together even with other nutrition-related problems.

Food safety and its importance

The formally accepted definition of ***food safety*** as noted above may suggest that there is such a thing as completely *safe food.* Nonetheless, professionals and experts have always been aware of the fact that the safety of food may only be something relative. One of the most fundamental demands of consumers in all societies that the government should guarantee safe food supplies, however, food cannot be always safe for everybody – as has been proven by recently uncovered cases in which the given food product could not have been

prepared in any way safer than it actually was, at the given level of knowledge and technical development. Two basic categories of food-borne hazards are distinguished: the ones we know something about, and the ones that are hitherto unknown. At the time of consumption before 1996 nobody knew anything about the potential dangers of disease caused in the human body by eating beef infected with BSE, or about the human health effects of dioxin mixed in to chicken feed. Therefore, if we want to be honest and wish to achieve the highest possible target, we must say that *we want to produce as safe food product as can be possibly produced in the given circumstances, taking into account the society's resources as well.*

Unsafe food

In the process whereby the European Union adopted a new food law and released new decrees on food hygiene several attempts were made at working out a definition for food safety and the issue was extensively discussed. However, the European Union decided – probably in view of the contradiction inherent in the FAO and WHO definition and the impossibility of its legal enforcement (in that no food that can be proven to be completely safe exists) – to *work out a definition for unsafe food*. The new food law adopted in January 2002 (Article 10 of Regulation (EC) 178/2002 provides that "Food shall not be placed on the market if it is unsafe".

Two criteria are specified in the regulation as the conditions to be met for food to be safe:

- on the one hand, it must not be harmful to human health with a view to continued processing, use and consumption;
- on the other hand, it must not be unsuitable for consumption for any other reason.

The importance of these stipulations lies in the fact that in many cases it would be difficult to scientifically prove that food that is deteriorated, disgusting or otherwise inadequate, is actually harmful to health. In this way, however, it is clear that such products cannot be marketed either.

Ways of achieving food safety

General rules on food hygiene, guidelines, instructions

One characteristic of the second half of the 1990s was that *general food hygiene guidelines* were incorporated in every country's food legislation. These guidelines were applied in an attempt of bringing together all of the general rules ensuring the best ways for establishing and operating food producing plants as well as commercial and catering units. However, it is not possible to work out all regulations on all products in minute detail. Serious mass food infections started out in some cases even from the finest units, kept clean and operated in accordance with the applicable general rules, as a consequence of such minor, seemingly negligible errors, as inadequate washing of hands after cutting poultry or insufficient heat treatment of one or another product. This is what happened in the case of the salmonella infection that broke out in Budapest on 6 June 1996, bringing down some 5,000 children,

landing nearly 1000 children in hospital, causing a disastrous situation in the Hungarian healthcare system.

HACCP system – enforcing the responsibility of the producer

The development and spreading of the *HACCP system* meant a new way towards achieving food safety. HACCP is the acronym of the name of the system in English (*Hazard Analysis and Critical Control Point).* The HACCP system was developed in the 1960s by NASA as part of its space exploration programme, to guarantee complete safety of astronauts' foodstuffs. From this angle the term "hazard" includes any and all contamination, foreign substance (e.g. bacteria, viruses, chemicals, physical contamination) or the condition/state of the food which may entail a potential risk to its consumer.

The HACCP system is a special regime developed for the prevention of health impairment caused by food-borne materials/substances that are harmful to human health. To provide for the safety of foodstuffs it is focused on how hazards come about and how then can be prevented or averted, examining the technology and the circumstances of processing individually (by product and process). In practice, it may be regarded as an individual safety plan concerning the product and/or technology concerned. In the course of its application where food is prepared the critical points of the given product/technology must be identified and the control and actions must be focused on the points so established.

The HACCP method eliminates actions that are carried out only as a matter of routine without actually adding to safety, together with any unnecessary checks, and it focuses attention to the real problems, keeping those steps under control that are really important, the ones that may lead to food-borne diseases in the case of the coincidence of specific circumstances. With its simple, logical and methodical applicability and palpable benefits it was quickly adopted by participants of food production. Its spreading was greatly accelerated by its formal recommendation, and publication among its documents, by the joint FAO–WHO Codex Alimentarius Committee. Thereafter both the European Union and other developed countries integrated it in some ways and to some extent in their own food regulations.

