United Nations
Economic and Social Commission for Western Asia
(ESCWA)

Agricultural Research Center
Egypt

EXPERT GROUP MEETING
ON THE HARMONIZATION OF NORMS,
REGULATIONS
AND LEGAL INSTRUMENTS FOR SELECTED
AGRICULTURAL INPUTS
WITH A VIEW TO REGIONAL COOPERATION
Cairo, 18-20 February 2001

Distr.
LIMITED
E/ESCWA/AGR/2001/WG.1/11
8 February 2001
ORIGINAL: ENGLISH

FAO GUIDELINES FOR ANIMAL FEED SAFETY

Note: This document has been reproduced in the form in which it was received, without formal editing. The opinions expressed are those of the author and do not necessarily reflect the views of ESCWA.

01-0170

I. INTRODUCTION

In recent years public concern about the safety of foods of animal origin has heightened due to problems that have arisen with bovine spongiform encephalopathy (BSE), dioxin contamination, outbreaks of foodborne bacterial infections, as well as growing concern about veterinary drug residues and microbial resistance to antibiotics. These problems have drawn attention to feeding practices within the livestock industry and have prompted health professionals and the feed industry to closely scrutinise food quality and safety problems that can arise in foods of animal origin as a result of animal feeding systems. It is important to note, nonetheless, that despite the magnitude of livestock production, the frequency of health problems associated with this sector is very low.

The livestock sector plays an essential role in agricultural and economic development as well as food security. The global livestock output grew at a rate of 2.4% in 1998 to surpass 218 million tonnes[1], and world demand and consumption of livestock products is expected to nearly double in the next 20 years[2]. Most of this increase is expected to take place in developing countries associated with greater population growth and emerging economies, particularly in Asia. As a global average for 1997, animal products provided about 16% of the calories in the diet. Meat and other animal products provide essential fatty acids, vitamins and minerals. The livestock industry therefore can be seen to have great economic and nutritional significance in the world as a whole.

In ESCWA countries, meat production has risen from 1.1 million tonnes in 1979 to 3.1 million tonnes in 1999, a growth of 15% per year for 20 years. In particular, chicken meat has increased from 280,000 tonnes to 1.4 million tonnes in that period; beef and buffalo meat from 384,000 to 722,000 tonnes; and sheep and goat meat from 297,000 to 620,000 tonnes. In addition, milk production has increased from 4 million tonnes to 7.4 million tonnes (of which cow milk is 3.9 million tonnes) and egg production from 291,000 to 630,000 tonnes in those twenty years (all data from FAOSTAT).

Most of this increase in production has been achieved from grain and imported protein cake. ESCWA countries produce 58 million tonnes of grain and import 26 million tonnes in addition (FAOSTAT, 1998 data). 21 million tonnes are used for feed. Imports of maize rose from 1.6 million tonnes in 1979 to 6.5 million tonnes in 1999; barley imports increased from 1.1 million tonnes to 4.3 million tonnes; soya bean cake imports rose from 165,000 tonnes to 2.2 million tonnes in the same period. Also, imports of meat meal rose from 24,000 tonnes in 1979 to 107,000 tonnes in 1999. Of the 44,000 tonnes imported in 1989 (the year that the UK banned the use of meat meal in ruminant feeds), over 10,000 tonnes was imported from the UK and France. These figures indicate the size and nature of the feed industry in these countries.

For the purposes of this paper, animal feed includes any substance, whether processed. semi-processed or raw which is used for animal consumption. This includes feed of varied origin such as: pasture, feed grains and compound feeds, crop residues and agro-industrial by-products.

II. POTENTIAL HAZARDS AND OTHER ISSUES ASSOCIATED WITH ANIMAL FEEDS

A. MYCOTOXINS

Mycotoxins are secondary metabolites produced by fungi of various genera when they grow on agricultural products before or after harvest or during transportation or storage. Both intrinsic and extrinsic factors influence fungal growth and mycotoxin production on a given substrate. The intrinsic factors include water activity, pH, and redox potential whereas extrinsic factors which influence mycotoxin production are relative humidity, temperature and availability of oxygen.

Many mycotoxins, with different chemical structures and biological activities, have been identified. They may be carcinogenic (e.g. aflatoxin B_1, ochratoxin A, fumonisin B_1), oestrogenic (zearalenone), neurotoxic (fumonisin B_1), nephrotoxic (ochratoxins, citrinin, oosporeine), dermonecrotic (trichothecenes) or immuno-suppressive (aflatoxin B_1, ochratoxin A, and T-2 toxin). Much of the published information on toxicity concerns studies in experimental animals and these may not reflect their effects in humans and other animals. In addition, the implications for human health of the presence of combinations of mycotoxins are not well understood.

