



manual

GOOD PRACTICES FOR THE FEED INDUSTRY

Implementing the Codex Alimentarius
Code of Practice on Good Animal Feeding



GOOD PRACTICES FOR THE FEED INDUSTRY

Implementing the Codex Alimentarius
Code of Practice on Good Animal Feeding

Recommended Citation

FAO and IFIF. 2010. *Good practices for the feed industry – Implementing the Codex Alimentarius Code of Practice on Good Animal Feeding*. FAO Animal Production and Health Manual No. 9. Rome.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations, or of IFIF concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO, or IFIF in preference to others of a similar nature that are not mentioned. The views expressed herein are those of the authors and do not necessarily represent those of FAO, or the IFIF.

ISBN 978-92-5-106487-0

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission of the copyright. Applications for such permission should be addressed to the Chief Publishing Policy and Support Branch
Office of Knowledge, Research and Extension
FAO
Viale delle Terme di Caracalla
00153 Rome
Italy

or by e-mail to: copyright@fao.org

Contents

Foreword - FAO	iv	
Foreword - IFIF	v	
Introduction	vii	
Glossary	ix	
Feed industry terms	xii	
Feed ingredient terms	xviii	
Abbreviations & Acronyms	xix	
SECTION 1		
Health hazards associated with animal feed	1	
SECTION 2		
General principles and requirements	7	
SECTION 3		
Good production practices	19	
SECTION 4		
On-farm production and use of feed and feed ingredients	37	
SECTION 5		
Methods of sampling and analysis	51	
APPENDIX I		
The Codex Code of Practice for Good Animal Feeding	59	
APPENDIX II		
National codes of practice	69	
APPENDIX III		
The role of national feed associations and setting up a feed association	73	

Foreword

FAO

Synergizing good practices on animal feed

Delgado *et al.* (1999) used the term 'Livestock Revolution' to describe the rapid growth of the global livestock sector in response to the increase in demand for food of animal origin which they said "has profound implications for human health, livelihoods and the environment."

Livestock production is growing fastest in the developing world, particularly in Asia and Latin America. Increased output has been achieved mainly through the intensification of production systems and through a shift towards poultry and pigs with much slower expansion of beef production; dairying too has increased in both scale and intensification. The industrialisation of livestock production systems, characterized by high animal densities and limited land base for the recycling of manure and other waste in crop agriculture, are associated with substantial environmental externalities and require particular attention to biosecurity, animal disease emergence and control as well as to animal welfare and domestic animal diversity management.

Good Agricultural Practices (GAP) and good practices in assessing, managing and communicating risks along the entire food chain are required. Such practices need to respect conditions of economic, environmental and social sustainability and to be geared towards protecting food safety and veterinary public health. FAO assigns high priority to the development of good agricultural and management practices in livestock production and animal health; their application in the livestock sector relies on the active involvement of the sector itself in the design of such practices. The close collaboration of industry and inter-governmental agencies such as FAO in this endeavour is key for achieving the desired impact.

Food safety is a core area of the collaboration of all actors, private and public, for the protection of the animal product food chain from the farm to the consumer. Given the direct links between animal feed and the safety of foods of animal origin, it is essential that feed production and manufacture are considered as an integral part of the food production chain. Feed production must therefore be subject, in the same way as food production, to the quality assurance of integrated food safety systems.

The Joint FAO/WHO Codex Alimentarius Commission approved three important Codes affecting livestock production: the Code of Practice for Good Animal Feeding, the Code of Hygienic Practice for Meat and the Code of Hygienic Practice for Milk and Milk Products. FAO is determined to assist in the practical implementation of these Codes across the sector by bringing together the relevant actors in the animal feed and animal production, processing and retail chain to address the critical issues of food safety and sustainable development. The close collaboration between FAO and the sector's relevant players, such as the International Feed Industry Federation (IFIF) in the case of the design, production and introduction of this Manual of Good Practices for the Feed Industry is instrumental for achieving these important objectives.

Samuel Jutzi

Director - Animal Production and Health Division
Food and Agriculture Organization of the United Nations (FAO)
Rome, Italy

Foreword

IFIF

Our industries should embrace this worthy endeavour

For the first time ever, the feed industry has developed an international Feed Manual that focuses on the issues of feed and food safety. Joining together to make this happen are the International Feed Industry Federation (IFIF) and the Food and Agriculture Organization of the United Nations (FAO).

This initiative has been assisted through the WTO-supported Standards and Trade Development Facility (STDF). The undertaking is certainly no small task, but with the recent adoption of the Codex Alimentarius *Code of Practice on Good Animal Feeding*, a manual that explains in detail these new requirements is a worthy endeavor and one which the world's feed and food industries should fully embrace and provide their complete support.

The Manual consists of five sections, explaining in detail how those involved in the production of animal feeds can implement the principles documented in the Codex Alimentarius' *Code of Practice on Good Animal Feeding*.

While it is not meant to be an all-inclusive document, this Feed Manual focuses on the issues of feed and food safety and carries with it a set of Appendices which contains the Code itself and additional supporting information related to the manufacture of safe feed. Also covered in body of the Manual is safe feeding practices for on-farm feeding (Section 4).

The International Feed Industry Federation aims to help meet the demand for safe and affordable food globally, through its membership, by:

- Promoting a range of processing technologies and engineering in feed manufacture, from processes relying on general and skilled labor to fully automated manufacturing systems
- Making use of a wide range of co-products, by-products and raw materials from primary agricultural production, the food industry and industrial sources
- Sponsoring university research in animal nutrition and other fields and conducting feeding and animal husbandry trials
- Developing systems of feed marketing and distribution to support livestock farming in markets that span the globe
- Playing a proactive role in educating feed manufacturers, consumers and regulatory authorities worldwide on a variety of issues that affect the supply of safe and affordable foods of animal origin.

While all are of significant importance, it is the last of these five goals that is key and helps take the accomplishment of Codex Alimentarius and its new feed standard beyond our industry to provide consumers with the assurances for which they are increasingly looking for in regard to the safety of their food.

Safety is important for the expansion of international trade in feed products as well as food products of animal origin. Both food exporting and importing countries, which include virtually every country, can benefit from a more level playing field to support the trade of safe food products.

Fred Stephens

President (2002-2008)
International Feed Industry Federation (IFIF)
Cheltenham, UK

Dave Cieslak

Chairman (2008-onwards)
International Feed Industry Federation (IFIF)
Cheltenham, UK

Acknowledgements



Members of the International Feed Industry Federation (IFIF) have substantially collaborated with the Food and Agriculture Organization of the United Nations (FAO) in the production of this manual. In particular IFIF and FAO wish to acknowledge the contributions made by: IFIF national Feed Associations, universities and feed industry members for significant contributions to drafting the manual. Primary contacts include Ariovaldo Zanni, Flavia Ferreira de Castro, Angela Pellegrino Missaglia and Dario Righi of the Brazilian Feed Industry Association (Sindirações), Richard Sellers and Dave Bossman of the American Feed Association (AFIA), Honjie Yang of the China Feed Industry Association (CFIA), Alexander Döring of the European Feed Manufacturers Federation (FEFAC), DeWitt Boshoff of the African Feed Millers Association (AFMA), Tim Herrman of Texas A&M University, George Kau of DSM, Karine Tanan of Provimi, Steve Auman of Potash Corporation of Canada and chairman of IFIF's Technical and Regulatory Committee and Roger Gilbert, Secretary General of IFIF. Grateful acknowledgement is given to all of these people and organizations for supplying relevant input for the various chapters. Several staff within the Nutrition and Consumer Protection Division and in the Animal Production and Health Division of the Agriculture and Consumer Protection Department of FAO, contributed to the technical review of the material.

Section 1 has been adapted and reprinted from the *Report of the FAO/WHO Expert Meeting on Animal Feed Impact on Food Safety* (2007).

The production of the manual has been realized with the financial contribution of the Standard and Trade Development Facility (STDF) of the FAO, the World Organisation for Animal Health (OIE), the World Bank Group, the World Health Organization (WHO) and the World Trade Organization (WTO).

Introduction

Animal feeds play a leading role in the global food industry, enabling economic production of products of animal origin throughout the world. They may be produced in industrial feedmills or in simple on-farm mixers. These feeds may be called 'industrial', 'formula', 'blended' or 'compound' feeds. Manufactured feeds are used to grow or maintain animals for food, fibre and other products under a wide range of farming conditions.

Efficient, intensive production of meat, milk, eggs and other foods requires blended and balanced feeds. Safe feed products enable farms to ensure food safety, reduce production costs, maintain or increase food quality and consistency and enhance animal health and welfare by providing adequate nutrition at every stage of growth and production. They also can reduce the potential for pollution from animal wastes by providing only necessary amounts of highly bio-available dietary nutrients. They should be used in conjunction with well-planned and efficient waste management systems to ensure safety of the environment.

Commercial production or sale of manufactured feed products takes place in more than 120 countries and directly employs more than a quarter of a million skilled workers, technicians, managers and professionals. Currently, there are an estimated 8 000 plants for manufactured feed production with capacities greater than 25 000 tonnes per year, along with other production facilities, including premix and specialty plants producing lower volumes of high-value products. Together, these plants manufacture more than 620 million tonnes of feed products annually.

Commercial feed manufacturing generates an estimated annual turnover and sales value equivalent to US\$85 billion worldwide. To supply the industry, the movement of feed raw materials, branded ingredients, handling and processing equipment and technical services is global in scope.

Although now serving mature, slower growing markets in many developed countries, the global feed industry continues to expand in volume and value in response to increases in world population, urbanization and growing consumer purchasing power. The demand for feed grows even more quickly when personal income rises in countries where there is unmet demand for more or better foodstuffs.

To help meet the demand for safe and affordable food, feed manufacturers around the world need to:

- Apply a range of processing technology and engineering in feed manufacture, from processes relying on general and skilled labour to fully-automated manufacturing systems;
- Make use of a wide range of co-products, by-products and otherwise surplus raw materials from primary agricultural production, food industry and industrial sources;
- Sponsor university research in animal nutrition and other fields and conduct their own feeding and animal husbandry trials.
- Play an increasingly proactive role in informing consumers and dialogue with regulatory authorities worldwide on a variety of issues that affect the supply of safe and affordable foods of animal origin.

A contemporary risk-based approach to feed safety requires that adequate measures should be applied at those points in the production and distribution chain where they will be of greatest value in reducing feed-borne risks to consumers. This should be reflected in the application of specific measures that are based on science and risk assessment, and a greater emphasis on prevention and control of contamination during processing. Application of the Hazard Analysis and Critical Control Point (HACCP) principles is a valuable element. Risk-based programmes have proved successful in

This manual is targeted at the commercial feed industries and farm-based feed mixers in developing countries and emerging economies in their endeavour to meet the rising quality and safety requirements of both the export and domestic markets, with the increasing participation of large-scale retailers everywhere.

achieving hazard control to the extent required for consumer protection. They are based on the required outcome rather than on detailed and prescriptive measures.

A number of national governments are implementing systems that redefine the respective roles of industry and government in delivering safe feed.

Irrespective of the delivery systems, the competent authority is responsible for defining the role of personnel involved in inspection activities where appropriate, and verifying that all regulatory requirements are met.

The principles of risk management should be incorporated wherever appropriate in the design and implementation of feed safety programmes. Further, newly recognized feed-borne risks to human health may require measures in addition to those that are usually applied in feed and food safety.

The FAO/WHO Codex Alimentarius Commission has approved in 2004 a *Code of Practice on Good Animal Feeding* (herein after referred to as the 'Code' - see Appendix I for the complete code). The Code implies a transition towards a risk-based approach covering the entire food chain. This Manual of Good Practices for the Feed Industry provides updated comprehensive information and practical guidelines (See Appendix II for a list of relevant national codes of practice) to assist producers and all stakeholders along the production and distribution chain to comply with the regulatory framework, which have or will come into force in response to the Code.

The application of the Code is an important step for the expansion of international trade in feed products as well as in products of animal origin. Both food exporting and importing countries can benefit from a more level playing field to support the trade of safe food products.

This publication is intended to guide managers of feedmills and the feed industry as a whole. It will also be of value to officers engaged in feed inspection, with their supervisory roles in feed safety. It can also serve as a training manual and guide to set up a National Feed Association (see Appendix III).

This Manual is targeted at the commercial feed industries and farm-based feed mixers in developing countries and emerging economies in their endeavour to meet the rising quality and safety requirements of both the export and domestic markets, with the increasing participation of large-scale retailers everywhere.

This Manual has been developed by a strict collaboration between the International Feed Industry Federation (IFIF) and FAO with the support of the Standards and Trade Development Facility (STDF) established by FAO, the World Organization for Animal health (OIE), the World Bank Group, the World Health Organization (WHO) and the World Trade Organization (WTO).

Glossary

Chemical residues

Residues of veterinary drugs and pesticides as described in the Definitions for the Purpose of the Codex Alimentarius¹.

Competent authority

The official authority charged by the government with the control of feed hygiene and safety, including setting and enforcing regulatory feed hygiene and safety requirements.

Competent body

A body officially recognized and overseen by the competent authority to undertake specified feed hygiene and safety activities.

Competent person

A person who has the training, knowledge, skills and ability to perform an assigned task, and who is subject to requirements specified by the competent authority.

Contaminant

Any biological or chemical agent, foreign matter or other substance not intentionally added to feed or food that may compromise feed and food safety or suitability.

Contamination

The introduction or occurrence of a contaminant in feed or food or the feed or food environment.