In applying the method, after the description of the attributes of and technological process every single technological step must be examined from the following aspects:

- What realistic hazard (biological, microbiological, chemical or physical) needs to be expected in the case of the given step during the course of preparation (manufacturing) and/or distribution?
- Is this hazard reliably eliminated by any subsequent step of the technology?
- If the hazard is not reliably eliminated by the technology, it must be checked whether the product can still be manufactured by applying supplementary actions and their continuous supervision.
  - If it can, the technological step concerned qualifies as a critical control point where continuous control must be provided for. In this case the control parameters of safe production must be established for these critical points, and then kept under continuous surveillance.
  - If this is not possible, the manufacture of the product must be abandoned because it cannot be safely produced.

The system also includes a registry of the checks carried out on the critical control points, certification of the adequate functioning of the systems and the provision of the employees with the necessary training.

Decision-making based on risk evaluation

Given the fact that food safety is, in terms of its purpose, a matter of human health, it must also be noted that health safety entail very substantial *economic implications* as well. As a consequence of the growth of world trade, and globalization, the free movement of goods has also been expanding to a global scale. The World Trade Organization *WTO* stipulates that the freedom of movement of goods may only be restricted on the basis of sound, scientifically validated reasons (WTO, 1995). Such reason may be found with the help of risk analysis.

The basic documents of risk analysis were worked out by the FAO–WHO Codex Alimentarius. Risk is a function of the likelihood of the occurrence of an effect causing health impairment, that is the consequence of a hazard, and of the gravity of the effect. It should be emphasized in relation to the definition that the process of risk analysis for food safety that it may only be interpreted with a view to the prevention of health impairment – as the most important goal – while taking into account the realistic possibilities and the requisites of feasibility.

Risk analysis is a combination of the closely integrated constituent (part) processes of risk assessment, risk management and risk communication. These are often supplemented by a fourth influencing factor: that of consumer risk perception. The processes of risk assessment, risk management and risk communication are summed up in Table 2. Consumer risk perception is not officially a part of risk analysis under the Codex system, therefore it is not included in the table. The part processes are not sharply separated from each other.

Table 2

Processes constituting risk analysis

Risk assessment	Risk management	Risk communication
Hazard identification	Risk identification	Between risk assessment and risk management officers
Hazard description	Review of possible alternatives of responding to the risk	With a wider range of stakeholders
Assessment of exposure to hazard	Execution of chosen alternative	With consumers (with the involvement of the media)
Description of risk	Monitoring of execution and review of effectiveness/efficiency	Feedback to government

Source: Szeitzné Szabó, 2000

Risk assessment

Risk assessment must be based purely on scientific knowledge; it cannot be affected by industrial, commercial, governmental or market protection interests. Its aim is to establish the extent to which the hazard concerned (e.g. bacteria, chemical) is present in the food and what degree and extent (acute, sub-acute or chronic) risk it poses to the population depending on the amount of the food consumed. The result of the risk assessment may – ideally – enable the establishment of that amount of the material concerned (hazard) that does not lead to health impairment, even if consumed regularly in the long run. If no such threshold can be established, the risk assessor explores quantity relationships between the extent of the hazard present in the food concerned and the consequential health effects. It is an international requirement that scientific risk assessment must be independent, and separated from risk management.

Risk management

Risk management is the entirety of all activities aimed at preventing, eliminating or mitigating the identified risk. Risk management tools include the introduction of legal regulations, the setting of thresholds and limits, the operation of a control networks, imposing obligations to perform itemized checks and, in the case of acute danger the blocking and destruction of products, together with the introduction of other actions by authorities. The list of possible actions that could be applied has to be reviewed and then the most suitable one have to be implemented. The effectiveness of the selected option(s) has/have to be monitored and, if necessary, changes have to be made. In this process the various influencing factors must already be taken into account, together with the conditions and requisites for the performance of the actions, their likely effects and their costs, and the society's resources and capacities. Risk management is primarily a governmental task but managers of food businesses also play a major role in it, through the effective operation of internal controls and full compliance with the applicable regulations.