Mycotoxins are regularly found in feed ingredients such as maize, sorghum grain, barley, wheat, rice meal, cottonseed meal, groundnuts and other legumes. Most are relatively stable compounds and are not destroyed by processing of feed and may even be concentrated in screenings. Different animal species metabolise mycotoxins in different ways. For example in pigs, ochratoxin A can undergo entero-hepatic circulation and is eliminated very slowly while it is rapidly excreted by poultry species. The polar mycotoxins, such as fumonisins, tend to be excreted rapidly.

Mycotoxins, or their metabolites, can be detected in meat, visceral organs, milk and eggs. Their concentration in food is usually considerably lower than the levels present in the feed consumed by the animals and unlikely to cause acute intoxications in humans. However residues of carcinogenic mycotoxins, such as aflatoxin B_1 and M_1, and ochratoxin A, when present in animal products pose a threat to human health, and their levels should be monitored and controlled. The Codex Alimentarius Commission is currently considering maximum limits for Aflatoxin M_1 in milk. The extent of mycotoxin accumulation in fish tissues due to consumption of contaminated feed is poorly understood.[3]

B. VETERINARY DRUGS

Veterinary drugs may be administered in animal feeds for livestock and aquaculture. If good veterinary practices are employed then MRLs should not be exceeded, however, if GVP is not adhered to, residues in foods of animal origin may exceed MRLs.

The need for the containment of antimicrobial resistance due to the use of antimicrobials in livestock, including their addition to feedstuffs, is gaining much attention. Antimicrobials are used for therapeutic, prophylactic or growth purposes, and in the latter case they are added to feed and/or water. Even first-line antimicrobials (e.g. glycopeptides) are being used as feed additives for growth promotion. The assessment and containment of public health risks associated with the use of antimicrobials in livestock is a matter of priority.

C. AGRICULTURAL AND OTHER CHEMICALS

Potential contaminants in feedstuffs include excessive residues of pesticides and fungicides, or other environmental contaminants such as the polychlorinated biphenyls (PCBs), dioxins and heavy metals including mercury, lead, or cadmium.

Dioxins and PCBs are ubiquitously present as contaminants in the environment and dietary intake represents the most common route of human exposure. PCBs and dioxins have similar physical and chemical properties. They are both lipophilic and persistent compounds that accumulate in the food chain, consequently biological samples often contain both dioxin and PCB congeners. Foods of animal origin are the greatest source of human exposure to these contaminants and animal feeds may be an important source of contamination for livestock. Contaminated fats or oils added either intentionally or unintentionally to manufactured feeds can be a source of dioxins and PCBs. These industrial pollutants may be emitted into the air contaminating soil and water and remaining deposited on pastureland. In this case grass-fed animals in highly contaminated areas may give rise to unsafe food products.

Weak associations have been reported between exposure to dioxins and soft tissue carcinomas and lung cancer. Initial symptoms of high PCB exposure are reversible dermal and ocular effects and persistent respiratory problems. Foetal exposure to dioxins and/or PCBs might be associated with cognitive deficits in infants and children. An increase in tumour incidence, as well as neurological, endocrine, hepatoxic and immunotoxic effects were observed in populations accidentally exposed to high levels of PCBs, polychlorinated dibenzofurans and polychlorinated quaterphenyls.[4] Maximum levels of these contaminants allowed in foods of animal origin have been established in some countries, but existing limits are quite variable.

Plant materials growing in areas with high levels of other environmental pollutants such as radionuclides and heavy metals that are used as feed may also lead to unacceptably high levels of contamination in food products of animal origin. Similarly, fish oils used as animal feed ingredients, may contain high levels of lipid-soluble contaminants if they are produced from fish grown in polluted areas. In Western Europe, effective measures to limit environmental pollution have been put in place. In Central and Eastern Europe some areas of high contamination occur due to industrial activity.[5]

D. INFECTIOUS AGENTS

Animal feed may be the source of a limited number of infections for farm animals that could lead to human illness on consumption of foods of animal origin. These include *Salmonella enterica*, *Bacillus anthracis*, *Toxoplasma gondii*, *Trichinella spiralis* and possibly the agent of bovine spongiform encephalopathy. The risk to human health from several other infectious agents which may contaminate feed or forage, appear to be either negligible or non-existent.