Critical control point (CCP)

A point, step or procedure in a feed or food process at which control can be applied and, as a result, a feed or food safety hazard can be prevented, eliminated or reduced to acceptable levels.

Critical limit

The maximum or minimum value to which a physical, biological or chemical hazard must be controlled at a critical control point to prevent, eliminate or reduce to an acceptable level the occurrence of the identified feed or food safety hazard.

Exposure assessment

The qualitative and/or quantitative evaluation of the likely intake of biological, chemical, and physical agents via food, as well as exposures from other sources if relevant.

Feed (Feedingstuff)

Any single or multiple materials, whether processed, semi-processed or raw, which is intended to be fed directly to food-producing animals.

Feed ingredient

A component part or constituent of any combination or mixture making up a feed, whether or not it has a nutritional value in the animal's diet, including feed additives. Ingredients are of plant, animal or aquatic origin, or other organic or inorganic substances.³

Feed additive

Any intentionally added ingredient not normally consumed as feed by itself, whether or not it has nutritional value, which affects the characteristics of feed or animal products.³ Micro-organisms, enzymes, acidity regulators, trace elements, vitamins and other products fall within the scope of this definition depending on the purpose of use and method of administration.

Good Hygienic Practices (GHP)

All practices regarding the conditions and measures necessary to ensure the safety and suitability of feed or food at all stages of the food chain.

¹ FAO/WHO. 2001. Codex Alimentarius Commission - Procedural manual - 12th Edition. Joint FAO/WHO Food Standards Programme, FAO, Rome. (available at <http://www.fao.org/DOCREP/005/Y2200E/y2200e00.htm#Contents>).

Good Manufacturing Practices (GMP)

A series of procedures in a branch or sector in which the standard of conduct is laid down (often with respect to hygiene and safety).

Hazard Analysis and Critical Control Points (HACCP)

A method to identify process steps where a loss or significant deviance from the required product quality and safety could occur if no targeted control is applied.

Hazard

A biological, chemical or physical agent in, or condition of, feed or food with the potential to cause an adverse health effect.

Hazard identification

The identification of biological, chemical, and physical agents capable of causing adverse health effects and which may be present in a particular feed or food or group of feeds or foods.

Hazard characterization

The qualitative and/or quantitative evaluation of the nature of the adverse health effects associated with biological, chemical and physical agents which may be present in feed or food. For chemical agents, a dose-response assessment should be performed. For biological or physical agents, a dose-response assessment should be performed if the data are obtainable.²

Maximum Residue Limit (MRL) for pesticides

The maximum concentration of a pesticide residue (expressed as mg/kg) recommended by the Codex Alimentarius Commission to be legally permitted in or on food commodities and animal feeds. MRLs are based on Good Agricultural Practices (GAP) data, and foods derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable.

Codex Maximum Residue Limit (MRL) for veterinary drugs

The maximum concentration of residue resulting from the use of a veterinary drug (expressed in mg/kg or µg/kg on a fresh weight basis) that is recommended by the Codex Alimentarius Commission to be legally permitted or recognized as acceptable in or on a food.

Medicated feed

Any feed which contains veterinary drugs as defined in the Codex Alimentarius Commission Procedural Manual¹

Pesticide

Any substance intended for preventing, destroying, attracting, repelling, or controlling any pest including unwanted species of plants or animals during the production, storage, transport, distribution and processing of food, agricultural commodities, or animal feeds or which may be administered to animals for the control of ectoparasites. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, fruit thinning agent, or sprouting inhibitor and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. The term normally excludes fertilizers, plant and animal nutrients, food additives, and animal drugs.²

Quality Assurance (QA)

All the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfil requirements for quality.

Quality Assurance (QA) system

The organizational structure, procedures, processes and resources needed to implement quality assurance.

² FAO/WHO. 2007. Codex Alimentarius principles for risk analysis, (Procedural Manual of the Codex Alimentarius Commission), Seventeenth Edition. Joint FAO/WHO Food Standards Programme. Rome. (available at http://www.codexalimentarius.net/web/procedural_manual.jsp)

³ FAO/WHO. 2004. *Code of Practice on Good Animal Feeding (CAC/RCP 54-2004)*. Rome. (available at http://www.codexalimentarius.net/download/standards/10080/CXC_054_2004e.pdf)

Risk

A function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard(s) in food.²

Risk analysis

A process consisting of three components: risk assessment, risk management and risk communication.²

Risk assessment

A scientifically based process consisting of the following steps: (i) hazard identification, (ii) hazard characterization, (iii) exposure assessment and (iv) risk characterization.²

Risk assessment policy

Documented guidelines on the choice of options and associated judgements for their application at appropriate decision points in the risk assessment, such that the scientific integrity of the process is maintained.²

Risk characterization

The qualitative and/or quantitative estimation, including attendant uncertainties, of the probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterization and exposure assessment.²

Risk communication

The interactive exchange of information and opinions throughout the risk analysis process concerning risk, risk-related factors and risk perceptions, among risk assessors, risk managers, consumers, industry, the academic community and other interested parties, including the explanation of risk assessment findings and the basis of risk management decisions.²

Risk estimate

The quantitative estimation of risk resulting from risk characterization.²

Risk management

The process, distinct from risk assessment, of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant for the health protection of consumers and for the promotion of fair trade practices, and, if needed, selecting appropriate prevention and control options.²

Risk profile

The description of the food safety problem and its context.²

Safe for human consumption

Safe for human consumption according to the following criteria:

- has been produced by applying all food safety requirements appropriate to its intended end-use;
- meets risk-based performance and process criteria for specified hazards; and
- does not contain hazards at levels that are harmful to human health.

Traceability/Product tracing

The ability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution. (Codex Adapted)

Undesirable substances

Contaminants and other substances which are present in and/or on feed and feed ingredients and which constitute a risk to consumers' health, including food safety-related animal health issues.³

Veterinary drug

Any substance applied or administered to any food producing animal, such as meat or milk producing animals, poultry, fish or bees, whether used for therapeutic, prophylactic or diagnostic purposes or for modification of physiological functions or behaviour.²

Feed industry terms

Ambient temperature

The temperature of fluid or gas (usually air) that surrounds objects on all sides.

Applicant

A producer or processor seeking certification against a standard for the production and supply of feed ingredients intended for feeding to livestock or companion animals.

Aspirate (to)

To remove chaff, dust, or other light materials by use of air.

Attrition

Reduction of particle size by friction, rubbing, or wearing away.

Baffle

Any type of plate or sheet used to direct the flow of product or air within a process system.

Balanced

A term describing a feed, diet, or ration that contains all known required nutrients in proper amounts and proportions based upon recommendations of recognised authorities in animal nutrition for a given set of physiological requirements and environmental conditions.

Base Mix

Similar to a supplement but containing only part of the animal's protein requirements, so must be used with high protein ingredients and grain.

Blend (to)

To mingle or combine two or more ingredients or feeds, but not necessarily to achieve uniform dispersion.

Block (to)

To agglomerate individual ingredients or mixtures into a large mass; the product of this process: agglomerated feed compressed or chemically hardened into a solid mass cohesive enough to hold its form and weighing over one kilo (approximately two pounds) and may weigh from 7kg to 240kg (15 to 500lbs).

Brick

Agglomerated feed compressed into a solid mass cohesive enough to hold its form and weighing less than one kilo (approximately two pounds).

By-product

A secondary product produced in addition to the principal product (also see co-product).

Cake

A mass resulting from the pressing of seeds, meat, or fish in order to remove oils, fats, or other liquids; accumulation of dust on a filter or other equipment.

Calibration

The demonstration that a particular instrument or device produces results within specified limits by comparison with those produced by a reference or traceable standard over an appropriate range of measurements.

Can (to)

To process, package, seal, and sterilize a feed for preservation in cans or similar containers.

Carry-over

Contamination of a material or product with another material or product that originates from previous use of equipment.

Carrier

An edible material to which ingredients are added (absorbed, impregnated, or coated) to facilitate their uniform distribution in feeds.

Check (to)

To monitor and measure of processes and products against policies, objectives and requirements for the product, with the reporting of results.

Chip (to)

To cut or break into fragments or small thin slices.

Chop (to)

To reduce particle size by cutting with knives or other sharp-edged instruments.

Clean (to)

To remove materials by any method.

Cleanings

Foreign matter, such as chaff, weed seeds, or dust, removed from cereal grains and other crops.

Clip (to)

To remove the ends of whole grain.

Code of Practice

It identifies the essential principles of feed hygiene to ensure the safety of feed for animals and their suitability for animal products for human consumption.

Combustion

A chemical process that usually is rapid and produces heat.

Commercial feed

All materials that are sold and distributed as feed, or to be mixed with feed, for animals except: unmixed seed, whole, processed, or unprocessed; straw, stover, silage, cobs, husks, and hulls; or individual chemical compounds not mixed with other ingredients.

Complete feed

A nutritionally adequate feed compounded by a specific formula to be fed as the sole ration and capable of maintaining life and/or promoting production without any additional substance except water.

Concentrate

A feed used with another to improve the nutritive balance of the total and intended to be diluted or mixed to produce a supplement or a complete feed; may be unsafe if fed free choice or alone as a supplement.

Condensation

The conversion of a substance (for example, water) from a vapor state to a denser liquid state, usually initiated by a drop in temperature.

Condense (to)

To reduce a material to a dense form by removing moisture.

Condition (to)

To achieve predetermined moisture levels and/or temperature of ingredients or a mixture of ingredients prior to further processing.

Control measure

Any action and activity that can be used to prevent or eliminate a feed / food safety hazard or reduce it to an acceptable level (Codex adapted).

Convection

The transfer of heat via a circulatory motion in a fluid occurring at non-uniform temperature caused by variations in density and the action of gravity.

Cook (to)

To heat in the presence of moisture to alter chemical and/or physical characteristics or to sterilize.

Cool (to)

To reduce temperature by air movement, usually accompanied by a simultaneous drying action.

Corrective action

Any action to eliminate a non-conformity.

Crack (to)

To reduce particle size by a combined breaking and crushing action.

Crimp (to)

To roll with corrugated rollers, possibly involving conditioning and cooling.

Cross-contamination

Contamination of a material or product with another material or product.

Crumble (to)

To reduce pellets to granular form.

Crumbles

Pelleted feed reduced to granular form.

Crush

See 'roll' later in this list

Cube

See 'pellet' on next page

Cube, Range

See pellet and range cube.

Cut

See 'chop' on opposite page

Damper

A valve for controlling airflow.

Degree day

18.31°C (65 degrees Fahrenheit) minus the mean temperature of the day.

Dehull (to)

To remove the outer covering from grain or seeds.

Dehydrate (to)

To remove moisture by heat.

Density

The ratio of the mass of a substance to its volume or the mass of a unit volume of a substance; weight can be substituted for mass if that will not cause confusion.

Density factor

The ratio of actual air density to density of standard air.

Diet

A feed ingredient or mixture of ingredients, including water, and is consumed by animals.

Diluent

An edible substance mixed with nutrients and/or additives to reduce their concentration and make them more acceptable to animals, safer, and easier to mix uniformly in a feed; also may be a carrier.

Dress (to)

To make uniform in texture by breaking or screening of lumps from feed and/or the application of water or other liquid.

Drug

A substance intended for use in the diagnosis, mitigation, treatment, cure, or prevention of disease in animals or a substance other than feed intended to affect the structure or any function of an animal's body.

Dry (to)

To remove water or liquids from materials.

Evaporate (to)

To reduce moisture in a material and reduce it to a denser form.

Expand (to)

To subject a feed or ingredients to moisture, pressure, and temperature that gelatinise the starch portion and then to increase the volume by abrupt reduction in pressure.

Extract (to)

To remove fat or oil from materials by heat and mechanical pressure or by solvents.

Extrude (to)

To press or push feed through constrictions under pressure.

Fan

A radial-flow or axial-flow device used to move air.

Feed mixture

See 'formula feed'.

Feed safety assurance

Part of feed safety management focused on providing confidence that feed safety requirements will be fulfilled.

Feedingstuff

See Glossary - Feed (Feedingstuff)

Fines

Any material that will pass through a screen whose openings are immediately smaller than the specified minimum size of crumbles or minimum diameter of pellets.

Flake

See 'roll' later in this list

Flakes

Flat pieces resulting from rolling or cutting an ingredient with or without steam conditioning.

Flour

Soft, finely ground meal obtained from the feedmilling of cereal grains, other seeds, or products and consisting essentially of the starch and gluten of endosperm.

Food

Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. Food shall not include feed.

Formula feed

A combination of two or more ingredients with or without additives proportioned, mixed, and processed according to specifications.

Free choice

A feeding system by which animals are given unlimited access to the separate components or groups of components constituting their diets.

Gas

A formless vapour that tends to occupy an entire space uniformly at ordinary temperatures and pressures.

Gelatinize (to)

To rupture starch granules by a combination of moisture, heat, and pressure or by mechanical shear.

Grind (to)

To reduce particle size using a hammer mill or roller feedmill.

Heat-process (to)

To subject to a method of preparation involving the use of high temperatures.

Homogenize (to)

To break down particles into evenly distributed globules small enough to remain emulsified.

Hopper

A funnel-shaped receptacle for delivering materials.

Humidity (absolute)

The weight of water vapor per unit volume, grammes per cubic centimetre (or pounds per cubic foot).

Humidity, relative

The ratio of the actual partial pressure of the water vapor in a space to the saturation pressure of pure water at the same temperature.

