

Challenges of Animal Derived Food Safety and Countermeasures

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Abstract. The safety of animal derived food has been at the forefront of societal concerns in recent years. In this paper, we stress major animal derived food issues and challenges including microbial pathogens, food additives and chemical residues. In addition, the countermeasures to animal derived food issues including animal health and welfare, animal identification and traceability, antimicrobial interventions, new processes and technologies in the processing and preservation of animal derived food products, and Risk assessment are discussed.

Keywords. Animal derived food; Safety; Microbial pathogens

1 Introduction

Animal derived food safety issues have frequently occurred in China in the recent years. Those challenges and related issues that will continue being of concern in the future may be divided into those associated with microbial pathogens and into other animal derived food safety issues, including food additives, chemical residues, products of food biotechnology or genetically modified organisms. Potential reasons for the increasing food safety concerns of recent and future years include: changes in animal production, product processing and distribution practices; increased international food trade; changing consumer needs and expectations for minimally processed and convenient food products; projected increases in worldwide animal derived food consumption; higher numbers of consumers at-risk for infection; emerging pathogens and microbial pathogen changes; advances in microbial detection; limited food handler and consumer education and training in proper food handling. The objective of this paper is to provide additional information on these major challenges and to put forward appropriate countermeasures

2 Challenges of animal derived food safety

2.1 Microbial pathogens

Animal derived food safety challenges associated with microbial pathogens may be divided into those dealing with problems caused by pathogens of current concern, pathogens of potential concern in the future, pathogen changes and adaptations, and the involvement of the environment in microbial

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pathogen concerns.

Microbial pathogens of current concern that need to be controlled in animal derived food include vibrio parahaemolyticus, Salmonella, Staphylococcus aureus, Shigellosis, enterohaemorrhagic E. coli including serotype O157:H7, Staphylococcus aureus, Campylobacter, as well as other enteric pathogens. A number of new, emerging, or evolving pathogenic microorganisms have been associated with documented foodborne illness episodes in the past 20-30 years, and their number appears to be increasing [1].

Additional foodborne pathogens recognized include Norovirus, resistant bacteria, prions or other unsuspected pathogens may be of greater concern in the future or may become associated with animal health pandemics. Other potentially important pathogens may be Mycobacterium avium subsp. Animal health threats with potential human health implications, such as foot and-mouth disease (FMD) viruses and avian influenza (AI) will remain major challenges in the years to come and may lead to major pandemics or disasters of worldwide concern.

Research has indicated in recent years that there is continuous adaptation and development of resistance by pathogenic microorganisms to antibiotics and potentially to traditional food preservation barriers such as low pH, heat, cold temperatures, dryness or low water activity, and chemical additives [2]. Furthermore, there is evidence of existence of strains of pathogens with enhanced ability for survival in their hosts, low infective doses, and increased virulence, sometimes after exposure to common environmental stresses [3]. Resistance of pathogens to antibiotics used in animal production or human medicine is of major concern in clinical settings, and will continue being important in the future [4]. Antibiotic resistance concerns are greater for potential loss in activity of drugs of choice. The issue of antibiotic usage in animal agriculture is complex in china. Although a ban of antibiotic use in animal agriculture is often proposed, it should be noted that it is unknown how such a ban might affect the extent of contamination of animal food products with resistant or nonresistant pathogens.

The environment will continue being associated with important international health issues, including food safety. The impact of animal derived food and wild animals and their manure as sources of environmental, water and food contamination, as well as the direct animal-to-human transmission of pathogens, will have to be taken seriously under consideration by those involved in the food industry in general, including producers, regulators, public health agencies and consumers.

2.2 Other animal derived food safety issues

In general, food additives, such as nitrite, common salt, Nisin, lactates, and other compounds, and chemical residues will continue being included on lists of consumer concerns and food safety issues. We do not really know how important it is for animal derived food to be antibiotics and hormone free or the potential contribution of nitrite used in cured animal derived food to cancer. However, residue issues, such as those associated with dioxins have caused major concerns in the past and they may reappear in the future [5]. In addition, advances in food biotechnology and in the production of genetically modified organisms GMO will continue to be controversial. The debate as to whether the meat, eggs and milk from livestock fed genetically modified feeds or produced by genetically modified livestock are safe to eat will continue. Use of cloning, however, in routine production of food animals is doubtful and unnecessary.

