

SLAUGHTERING AND PROCESSING OF LIVESTOCK

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Summary

Microbiological and chemical hazards to human health that are associated with food animal production and food processing may arise on the farm, in the food plant and in the distribution chain. Awareness on the part of food animal producers and the members of the meat industry that such hazards may exist in foods is the first step towards their control.

A positive approach to animal health on the farm with the objective of eliminating or minimizing exposure of food-producing animals to these hazards, supported by *ante-* and *post-mortem* veterinary examination of all food animals at the meat plant, is the

central component of the longitudinal integrated safety assurance (LISA) schemes now being adopted in many developed countries.

Animal welfare considerations contribute to the production of healthier animals as a source of healthy food and are of major importance to all concerned with the production of a safe food supply, on humanitarian as well as economic grounds.

These control measures along with the regulation of processing and storage conditions and the prevention of environmental contamination in the meat plant and distribution chain are the cornerstones of food hygiene practice and are essential to providing the level of safety assurance required by the consumer and by international trade.

This coordinated approach to food safety should have the full support of food producers and processors and of the scientific community at the both national and international level.

1. Background

It has long been a tenet of food safety assurance that healthy food comes from healthy animals. In the current climate of public opinion, the pre-condition that a healthy animal is one that is adequately and humanely cared for throughout its life, may also be added. In the developed countries terms such as “healthy animals” are uniformly applied to indicate that the animals are free from clinical disease and have not been unduly exposed to hazards likely to be of concern to the end consumer. Likewise, the term “humanely cared for” denotes that the level of animal welfare to which the animals have been subjected conform with broadly accepted societal norms. In other cases, in some of the so-called developing countries and in many countries in Asia, due to the underlying prevalence of specific zoonoses in the national animal population, the absence of certain foodborne hazards of concern to consumers and the regulatory authorities in the developed countries, cannot be guaranteed, nor can the same norms of animal welfare be observed. On the contrary, the perceptions of animal welfare, and of food hygiene, may be on an entirely different plain in these countries.

The diversity of perception of these concepts reflects the diversity of humankind. Consequently, in any treatise on the role of animal production in human nutrition due account has to be given to the local acceptance of traditional values, many of which have their origins in religion or, less formally, local custom. Thus, the place of the ox in village or rural life in India or parts of the African continent together with its role as a provider of fuel rather than food, and as a symbol of wealth, require recognition and understanding on the part of the outsider. Yet in some such cultures it has long been possible to recognize that, indeed, the true wealth of livestock in the national sense may be derived from its monetary value on the world meat market. Countries such as Zimbabwe and Tanzania have demonstrated this fact effectively through their trading links with the European Union, where they have been significant players in the red meat market. In these cases, any impediments associated with the imposition of trading standards in the form of regulatory controls aimed at the protection of both the health and safety of the European consumer and the health of European livestock, have been readily overcome. This has required inputs from appropriately qualified advisors and

trained personnel, as well as considerable long-term investment in plant and equipment. By this means, the meat industries in these countries have responded to the demands of the marketplace for an adequate level of food safety, in much the same way as home suppliers have been obliged to do.

A sustained supply of safe meat product demands vigilance. Here the role of the medical profession, particularly those specializing in occupational medicine, public health and epidemiology, along with veterinary specialists in these fields is pre-eminent. In this context the pivotal role of risk analysis and the application of hazard analysis critical control (HACCP) systems of prevention throughout the food chain has been emphasised in all recent international trade agreements. The risks involved are very real when one considers the persistence of such human parasitic diseases as trichinosis and taeniasis and bacterial zoonoses such as campylobacteriosis and salmonellosis, conditions that are invariably associated with exposure to infected or infested food. Nor is the concern limited to human diseases. Rather, a major driving force in recent World Trade negotiations has been the objective of preventing the risk of introduction of “exotic diseases” into countries through trade in contaminated meat and meat-based products. On the other hand, in the developed countries, the current epidemic of bovine spongiform encephalopathy (BSE) in Great Britain has brought the realisation that the incorporation of contaminated meat-based products, in this case ruminant meat and bone meal, in the diet of cattle, may have serious consequences for the health of a national cattle population over a number of years, with disastrous consequences for trade. The human health implications of this tragedy are as yet unclear.

