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International 58th Meat Industry Conference "Meat Safety and Quality: Where it goes?"

New trends towards more effective food safety control

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Abstract

Sufficiency of safe and prime-quality food is one of the priorities of modern society. In meat production, an important measure to prevent zoonotic agents being transferred from animals to humans via meat is modern meat inspection. Systems for food safety assurance at the level of food producers include HACCP and GMP. One of the methods for validation and verification of GMP and HACCP systems is the implementation of process hygiene criteria at slaughterhouses. In case of the occurrence of foodborne disease, reliable and fast methods for detection of the causative agent are necessary.

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1. Introduction

Nowadays, food safety is a priority when producing food. Based on the current knowledge and diagnostic possibilities, food safety means the food does not contain pathogens or chemical contaminants in amounts which could induce an illness in a person. It means that food must conform to the conditions given by food legislation. In

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contrast to food safety, quality of food is "harmless to health" (has no effect on health), although it also means the food meets the typical standards characteristic of a particular product.

1.1. Food and Food Safety

Sufficiency of safe and quality food is one of the priorities of the modern society. Food, together with drinking water and energy resources, belongs to the strategic materials ensuring stability and development of society. The contemporary trend is to eat fresh food with minimal amount of additives and as little processed as possible. However, this trend goes hand in hand with certain risks. It is necessary to realize that unprocessed food, as well as ingredients, are hardly ever sterile and usually contain microorganisms, the types and numbers of which in food are influenced by the quality of the raw material and the degree of its processing. Most microorganisms come from the natural microbiota of the food ingredients and from the microbiota inserted during the processing, storage and distribution. In most cases, food microbiota has only a limited influence over the quality of food, and its consumption does not cause any problems. However, there are some cases in which the presence of microorganisms can have a negative effect either on the consumer or on the food itself. The presence of microorganisms can result in the spoilage of food and can change its organoleptic properties but can also cause health problems in consumers. Economic losses caused by the damage of food are estimated to more than $35 billion a year, according to Forbes magazine. The losses caused by the foodborne diseases are even higher. In 2005, 1.8 million deaths from diarrhoeal diseases were reported, largely attributable to contaminated food and drinking water[1]. There are over 200 known microbial, chemical or physical agents that can cause foodborne illness when ingested. More than 75% of these agents are zoonotic[2]. These agents cause zoonoses, diseases transmissible from animals to humans. The increasing importance of the foodborne diseases is emphasized by several aspects[3]. Among the most important ones are globalization, change of the age structure of the population, intensified production or on the other hand a free-range/organic animal production, climate change etc. (Table 1).

There are several systems in the food production to prevent risks for human health. Some of them are obligatory for the producers and some are optional, given more or less by the business requirements, and besides food safety, they also help to guarantee food quality.

Production of food safety starts in the primary production. If food becomes contaminated at this point, it is very difficult to eliminate this contamination in other production stages. For example, when animals during fattening are contaminated with *Salmonella* or *Campylobacter*, these do not induce any clinical symptoms of animal disease; however, during slaughtering, meat and organs can get contaminated thus becoming a risk for foodborne illness.

Table 1. A system approach to food safety (adopted by Havellar et al. 2010).

DRIVERS	SOURCES	PATHWAYS			OUTCOMES
	Pathogens	Farms	Processing/Distribution	Preparation/Consumption	Public health
Globalization	Reduced geographical barriers to spread (of new variants)	Inadequate sanitation: higher pathogen loads Intensified contact structures	Long and complex supply chains Varying hygiene levels		Increased risk
Minimal processing	Adaptation		Less kill steps		Increased risk if not well controlled
Laboratory methods	Discovery of new pathogens or variants Omics approaches				Increased observed risk
Water, waste and energy		Irrigation water quality	Water/energy savings cleaning, process and		Increased risk

		Waste recycling	ingredient water quality		
Evolution	transfer of virulence factors Antimicrobial resistance	New reservoirs	Increased survival	Increased infectivity	Increased risk
Population contact structures	Species jumps (spill-over from epizootics or exploitation of new agricultural areas)	Contact zoonosis (MRSA, Q-fever)			Increased risk
Food choice	Psychrotrophs Re-emerging pathogens	Exotic/ethnic foods Regional products	No or mild processing, less heat treatment Increased pre-processing and -packaging	Convenience foods Year round availability Healthy foods ts) Less fat/salt/sugar Eating outside home	Increased risk
Animal friendly and organic production	Reduced AMR	Re-emergence (*Trichinella*, *Toxoplasma*) Higher (*Campylobacter*) or lower prevalence (*Salmonella*)			Risk no clear

1.2. Veterinary Meat Inspection

In meat production, the important preventive measure is meat inspection. Meat inspection is one of the most widely implemented and longest running systems of surveillance. It was primarily introduced to identify meat and animals that are not fit for human consumption, and additionally was recognized as a suitable source of data collection and for monitoring a broad spectrum of diseases and conditions concerning animal health and welfare[1]. Meat inspection is divided into two basic parts, ante mortem inspection and post mortem inspection.