3 Countermeasures of animal derived food safety issues

3.1 Animal health and welfare

The issue of humane treatment of food animals is very important and should receive increased attention worldwide [6]. Evidence suggests that animal stressing may damage animal derived food quality, and lead to more contamination and cross-contamination with pathogens as it may lead to increased pathogen shedding. Irrespective of whether good animal husbandry practices make beef and

dairy products safer or of better quality, humane treatment of animals is essential and should be practiced by all involved in animal handling.

3.2 Animal identification and traceability

Animal identification and traceability with technologies such as electronic ear tags or retinal scanning, as well as food product recalls, are major issues of worldwide interest and may have major food safety implications [7]. Implementation of effective systems can be very useful in tracking, containment and recalls of animals or their products when necessitated due to public health or other concerns. Success of animal identification efforts will depend on complete and mandatory implementation of effective systems. Issues to be considered by a country when in the process of establishment of animal identification and tracking systems include selection of the proper technology, maintenance of confidentiality, selection of precision requirements, and payment of costs. It should include premises number and animal identification number, and it should cover feed, livestock and animal products.

3.3 Antimicrobial interventions from farm to table

There is widespread agreement to be proactive efforts to reduce, eliminate or control pathogens at all stages of the food chain. The best strategy for improving the microbiological quality of animal derived food is by applying antimicrobial intervention technologies that: reduce contamination on the live animal; minimize the access of microorganisms to the product; reduce the contamination that has gained access to the product; inactivate microorganisms on the product without cross-contamination; and prevent or control growth of microorganisms which have gained access to the animal derived food and have not been inactivated [8]. A comprehensive strategy for foodborne pathogen control should be based on an integrated approach which involves application of interventions at pre-harvest, postharvest, processing, storage, distribution, merchandizing, preparation, food service, and consumption. Control of food hazards is a shared responsibility of producers, packers, processors, distributors, retailers, food service operators and consumers, and needs an integrated approach from farm to table.

3.4 New processes and technologies

A variety of new or novel technologies are being evaluated, proposed or in some cases approved, and to some degree used, in the processing and preservation of animal derived food products. Such technologies include irradiation, high hydrostatic pressure, electroporation with pulsed electric fields, ultrasonic waves, oscillating magnetic fields, cell lysis with bacteriophages or enzymes, smart antimicrobial packaging or edible antimicrobial films, and various combinations of such treatments or processes.

3.5 Food safety risk assessment

Food risk regulators have adopted risk analysis as an approach for assessing, communicating and managing risks in relation to food safety. Risk analysis is a structured approach consisting of three components: risk assessment, risk management and risk communication. The concept of risk analysis needs further development and adoption in order to lead to hazard control measures on the basis of performance, process and product criteria based on risk assessment and feasible food safety objectives, and managed by HACCP implemented by fully trained personnel [9]. This approach will allow better international cooperation, collaboration and harmonization, leading to improved control of foodborne hazards.

There is a need to conduct microbiological risk assessments in order to identify risk factors and to establish food safety objectives, before setting performance and process criteria for the industry to achieve through HACCP [9]. These activities will need to be based on proper research to fill data gaps

identified by risk assessments, and application of predictive microbiology and mathematical modeling concepts to better understand pathogen responses under various conditions of product processing and handling.

HACCP programs should be applied throughout the food chain and should be based on a foundation consisting of effective prerequisite programs, including good manufacturing practices (GMP) and good hygiene practices (GHP). This can be accomplished through development and implementation of specific standard operating procedures (SOP). A complete SOP should address what is to be done, by whom, when, why and how, and should also provide guidance as to what to do if a deviation or other problem develops.

In addition, there is a need for intensive efforts to educate food-handlers and consumers in food safety principles. It is necessary to teach consumers the basics of proper cooking of animal foods, thorough washing of raw vegetables, and separation of uncooked from ready-to-eat foods, and washing of hands, cutting boards, knives, etc. At-risk individuals should be instructed to avoid or cook risky foods, and to avoid raw or unpasteurized foods.

4 Conclusions

In summary, microbial hazards and chemical residue associated issues will continue being major challenges to animal derived food safety well into the future. It is important to realize that management of animal derived food safety risks should be based on an integrated effort and approach that applies to all sectors, from the producer through the processor, distributor, packer, retailer, food service worker and consumer.

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