Risk communication

Risk communication ensures the necessary flows of information and the contacts among organizations, institutions and persons in any way involved in or affected by the risks concerned. Rather than being a one-way process, it is an interactive exchange of information and opinions, concerning hazards and risks, the possibilities of mitigating risks, among risk assessors, risk managers, consumers, food processing and feed producing businesses, the scientific community and other stakeholders. Accordingly the process of risk communication involves scientific consultants, decision makers (government, central authorities), those implementing decisions (regional bodies of authorities, laboratories), those affected by decisions (industry, trade, catering) and consumers, usually attracting extensive media coverage.

Risk communication has become an at least as important element of the risk analysis process, as are risk assessment and risk management, from which it is not separable (Figure

5). For this reason, instead of the conventional three interlinked circles (on the left hand side of the figure) this system is illustrated showing up risk communication as fully embracing the entire process (as is presented on the right hand side of the figure).

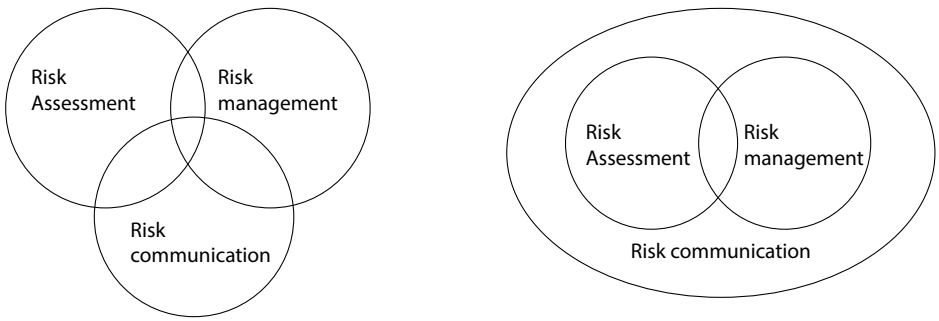

Figure 5

Relationships among the processes involved in risk analysis

Source: Szeitzné Szabó, 2000

Consumer risk perception

Consumers' risk perception has been changing; people are growing increasingly concerned about food safety. The provision of scientifically sound information, if properly carried out, may make valuable contributions to raising society's food safety culture, to raising the standards of food safety and to reducing food-borne diseases. Information withheld, or mistakes in the communication of information however, make consumers uncertain and, by triggering panic responses, it may lead to the immediate loss or collapse of the product's or producer's market. Consumers' growing concern and distrust is clearly indicated by the findings of public opinion surveys.

According to *Eurobarometer 49 Food Safety* the majority (68%) of consumers in the European Union have concerns about food safety. As regards the credibility of the information supplied to them, consumers trust consumer protection organizations the most (one in every two consumers). One in five consumers trusts their national governments and one in five believes what the EU institutions have to say to them. Food producers are regarded to be the least trustworthy (one in eight believes them) since people are convinced that they are more interested in selling their products than in making them safe. Consumer opinion is something decision makers cannot afford to disregard. This is because consumers are at the same time voters when it comes to elections; by casting their votes they make sure that the government in office cannot forget that if it wishes to continue in office it has to respect what consumers want.

The authority's role in maintaining the safety of the food chain

Food safety – which, in the broader sense of the term, comprises also the actions to be taken across the entire food chain to ensure the safety of the end product – is one of the few functions over which comprehensive, regular and tight EU and national supervision and control is exercised, one that is nearly entirely governed at an EU level, by regulations. The system of food chain control has undergone major changes in Hungary. Year 2003 saw the establishment of the Hungarian Food Safety Office (HFSO), whose key tasks – besides risk assessment at a national level – included the coordination of the system of institutions involved in various specific fields of food control, operating under the supervision of different ministries. Hungary's EU accession was followed in 2007 by the closure, transformation and/or merger into the Central Agricultural Office (CAO), of institutions dating back to decades, or even a century or so. The two institutions were merged in 2012 to create what is now called the National Food Chain Safety Office (NFCSO), overseeing the entire food chain in Hungary, together with even other areas that are only indirectly linked to the food chain, performing the tasks of the competent authority regarding the controlling of the food chain, in cooperation with the competent departments of the regional government offices. Regular on-site checks of the adequacy of controls exercised by national authorities are carried out from time to time by the European Union's competent office, the *Food and Veterinary Office* (FVO).