Hydrolyze (to)

To split complex molecules into simple units by a chemical reaction with water.

Kibble (to)

To crack or crush bake or extruded feed that has been cooked prior to or during the extrusion process.

Mash

A mixture of ingredients in meal form.

Meal

An ingredient that has been ground or otherwise reduced in particle size.

Micro-ingredients

Vitamins, minerals, antibiotics, drugs/medicines, and other materials usually required in feeds in small amounts as feed additives.

Mill run

The state in which a material comes from the feedmill; ungraded and usually uninspected.

Mix (to)

To combine two or more materials with or without feed additives by agitation to a specific degree of dispersion.

Pallet

A portable platform used for storage or moving of materials and packages.

Palletize (to)

To place material on a pallet for storage or to transport by means of a pallet.

Pearl (to)

To reduce dehulled grain into smooth particles by machine brushing or abrasion.

Pellet (to)

To agglomerate feed by compacting and forcing it through die openings by a mechanical process; the product resulting from this process (hard pellet).

Pellet, soft

A pellet containing a large percentage of liquids and requiring immediate dusting and cooling.

pH

A term that expresses the intensity of the acidic or alkaline condition of a material.

Pop (to)

To expand whole or cracked grain by heat, sometimes under pressure.

Premix

A uniform mixture of one or more microingredients/additives with a diluent and/or carrier to facilitate their even distribution in a larger mix.

Press (to)

To compact or mold by pressure; to extract fat, oil, or juice under pressure.

Primary feed

A feed formulated from single ingredients, sometimes containing a premix (less than less than 45.5 kg per ton or 100 pounds per ton).

Processing aid

Any substance not consumed as a feedingstuff by itself, intentionally used in the processing of feedingstuffs or feed ingredients to fulfil a technological purpose during treatment or processing which may result in the unintentional but technologically unavoidable presence of residues of the substance or its derivatives in the final product, provided that these residues do not have an adverse effect on animal health, human health or the environment and do not have any technological effects on the finished feed.

Product

A material produced from one or more other materials as a result of chemical or physical change.

Production

All operations of receipt of materials, production, packaging, repackaging, labelling, relabelling, control, release, storage and distribution of premixtures, compound feed and medicated feed and the related controls.

Puff (to)

To expand whole, cracked, or processed grain by pressure and heating.

Pulverize

See 'grind'.

Quality control

A system based upon sampling and testing, with the intention of ensuring compliance with specification and identifying non-conforming products.

Radiation

The emission of radiant energy (heat) in the form of waves.

Range cube

A large pellet designed to be offered to animals on the ground.

Ration

The amount of total feed that is provided to one animal over a 24-hour period.

Record

Document stating results achieved or providing evidence of activities performed.

Returns

Compound feeding stuffs, medicated feed or premixtures generated either during the production process, or subsequently, that are suitable for reworking. Returns originate from a variety of sources each with its special characteristics. They include:

- out of date stock (good housekeeping must keep this to a minimum in factories, stores, retail premises and on farm);
- non-conforming feed (e.g. starting up problems, poor texture, deterioration in plant and on farm, errors in ordering or dissatisfaction);
- sievings on plant processing, where applicable, or at bulk loading of textured feedingstuffs;
- flushings and cleanings (resulting from plant scouring and change-overs);
- broken bags and spillage.

Note: A distinction must be made between internal returns that are products which have not left the site, from external returns.

Roll (to)

To change the shape and/or size of particles by compressing them between rollers, sometimes involving conditioning.

Scalp (to)

To remove larger materials by screening.

Scour

See 'clip'.

Scratch

Cleaned whole, cracked, or cut grain, usually in a mixture.

Screen (to)

To separate various-sized particles by passing over and/or through screens.

Secondary feed

A feed manufactured by mixing supplements with other ingredients such as grain.

Self fed

A feeding system in which animals have continuous free access to some or all components of a ration, either individually or as mixtures.

Separate (to)

To classify by particle size, shape, and/or density.

Separation, magnetic

The removal of ferrous materials by magnetic attraction.

Sift (to)

To pass materials through wire sieves to separate particles of different sizes.

Site

Factories / buildings sharing the same premises, under the same senior management control and involved in various stages of the same continuous process.

Solubles

Liquid containing dissolved substances obtained from processing animal or plant materials, sometimes also containing some fine suspended solids and may be dried.

Specific gravity

The weight of a liquid compared to water, which is assigned a value of 1.0.

Spray dehydrate

To dry materials by spraying them on the surface of a heated drum and then recovering them by scraping from the drum.

Standard air

Dry air at 21.11 degrees Celsius (70 degrees Fahrenheit) and 760 mmHg (torr) (29.92 inches) of mercury, generally equivalent to 1.2041 kg/m³ (0.075 pounds per cubic foot) or 1013.25 millibars.

Standard atmosphere

The condition when air is at 1 atm and temperature is 20 degrees Celsius (68 degrees Fahrenheit).

Standard conditions

Temperature of 20 degree Celsius (68 degrees Fahrenheit) pressure of 101.325 kPa (14.696 psi) and relative umidity of 52 percent; used as a basis for air conditioning calculations.

Steam (to)

To treat ingredients with steam to alter physical and/or chemical properties.

Supplement

A feed used with another to improve the nutritive balance or performance of the animal; can be fed undiluted, diluted and mixed to produce a complete feed, or free choice with other parts of the ration available separately.

Supplier

Organisation or person that provides a product.

Temperature/Dew-point

The temperature corresponding to saturation (100 percent relative humidity) for a given absolute humidity at constant pressure.

Toast (to)

To brown and dry by exposure to a fire or gas or electric heat.

Trace Minerals

Mineral nutrients required by animals in micro amounts (measured in units of grams per kg or smaller).

Vacuum

A reduction in pressure below atmospheric pressure.

Vitamins

Organic compounds that function as parts of enzyme systems essential for the transformation of energy and the regulation of metabolism in the body.

Wafer (to)

To agglomerate feed of a fibrous nature by compressing it into a form usually having a diameter or cross section measurement greater than its length; the product of this process.

Wet-mill (to)

To steep in water with or without sulphur dioxide to soften grains and facilitate the separation of component parts.

Wet-render (to)

To cook with steam under pressure in a closed tank.

Feed ingredient terms

Biscuit

A hard or crisp, dry, baked product.

Chaff

Seed coverings together with other plant parts separated from seeds during threshing or processing or hay or straw processed by cutting into coarse particle size.

Dust

Small solid particles created by the breaking up of larger particles through processes such as crushing or grinding; to sprinkle with fine particles.

Feed additive

See Glossary - Feed additive.

Grain

Seed from cereal plants.

Grits

Coarsely ground grain from which the bran and germ have been removed; usually screened to uniform particle size.

Groats

Grain from which the hulls have been removed.

Hull

The outer covering of grain or other seed.

Protein

Any of a large class of naturally occurring complex combinations of amino acids.

Raw material

All materials used for manufacturing, processing or blending into feed ingredients.

Waste

Substances or objects that fall out of the commercial cycle or out of the chain of utility.

Waste is a substance or object which:

- Someone wants to get rid of and cannot be used for any other purpose;
- Is destined for dumping/land filling;
- Is not intended for re-use, recovery or recycling as animal feed;
- Cannot be used for any other purpose.

Abbreviations & Acronyms

AAA	<i>Animal Agricultural Alliance</i>	ARPAS	<i>American Registry of Professional Animal Scientists</i>
AAFCO	<i>Association of American Feed Control Officials</i>	ASSALZOO	<i>Feed Manufacturers Association, Italy</i>
AAS	<i>Atomic Absorption Spectrometry</i>	BSE	<i>Bovine Spongiform Encephalopathy</i>
ADI	<i>Average Daily Intakes</i>	CCMAS	<i>Codex Committee on Methods of Analysis and Sampling</i>
AFBF	<i>American Farm Bureau Federation</i>	CEN	<i>European Committee for Standardization</i>
AFDO	<i>American Food and Drug Officials</i>	CESFAC	<i>Feed Manufacturers Association, Spain</i>
AFIA	<i>American Feed Industry Association, USA</i>	CDC	<i>Centers for Disease Control and Prevention</i>
AFMA	<i>Animal Feed Manufacturers Association, South Africa</i>	CFA	<i>Cyprus Association of Feed Manufacturers</i>
AFPWTC	<i>The Association of Feed Producers, Warehouse-keepers and Trade Companies, Slovakia.</i>	CFIA	<i>Canadian Food Inspection Agency</i>
AFRIS	<i>Animal Feed Resources Information System</i>	CFIA	<i>China Feed Industry Association</i>
AHI	<i>Animal Health Institute</i>	CMSO_ZZN	<i>Ceskomoravské sdružení organizací zemědělského zásobování a nákupu, Czech Republic</i>
AIC	<i>Agricultural Industry Confederation, UK</i>	COCERAL	<i>European Committee of the Cereal and Animal Feed Trade</i>
AID	<i>Agency for International Development (US State Department), USA</i>	CONAFAB	<i>Mexican Feed Manufacturers Association</i>
AKEFEMA	<i>Association of Kenya Feed Manufacturers</i>	COOL	<i>Country-of-Origin Labeling</i>
ALOP	<i>Appropriate Level of Protection</i>	COPA/COGECA	<i>Committee of Agricultural Organisations within the European Union/General (Confederation of Agricultural Co-operatives in the European Union)</i>
ANAC	<i>Animal Nutrition Association of Canada</i>	CREES	<i>Cooperative Research Education and Extension Service (USDA)</i>
AOAC	<i>Association of Official Analytical Chemists, USA</i>	CRM	<i>Certified Reference Material</i>
APFACA	<i>Association Professionnelle des Fabricants d'Aliments Composés pour Animaux / Beroepsvereniging van de Mengvoederfabrikanten, Belgium</i>	CV-AAS	<i>Cold Vapour Atomic Absorption Spectrometry</i>
APHIS	<i>Animal and Plant Health Inspection Service, USA</i>	CWA	<i>Clean Water Act</i>
APPI	<i>Animal Protein Producers Industry</i>	DAKOFO	<i>Feed Manufacturers Association, Denmark</i>
APWMC	<i>Animal and Poultry Waste Management Center</i>	DDGS	<i>Dried Distillers' Grains with Solubles</i>
AQLs	<i>Acceptance Quality Levels</i>		

<i>DFM</i>	<i>Direct-Fed Microbials</i>	<i>GAP</i>	<i>Good Agricultural Practices</i>
<i>DGS</i>	<i>Distillers' Grains with Solubles</i>	<i>GC/HR-MS</i>	<i>Gas Chromatography – High Resolution Mass Spectrometry</i>
<i>DVT</i>	<i>Deutscher Verband Tiernahrung eV, Germany</i>	<i>GF-AAS</i>	<i>Graphite Furnace Atomic Absorption Spectrometry</i>
<i>ECD</i>	<i>Electron Capture Detection</i>	<i>GFMA</i>	<i>Ghana Feed Millers Association</i>
<i>EFMC</i>	<i>European Feed Manufactures Guide</i>	<i>GHP</i>	<i>Good Hygienic Practices</i>
<i>ELISA</i>	<i>Enzyme-Linked Immuno Sorbent Assay</i>	<i>GMO</i>	<i>Genetically Modified Organism</i>
<i>EMFEMA</i>	<i>European Manufacturers Association of Feed Mineral Materials</i>	<i>GMP</i>	<i>Good Manufacturing Practices</i>
<i>EPA</i>	<i>Environmental Protection Agency</i>	<i>GOARN</i>	<i>Global Outbreak Alert and Response Network</i>
<i>EPCRA</i>	<i>Emergency Planning and Community Right-to-Know Act</i>	<i>GPVD</i>	<i>Good Practices in the Use of Veterinary Drugs</i>
<i>EPIC</i>	<i>Emergency Prevention and Intelligence Centre</i>	<i>GRAS</i>	<i>Generally Recognised as Safe</i>
<i>EC</i>	<i>European Community</i>	<i>GVP</i>	<i>Good Veterinary Practices</i>
<i>EU</i>	<i>European Union</i>	<i>GZS</i>	<i>Gospodarska Zbornica Slovenije, Slovenia</i>
<i>FAO</i>	<i>Food and Agriculture Organization of the United Nations</i>	<i>HACCP</i>	<i>Hazard Analysis and Critical Control Point</i>
<i>FASS</i>	<i>Federation of Animal Science Societies</i>	<i>HAZCOM</i>	<i>Hazard Communication Act</i>
<i>FCI</i>	<i>Facility Certification Institute</i>	<i>HG-AAS</i>	<i>Hydride Generation Atomic Absorption Spectrometry</i>
<i>FDA</i>	<i>Food and Drug Administration, USA</i>	<i>HHS</i>	<i>United States Department of Health and Human Services</i>
<i>FEEDLATINA</i>	<i>Latin American and Caribbean Feed Industry Association</i>	<i>HPLC</i>	<i>High Performance Liquid Chromatography</i>
<i>FEDIAF</i>	<i>European Pet Food Industry Federation</i>	<i>IACA</i>	<i>Feed Manufacturers Association, Portugal</i>
<i>FEFAC</i>	<i>European Feed Manufacturers Federation (Federation Européenne des Fabricants d'Aliments Composés)</i>	<i>ICP-AES</i>	<i>Inductively Coupled Plasma-Atomic Emission Spectrometry</i>
<i>FEFANA</i>	<i>EU Feed Additives and Premixtures Association</i>	<i>IGFA</i>	<i>Irish Grain & Feed Association</i>
<i>FFDCA</i>	<i>Federal Food, Drug and Cosmetic Act</i>	<i>IFIF</i>	<i>International Feed Industry Federation</i>
<i>FFDIF</i>	<i>Feed Manufacturers Association, Finland</i>	<i>IFIS</i>	<i>International Feed Ingredients Standard</i>
<i>FIFANA</i>	<i>European Ingredient Manufacturers Association</i>	<i>IFSA</i>	<i>International Feed Safety Alliance</i>
<i>FML</i>	<i>Feed Feedmill License</i>	<i>INFOSAN</i>	<i>International Food Safety Authorities Network</i>
<i>FMT</i>	<i>Feed Manufacturing Technology</i>	<i>ISO</i>	<i>International Standards Organisation</i>
<i>FS</i>	<i>Föreningen Foder och Spanmal, Sweden</i>	<i>IPM</i>	<i>Integrated Pest Management</i>
<i>FTAA</i>	<i>Free Trade Agreement of the Americas</i>	<i>IZP</i>	<i>IZBA Gospodarcza, Poland</i>
		<i>LANTMÄNNEN</i>	<i>Svenska Lantmännen, Sweden</i>