Heat treatments of varying severity are commonly used to ensure the microbiological quality of animal feed. Irradiation may be considered a potentially important control measure for certain microbial agents in the feed of food-producing animals. The Joint FAO/IAEA/WHO Study Group on High Dose Irradiation which convened in Geneva, in September 1997, concluded that food irradiated to any dose appropriate to achieve the intended technological objective is both safe to consume and nutritionally adequate[6]. As their conclusion was partly based on animal feeding studies in a broad cross section of species, fed a variety of diets, it may be assumed that the study group conclusion would also apply to

irradiated animal feed. Notably, irradiation is not permitted either by EC Regulation or by Codex Guidelines in organic production systems[7].

1. *Transmissible Spongiform Encephalopathies (TSEs)*

TSEs in ruminants are non-febrile neurological diseases of man and many animal species including ruminants. They have a long incubation period and are ultimately fatal. TSEs are associated with incompletely defined agents, currently termed prions, which are resistant to normal heat treatment of feed and food. Sheep scrapie has been recognised for over 250 years, while Bovine Spongiform Encephalopathy (BSE) was first recognised in the United Kingdom in 1986. For BSE it has been postulated that the aetiological agent enters the feed primarily through rendered infected tissues (notably the tissue of the central nervous system and the reticuloendothelial system) under conditions of insufficient heat treatment to destroy or inactivate the infectious agent. The reported occurrence of a new variant of the human TSE, Creutzfeldt-Jacob Disease (CJD), has raised the possibility of an association with BSE in cattle with CJD in humans through consumption of meat from BSE infected cattle. At the present time, there is a strong presumption of a link between this new variant and the possible transmission of the infective agent from infected bovine tissue to humans.

2. *Other Infectious Agents*

Salmonellae are widely distributed in nature, and animal feed is only one of many sources for farm animals. Animal and plant origin feed ingredients are frequently contaminated with *Salmonellae*. Processed feed can be contaminated from these raw feed ingredients.

There are over 2000 Salmonella serotypes and these can be divided arbitrarily into three unequally sized groups. These include the species specific serotypes such as *S. dublin* (cattle); the invasive serotypes which may cause septicaemic disease in several animal species (e.g. *S. enteritidis* and *S. typhimurium*); and the non-invasive serotypes which tend not to result in septicaemia. Members of the first group are not recognised as foodborne pathogens. The third group is by far the largest and may be associated with subclinical infections in farm livestock. They can cause disease on occasion and are associated with food poisoning in humans. The principal manifestation of human salmonellosis is a gastroenteritis. Septicaemia occurs in a proportion of patients.

Toxoplasma gondii, the protozoan is found in cats and based on serological surveys also in birds, other domesticated species including sheep, pigs, goats, and horses. The primary source of infection for animals is feedstuffs contaminated with faeces of cats and possibly rodent tissues. A proportion of humans may become infected following the handling or consumption of contaminated raw meat.

Trichinella spiralis is a nematode which parasites the intestinal tract of mammals, particularly pigs. The larvae encyst in the tissues, particularly the muscles which act as a source of infection for humans who consume raw or partially cooked meat. The clinical manifestations include fever, muscle pain, encephalitis, meningitis, myocarditis and rarely death. The cysts can be killed by freezing infected carcasses at -18 degrees C for 20 days. They are also heat sensitive and are killed by traditional rendering temperatures. Effective cooking of raw meat and table scraps before feeding to farm animals would eliminate this hazard.

Bacillus anthracis, which causes anthrax, sporulates on exposure to air and the resulting spores can survive for long periods in the environment and in contaminated animal feed. The spore is widespread in some CIS countries. There have been cases of anthrax in people who have consumed the meat of infected animals.

III. CONTROL OF FEEDBORNE HAZARDS

Given the direct links between feed safety and safety of foods of animal origin, it is essential that feed production and manufacture be considered as an integral part of the food production chain. Feed production must therefore be subject, in the same way as food production, to quality assurance including food safety systems based on the Hazard Analysis and Critical Control Point (HACCP) system.

Industry is ultimately responsible for the quality and safety of the food and feed that it produces. National authorities should provide guidance to industry including codes of practice and standards that they must respect. Governments must also establish the necessary controls to ensure that industry consistently meets mandatory quality and safety requirements.