RASFF system

Close cooperation among member states is enabled by the *Rapid Alert System for Food and Feed (RASFF)*. The RASFF was put in place by the Union's food law, Regulation (EC) 178/2002. All of the existing member states, the European Commission, particularly its directorate general in charge of food safety and consumer protection (DG SANTE), the European Food Safety Authority (EFSA), and the member states of the European Free Trade Association (Iceland, Liechtenstein, Norway and Switzerland) participate in the system. In every Member State one institution (national contact point) was designated. The centre of the RASFF system in Hungary is the National Food Chain Safety Office, performing on-duty service tasks and those of being in readiness, in a 24 hours/7 days system.

The system is in place for receiving notifications of actual or potential health risks entailed by food or feed products, where it is possible that the product has been transported to other member states as well, or the notification may carry valuable information for other member states for any reason. Four types of notification may be made: alarm, information notification, border rejection notification and news. An alarm is sent when the authority has detected a major hazard, the product concerned is on the market and immediate action is required. The adequate operation of the tracing systems plays a particular role in the investigation of cases. This is because every food industry undertaking is obliged to operate a tracing system, that is, to keep records of every product delivered to and from its premises. Even so, it often takes a long time for identifying the movements of a given product through multiple stages of processing and transports, as a consequence of the complexity of the food chain.

Since the system has been put in place to keep tracks of and to enable the withdrawal of products that are potentially harmful to human health, the creation of a separate network for the investigation of fraud and counterfeiting, with no immediate hazard to human health, is in progress.

Intentional food contamination, counterfeiting and fraud

While the authority's controlling activities are in place primarily to monitor officially operating businesses, their compliance with the applicable statutory regulations, and known risks, detecting and investigating deliberate covert and illegal activities is a specific challenge and is not part of the daily routine. In this case the tasks are shared by criminal investigation authorities, tax and customs authorities and food control.

Deliberate actions may be categorized as follows:
1. Food counterfeiting, fraud
Food counterfeiting and fraud is manipulation of foodstuffs, exclusively for illegal *gain.* While doing so*, the perpetrator endangers life and health* but that is not his goal; that is only a "side effect" not intended even by the perpetrator, because it draws attention to his activity. Today, however such "side effects" may endanger large numbers of people. Recent cases of food contamination have proven that contaminated foodstuffs may be quickly delivered to markets all over the world, it may be incorporated in a great variety of other products and then make large numbers of people ill. Some 20,000 people got sick and 800 died after the use of "bleached" industrial oil sold for cooking oil in 1981 in Spain. A milk-based baby food product contaminated with melamine made some 300,000 children sick in 2008 in China. One example from Hungary was a case of domestic ground paprika contaminated with a lead-containing paint, which got entire families to hospital with lead poisoning. There are cases of counterfeiting that cause only *economic damage* through reduced quality, or undermine a company's good reputation. Such cases include re-labelling, re-packaging and the sale of a product of inferior quality as a premium product, or the sale of conventionally produced product as organic food. One domestic example of this kind of fraud was the sale of pork, after artificial colouring, for tenderloin, some of which even made it to foreign markets.

2. Intentional food contamination
In the case of intentional food contamination the perpetrator's definite purpose is to have the product *make the consumer sick*. This category includes cases motivated by political, religious or moral conviction along criminal acts committed for other, individual motives. Malicious food contamination is a practice with a long history, as is indicated by the expression *food poisoning,* which is still commonly used for all food-borne diseases. Poisoning food and drinks could be family dramas and criminal acts affecting a handful of people, but this kind of poisoning has, from the very beginning, been also practised for political ends. It was not a simple coincidence that food tasters were to be found in all rulers courts in the middle ages. Opponents at war often resorted to destroying each other's livestock or crops,

poisoning wells, springs or food resources. Such news and accusations are to be found on the world wide web even today.

3. Food-terrorism

According to the definition adopted by the World Health Organization food terrorism is "an act or threat of deliberate contamination of food or water for human consumption with chemical, biological or radionuclear agents for the purpose of causing injury or death to civilian populations and/or disrupting social, economic or political stability" (WHO, 2002: 1.). The threat of food terrorism exists today as well. On 17th January 2002 the WHO Executive Board adopted a resolution (EB 109.R5), recognising the importance of protecting the safety of foodstuffs as part of the wide response to be made against malicious and harmful use of biological, chemical and radioactive materials.