LC-DAD	<i>Liquid Chromatography with Diode Array Detector</i>	OTC	<i>Over-the-counter</i>
LC-MS	<i>Liquid Chromatography–Mass Spectrometry</i>	PCB	<i>Polychlorinated Biphenyl</i>
LD50	<i>Lethal Dose 50 Percent</i>	PCR	<i>Polymerase Chain Reaction</i>
LGPA	<i>Lithuanian Grain Processors Association, Lithuania</i>	PDI	<i>Pellet Durability Index</i>
LQ	<i>Limiting quantity</i>	PEL	<i>Permissible Exposure Limits</i>
JEFCA	<i>Joint FAO/WHO Expert Committee on Food Additives</i>	PFI	<i>Pet Food Institute, USA</i>
JEMRA	<i>Joint Expert Meetings on Microbiological Risk Assessment</i>	PM-2.5	<i>Particulate Matter of 2.5 Micra</i>
JMPR	<i>Joint FAO/WHO Meetings on Pesticide Residues</i>	PM-10	<i>Particulate Matter of 10 Micra</i>
MPC	<i>Milk Protein Concentrates</i>	PPE	<i>Personal Protective Equipment</i>
MPL	<i>Maximum Permissible Level</i>	PPP	<i>Pollution Prevention Plan</i>
MRA	<i>Microbiological Risk Assessment</i>	PQA	<i>Pork Quality Assurance Programme</i>
MRL	<i>Maximum Residue Limits</i>	PT	<i>Proficiency Testing</i>
MS	<i>Mass Spectrometry</i>	QA	<i>Quality Assurance</i>
MSBC	<i>Menadione Sodium Bisulfite Complex (Vitamin K)</i>	QC	<i>Quality Control</i>
MSDS	<i>Material Safety Data Sheets</i>	QMS	<i>Quality Management System</i>
MSQA	<i>Meat Safety Quality Assurance System</i>	RUPP	<i>Restricted Use Protein Products</i>
MUMS	<i>Minor Use/Minor Species</i>	SEVIZ	<i>Hellenic Feed Industry Association, Greece</i>
NACA	<i>Network of Aquaculture Centres in Asia-Pacific</i>	SFMCA	<i>Stock Feed Manufacturers' Council of Australia</i>
NAFTA	<i>North American Free Trade Agreement</i>	SINDIRAÇÕES	<i>Brazilian Feed Industry Association</i>
NCBA	<i>National Cattlemen's Beef Association</i>	SNIA	<i>Syndicat National des Industriels de la Nutrition Animale, France</i>
NCC	<i>National Chicken Council</i>	SPCC	<i>Spill Prevention, Control and Countermeasure</i>
NEVEDI	<i>Nederlandse Vereniging Diervoederindustrie, The Netherlands</i>	SPS	<i>Sanitary and Phytosanitary (Agreement)</i>
NFI	<i>National Fisheries Institute</i>	SRM	<i>Specified Risk Material</i>
NGFA	<i>National Grain and Feed Association</i>	STDF	<i>Standards and Trade Development Agency</i>
NRA	<i>National Renderers Association</i>	SWPPP	<i>Storm Water Pollution Prevention Plan</i>
NRC	<i>National Research Council, USA</i>	TAFMA	<i>Tanzania Animal Feed Manufacturers Association</i>
NZFMA	<i>New Zealand Feed Manufacturers Association</i>	TBT	<i>Technical Barriers to Trade (Agreement)</i>
OIE	<i>World Organisation for Animal Health</i>	TDI	<i>Tolerable Daily Intake</i>
OSHA	<i>Occupational Safety & Health Administration</i>	TEF	<i>Toxicity Equivalence Factor</i>
		TEQ	<i>Toxic Equivalencies (Dioxin)</i>
		TMDL	<i>Total Maximum Daily Load</i>

TQM Total Quality Management
TRI Toxic Release Inventory
TRQ Tariff Rate Quota
TSP Total Suspended Particulate
UPA Uganda Poultry Association
VFD Veterinary Feed Directive

VFÖ Fachverband der Futtermittelindustrie
Österreichs, Austria
WHO World Health Organisation
WRO World Renderers Organisation
WTO World Trade Organisation

SECTION 1

Health hazards associated with animal feed





INTRODUCTION

Food safety hazards associated with animal feed can be biological, chemical or physical. Each hazard is associated with particular sources and routes of contamination and exposure. Risk management must be based on a thorough understanding of these characteristics. The role of water as a potential source of hazards should not be overlooked. Hazards may be introduced with source materials or via carryover or contamination of products during handling, storage and transportation. The presence of a hazard may also result from accidental or deliberate (e.g. fraud or bioterrorism) human intervention. Risk management should be based upon preparedness and prevention rather than reaction after detection of the problem. Important issues that have contributed to this evolution include:

- (i) Bovine Spongiform Encephalopathy (BSE) and other prion diseases;
- (ii) impact on food safety of antimicrobial use in animals;
- (iii) newly recognized undesirable substances: melamine, dioxins, dibenzofurans and dioxin-like polychlorinated biphenyls (PCBs);
- (iv) the presence of genetically modified organisms, crops and enzymes in feed;
- (v) by-products of new technologies (e.g. bio-fuel production) used in feed production;
- (vi) radionuclides;
- (vii) development of aquaculture industries and the search for new/better aquaculture feeds;
- (viii) feed (and food) as the target of bioterrorism; and
- (ix) emerging technologies, such as the use of products of nanotechnology in feed.
- (x) Selection of undesirable substances and micro-organisms of concern

The following criteria have been used to select hazards of current importance in feed:

- (i) relevance of the hazard to public health;
- (ii) extent of the occurrence of the hazard;
- (iii) impact of the hazard on international trade in food and feed.

Among others, the following feeds and feed ingredients are considered:

- compound/complete feeds;
- grains and oilseeds (whole and meals), fruit and vegetable by-products, including oils;
- forage, including grasses, hay and silage;
- directly dried products (e.g. bakery by-products);
- biofuel by-products (e.g. distillers' grains with solubles (DGS), dried distillers' grains with solubles (DDGS) and glycerol);

- food processing by-products and co-products;
- minerals, including trace elements, and binders;
- animal by-products, including meat and bone meal and fats;
- aquatic products, including fishmeal, shellfish, fish by-products, seaweed and krill;
- fermentation/biomass and dried products;
- viable microbes;
- silage additives.

The following undesirable substances and micro-organisms are currently considered to be the most important:

CHEMICAL SUBSTANCES Dioxins, dibenzofurans, and dioxin-like PCBs (dioxins)

Because of the ubiquitous presence of dioxins in the environment, the threat of dioxin contamination posed by feed ingredients may originate from many different sources. Since the Belgian dioxin crisis in 1999, dioxins have become important considerations for feed safety. Since then, numerous cases of contamination involving dioxin from unexpected sources have been reported. This has shown that dioxins may be inherent to a product (e.g. clay minerals), or introduced during processing (e.g. lime in citrus pulp). Dioxins can be introduced if contaminated fuels are used in the drying of feed products; for example treated wood, poor quality coal or contaminated fuel oil. Dioxins have also been known to contaminate forage crops grown in the vicinity of certain industrial processes (e.g. incinerators).

Dioxins and dioxin-like PCBs are two related groups of toxic compounds, both comprising a number of congeners. Each congener has its own toxicity as expressed by the toxicity equivalence factor (TEF).

It has been postulated that most human exposure to dioxins is as a result of foods of animal origin, which in turn may arise from the presence of dioxins in animal feeds. Dioxins accumulate in fat to a high degree, so even extremely low levels of dioxin in feed can become significant over the lifetime of an animal and result in unacceptable residues in human foods such as meat, milk, and eggs. Toxicokinetic models have been developed to estimate the transfer rates of dioxins to animal tissues (Van Eijkeren *et al.* 2006)

As such, implementing controls for dioxins in feed represents an important step towards reducing dioxins in the food chain. In particular, screening programmes have indicated that

dioxins may arise in feed via their presence in mineral sources, such as clays, recuperated copper sulphate, zinc oxide; food by-products; and fish by-products such as fish meal and fish oils.

There is a need for development/improvement of inexpensive and accurate screening methods. Feed and food exposure studies are necessary to account for all sources of dioxin entering the feed chain.

Mycotoxins: Aflatoxin B1

In the last decade, many studies have been conducted on mycotoxins. Most frequently occurring mycotoxins (aflatoxin B1, ochratoxin A, zearalenone, fumonisin B1, deoxynivalenol, T-2 and HT-2) are currently considered for their effects on animal health.

However, when focusing on how mycotoxins play a role in food safety, attention should be limited to mycotoxins that are known to be transferred from feed to food of animal origin, as this food represents a significant route of exposure for humans.

Although the scientific community is aware

of the following transfers from feed to food: aflatoxin B1 to liver, aflatoxin B1 to milk as aflatoxin M1, aflatoxin B1 to eggs as aflatoxicol; ochratoxin A to meat; deoxynivalenol to meat as DOM1; zearalenone to meat as zearalenol, evaluating transfer rate and route of exposure in humans is restricted to aflatoxin B1 for animals producing milk.

Farmers should bear in mind that animals fed on aflatoxin contaminated feed do not show symptoms of aflatoxin toxicity.

Feeds most susceptible to aflatoxin are: cereals (especially maize), cottonseed, peanut, copra, palm kernel and rice bran but caution is required with any feed products grown in tropical and sub-tropical regions, particularly where they are not dried or processed promptly after harvesting. Aflatoxin contamination is not homogeneous; it is therefore very important to apply an appropriate sampling method. Feeds having a significant aflatoxin contamination should not be fed to dairy cows or other animals producing milk for human consumption or to other food-producing animals.

TABLE 1. Minerals, their sources and bioaccumulation in animal tissues

Mineral	Sources	Bioaccumulation in animal tissues:
Arsenic (inorganic)	Sea plants, fish products and supplemental minerals	Fish
Cadmium	Mineral supplements (such as phosphate, zinc sources) Forage/grains (depending on geographical area) Manure, sewage, sludge or phosphate fertilizers can enrich soil	Kidney and liver Shellfish, oysters, salmon and fungi, have the highest concentrations There are low concentrations in fruits, dairy products, legumes, meat, eggs and poultry
Lead	Contaminated soil, lead paints, water from plumbing systems that contain lead, batteries Mineral supplements (copper sulphate, zinc sulphate, zinc oxide) Lead is also a natural contaminant of calcium carbonate (limestone) in some regions	Bone, brain and kidney
Mercury/methyl mercury	Anthropogenic contamination, fish meal	Liver, kidney Fish, marine mammals

Source: NRC. 2005. Mineral tolerance of animals. Washington DC, National Research Council

There is some evidence to suggest that mycotoxins can concentrate in dried distillers' grains with solubles (DDGS) during the processing of grains for ethanol production. They also concentrate in cereal bran.

Heavy metals

Cadmium is a ubiquitous contaminant that is present in many feed and feed ingredients, in particular minerals, and forages grown near smelting and mining areas. Arsenic and mercury are heavy metals which are widespread in the environment and which can be found in many feeds, in particular in feeds of marine origin. Lead is also a ubiquitous contaminant. Table 1 summarizes the most relevant minerals, their sources and bioaccumulation in animal tissues.

Veterinary drugs

As veterinary drugs may be a potential risk for food safety, they should be used according to good practices in the use of veterinary drugs (GPVD) (OIE, 2007).

Residues of veterinary drugs can be present in feed when ingredients of animal origin (terrestrial and aquatic) are used, but this is not a very significant route of exposure.

Veterinary drug residues may be found in food products as a result of the carryover of veterinary drugs in feed during feed production. Therefore, it is important to follow the Code recommendations (flushing, sequencing, cleaning) when feed for food-producing animals is produced after the production of a medicated feed.

It is also important to take into account the illegal use of drugs in animal feed which may result in unsafe residues in meat, milk or eggs (e.g. chloramphenicol/nitrofurans in shrimps and chloramphenicol in milk powder).

There is some evidence to suggest that antibiotics used in the fermentation process to control microbiological contamination during the processing of grains for ethanol production may concentrate in DDGS.