The foregoing outlines the responsibilities of both industry and national governments in ensuring safety of feed and food. It is important to realise however that the large volume of international trade in foods of animal origin, as well as in feedstuffs, adds an important international dimension to the control of animal feedstuffs. Furthermore the World Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) advocates that national standards related to food safety be harmonised with international standards. In light of existing shortcomings in the regulation of feed safety, several actions and activities have been undertaken at international level to develop sound standards, guidelines and recommendations in this area. International organizations also have an important role to play in providing information and training which could be used at national level to improve the knowledge and skill of those involved in all areas of the feed industry, including primary producers of feed materials, in order to prevent failures in food/feed safety systems rather than control them.

A. WORK AT INTERNATIONAL LEVEL ON THE SAFETY OF ANIMAL FEEDSTUFFS

Several international organizations are actively involved in work related to the safety of animal feedstuffs. They generate and disseminate information on various aspects of feeds and their use including potential food safety hazards linked to feed. Furthermore, they provide technical assistance to countries aimed at improving feed production, feeding practices and feed control programmes.

Animal feed safety has become one of the priority areas in the Animal Production and Health Division of FAO which has established a substantial information system on animal feed resources available on the World-Wide-Web, CD-Rom and in printed publications. The system includes detailed scientific and practical information on over 700 feedstuffs, with data sheets, full text articles and reviews. There will be increasing emphasis on feed safety and several reports have been already commissioned on this subject, including one on the use of wastes and by-products.

The Codex Alimentarius Commission (CAC), which was established by the Joint FAO/WHO Food Standards Programme in 1962, is an intergovernmental body comprising 165 members whose responsibility it is to develop and publish international standards, guidelines and codes of practice related to food quality and safety. Codex Alimentarius standards are recognised in the WTO SPS Agreement as the bench marks for food safety.

Several existing Codex standards, guidelines and recommendations include provisions relating to the quality and safety of animal feeds and food of animal origin. These include:

- **Codex General Standard for Contaminants and Toxins in Food (Codex Stan 193-1995)**

This standard contains the main principles and procedures which are used and recommended by the Codex Alimentarius in dealing with contaminants and toxins in food and feeds and list the maximum levels of contaminants and natural toxicants in food and feeds which are recommended by the CAC to be applied to commodities moving in international trade.

- **List of Codex Maximum Residue Limits (MRLs) for Pesticides and Codex Extraneous Maximum Residue Limits (EMRLs) (General Text, Volume 2A and MRLs, Volume 2B)**

This text explains the basis for establishing the Codex MRLs and EMRLs and states the considerations related to human daily intake. A list of the commodities and Codex MRLs/EMRLs is provided.

- **List of Codex Maximum Residue Limits (MRLs) for Veterinary Drugs (Volume 3)**

The Codex MRLs for Veterinary Drugs are provided.

- **Recommended International Code of Practice for Control of the Use of Veterinary Drugs (CAC/RCP 38-1993, Volume 3)**

This code sets out guidelines on the prescriptions, application, distribution and control of drugs used for treating animals, processing animal health and improving animal production. It includes Good Practices in the Use of Veterinary Drugs (GPVD), including premixes for the manufacture of medicated feedstuffs.

- **Code of Practice for the Reduction of Aflatoxins in Raw Materials and Supplemental Feeding Stuffs for Milk Producing Animals (CAC/RCP 45-97)**

This code of practice outlines measures and procedures that should be followed during crop production, harvest, storage, transport and feed production in order to minimise contamination of feedstuffs with aflatoxin.

- **Codex Standards for Processed Meat and Poultry Products (Part 1 Volume 10-1994)**

- **Codes of Practices and Guidelines for Processed Meat and Poultry Products (Part 2 Volume 10 - 1994)**

- **Meat Hygiene Codes (Part 3 Volume 10 –1994)**

These standards, codes of practice and guidelines relate to the quality and safety of the animal origin products resulting from methods and procedures utilized in, and including feeding of, production animals.

There are several issues currently being considered by the CAC which are directly related to the safety of feedstuffs. Perhaps most significant, was the decision of the 23rd Session of CAC (28 June – 3 July 1999) to establish a Codex Ad Hoc Intergovernmental Task Force on Good Animal Feeding which would address all issues relating to animal feeding. The terms of reference of the Task Force are the following:

- To complete and extend the work already done by relevant Codex Committees on the Draft Code of Practice for Good Animal Feeding;
- To address other aspects which are important for food safety, such as problems related to toxic substances, pathogens, microbial resistance, new technologies, storage, control measures, traceability, etc.;
- To take full account of and collaborate with, as appropriate, work carried out by the relevant Codex Committees and other relevant international bodies, including FAO, WHO, OIE and IPPC.