Detection and elimination from the food chain of meat derived from visibly diseased animals has been effectively accomplished by the traditional meat inspection procedures that date from the mid-1800s. Today, however, the main human health hazards originate with the carriage, at the time of slaughter, of the causative agents by clinically healthy animals and poultry. Current methods of inspection used in the regulatory control of meat and meat products entering the human food chain have come under scrutiny in recent years, due to their limited effectiveness in addressing the detection of these hidden foodborne hazards together with the receding importance in international terms, from the human or animal health viewpoint, of those diseases for which these inspection procedures were designed to detect. Likewise, the detection, or rather the prevention, through regulatory measures, of residues of harmful chemicals including animal remedies and growth promotants in meat and meat products, is another issue of some contention in the context of commercial slaughtering practices. In addition, operational and environmental hygiene in so far as they affect the safety of the meat and meat product at all stages of processing, packaging and storage are of direct concern to the regulatory authority, since compliance with specified hygiene standards in these areas is a prerequisite for the health certification of product in most developed countries and is a specified requirement of international trade in such products. The developments in biotechnology notably those relating to rapid methods for the detection of unwanted residues and other contaminants, biological or otherwise, is providing a new and practical approach to safety assurance based on statistical sampling programs, internal quality control systems and rational assessment procedures.

Health and safety issues affecting workers in meat plants require consideration here.

There are serious and ever-present risks relating to such practices as animal management in the lairage, pre-slaughter stunning, dehiding and carcass splitting and the handling of designated high risk materials in the rendering areas of these premises. Proper plant and equipment design, lighting and, most important of all, focused operative training and effective supervision which takes account of the physical nature of the raw material and the biological as well as physical hazards associated with these practices, require to be addressed by management, as well as regulators, in such a way as to ensure that risk management is properly and effectively practiced at all times. The need for research and training in this area is paramount.

2. Pre-Harvest Aspects

2.1 Animal Production Aspects

The safety of foods of animal origin relies upon the application of effective control measures at all stages of the production, processing and distribution chain. Many of the measures that can be implemented on the production unit or farm, during transportation and in the meat plant are well recognized and there are established provisions in the relevant legislation on red and white meat production in most countries and on international trade in such products. However, legislation on its own, national or otherwise, cannot be expected to ensure a consistent supply of safe meat. Rather, it is a duty of care on the part of farmers, feed manufacturers, animal production specialists, livestock hauliers, livestock market managers and food scientists, that they assume their responsibility, side by side with the regulatory authorities and the meat trade, for product safety.

Intensification in food animal production has focused attention on aspects of animal husbandry which may have a profound effect on herd and flock health, on the quality of the environment and ultimately, on the quality and safety of the meat product and its derivatives. These changes have resulted in a greater reliance by the veterinary food hygienist on information concerning the on-farm practices used in food animal production, in order to be in a position to issue valid veterinary certification in regard to the health of the final food product. This form of extended health control of foods of animal origin (LISA – Longitudinal Integrated Safety Assurance) is much in demand and, when used in conjunction with Hazard Analysis Critical Control Point (HACCP) programs, forms an integral part of food quality and safety assurance schemes. This is a natural development of the practice of veterinary preventive medicine in relation to the production of foods of animal origin for human consumption, the objectives of which are to ensure that :

- (i) the food, as produced on the farm, is both wholesome and marketable,
- (ii) the animals' efficiency as a food-producing animal is not compromised, and
- (iii) the animal itself is dealt with in an humane manner throughout its life.

The pre-harvest aspects of meat production are highly relevant to the production of a safe food supply, as microbiological hazards to human health that are associated with meat production and meat processing may arise on the farm, as well as in the food plant and in the distribution chain. Awareness that such hazards may exist or can be

introduced at these various stages in the food chain is the first step towards their control. A positive approach to animal health on the farm with the objective of eliminating or minimizing exposure of food-producing animals to these hazards, supported by *ante-* and *post-mortem* veterinary examination of animals at the meat plant, removes overtly diseased animals from the food chain and improves confidence in the safety of the food product. These control measures, along with the regulation of processing and storage conditions and the prevention of environmental contamination in the food plant and distribution chain are the cornerstones of food hygiene practice and are essential to the requirements of international trade in foods of animal origin.

2.2 Animal Diseases of Concern

Zoonotic diseases are of particular concern because of the risk of transmission of the causal agent to the producers and food plant workers as well as consumers. In 1995 a group of leading public health specialists in the Animal Production Technical Analysis Group on Risk and Health Impact ranked food-borne pathogens according to acute and chronic human health effects in the United States. The top six priority food-borne agents were adjudged to be:

- (i) *Salmonella* spp. (non-typhoid),
- (ii) *Campylobacter jejuni/coli*,
- (iii) *Toxoplasma gondii*,
- (iv) *Escherichia coli* O157:H7,
- (v) *Listeria monocytogenes*,
- (vi) jointly, *Yersinia enterocolitica* and *Trichinella spiralis*.