Organochlorine pesticides

The continued presence of organochlorine pesticides in the environment, as well as their ongoing use in some countries, can cause exposure through food as a result of accumulation in the fat tissues of animals that have been fed on contaminated feed. Such animals will usually not exhibit specific clinical symptoms of the contamination. Animal products such as meat

could accumulate these substances, which are extremely persistent and which decompose very slowly. Contaminated animal products can cause food safety issues for humans.

Microbiological hazards

The primary sources of microbiological hazards in feed are contaminated pasture land, forages and animal and vegetable protein meals fed directly to animals..

Brucella

In some countries, where *Brucella* infection occurs, infected ruminants can deliver offspring or abort in fields that are grazed or from which pasture is harvested and used for animal feed. It is well known that the placentas of infected animals contain high levels of *Brucella* micro-organisms. If contaminated forage is fed to milking animals, the micro-organisms may be excreted in their milk. If this milk is not pasteurized prior to consumption by humans, it is a risk to food safety.

Salmonella

Salmonella is still of worldwide human health concern. It is clear that infection in animals has a direct impact on transmission to humans via food of animal origin. Contaminated feed might represent an important route of exposure to *Salmonella*.

Endoparasites

Some endoparasites of animals, such as *Echinococcus*, *Toxoplasma gondii*, *Cisticercus* and *Trichinella*, present a risk to human health, and ingestive stages can contaminate animal feeds. These pathogens can colonize/infect farm animals, and may pose a threat to human health if infected or contaminated products are ingested.

Toxic plants

There are many toxic plants found in grasslands around the world. Their toxic effects, and the potential presence of some toxic compounds in milk and meat, are well documented (Panter and James, 1990; James *et al.* 1994; Riet-Correa and Medeiros, 2009). However, there is a lack of information about metabolic rates, residues, maximum residue limits (MRL) and average daily intakes (ADI) for these different toxicants. This risk pathway can be controlled by following Good Agricultural Practices.

REFERENCES

- James L.F., Panter K.E., Molyneux R.J., Stegelmeier B.L. and Wagstaff D.J.** 1994. Plant toxicants in milk, In S.M. Colegate and P.R Dorling. eds. Plant associated toxins, p.83-88. Wallingford, UK, CAB International;
- OIE. 2007. Appendix 3.9.3.** Guidelines for the responsible and prudent use of antimicrobial agents in veterinary medicine. Terrestrial Animal Health Code, Sixteenth Edition, pp. 549–556;
- Panter K.E. and James L.F. 1990.** Natural plant toxicants in milk: a review. *J. Anim. Sci.*, 68:892–904;
- Riet-Correa, F and Medeiros, R.M.T.** 2001. Intoxicações por plantas em ruminantes no Brasil e no Uruguai: importância econômica, controle e riscos para a saúde pública pública, *Pesquisa Veterinária Brasileira*, 21(1);
- Van Eijkeren, J.C.H., Zeilmaker, M.J., Kan, C.A., Traag, W.A. and Hoogenboom, L.A.P.** 2006, A toxicokinetic model for the carry-over of dioxins and PCBs from feed and soil to eggs *Food Additives and Contaminants*, 23(5): 509–517.

General principles and requirements

General principles and requirements

Feed and feed ingredients should be obtained and maintained in a stable condition so as to protect feed and feed ingredients from contamination by pests, or by chemical, physical or microbiological contaminants or other objectionable substances during production, handling, storage and transport. Feed should be in good condition and meet generally accepted quality standards. Where appropriate, good agricultural practices, good manufacturing practices (GMPs) and, where applicable, Hazard Analysis and Critical Control Point (HACCP) principles¹ should be followed to control hazards that may occur in food. Potential sources of contamination from the environment should be considered.

Parties that produce feed or feed ingredients, those that rear animals for use as food and those that produce such animal products need to collaborate to identify potential hazards and their levels of risk to consumers' health. Such collaboration will enable the development and maintenance of appropriate risk management options and safe feeding practices.

Feed ingredients

Feed ingredients should be obtained from safe sources and be subject to a risk analysis where the ingredients are derived from processes or technologies not hitherto evaluated from a food safety point of view. The procedure used should be consistent with the Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius.² Manufacturers of feed additives in particular should provide clear information to the user to permit correct and safe use. Monitoring of feed ingredients should include inspection and sampling and analysis for undesirable substances using risk-based protocols. Feed ingredients should

meet acceptable and, if applicable, statutory standards for levels of pathogens, mycotoxins, pesticides and undesirable substances that may give rise to consumers' health hazards.

Labelling

Labelling should be clear and informative as to how the user should handle, store and use feed and feed ingredients. Labelling should be consistent with any statutory requirements and should describe the feed and provide instructions for use. Labelling or the accompanying documents should contain, where appropriate:

- information about the species or category of animals for which the feed is intended;
- the purpose for which the feed is intended;
- a list of feed ingredients, including appropriate reference to additives, in descending order of proportion;
- contact information of manufacturer or registrant;
- registration number if available;
- directions and precautions for use;
- lot identification;
- manufacturing date;
- "use before" or expiry date.

This sub-section does not apply to labelling of feed and feed ingredients derived from modern biotechnology.³

Traceability/product tracing and record keeping of feed and feed ingredients

Traceability/product tracing of feed and feed ingredients, including additives, should be enabled by proper record keeping for timely and effective withdrawal or recall of products if known or probable adverse effects on consumers' health are identified. Records should be maintained and readily available regarding the production, distribution and use of feed and feed ingredients to facilitate the prompt trace-back of feed and feed ingredients to the immediate previous source and trace-forward to the next subsequent recipients if known or probable adverse effects on consumers' health are identified.⁴

Special conditions applicable to emergency situations

Operators should, as soon as reasonable, inform the competent authorities in the

country if they consider that a feed or feed ingredient does not satisfy the feed safety requirements established in this Code. The information should be as detailed as possible and should at least contain a description of the nature of the problem, a description of the feed or feed ingredients, the species for which it is intended, the lot identifier, the name of the manufacturer and the place of origin. The competent authorities and operators should immediately take effective measures to ensure that those feed or feed ingredients do not pose any danger to consumers' health.

As soon as it becomes likely that a particular feed or feed ingredient is to be traded internationally and may pose a danger to consumers' health, the competent authorities of the exporting countries should notify, at least, the competent authorities of the relevant importing countries. The notification should be as detailed as possible and should at least contain the particulars indicated in the previous paragraph.

Inspection and control procedures

Feed and feed ingredients manufacturers and other relevant parts of industry should practice self-regulation/auto-control to secure compliance with required standards for production, storage and transport. It will also be necessary for risk-based official regulatory programmes to be established to check that feed and feed ingredients are produced, distributed and used in such a way that foods of animal origin for human consumption are both safe and suitable. Inspection and control procedures should be used to verify that feed and feed ingredients meet requirements in order to protect consumers against food-borne hazards.⁵ Inspection systems should be designed and operated on the basis of objective risk assessment appropriate to the circumstances.⁶ Preferably the risk assessment methodology employed should be consistent with internationally accepted approaches. Risk assessment should be based on current available scientific evidence.

Monitoring of feed and feed ingredients, whether by industry or official inspection bodies, should include inspection and sampling and analysis to detect unacceptable levels of undesirable substances.



Health hazards associated with animal feed

All feed and feed ingredients should meet minimum safety standards. It is essential that levels of undesirable substances are sufficiently low in feed and feed ingredients that their concentration in food for human consumption is consistently below the level of concern. Codex Maximum Residue Limits and Extraneous Maximum Residue Levels set for feed should be applied. Maximum residue limits set for food, such as those established by the Codex Alimentarius Commission, may be useful in determining minimum safety standards for feed.

Feed additives and veterinary drugs used in medicated feed

Feed additives and veterinary drugs used in medicated feed should be assessed for safety and used under stated conditions of use as pre-approved by the competent authorities.

Veterinary drugs used in medicated feed should comply with the provisions of the Codex Recommended International Code of Practice for the Control of the Use of Veterinary Drugs.⁷

Borderlines between feed additives and veterinary drugs used in medicated feed may be set to avoid misuse.

Feed additives should be received, handled and stored to maintain their integrity and to minimise misuse or unsafe contamination. Feed containing them should be used in strict accordance with clearly defined instructions for use.

Antibiotics should not be used in feed for growth promoting purposes in the absence of a public health safety assessment.⁸

Feed and feed ingredients

Feed and feed ingredients should only be produced, marketed, stored and used if they are safe and suitable, and, when used as intended, should not represent in any way an unacceptable risk to consumers' health. In particular, feed and feed ingredients contaminated with unacceptable levels of undesirable substances should be clearly identified as unsuitable for animal feed and

not be marketed or used.

Feed and feed ingredients should not be presented or marketed in a manner liable to mislead the user.

Undesirable substances

The presence in feed and feed ingredients of undesirable substances such as industrial and environmental contaminants, pesticides, radionuclides, persistent organic pollutants, pathogenic agents and toxins such as mycotoxins should be identified, controlled and minimised. Animal products that could be a source of the Bovine Spongiform Encephalopathy (BSE) agent⁹ should not be used for feeding directly to, or for feed manufacturing for, ruminants. Control measures applied to reduce unacceptable level of undesirable substances should be assessed in terms of their impact on food safety.

The risks of each undesirable substance to consumers' health should be assessed and such assessment may lead to the setting of maximum limits for feed and feed ingredients or the prohibition of certain materials from animal feeding.

Source: Code of practice on good animal feeding (CAC/RCP 54-2004).

¹ Hazard Analysis and Critical Control Point, as defined in the Annex to the Recommended International Code of Practice on General Principles of Food Hygiene (CAC/RCP 1-1969).

² Procedural Manual of the Codex Alimentarius Commission.

³ Whether and how to label animal feed and feed ingredients derived from modern biotechnology awaits developments on food labelling, being considered by the Codex Committee on Food Labelling.

⁴ Development of detailed measures on traceability/product tracing should take into the account: Principles for Traceability/Product Tracing as a tool within a Food Inspection and Certification System (CAC/GL 60-2006).

⁵ Principles for Food Import and Export Inspection and Certification (CAC/GL 20-1995).

⁶ Guidelines for the Design, Operation, Assessment and Accreditation of Food Import and Export Inspection and Certification Systems (CAC/GL 26-1997).

⁷ CAC/RCP 38-1993.

⁸ WHO. 2000. Global Principles for the Containment of Antimicrobial Resistance in Animals Intended for Food, June 2000, Geneva, Switzerland.

⁹ Joint WHO/FAO/OIE Technical Consultation on BSE: public health, animal health and trade, OIE Headquarters, Paris, 11-14 June 2001.

INTRODUCTION

The use of suitable, safe and good quality feed and feed ingredients is of paramount importance to livestock production. Safe feed is an essential element to reduce and prevent food safety hazards entering the food chain.

The presence in feed of food safety hazards that can lead to public health problems should be prevented or minimised. Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP) and, if applicable, Hazard Analysis and Critical Control Point (HACCP) are important instruments to control hazards in the feed production process.

The introduction of the food chain approach, which recognizes that responsibility for the supply of safe, healthy and nutritious food is shared along the entire food chain, has served to highlight the importance of feed safety. The food chain, thus, comprises every step from primary production to final consumption. Stakeholders include farmers, fishermen, slaughterhouse operators, feed ingredient producers, feed producers and processors, food processors, transport operators, distributors (wholesale and retail) and consumers, as well as governments responsible for protecting public health.

All parties involved in feed and animal production should ensure that safe and good quality feed and feed ingredients are produced and used in food production animal, thus reducing the risk to human health. There is a need for collaboration between all parties involved in the food production chain, including those in a position to provide veterinary clinical and epidemiological information, to establish the linkage between any identified or potential hazards and the level of risk. Such information is essential for the development and maintenance of appropriate risk management options and safe feeding practices.

The Codex Alimentarius *Code of Practice on Good Animal Feeding* contains a set of principles which aim at ensuring that feed and feed ingredients are obtained, produced, processed, stored, transported, distributed and used in a way that they do not represent a danger to human health.

This section provides clarification elements to the principles and requirements of the Code.

FEED INGREDIENTS

Quality and safety of feed ingredients are essential for the production of safe and quality feed, which are critical to the production of safe and quality animal food products, such as meat, milk, eggs, etc.

The safety of feed ingredients should be assessed prior to their use in animal feeding. The assessment of feed and feed ingredients

BOX 1

Ingredients that should not be used in animal feeding

Animals should not be given feed and feed ingredients that:

- Are recognized as likely to introduce zoonotic agents (including transmissible spongiform encephalopathies – TSEs) to the slaughter population; or
- Contain chemical substances (e.g. veterinary drugs, pesticides) or contaminants that could result in residues in meat at levels that make the product unsafe for consumption

Source: Codex Code of Hygienic Practice for Meat (CAC/RCP 58-2005)

Feed ingredients should be produced using procedures that minimize potential contaminants, promote appropriate product safety, quality and integrity and meet *all* applicable standards for use (See Boxes 1, 2 and 3). They should be of merchantable quality, comply with appropriate statutory standards for contaminants and relevant regulations.

BOX 2

Prevent introducing health hazards (milk and milk products)

With consideration given to the end use of the milk, forage and feed for lactating animals should not introduce, directly or indirectly, contaminants into milk in amounts that present an unacceptable health risk to the consumer or adversely affect the suitability of milk and milk products

It has been shown that improper procurement, manufacturing and handling of animal feed can result in the introduction of chemical hazards such as pesticides residues, mycotoxins and of other contaminants which can affect the safety and suitability of milk or milk products.