The first session of this task force was held in Copenhagen from 13-15 June 2000 and the next session will be March 2001.

The issue of animal feed is a complex one requiring multi-disciplinary inputs and collaboration from the fields of human and veterinary medicine, agriculture, academia and from national control agencies. Several organizations are already involved in various aspects of this issue and it is important that there be coordination and discussion among the different parties involved if clear and sound guidance that is widely supported is to be developed in a timely manner. The Intergovernmental Codex Task Force on Safe Animal Feeding is an important forum for the required collaboration and consensus.

One of the main tasks facing the Task Force is the completion of the Draft Code of Practice for Good Animal Feeding that was prepared by a panel of experts on the subject during an FAO Expert Consultation that was held in Rome in 1997. The draft code, along with comments submitted by several countries and international organizations will form the basis of the discussions on this topic. All food safety issues identified by the CAC in the terms of reference of the task force can be considered in the elaboration of the new code. It is considered by some parties that the development of positive and negative lists of feed ingredients may be an important contribution to the control of animal feed internationally.

1. *Antimicrobial resistance*

The matter of antimicrobial resistance is actively being considered by the International Office of Epizootics (OIE), which has set up an *ad hoc* expert group on the topic. Among other issues, this group will consider the development of technical guidelines on the prudent use of antimicrobials and the monitoring of quantities of antimicrobials used in animal husbandry. The *ad hoc* expert group called upon FAO to take up the role of coordinator with regard to the use of antibiotics as growth promoters.

WHO has held a series of meetings on the question of antimicrobial resistance and based on their findings has recommended the termination of the use of antimicrobials as growth promoters if similar products are also licensed in human medicine. The European Commission Scientific Steering Committee on Antimicrobial Resistance made a similar recommendation in the report of a meeting held in May 1999. The WHO has also prepared draft guidelines for the containment of antimicrobial resistance from antimicrobial use in livestock, which will form the basis of discussions in an expert consultation on the same subject in June 2000. This will have direct implications for animal feeding practices.

The question of microbial resistance is also being discussed within the Codex Committee on Residues of Veterinary Drugs in Foods (CCRVDF) and the Codex Committee on Food Hygiene (CCFH). The former CCRVDF receives scientific advice from the FAO/WHO Joint Expert Committee on Food Additives which currently considers the impact of antimicrobial residues on the gut but does not consider the transfer of antimicrobial resistance arising from the use of antimicrobials and their release into the environment, as this is beyond their terms of reference. The role of CCRVDF in broader discussions of the question of antimicrobial resistance is uncertain. CCFH considers antimicrobial resistant bacteria in relation to food hygiene. This committee is already involved in risk assessment associated with microbiological contamination of food, and is therefore well-placed to take a risk analysis approach to the question of antimicrobial resistance.

2. *Environmental and industrial contaminants*

The recent problems originating from the contamination of animal feed in Belgium highlighted the existing disparity among regulations in different countries related to the presence of dioxins and PCBs in foods including their maximum allowed limits. The Codex Committee on Food Additives and Contaminants (CCFAC) has requested that the FAO/WHO Joint Expert Committee on Food Additives (JECFA) consider these groups of compounds and provide scientific advice to guide the Committee in its task of establishing guideline or maximum levels in food and feed.

WHO held an expert consultation on assessment of the health risk of dioxins in Geneva in May 1998. The consultation evaluated the tolerable daily dose of dioxins to which a human can be exposed without appreciable health risk. In light of epidemiological data concerning the effects of dioxins at low levels of exposure and based on animal studies, the TDI was reduced from 10pg/kg body weight to a range of 1-4pg/kg body weight.

CCFAC has also initiated work on a proposed draft Code of Practice for Source Directed Measures to Reduce the Contamination of Food with Chemicals[8]. At the 32nd Session of this Committee it was decided to forward this proposed draft to the Executive Committee for preliminary adoption. This work is important in terms of reducing contamination of animal feed which is produced in areas highly affected by environmental pollutants. CCFAC is also currently working to establish maximum limits for the presence of lead and cadmium in food and feed materials.

Programmes to monitor and control levels of environmental and other chemical contaminants in food and feed must be supported by adequate analytical expertise and equipment. The dioxin crisis revealed that until recently, few laboratories were equipped to carry out testing for this group of contaminants. FAO is frequently involved in providing technical assistance to countries to improve their capability in food contaminant analysis.