The WHO warned that the deliberate contamination of foodstuffs by terrorists is a real and present treat and contamination at any point of the food chain may result in extensive, even global, health consequences. Such threats today are of an even higher scale than before, due to mass production and global trade. Technical possibilities have also become much more advanced and poisonous and infectious substances and materials are now very easy to come by or produce. Such substances can be accessed via the internet, where all of the information required for would-be perpetrators is also readily available. The perpetrator's intent is generally still hidden when the infection or poisoning occurs, or at the time of its threat – this can only be clarified by investigations or the perpetrator's admission, or reports received by the authorities concerned.

Terrorism itself is usually politically motivated, but sometimes there are other causes (e.g. religious motives). Food terrorism is rarely driven by political motives, but products of a chain store or a food manufacturer are more likely to be poisoned – or such threats are made – causing major economic and moral damage and potentially even panic among the population. Threats or endangering are increasingly frequently motivated by blackmailing, the intent to take vengeance, but these may even be acts caused by lone individuals with mental problems.

Entire food product lots or deliveries are difficult to infect or poison, therefore the likelihood of such an occurrence is relatively low. Possible acts of food terrorism are nonetheless of outstanding importance because besides causing acute disease such acts may threaten with the escalation of food scarcity to serious scales (CDC, 2000). Panic may also be caused when only part of the food supplies is endangered but the potentially infected or poisoned product or lot cannot be identified so consumers reject all similar products. Targeted acts of terrorism may even be aimed at livestock, arable lands or feed and jeopardize food supplies by triggering epidemics in livestock or destroying crops.

As for the procedure and protection, similar methods need to be applied for the prevention, investigation and termination of all kind of deliberate cases of contamination. For this reason, all cases of intentional food contamination must be regarded as food terrorism, from a technical/professional aspect. Governments and food industry enterprises alike, must get prepared for preventing and averting the possibility of intentional food contamination. The vulnerabilities of infrastructure systems and businesses must be assessed and then action plans and communication plans must be prepared and rehearsed in simulation exercises in case a crisis develops.

Preparations for countering food-terrorism

Each of the government, international organizations and food industry enterprises should have its own specific set of tasks in the preparations.

The conditions and requisites for effective *governmental preparations and defence* include:

- Strong and properly functioning public health system, in close cooperation with the curative network;
- Effective surveillance system incorporating elements of symptomatic surveillance.
- Strong and properly functioning food chain control system that is also prepared for taking actions in case of emergency as well.
- Well-prepared laboratory system that is capable of detecting rarely encountered pathogens and chemicals that are not normally present in foodstuffs and of simultaneous processing of large numbers of samples, and that is connected to the rapid alarm system.
- Extensive cooperation across food chain controlling and health organizations, as well as other (disaster management, criminal, agricultural, environmental etc.) authorities and organizations concerned.

As for the activities of *international organizations* mention must be made of the WHO recommendation (2002), according to which the hazard of deliberate infection and poisoning of foodstuffs may be alleviated by adhering to the rules of the good practice relating to the operation of food safety systems, but the possibility of a deliberate threat requires specific consideration and analysis. To ensure quick communication on food safety incidents the WHO is operating a global system called *INFOSAN Emergency.* Its contact point in Hungary is the National Food Chain Safety Office. At an European level the aforementioned rapid alarm system called RASFF is also in place for immediate communication concerning food contamination or infection.

Food defence is part of the responsibilities of businesses. Due to the nature of the problem the use of the current technologies applied in the area of primary food production and processing and the tools available for prevention does not result in complete safety from intentional food infections and contaminations. Every unit, particularly large enterprises engaged in the production and marketing of food products and units of outstanding importance from the aspect of critical infrastructure must get prepared for such occurrences. They must work out preparation plans for the prevention of occurrences, together with action and communication plans setting out tasks to be carried out in crisis situations, to prevent or respond to panic.