Examples of other microbiological hazards associated with food animal production and food processing, but which do not necessarily cause clinical disease in animals, are presented in Table 1.

Microbial agents of concern (examples)	Control points			
	Feed/water	Silage	Effluents	Transport
<i>Salmonella</i> spp.	+++	??	++	^^^
<i>Listeria</i> spp.	+	++	+	~
<i>Aeromonas</i> spp.	++	??	??	~
<i>E. coli</i> O157:H7	+	??	+	^^
<i>Campylobacter</i> spp.	++	~	~	^^^
<i>Yersinia</i> spp.	+	??	~	~
<i>Clostridium</i> spp.	++	+	+	^^
<i>Leptospira</i> serovars	+	??	+	~
<i>Cryptosporidium</i> spp.	+	??	+	~
<i>Taenia saginata</i>	++	??	++	??
<i>Toxoplasma gondii</i>	++	??	~	??
<i>Brucella abortus</i>	+	??	++	^
<i>Mycobacterium bovis</i>	+	??	+	^
enteroviruses	??	??	+	~
mycotoxins	++	+	??	??

Benefit of control: + limited; ++ some benefit; +++ effective
 ~: importance questioned
 ^: increased risk

Other control factors include:

- identification of animal/farm of origin/carrier and segregation of clinical cases
- identification and approval of casualty/emergency cases for slaughter for human consumption.

Table 1. Factors affecting the microbial safety of meat: control points on the farm and during transportation

Many public health experts believe that reducing these organisms in animals prior to slaughter will reduce process contamination.

At the production, or pre-harvest level, diseases such as brucellosis, leptospirosis and tuberculosis and in some cases, anthrax, represent direct hazards for farm workers and their families. The entry of animals affected with these conditions into meat plants clearly poses extreme risks for operatives, not to mention the consequences of the release of contaminated meat from such animals into the food chain.

Tuberculosis in cattle and its importance as a cause of disease in the human population represents one of the principal reasons for the introduction of direct inspection methods in meat control. As a clinical entity in cattle this disease is now all but eradicated in most developed countries, where the most common manifestation of the disease nowadays is the disclosure of tubercles in one or more lymph nodes in the course of *post-mortem* examination. Isolated incidences in which there is direct involvement of infected cattle as the source of *Mycobacterium bovis* infection in human cases still occur; however, few of these cases are directly related to the consumption of contaminated meat. Nevertheless, all necessary precautions should be taken to prevent meat and offals with tuberculous lesions, and those without visible lesions but which contain viable tubercle bacilli reaching the consumer. In this regard very special attention should be paid to preventing contamination of healthy, uninfected meat with *M. bovis* in the course of carcass dressing. In sheep production, the protozoan parasite, *Toxoplasma gondii*, is the commonest cause of ovine abortion in flocks throughout Ireland. This agent is acquired by the ewe from infected cats through the inhalation or ingestion of infective oocysts. Consequently the prevention of toxoplasmosis in sheep is difficult, despite the introduction recently of a vaccine for the condition. While the development of the disease, toxoplasmosis, in man, as stated earlier, is dependant upon other factors, it is necessary to ensure that exposure to this agent is kept to a minimum at all times. Such exposure can arise through environmental exposure to oocysts from infested cats, either by inhalation or ingestion and, significantly, by the ingestion of undercooked *Toxoplasma*-infested sheep meat.

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Biographical Sketch

John Daniel Collins is the Professor of Farm Animal Clinical Studies at University College Dublin, Ireland. As Head of the Department of Large Animal Clinical Studies, he is involved on a day-to-day basis with issues of animal health and food hygiene relating to the meat industry. He specializes in veterinary preventive medicine and veterinary public health and has an established reputation as an expert in veterinary public health and food hygiene in Ireland and abroad. He is a member of the Board of the Food Safety Authority of Ireland, a statutory body with responsibility for consumer protection. His research in food hygiene has been concerned with the prevention of contamination of foods with harmful residues and microbiological pathogens through the implementation of pre-harvest and in-plant avoidance procedures. He has practical experience of both the production and processing aspects of the food industry and has participated in national and international projects aimed at the development and implementation of HACCP-based systems in the red meat, poultry meat and dairy industries. He acts as an adviser and independent consultant in veterinary public health and food hygiene to State and semi-State bodies and the medical profession as well as industrial companies and consumer groups. He has published widely on animal health and food safety issues, in particular on the pre-harvest aspects of food safety. He is the Director of the Veterinary Epidemiology and Tuberculosis Investigation Unit at University College Dublin and has considerable experience in the management and control of tuberculosis in cattle populations.