3. *Mycotoxin contamination*

During its 32nd Session held in Beijing in March 2000, the Codex Committee on Food Additives and Contaminants decided to create a single general Code of Practice for the Prevention of Mycotoxin Contamination in Cereals, including specific Annexes related to the prevention of Ochratoxin A, Fumonisins and Zearalenone contamination in cereals, for consideration at its next meeting. Given that approximately 26% of the world cereal production is used directly for animal feeding (FAOSTAT) this work has direct implications for the control of mycotoxin contamination in feed.

The capability and reliability of food control analytical services are important considerations in the implementation of national programmes to ensure feed safety. FAO, in collaboration with the International Agency for Atomic Energy (IAEA), has been widely involved in improving analytical quality assurance in laboratories carrying out mycotoxin analysis and has implemented several training courses on this topic. FAO training programmes help prepare laboratories to obtain official accreditation.

4. *Transmissable Spongiform Encephalopathies*

Research and investigation continues in the area of TSEs due to the important implications for the safety of foods of animal origin. In December 1999, WHO, in collaboration with the International Offices of Epizootics (OIE), held a consultation on Public Health and Animal Transmissable Spongiform Encephalopathies – Epidemiology, Risk and Research Requirements. The recommendations of this consultation included the need for continued priority to be placed on surveillance of Creutzfeldt-Jacob Disease (CJD) and evaluation of animal TSE zoonotic potential; and, continued emphasis on programmes for the control and eventual eradication of TSEs in livestock including the development of improved diagnostic testing methods.

In the face of a wave of consumer doubt fuelled by new evidence of the spread of Bovine Spongiform Encephalopathy (BSE) in the European Community, the WHO, OIE and FAO have jointly agreed to conduct a further consultation on BSE, Trade and Public Health in June 2001. BSE is widely regarded as the cause of variant Creutzfeldt-Jakob disease (vCJD), a rare but fatal brain disease that has thus far killed over 90 people. The largest outbreak of BSE has been in the UK, with almost 200,000 cases reported, but cases have been reported in native cattle in France, Switzerland, Belgium, Denmark, Ireland, Luxembourg, Netherlands, Portugal and most recently in Germany, Spain and Italy. While no cases of BSE in native cattle herds have been reported outside of these countries (there are rare reports from countries who imported cases), potential spread may have occurred through exportation of meat-and-bone meal feed supplements, and this has triggered renewed concerns about globalization of BSE. This meeting will review current evidence on the safety of bovine based foods, the risk that BSE may be occurring in countries where no cases have yet been reported and make recommendations on how to avoid an international epidemic of BSE and vCJD.

FAO issued a press briefing on 26 January 2001 that urged countries around the world, not just those in Western Europe, to be concerned about the risk of bovine spongiform encephalopathy (BSE) and its human form, the new variant Creutzfeldt-Jakob disease (nvCJD). In a statement issued in Rome, FAO called for action to protect the human population, as well as the livestock, feed and meat industries. It suggested that all countries which have imported cattle or meat and bone meal (MBM) from Western Europe, especially the UK, during and since the 1980s, can be considered at risk from the disease. It added that countries at risk should implement effective surveillance for BSE in cattle and controls on the animal feed and meat industries. At present, this means: laboratory testing of samples from slaughtered cattle, and correct disposal of fallen stock and improved processing of offals and by-products. Within countries, FAO recommended applying the Hazard Analysis and Critical Control Point system (HACCP) which aims at identifying potential problems and taking corrective measures throughout the food chain. Some of the issues include the production of animal feed, the raw materials used, cross-contamination in the feed mill, labelling of manufactured feeds, the feed transport system, as well as monitoring imported live animals, slaughtering methods, the rendering industry and the disposal of waste materials. Legislation to control the industry and its effective implementation is required, including capacity building and the training of operatives and government officials.

B. Code of Practice for Good Animal Feed Production, Handling and Storage

The FAO Expert Consultation on Animal Feeding and Food Safety held in 1997 noted that quality assurance (QA) begins with the concept of what the feed product is to be, in terms of the species being fed and the results being sought. Ingredient specifications are important to quality assurance in defining the quality of the feedstuffs to be accepted by the processor when the raw materials are received for processing. The formulation of the finished feed, including any added medications, should meet the regulatory requirements of the government as well as satisfy the animal production objectives of the customer. Other QA factors involve the manufacture and distribution of the feed. Key elements in effective quality assurance at the feed production facility should include proper sampling, laboratory testing and microscopy, in-plant quality control, control of drug carry-over, plant sanitation and integrated pest management, plant cleanliness, the receiving area, and storage. Quality assurance procedures must be clearly documented and records maintained.