General food safety considerations must be part of the attention paid to the threat of deliberately caused infection and poisoning. The methodical approach to be chosen should include an analysis of the main phases of production from raw materials up to the end user, with a view to the possibility of threats that may be caused deliberately. Making operations safer and the performance of more effective and efficient quality controls is highly likely to be capable of reducing the possibility of deliberate infection/poisoning with the help of the preventive systems, which will thus be more difficult to interfere with and by which the likelihood of detection will be higher.

The key elements of the food defence plan

To enhance safety the WHO recommends the application of the following actions that can be integrated in the general food safety systems in the area of food production and marketing:

- preparation of special safety plans in which the points in the product chain that are most exposed to deliberate contamination are analyzed;
- obtaining a reasonable quantity of information on the origin, storage and transport of the raw materials delivered to the company, checking the integrity of the packaging upon receipt of delivery;
- restriction of documentation of access to places regarded as critical from the aspect of terrorist acts, including manufacture, storage and transport;
- closing processes of production to the extent possible, and as reasonable from the aspect of technologies and hygiene;
- employment in production of staff with adequate qualifications for the tasks to be carried out, who are provided with adequate training and controlled to the extent necessary and possible;
- monitoring of other persons (internal and external) accessing the areas of production, prominent identification and accompanying of persons on the premises;
- choice and use of packaging that indicates unauthorized opening, together with impairments;
- introduction and operation of an effective product withdrawal system;
- ensuring product traceability across the whole of the production chain, facilitating product withdrawal and the investigation of the origins of suspicious lots/batches or input materials;
- In addition to the above actions consideration must be given to all reasonable possibilities for minimising the hazard of subsequent infection/poisoning of the finished product.

The majority of these actions have already been integrated in good manufacturing practices and internal quality management systems (e.g. ISO 22000) applied at multiple factories.

Actions proposed to take in the case of an occurrence

Preparations must be made to the unwelcome case of the food chain or any of its elements being actually attacked or any food product being intentionally contaminated or infected.

1. Preparation of action plan
A business should prepare a detailed action plan covering all material aspects, setting out tasks to be carried out upon a suspected case of deliberate infection/contamination of its products. The plan must include prompt actions to be carried out concerning the lot/batch concerned (blocking, separation), checking the information received, organization of the process of product withdrawal if necessary, notification of the authorities and information of the media. It is key that persons responsible for the performance of each of the envisaged activities be identified and appointed.

Active cooperation with the authorities should also be regulated as part of the disaster response/recovery plan. Threats and suspicious activities must be notified to the competent authorities and the national security organizations. Efficient and quick exchange of information with the authorities should be organized in order to enable the blocking of the entire quantity of the endangered food product as quickly as possible on the basis of adequate assessment of the evidence and risks. The authorities themselves must also prepare their own crisis management and communication plans, including tasks to be carried out in relation to such situations, and keep such plans up-to-date through regular exercises.

2. Consumers' role in case of suspicion of deliberately caused food safety hazards
Consumers also have a role in detecting and notifying deliberate or accidental contamination. If the packaging of a product is not unimpaired or if its external appearance, smell or taste differs is other than it is normally, it must not be consumed. If the product is suspected to have been tampered with, the retailer or the supplier, as well as the competent public health authority and the criminal investigation authority must be notified.

3. Communication in the case of a threat
Communication with the media and the public is expected from the government, the producer and the distributor alike, to enable the management of concerns and any rumour. Panic and hysteria may have much more serious consequences to healthcare sector, industry or trade than the actual terrorist threat itself. On the other hand, hiding information from the public may result in loss of confidence in the government, public authorities and the producer/distributor. In view of the above, no effort must be spared to make sure that information be comprehensive and honest.

Worries about terrorist attacks and the risks of unfounded rumours must also be taken into account in the management and communication of the threat/emergency. The sense of being threatened is likely to linger on for quite a while after the occurrence, whether or not it was followed by diseases. For the delivery of his "message" the perpetrator may find it more important to disrupt public life and the day-to-day routines of the population than the number of people actually infected or poisoned. Accordingly, efforts must be made during communication to make sure that the provision of information is not turned unintentionally into a means promoting the terrorists' goals. Such communication methods must be elaborated and applied that provide the necessary information as required for public safety but cannot contribute to raising panic.

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