Source: Codex Code of Hygiene Practice for Milk and Milk Products (CAC/RCP 57-2004)

should be based on the Codex Principles for Risk Analysis⁵. The risk assessment of microbio-

logical and chemical hazards in feed and feed ingredients should be developed considering relevant Codex texts such as: the Principles and Guidelines for the Conduct of Microbiological Risk Assessment⁶; the Risk Analysis Principles applied by the Codex Committee on Pesticide Residues; the Risk Analysis Principles applied by the Codex Committee on Residues of Veterinary Drugs in Foods; and the Risk Analysis Principles applied by the Codex Committee on

BOX 3

Prevent introducing health hazards (eggs and eggs products)

Feed for the laying and/or breeding flock should not introduce, directly or indirectly, microbiological or chemical contaminants into eggs that present an unacceptable health risk to the consumer or adversely affect the suitability of eggs and egg products.

The improper procurement, manufacturing and handling of animal feed may result in the introduction of pathogens and spoilage organisms to the breeding and laying flock and the introduction of chemical hazards, such as pesticides residues and other contaminants, which can affect the safety and suitability of eggs and egg products.

Producers should take care where appropriate, during production, transportation, preparation, processing, procurement, storage, and delivery of feed to reduce the likelihood of introducing hazards into the production system.

- To minimize the risk associated with hazards in the feed, good purchasing practices for feed and feed ingredients should be employed. This may include using vendor assurances, contractual agreements and/or purchasing batches of feed that have had microbiological and chemical analysis and are accompanied by certificates of analysis.
- Feed should be managed so that it does not become mouldy or contaminated from waste including faeces.
- As feed can be a source of contamination, heat or other treatment of feed to reduce or eliminate pathogens including Salmonella should be considered.
- When the egg producer processes their own feed, information should be kept about its composition, the origin of the ingredients, relevant processing parameters and where practicable, the results of any analyses of the finished feed.
- The owner should keep a record of relevant information concerning feed.

Source: Codex Code of Hygiene Practice for Eggs and Egg Products (CAC/RCP 15-1976)

BOX 4

Rationale of traceability/product tracing

The application of a traceability/product tracing tool by a competent authority should improve the effectiveness and/or efficiency of the actions that may be necessary regarding its measures or requirements within its food inspection and certification system.

Traceability/product tracing is a tool that when applied in a food safety context does not in itself improve food safety outcomes unless it is combined with appropriate measures and requirements. It can contribute to the effectiveness and/or efficiency of associated food safety measures¹.

Traceability/product tracing is a tool that when applied in a food inspection and certification system can contribute to the protection of consumers against deceptive marketing practices and facilitation of trade on the basis of accurate product description².

In every case a traceability/product tracing tool should be justified within the context of the food inspection and certification system and the purpose, objectives and specifications of the traceability/product tracing tool clearly described. The scope and extent of application of the tool should also be consistent with the described need.

Source: Codex Principles for Traceability/Product Tracing as a tool within a Food Inspection and Certifications System (CAC/GL 60-2006)

¹For example, by providing information on suppliers or customers involved in potential food safety issues so enabling targeted product recall/withdrawal.

²For example, by reinforcing confidence in the authenticity of the product and the accuracy of information provided on the products (e.g. country of origin, organic farming, religious concerns such as kosher or halal). Box 4

Food Additives and the Codex Committee on Contaminants in Foods⁷.

Information should be provided in order to ensure that feed and feed ingredients are appropriately used and stored thus avoiding the introduction of food hazards in the food chain. Feed ingredients users should be sure that ingredients they purchased for feed are free from contamination which would not ordinarily be removed by processing.

Product information allows for:

- the minimization of losses through the establishment of efficient recall procedures;
- better quality and process control due to avail-

lability of information on raw materials;

- unnecessary repetition of measurements in two or more successive steps;
- possibility of correlating product data with raw material characteristics and processing data;
- better planning to optimize the use of raw material for each product type;
- avoidance of uneconomic mixing of high and low quality raw materials;
- ease of information retrieval in quality management audits.

Ingredient specification is of great importance for the conducting of the quality and safety assurance programme. Specifications are the basis for the agreements with suppliers, for the formulation of feeds, for the hazard analysis and the controls derived thereafter.

Purchasers should evaluate suppliers based on their ability to supply products in accordance with pre-established specifications. Purchasing specifications should be established to clearly define the product or service to be ordered and may utilize official ingredient definitions.

Suppliers can be evaluated through supplier visits, supplier certification, purchase contracts, monitoring of the ingredient supplied and a combination thereof.

Worldwide, there are many different systems used by the feed industry to assure the safety and quality of the various feed ingredients. Some countries have negative lists, lists of ingredients that can be used under limitations, exclusion lists for ingredients and their amounts, positive lists that include ingredients that can be used according to limitations or intended uses.

Ongoing sampling of feed ingredients should be carried out to be certain that quality and safety standards are met. Testing for any suspected contaminants, plus a constant effort at good housekeeping, will minimize health problems attributable to animal feeding. Any feed ingredient suspected of possible contamination should not be used in the production of animal feed, unless through proper sampling and testing, it is found to be appropriate for the species and class of animal it is intended.

BOX 5

Design of traceability/product tracing

The traceability/product tracing tool may apply to all or specified stages of the food chain (from production¹ to distribution), as appropriate to the objectives of the food inspection and certification system.

The traceability/product tracing tool should be able to identify at any specified stage of the food chain (from production to distribution) from where the food came (one step back) and to where the food went (one step forward), as appropriate to the objectives of the food inspection and certification system.

The objectives, scope and related procedures of a food inspection and certification system that includes a traceability/product tracing tool should be transparent and made available to competent authorities of the exporting country upon request.

Source: Codex Principles for Traceability/Product Tracing as a tool within a Food Inspection and Certifications System (CAC/GL 60-2006)

¹Production can be interpreted in such a broad manner as to cover food producing animals, feed, fertilizers, pesticides, veterinary drugs and any input of plant or animal origin, etc. if relevant for the specific applications of traceability/product tracing to food.

⁵ FAO/WHO. Codex Alimentarius Commission Procedural Manual, Rome (ftp://ftp.fao.org/codex/Publications/ProcManuals/Manual_16e.pdf).

⁶ FAO/WHO. 2001. Principles and guidelines for the conduct of microbiological risk assessment. Food and Nutrition/Codex Alimentarius – Joint FAO/WHO Food Standards Programme, Rome. (http://www.codexalimentarius.net/download/standards/357/CXG_030e.pdf).

⁷ FAO/WHO. Codex Alimentarius principles for risk analysis (Procedural Manual of the Codex Alimentarius Commission). Joint FAO/WHO Food Standards Programme. Rome.

LABELING

Product labeling should provide the users with all necessary information to properly handle, store and use the feed and feed ingredients, in order to prevent health hazards entering the food chain. It is important that users are adequately trained to fully understand and appropriately use labeling information.

Information on feed ingredients and purpose enable users to meet animals' dietary requirements according to their productive and physiological needs.

Labeling information on species and categories of animals for which the feed is intended is necessary because the risk to human health may change when certain feed or feed ingredients are fed to different species or categories of animal (e.g. mammalian proteins when fed to ruminants).

Insufficient product information, and/or inadequate knowledge of general feed and food hygiene, can lead products to being mishandled at later stages in the food chain. Such misleading can result in feed contamination or products becoming unsuitable for consumption, even where adequate hygiene control measures have been taken earlier in the feed chain.

All labeling information on source of feed and feed ingredients (e.g. manufacturers, lot identification, manufacturing date, etc.) are essential for record keeping, traceability/product tracing and products recall, as necessary. These information may also help effective stock rotation. Correct labeling will assure correct information to be supplied to working inventories, packaging and other records.

Medicated feed labeling will require specific information on the active drug ingredients, species and class of animals for which the feed is intended, purpose or indications of use, warning and caution statements. Warning statements include the withdrawal times and other statements related to protection of human health. Caution statements are related to animal safety or drug stability and misuse of the medicated feed.

TRACEABILITY/PRODUCT TRACING AND RECORD KEEPING OF FEED AND FEED INGREDIENTS

Traceability/product tracing is a tool that may be applied in a feed and food chain, when and as appropriate, to contribute to the protection of human health against food borne hazards and

deceptive marketing practices, and the facilitation of trade on the basis of accurate product description. (Boxes 4 and 5)

Traceability/product tracing ensures it is possible to identify at any stage of the feed and food chain, where the product (feed or food) came from and to where it has gone. This would allow the creation of a set of historical data to trace a product throughout the production chain.

Traceability/product tracing is enabled by appropriate record keeping procedures that show the path of a particular product or ingredient from suppliers into the business, through all intermediate steps which process and combine ingredients into new products and through the supply chain to customers.

Traceability/product tracing is based on the ability to identify a specific product at any point of the feed and food chain. Throughout the feed and food chain, new identities are constantly created as ingredients are combined in recipes, goods are bulked up for delivery, and/or large batches split to a number of destinations. Traceability requires that the batch can be identified and that this identification gives the links to the product history. Additional information may be carried e.g. information on processing efficiencies to be calculated for manufacturing systems, information concerning ingredient quality or origin. The amount and type of information can be extended as required by the system, and it may be carried for only part of, or throughout the whole food chain.

Traceability/product tracing may be used in investigation of non conformities and in support of a withdrawal or recall of products, when necessary.

SPECIAL CONDITIONS APPLICABLE TO EMERGENCY SITUATIONS

When a feed emergency arises, timely communication of the nature and extent of the safety problem to all relevant parties is essential to minimize potential adverse public health effects. Experience has shown that information about feed and food safety emergencies must be integrated in a single system in order to ensure food safety. Such system should have criteria for the identification of emergency situations.

The competent authorities should identify the source of the hazard (e.g. contamination) and, once the source is identified, take appropriate measures where possible, to reduce or eliminate the source. In emergency situations, traceabi-

lity/product tracing is an important tool for the prompt identification of the source of hazards (Box 6).

INSPECTION AND CONTROL PROCEDURES

The production of safe and quality feed and feed ingredients is a shared responsibility of feed operators and competent authorities. Feed safety and quality rely on effective control procedures and feed inspection programmes, implemented by both feed operators and competent authorities. The confidence of feed users, in the quality and safety of their supply, and ultimately of consumers in the quality and safety of the food,

depends in part on their perception as to the effectiveness of control measures.

Self-control programmes assist feed operators to comply with applicable regulatory standards and other requirements (e.g. specifications defined by the manufacturer or purchasers). Self-control programmes should encompass incoming feed, finished feed and intermediates. Self control programmes may include: physical inspections, sampling procedures, chemical and microbiological analyses, actions in case of non compliance, responsibilities of the staff involved in the production and feed safety control, etc. (Box 7).

Competent authorities are responsible to carry out regulatory feed inspection to verify compliance with statutory requirements. Surveillance inspections are conducted to determine whether a firm is substantially in compliance with the regulations. Compliance inspections are conducted to evaluate a firm's compliance with the provisions of the regulations and to document inspectional observations supporting possible enforcement action. Utilizing a scientific- and

BOX 6

Principles for the Exchange of Information in Food Safety Emergency Situations

In the event that a feed or food emergency is identified, the exchange of information should take into account:

- Its nature and extent, where possible, described clearly and completely by the relevant competent authorities;
- The exchange of information on safety emergencies to be conducted between official contact points designated by the competent authorities;
- The information to all known affected and potentially affected countries without delay by the country that detected the safety emergency situation, whether it is an importing or exporting country;
- The sharing of information by competent authorities detecting a food safety emergency to enable all affected and potentially affected countries to make informed risk management and/or risk communication decisions;
- The availability and provision of clear, relevant, factual and timely information to all stakeholders to the extent possible;
- Flow of the information that should be transparent and continue during all phases of the emergency situation to enable continuous evaluation and development of the emergency response.

Source: Codex Principles and Guidelines for the Exchange of Information in Food Safety Emergency Situations (CAC/GL 19-1995)

BOX 7

Quality assurance

The voluntary utilization of quality assurance by food businesses should also be encouraged in order to achieve greater confidence in the quality of products obtained. If safety and/or quality assurance tools are used by food businesses, the official inspection and certification systems should take them into account in particular through the adaptation of their control methodologies.

Governments do, however, retain the fundamental responsibility to ensure by official inspection and certification¹ the conformity of foodstuffs to requirements.

The degree to which industry effectively utilizes quality assurance procedures can influence the methods and procedures by which government services verify that requirements have been met, where official authorities consider such procedures to be relevant to their requirements.

Source: Codex Guidelines for the Design, Operation, Assessment and Accreditation of Food Import and Export Inspection and Certification Systems (CAC/GL 26-1997)

¹ For the purpose of these guidelines, "inspection and certification" means "inspection and/or certification."

BOX 8**Inspection and risk analysis**

Consistent and transparent application of risk analysis will facilitate international trade by increasing confidence in the food safety and in the inspection systems of trading partners. It will also enable inspection resources to be targeted effectively on hazards to public health arising at any stage of the food production and distribution chain.

The principles of Hazard Analysis Critical Control Point (HACCP) developed by the Codex Committee on Food Hygiene¹ provide a systematic basis for the identification and control of hazards so as to ensure the safety of food. The use of a HACCP approach by food businesses should be recognized by governments as a fundamental tool for improving the safety of foodstuffs.