Clear guidance from governments to industry regarding required features of feed quality assurance programmes constitutes an important preventative approach to feed safety. Such guidance can be provided through codes of practice for the animal feed and livestock sectors covering all stages of feed production, handling and storage to its ultimate use. The code could cover such issues as: production of feed materials; sourcing of feed materials; use of additives and veterinary medicinal substances; structures, equipment and materials used in feed manufacture, packaging, handling or storage; product and personnel flows through the facilities; processing operations; labelling requirements; transport and storage of finished product; traceability mechanisms; and, appropriate record-keeping.

Applying HACCP ensures that all potential safety hazards are thoroughly analysed and assessed, that critical limits are established for all points along the chain that must be controlled to avoid occurrence of safety hazards, that effective systems for monitoring the critical control points are in place, and that plans for corrective action are established in the event of problems within the production chain. Processors and handlers of animal feed must further ensure that adequate documentation is maintained to demonstrate their adherence to HACCP principles.

The work currently being undertaken at international level to establish a Code of Practice for good animal feeding will be instrumental in ensuring a uniform approach to assuring the quality of feed.

C. National Programmes to Prevent Foodborne Hazards Related to Animal Feed

A basic component of the national controls necessary to guarantee the quality and safety of feeds and foods includes legislation and regulations. The legislation defines responsibilities and designates authority with respect to the wide spectrum of activities involved, establishes basic procedures to be followed in enforcing the legislation, and provides standards, guidelines and other recommendations to be respected by the industry in the production of animal feed.

Legislation and regulations concerning the production, manufacture, handling, storage and use of animal feed should be coherent and complementary parts of national food legislation. The development and implementation of food law is a political process, which is dynamic and evolutionary and often reflects changing public and political concerns. Unless governments undertake periodic review of food/feed legislation to ensure its coherency, it may become a patch work of additions and revisions leading to overlapping, redundant and conflicting jurisdictions for government agencies and gaps that could give rise to

public health problems. Recent food safety problems involving unsafe feed have demonstrated certain weaknesses and gaps in existing legislation in force in many countries.

Some countries may wish to update policies in line with today's food and feed safety issues. For example given the current possibilities of modern biotechnology, it may be necessary that regulations and procedures for the evaluation, authorisation and labelling of foods produced from biotechnology, be established. Measures instituted should not be more restrictive than necessary to meet legitimate food/feed quality and safety objectives.

The WTO SPS Agreement calls upon members to harmonise food safety measures internationally. Recent food safety crises linked to feed contamination have heightened international awareness of existing disparity among national legal limits for maximum levels of contaminants that could be associated with animal feedstuffs. This raises questions about the appropriate level of consumer protection and also constitutes a barrier to trade. Current work by relevant international organizations to determine appropriate guidelines levels of contaminants is necessary to facilitate eventual harmonisation of regulations without compromising public safety.

Enforcement of legislation and regulations depends on effective administration of feed control programmes, the existence of an inspection service whose staff is well trained in feed production and manufacture and related safety issues and analytical services adequately equipped and with sufficient capacity and the required technical expertise to carry out the volume and types of analyses necessary to support monitoring and surveillance programmes as well as routine regulatory testing.

There is agreement throughout the international community that food safety measures should be scientifically justified. This highlights the need for research on feed-related safety hazards in foods of animal origin. The establishment of research networks could be a useful strategy to promote sharing of scientific information and hence improve the chances of building more rapidly on scientific developments to arrive at reliable answers to questions regarding feed safety and quality.

Where potential problems associated with feed are not effectively covered by existing rapid alert systems for food safety, governments should take the necessary steps to ensure the implementation of swift action to contain and eliminate any feed safety problems with the potential to cause public health risk. In the case of feed in international trade, Codex provides guidelines for the Exchange of Information in Food Control Emergency Situations (CAC/GL 19-1995).

In seeking to address the weaknesses in feed control that have become apparent in recent years, governments must pay considerable attention to the inter-relations that exist between different agencies and the need to establish cooperative and coordinating mechanisms to ensure the best possible implementation of all programmes while giving privilege to public health concerns when these arise. The composition and safety of feed have important food safety implications, but are also critical considerations in animal health and husbandry. It is fitting therefore that governments establish suitable mechanisms for food safety agencies, agriculture departments and veterinary services to work together in determining the best policies and actions with regard to animal feed. It must be emphasised that an important aspect of control lies in training. Poor practices within the animal feed industry are often linked to lack of knowledge of associated hazards and how these should be managed. The development of relevant training and extension programmes for people involved in the feed industry or in animal feeding at farm level is an important aspect of control of animal feed.