Originally, post mortem inspection was of crucial importance because during this inspection, mainly, the pathologic-anatomical changes relating to infection and disease occurrence were identified. Eventually, in most developed countries the number of infectious diseases in animals was reduced radically, (e.g. foot and mouth diseases, African swine fever, tuberculosis, malleus etc.). These pose a threat mainly to the animals, and are characterized by pathologic-anatomical changes. Contrasting this, the number of farm animals which show no clinical or pathological signs of disease but are considered to be carriers of zoonotic agents has risen. Nowadays, many of these zoonotic agents do not induce clinical symptoms in animals, or the symptoms are very moderate; animals can become asymptomatic hosts to the zoonotic agents (e.g. *Salmonella, Campylobacter* spp., *Listeria monocytogenes*, *E. coli* O157), which can pose a major risk to humans. During large-scale slaughtering with routine inspection, it is impossible to macroscopically detect these microbiological hazards or conduct thorough inspection of each slaughtered animal. Additionally, the mechanical action of cutting any changed tissue or lymph nodes can spread microorganisms and cross-contaminate other meat or organs. For both reasons, over the last decade, the current meat inspection protocol has been challenged. The performance of meat inspection is highly correlated with the presence of clinical and/or pathological signs in affected animals. Early or subclinical cases are likely to be "non-detectable" at slaughter. On the other hand, meat inspection can call attention to animal disease occurrence. This is mainly the case for example, for respiratory diseases or parasitic infections. The information obtained can be used as feedback to veterinarians and farmers. That is why the current inspection methods have been revised and

adjusted according to the seriousness and frequency of the occurrence of the pathogens in particular animal species. Meat inspection methods can be adjusted according to the conditions in which animals are kept or according to age categories. Great attention is paid to the ante mortem inspection which remains essential for the traceability and detection of animal welfare conditions. If there is no suspicion of health harmfulness, post mortem inspection moves to visual inspection only. Nevertheless, alternatives to traditional inspection procedures can be used, provided that these lead to a level of safety that at least equals that offered by the traditional procedures[4].

1.3. Role of GMP and HACCP systems

Another system assuring food safety at the level of the producers is HACCP (Hazard Analysis Critical Control Points). The principal of HACCP is to identify technological methods in the production process which can eliminate hazards (physical, chemical or biological). Apart from the critical control points, the producer has to establish limits of the critical control points, methods for their monitoring, and corrective steps. Verification of the whole system is an inseparable part of HACCP. The object of verification is to confirm that the system is working properly and the hazards are effectively kept under control[5]. For primary production where it is almost impossible to introduce HACCP but also for the food processing, GMP (Good Manufacturing Practice) is instigated. This is a system with the target of increasing food safety. It operates by setting rules for processing so that the risks of a harmful food occurrence are eliminated, and at the same time the law is not broken. Principals of GMP are created for each production stage and describe precisely, for example, the basic requirements for technological procedures, staff behaviour, premises etc. The two systems, GMP and HACCP, follow up and are complementary. Besides the HACCP system, there are other systems, including BRC (British Retail Consortium), Food Safety System Certification 22000 or IFS (International Food Standard).

One of the methods for validation and verification of GMP and HACCP systems is the implementation of process hygiene criteria at slaughterhouses (EC No 2073/2005 on microbiological criteria for foodstuffs). In this EU regulation, food business operators at slaughterhouses are responsible for implementing and meeting process hygienic criteria. Food business operators regularly have to take swabs from carcasses to determine whether the set *Salmonella* and indicator microorganism criteria are met. Indicator microorganisms (TVC, *Enterobacteriaceae*) are groups of bacteria which indicate possible problems with general hygiene and faecal contamination; these could lead to pathogen presence on meat[6]. Based on the results of microbiological examination, in the case of unacceptable *Salmonella* prevalence or high numbers of indicator microorganisms, the food business operator must undertake suitable corrective actions.

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