Source: Codex Guidelines for the Design, Operation, Assessment and Accreditation of Food Import and Export Inspection and Certification Systems (CAC/GL 26-1997)

¹Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its Application, Annex to the Recommended International Code of Practice - General Principles of Food Hygiene (CAC/RCP 1 -1969).

risk-based approach will improve the ability to prioritize and allocate inspection resources by targeting firms, facilities, products and processes posing the greatest risks to animal or human health (Box 8).

The frequency and intensity of controls by inspection systems should be designed to take account of risk and the reliability of controls already carried out by those handling the products including producers, manufacturers, importers, exporters and distributors.

The nature and frequency of inspection, sampling and testing should be based on the risk to human health and safety presented by the product, its origins and the history of conformance to requirements and other relevant information. Control should be designed to account for factors such as: the risk to human health posed by the product; the likelihood of non-compliance with requirements; history of conformity of producers,

processors, manufacturers, exporters, importers and distributors.

Laboratory testing is an important part of any quality control and quality assurance programme. This is the process of measuring specific components of a feed or ingredient sample to assure that it meets quality specifications. Tests involve measurements of biological, chemical, and physical properties to assess the quality of a product in comparison to a predetermined standard.

Health hazards associated with animal feed

Food safety hazards associated with animal feed can be biological, chemical, or physical. Each hazard is associated with particular sources and routes of contamination and exposure. Hazards may be introduced with source materials or via carryover or contamination of products during handling, storage and transportation. The presence of a hazard may also result from accidental or deliberate (e.g. fraud or bioterrorism) human intervention. Examples of hazards in foods that can be linked to feed and have long been recognized include: mycotoxins, unacceptable residues levels of veterinary drugs and agriculture and industrial chemicals (e.g. dioxins) and pathogens (e.g. the causative agent of bovine spongiform encephalopathy).

Feed additives and veterinary drugs used in medicated feed

Medicated feed is any mixture of a veterinary drug(s) and feed(s) which is ready prepared for marketing and intended to be fed to animals without further processing, because of its curative or preventive properties or other properties as a medicinal product. Premix for medicated feeds (medicated premixtures) are veterinary drugs prepared in advance with a view to the subsequent manufacture of medicated feeds.

Veterinary drugs may be a potential risk for food safety and should be used according to good practice in the use of veterinary drugs (Box 9).

Antimicrobial drugs are powerful tools for the management of infectious diseases in animals and humans. It is essential that all countries put in place the appropriate systems to ensure that veterinary antimicrobial drugs are manufactured, marketed, distributed, prescribed and used responsibly, and that these systems are adequately audited (Box 11).

Codex maximum residue limits (MRLs) for veterinary drugs in food can be found in the Codex on-line database on MRLs for veterinary drugs on

Codex website: http://www.codexalimentarius.net/mrls/vetdrugs/jsp/vetd_q-e.jsp.

Feed additives are used in feed for different purposes, e.g. to increase the digestibility; to improve the organoleptic and physical characteristics; to improve palatability; to extend shelf-life; to prevent deterioration; to affect the characteristic of certain products of animal origin (e.g. salmoned trouts and egg yolk colour); etc. Certain substances, such as microorganisms, enzymes, vitamins, etc. may be classified as feed additives according to their purpose of use and methods of administration.

Feed additives should be assessed for safety and produced and used according to relevant regulations and manufacturing instructions.

Feed and feed ingredients

Feed, feed ingredients and forage may be the source of contamination for food producing animals. Chemical and biological substances, that can be intentionally or unintentionally incorporated into feed in different stages of the feed production chain and fed to the animals, may result in hazards in foods of animal origin.

To prevent hazardous effects due to contamination or deterioration, feed and feed ingredients should be obtained from reliable sources, preserved in stable conditions and appropriately handled. When produced or received, feed and feed ingredients should be in good condition and comply with relevant safety and quality standards. It is important that all levels of undesirable substances are sufficiently low in feed and feed ingredients so that their concentration in food for human consumption is consistently below the level of concern.

Where food-borne hazards originate in feed, they should be adequately controlled. Quality assurance is applicable to all stages of production to ensure the safety of the consumer. Manufacturers should provide adequate information to enable the quality and safety of feed to be maintained after delivery.

Controls throughout the all production process to identify potential associated hazards to human health should be carried out. These controls should protect incoming and finished feed from contamination. Feed and feed ingredients contaminated with unacceptable levels of undesirable substances

BOX 9

Good Practice in the Use of Veterinary Drugs (GPVD) is the official recommended or authorized usage including withdrawal periods, approved by national authorities, of veterinary drugs under practical conditions.

Source: Codex Alimentarius Commission – Procedural Manual

Residues of veterinary drugs can be present in feed when ingredients of animal origin (terrestrial and aquatic) are used, and may be found in food products as a result of the carry over of veterinary drugs in feed during feed production.

Competent authorities should control the use of veterinary drugs and verify that appropriate practices are being applied and effective measures are in place within the veterinary drugs distribution and feed and food production systems in order to provide effective protection of human health and to facilitate food trade.

Producers should only use veterinary drugs which have been approved for use in food producing animals.

Non-approved veterinary drugs should not be used.

Veterinary drugs should be used in accordance with the officially approved/recognized instructions (Box 10).

BOX 10

Codex maximum limit for residues of veterinary drugs (MRLVD) is the maximum concentration of residue resulting from the use of a veterinary drug (expressed in mg/kg or µg/kg on a fresh weight basis) that is recommended by the Codex Alimentarius Commission to be legally permitted or recognized as acceptable in or on a food.

It is based on the type and amount of residue considered to be without any toxicological hazard for human health as expressed by the Acceptable Daily Intake (ADI), or on the basis of a temporary ADI that utilizes an additional safety factor. It also takes into account other relevant public health risks as well as food technological aspects.

When establishing an MRL, consideration is also given to residues that occur in food of plant origin and/or the environment. Furthermore, the MRL may be reduced to be consistent with good practices in the use of veterinary drugs and to the extent that practical analytical methods are available.

Source: Codex Alimentarius Commission – Procedural Manual

BOX 11**Responsible use of veterinary antimicrobial drugs in food-producing animals**

The responsible use of veterinary antimicrobial drugs in food-producing animals:

- is controlled by the veterinary profession or other parties with the required expertise.
- is part of good veterinary and good animal husbandry practice and takes into consideration disease prevention practices such as the use of vaccination and improvements in husbandry conditions.
- aims to limit the use of veterinary antimicrobial drugs according to their approved and intended uses, and takes into consideration on-farm sampling and testing of isolates from food-producing animals during their production, where appropriate, and makes adjustments to treatment when problems become evident.
- should be based on the results of resistance surveillance and monitoring (microbial cultures and antimicrobial sensitivity testing), as well as clinical experience.
- does not include the use for growth promotion of veterinary antimicrobial drugs that belong to or are able to cause cross resistance to classes of antimicrobial agents used (or submitted for approval) in humans in the absence of a risk analysis. This risk analysis should:
 - be undertaken by the appropriate national regulatory authority;
 - be based on adequate scientific evidence;
 - focus on the potential to impact resistance to antimicrobials used in human medicine.
- is aimed at all the relevant parties, such as:
 - regulatory and scientific authorities;
 - the veterinary pharmaceutical industry;
 - distributors and others handling veterinary antimicrobial drugs;
 - veterinarians, pharmacists and producers of food-producing animals.

Source: Codex Code of Practice to Minimize and Contain Antimicrobial Resistance (CAC/RCP 61-2005)

Undesirable substances

Undesirable substances include, among others, pathogens, mycotoxins, pesticides, agricultural and industrial chemicals, heavy metals and radio-nuclides. Undesirable substances that may be present in feed and feed ingredients should be identified, controlled and minimized. Undesirable substance should be reduced to acceptable levels that do not cause harmful or undesirable effects. The methods for determining residues of undesirable substances are becoming increasingly sophisticated, so that even quantities of residues which are negligible for animal and human health can be detected.

should be clearly identified as unsuitable for animal feed and not be marketed or used.

Intake points, processing equipments, conveying systems and storage facilities should be designed and operated to minimize the possibility of contamination.

Good production practices

Production, processing, storage, transport and distribution of feed and feed ingredients

The production, processing, storage, transport and distribution of safe and suitable feed and feed ingredients is the responsibility of all participants in the feed chain, including farmers, feed ingredient manufacturers, feed compounders, truckers, etc. Each participant in the feed chain is responsible for all activities that are under their direct control, including compliance with any applicable statutory requirements.

Feed and feed ingredients should not be produced, processed, stored, transported or distributed in facilities or using equipment where incompatible operations may affect their safety and lead to adverse effects on consumers' health. Due to the unique characteristics of aquaculture, the application of these general principles must consider the differences between aquaculture and terrestrial-based production.

Where appropriate, operators should follow GMPs and, where applicable, HACCP principles to control hazards that may affect food safety. The aim is to ensure feed safety and in particular to prevent contamination of animal feed and food of animal origin as far as this is reasonably achievable, recognising that total elimination of hazards is often not possible.

The effective implementation of GMPs and, where applicable, HACCP-based approaches should ensure, in particular, that the following areas are addressed.

Premises

Buildings and equipment used to process feed and feed ingredients should be constructed in a manner that permits ease of operation, maintenance and cleaning and minimises feed contamination. Process flow within the manufacturing facility should also be designed to minimise feed contamination. Water used in feed manufacture should meet hygienic standards and be of suitable quality for animals. Tanks, pipes and other equipment used to store and convey water should be of appropriate materials which do not produce unsafe levels of contamination.

Sewage, waste and rain water should be disposed of in a manner which avoids contamination of equipment, feed and feed ingredients.

Receiving, storage and transportation

Chemical fertilizers, pesticides and other materials not intended for use in feed and feed ingredients should be stored separately from feed and feed ingredients to avoid the potential for manufacturing errors and contamination of feed and feed ingredients.

Processed feed and feed ingredients should be stored separately from unprocessed feed ingredients and appropriate packaging materials should be used. Feed and feed

ingredients should be received, stored and transported in such a way so as to minimize the potential for any cross-contamination to occur at a level likely to have a negative impact on food safety.

The presence of undesirable substances in feed and feed ingredients should be monitored and controlled.

Feed and feed ingredients should be delivered and used as soon as possible. All feed and feed ingredients should be stored and transported in a manner which minimizes deterioration and contamination and enables the correct feed to be sent to the right animal group.

11 Joint WHO/FAO/OIE Technical Consultation on BSE: public health, animal health and trade, OIE Headquarters, Paris, 11–14 June 2001.

5 CAC/RCP 54-2004

38. Care should be taken to minimize deterioration and spoilage at all stages of handling, storage and transport of feed and feed ingredients. Special precautions should be taken to limit fungal and bacterial growth in moist and semi-moist feed. Condensation should be minimized in feed and feed ingredient manufacturing and processing facilities. Dry feed and feed ingredients should be kept dry in order to limit fungal and bacterial growth.

39. Waste feed and feed ingredients and other material containing unsafe levels of undesirable substances or any other hazards should not be used as feed, but, should be disposed of in an appropriate manner including compliance with any applicable statutory requirements.

5.3 Personnel training

40. All personnel involved in the manufacture, storage and handling of feed and feed ingredients should be adequately trained and aware of their role and responsibility in protecting food safety.

5.4 Sanitation and pest control

41. Feed and feed ingredients, processing plants, storage facilities and their immediate surroundings should be kept clean and effective pest control programmes should be implemented.

42. Containers and equipment used for manufacturing, processing, transport, storage, conveying, handling and weighing should be kept clean. Cleaning programmes should be effective and minimise residues of detergents and disinfectants.

43. Machinery coming into contact with dry feed or feed ingredients should be dried following any wet cleaning process.

44. Special precautions should be taken when cleaning machinery used for moist and semi-moist feed and feed ingredients to avoid fungal and bacterial growth.

5.5 Equipment performance and maintenance

45. All scales and metering devices used in the manufacture of feed and feed ingredients should be appropriate for the range of weights and volumes to be measured, and be tested regularly for accuracy.

46. All mixers used in the manufacture of feed and feed ingredients should be appropriate for the range of weights or volumes being mixed and be capable of manufacturing suitable homogeneous mixtures and homogeneous dilutions, and be tested regularly to verify their performance.

47. All other equipment used in the manufacture of feed and feed ingredients should be appropriate for the range of weights or volumes being processed, and be monitored regularly.

5.6 Manufacturing controls

48. Manufacturing procedures should be used to avoid cross-contamination (for example flushing, sequencing and physical clean-out) between batches of feed and feed ingredients containing restricted or otherwise potentially harmful materials (such as certain animal by-product meals, veterinary drugs). These procedures should also be used to minimise cross-contamination between medicated and non-medicated feed and other incompatible feed. In cases where the food safety risk associated with cross-contamination is high and the use of proper flushing and cleaning methods is deemed insufficient, consideration should be given to the use of completely separate production lines, transfer, storage and delivery equipment.

49. Pathogen control procedures, such as heat treatment or the addition of authorised chemicals, should be used where appropriate, and monitored at the applicable steps in the manufacturing process.

5.7 Recalls

50. Records and other information should be maintained as indicated in sub-section 4.3 of this Code to include the identity and distribution of feed and feed ingredients so that any feed or feed ingredient considered to pose a threat to consumers' health can be rapidly removed from the market and that animals exposed to the relevant feed can be identified.

Source: Code of practice on good animal feeding (CAC/RCP 54-2004).