The control of BSE offers a clear illustration of the need for close collaboration among food control and other concerned agencies. Measures that have been established in Europe and elsewhere centre around surveillance and notification of BSE in live animals, establishment of processing conditions for mammalian tissues to be used in animal feed and prevention of the use of mammalian tissues in feedstuffs for ruminants. The first of these activities would fall under the responsibility of veterinary services. The complexity of the flows of raw material, animal meal and compounds containing animal meal highlights the need for close cooperation between various agencies in order to achieve public health objectives.

IV. CONCLUSIONS

Certain chemical substances and biological agents incorporated into feed at any stage of production up to the point of feeding, either intentionally or unintentionally, can result in hazards in food of animal origin. National food safety programmes should therefore include the control foodborne hazards that originate in feedstuffs.

Effective control of animal feedstuffs requires multi-disciplinary input. There is a need for collaboration between all parties involved in feed and animal production, especially those in a position to provide veterinary clinical and epidemiological information, to establish the linkage between any identified or potential hazard and the level of risk. Such information is essential for the development and maintenance of appropriate risk management options and safe feeding practices.

The disciplines that apply to international trade in both food and feed, as well as in feed ingredients were agreed upon during the Uruguay Round of Multilateral Trade Negotiations and set out in the SPS Agreement. Considerable work has been undertaken by the international community to support a uniform approach towards ensuring feed safety that is consistent with SPS principles.

V. RECOMMENDATIONS

Countries should review existing food safety and quality legislation so as to ensure that it provides an adequate basis for the control of feed-related hazards with the potential to cause public health risks.

Countries should participate to the fullest extent possible in the work being undertaken by international organizations involved in developing standards, guidelines and recommendations relating to feed-borne hazards.

Continued research is needed into the public health implications of animal feeds to support risk analysis of feedborne hazards. This would facilitate the setting of MRLs and the determination of effective control measures for protecting public health.

Suitable analytical and diagnostic methods should be developed for rapid screening and confirmation of feedborne hazards in national surveillance and monitoring programmes as well as in routine regulatory testing.

Mechanisms should be established to ensure multi-disciplinary scientific input, involving human medicine, veterinary medicine, animal science, crop science, food/feed technology, environmental science and toxicology, into policy and programme decisions relating to the control of feedborne hazards.

Dialogue among producers of feed or feed ingredients, livestock and aquaculture industries and government should be encouraged as an essential part of the process of elaborating codes of practice for the feed industry. This will ensure that eventual regulations and guidelines are practicable and widely supported.

Coordination and cooperation among several government agencies and departments may be necessary to ensure successful and efficient implementation of feed control programmes.

International organizations should continue to develop and make available information related to animal feed safety to their member countries thus supporting national feed control programmes.

REFERENCES

[1] FAO, 2000. State of Food and Agriculture – 13th Session. Report of Conference held in Rome, 12-23 November 1999Rome

[2] Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois C.. 1999 *Livestock to 2020: The Next Food Revolution.* International Food Policy Research Institute, Food, Agriculture, and the Environment Discussion Paper No. 28, 72 pp

[3] FAO/NACA/WHO 1998. Report of a Technical Consultation on Food Safety Issues Associated with Products from Aquaculture. WHO Technical Series 883, Geneva.

[4] FAO/WHO 1999. Discussion Paper on Dioxins. Codex Committee on Food Additives and Contaminants, 32ND Session, Beijing, People's Republic of China, 20-24 March 2000. CX/FAC 00/26.

[5] WHO 1999. Surveillance programme for control of foodborne infections and intoxications in Europe. 7th Report 1993-1997. Federal Institute for Health Protection of consumers and veterinary medicine. In preparation

[6] FAO/IAEA/WHO, 1999. Report of the Joint Study Group on High Dose Irradiation, Geneva 15-20 September 1997. Technical Report Series 890, WHO.

[7] FAO/WHO 1999. Codex Alimentarius Commission Guidelines for the Production, Processing, Labelling and Marketing of organically produced foods *cac/gl 32-1999*

[8] FAO/WHO 2000. Report of the Codex Committee on Food Additives and Contaminants, 32nd Session, Beijing China, 20-24 March 2000. Alinorm 01/12.