INTRODUCTION

Because of the implications for human health, there is an increasing demand for greater attention to risk management by all those involved in the production and utilisation of feed. Given the direct linkage between feed safety and the safety of food products derived from farmed animals, it is essential that feed manufacture and feed production in general be dealt with as important parts of the food production chain. The Code defines feed safety as “all conditions and measures necessary to ensure the safety and suitability of feed at all stages of the feed production chain”.

In some countries feed is already considered very much part of the food chain and safety programmes have been developed by various national feed associations based on this premise. All reflect the importance of keeping feed products safe and free of contaminants. Feed and food safety hazards can occur at any stage of the feed processing chain; therefore, adequate control along the whole feed and food chain is of utmost importance.

Most of the regulations, standards and guides published worldwide by different governments, trade institutions and private sector bodies emphasize the responsibility of all participants to ensure feed safety throughout the food chain. Key tools in achieving this are the application of HACCP principles and the maintenance of traceability; the main goal being to ensure the risk of contaminating feed for food producing animals is kept as low as possible.

GAPs and GMPs are important prerequisite programmes for the implementation of HACCP principles. Effective hazard control is ensured by the combination of prerequisite programmes and the HACCP plan.

In this Section we will consider the detailed application of GMP and HACCP to feed production

Good Agricultural Practices in the primary production and on-farm handling of feed ingredients will be covered in Section 5 of the this manual, which addresses “On-farm production and use of feed and feed ingredients”

GOOD MANUFACTURING PRACTICES

GMPs are the practices and procedures that ensure the safety and suitability of feed and food; they should be applied throughout the feed chain.

Buildings and facilities

The design and construction of all buildings and facilities should ensure that feed products are protected from contamination at all times. There should be adequate space for all operations and the safe storage of equipment and materials. Easy access should be possible for maintenance and cleaning operations. Location, design and construction of premises should deter pests and restrict access by pests to a minimum.

Location of feed establishment

Potential sources of contamination should be considered when deciding where to locate feed establishments, as well as the effectiveness of any reasonable measures that might be taken to protect feed. Establishments should be located in areas that are not exposed to undesirable levels of smoke, dust and other contaminants.

Establishments should normally be located away from:

- Environmentally polluted areas and industrial activities which pose a serious threat of contaminating feed;
- Areas subject to flooding (unless sufficient safeguards are provided);
- Areas prone to infestations of pests or the presence of domestic and wild animals;
- Areas where wastes, either solid or liquid, cannot be removed effectively.

Design and layout

The internal design and layout of establishments should permit good hygiene practices, including protection against cross-contamination. Activities should be adequately separated by physical or other effective means where cross-contamination may result.

Buildings and facilities should be designed to allow easy access for cleaning, including access to the inside of relevant equipment. There should be enough space to satisfactorily conduct all process operations and product inspections.

The building exterior should be designed, constructed and maintained to prevent entry of contaminants and pests. There should be no unprotected openings, air intakes should be appropriately located, and the roof, walls and foundation should be maintained to prevent leakage.

Gardens and other vegetation should be limited to the external areas. Parking areas, external areas and all access routes to the manufacturing plant should be designed to avoid contamination

of the production area, for example by the tracking of mud or snow by vehicles.

Where necessary, designated and appropriately designed storage areas for toxic, explosive or inflammable materials should be provided and located away from manufacturing, storage and packing areas.

Intake and loading facilities should be designed and constructed to maintain the safety of incoming raw materials and outgoing finished feeds. Controls should be in place to avoid contamination by water or pests.

Internal structure and fittings

Structures within the establishment should be built of durable materials. They should be easy to maintain and clean and, where appropriate, to disinfect. In particular the following specific conditions should be satisfied where necessary to ensure the safety and suitability of feed:

- The surfaces of walls, partitions and floors should be made of impervious materials with no toxic effect in intended use;
- Walls and partitions should have a smooth surface that enables and facilitates cleaning;
- Floors should be constructed to allow adequate drainage and cleaning, when necessary due to the nature of operation;
- Ceilings and overhead fixtures should be constructed and finished to minimize the build up of dirt and condensation, and the shedding of particles;
- Windows should be easy to clean, constructed to minimize the build up of dirt, be fitted with removable and cleanable insect-proof screens;
- Doors should have smooth, non absorbent surfaces and be easy to clean.
- Working surfaces, such as weighing tables that may come in direct contact with feed ingredients should be in sound condition, durable and easy to clean and maintain.

Water supply

Any water coming into contact with feed products should be of potable quality. There should be an adequate supply of potable water with appropriate facilities for its storage, distribution and temperature control. Potable water should be as specified in the latest edition of WHO guidelines for drinking water quality (WHO, 2006).

Non-potable water, for use in fire control, steam production, refrigeration and similar purposes should have a separate system. Non-potable water systems should be identified and should

not connect or allow reflux into, potable water systems. All hoses, taps and other similar possible sources of contamination should be designed to prevent back-flow or siphoning.

Water treatment chemicals, where used, should be food compatible. Chemical treatment should be monitored and controlled to ensure the correct dosage is delivered.

Recirculated water should be treated, monitored and maintained as appropriate for its intended purpose. Recirculated water should have a separate distribution system which is clearly identified.

Cleaning facilities

Adequate facilities, suitably designated, should be provided for cleaning feed utensils, equipment and vehicles used to transport feed products. Such facilities should have an adequate supply of hot and cold water, where appropriate.

Facilities should ideally be constructed of corrosion-resistant materials that can easily be cleaned and should be provided with potable water at temperatures appropriate for the cleaning chemicals used. All cleaning chemicals should be food compatible.

Equipment cleaning facilities should be adequately separated from feed storage, processing and packaging areas to prevent contamination.

Personnel hygiene facilities

Personnel hygiene facilities should be available to ensure that an appropriate degree of personal hygiene can be maintained. When appropriate, facilities should include:

- Adequate means of hygienically washing and drying hands, including wash basins and a supply of hot and cold, or a suitably controlled temperature water;
- A constant supply of potable water;
- An adequate number of toilets of an appropriate hygienic design with hand wash basins in close proximity provided with soap, paper towels or other suitable means for drying hands;
- Adequate changing facilities for personnel.

Facilities should be suitably located and designed. Whenever the nature of operations require, there should be facilities to wash and/or disinfect hands in product handling areas.

Air quality, temperature and ventilation

Adequate means of natural or mechanical ventilation should be provided to:

- Minimize airborne contamination of feed from aerosols and condensation droplets, specially in open production systems;

TABLE 2. Premises layout and design recommended practices

Premises design and facilities	Recommended practices	Objective
Location	Away from polluted areas, areas subject to flooding, pest infestations and presence of wastes	Avoid feed contamination
Design and lay out	Physical separation of activities that can cause contamination Covering and protection of intake and loading facilities Sufficient space to conduct operations Prevention against the entry of pests and contaminants No cross-connection between sewage and drainage systems	Enable good cleaning operations Prevent external and cross-contamination Prevent contamination through weather, pests and others
Internal structures and fittings	Walls, doors and partitions with smooth surface Windows fitted with removable and cleanable screens Floors with adequate drainage	Allow cleaning Avoid build up of dirt
Equipment	Made of non toxic materials Control operation conditions efficiently Easy to disassemble, clean and maintain Identify waste and dangerous substances containers	Avoid feed contamination and carry-over Monitor CCPs efficiently Avoid accidental and malicious contamination
Water supply	Potable water, where needed, according to WHO guidelines Monitored and controlled chemical treatment	Avoid feed and equipment contamination
Drainage and waste disposal	Constructed not to cross-connect with potable water	Avoid feed and equipment contamination
Cleaning facilities	Corrosion resistant and easily cleanable Separated from production and storage areas	Prevent contamination Maintain utensils and small equipment in cleaned conditions
Hygiene facilities	Provided with means for washing and drying hands Hand wash basins near toilets Availability of soap and paper towels Constant supply of potable water Availability of protective clothing	Maintain adequate personal hygiene to avoid feed contamination Avoid people to pass through areas without washing hands
Air quality, temperature and ventilation	Control of temperature, humidity and ventilation, where necessary. Air flow from clean to contaminated areas	Minimize air-borne contamination of feed
Lighting	Adequate artificial or natural lighting sources Protected lighting fixtures	Ensure hygienic and inspection conditions. Protect food so that it is not contaminated by breakages
Storage	Permit adequate maintenance, cleaning and inspection activities Cleaned as soon as possible after product damage or spillage Separate areas for rejected products, waste material and chemicals	Avoid deterioration and spoilage of stored materials Prevent contamination of other areas

- Control ambient temperatures where these may adversely affect feed safety. If necessary, heating, cooling or air-conditioning systems should be designed and installed so that air-intake or exhaust vents do not cause contamination of products, equipment or utensils;
- Provide ventilation of sufficient capacity to prevent grease and condensation from collecting on walls and ceilings;
- Control humidity and ensure the safety and suitability of feed.

Ventilation systems should be designed and constructed to ensure intakes draw only clean air. Ideally design should ensure that air flows from clean areas to contaminated areas. Mechanical ventilation systems should be adequately maintained and cleaned.

Lighting

Lighting sources should be sufficient to ensure that hygienic conditions are maintained throughout the production and storage areas, as well as where equipment and utensils are cleaned, in hand-washing areas and toilets. Where artificial lighting is required, it should be designed to ensure that it reflects true colours.

Adequate lighting conditions are particularly important in areas where feed is visually inspected or instruments are monitored (Box 12).

BOX 12

Lighting conditions

Recommended lighting:

- 540 lux in inspection areas
- 220 lux in work areas
- 110 lux in other areas

Equipment

Equipment and containers should be made of non toxic materials, capable of being disassembled to allow proper maintenance, cleaning and inspections.

Equipment should be placed away from the walls to facilitate cleaning and maintenance and to prevent pest infestation.

Equipment designed to achieve and control specific process conditions such as temperature, humidity and air flow should be provided with appropriate metering devices and their accuracy checked regularly. These requirements are intended to ensure that:

- Harmful or undesirable micro-organisms or their toxins are eliminated or reduced to safe levels or their survival and growth effectively controlled;
- Where appropriate, critical limits established in HACCP based-plans can be monitored;
- Temperatures and other conditions necessary to feed safety and suitability are achieved and maintained.

Containers for waste, by-products and inedible or dangerous substances should be specifically identifiable and suitably constructed. Containers that hold dangerous substances should be identified and lockable to prevent contamination of products and environment. No containers used for holding waste or harmful materials should be used for holding feed products.

Utensils such as spoons and knives used to open bags and weigh additives and drugs should be tethered or otherwise kept safe and not placed on the floor or over raw material bags and pallets.

Mixers must be appropriate for the range of weights and volumes required to obtain homogeneous mixtures.

Weighing equipment such as scales and other metering devices should be appropriate for the weights and volumes to be used. Accuracy of the weighing and dosage equipment should be compatible with the items to be weighed.

Where bulk bins are in use, controls should be in place to ensure only the correct raw materials are loaded into any bin.

Sieves, screens, filters and separators should be regularly checked for possible damage and to ensure their effective operation.

Equipment, containers and other utensils that come into contact with feed, should be designed and constructed to ensure that, where necessary, they can be adequately cleaned and maintained to avoid contamination of feed. Equipment, containers and utensils should be made of materials with no toxic effect in intended use.

Equipment should be designed to allow maintenance, cleaning, monitoring and facilitate inspections for pests.

Coatings, paints, chemicals, lubricants and other materials used for surfaces or equipment that may have contact with feed should be such that they will not contribute to unacceptable contamination of feed.

Equipment used to mix, cook, store and transport feed should be designed to achieve and maintain the required operating conditions. Such

equipment should be designed to allow essential temperatures, humidity, pressure and mixing conditions to be monitored and controlled. Any controls implemented should ensure that:

- Where appropriate, critical limits established in HACCP based plans can be monitored;
- Temperature, humidity and other process conditions necessary for feed safety and suitability can be efficiently achieved and maintained.

Calibration methods and frequencies should comply with manufacturers' recommendations for all equipment monitoring and or controlling devices that may have an impact on feed safety. Calibration of equipment should be performed by appropriately trained personnel.

Personal hygiene

People known or suspected to be suffering from or to be a carrier of a disease or illness likely to be transmitted through feed, should not be allowed to enter any process area if there is a likelihood of their contaminating feed products. Any person so affected should immediately report any illness or symptoms of illness to management and be assigned suitable duties or sent home.

Symptoms which should be reported to management, include:

- Jaundice
- Diarrhea
- Vomiting
- Fever
- Sore throat with fever
- Visibly infected skin lesions (boils, cuts, etc)
- Discharges from the ear, eye or nose

Feed handlers should maintain personal cleanliness and, where appropriate, wear suitable protective clothing, head covering and safety footwear that have to be kept in a hygienic condition. Clothing should be designed to not only protect the personnel where necessary but also to avoid contamination of feed products by personnel.

Where gloves are worn, controls should be in place to ensure these do not get into the feed products.

There should be clear rules on smoking and eating/drinking on site. Designated facilities should be provided away from areas where feed products are handled, stored or processed.

Personal effects, such as items that might fall out of pockets and which may pose a threat to the safety and suitability of feed, should not be carried into areas where feed is stored, processed or handled.

Contractors and any other person, including staff members, visiting the processing and handling areas should wear protective clothing and adhere to the other personal hygiene provisions.

Cleaning

Cleaning should remove residues and dirt that may be a source of contamination. The cleaning methods and materials must be compatible with feed products. Sufficient standards of cleanliness should be employed to ensure that exposure to pests and pathogens is minimised at all stages of processing, storage and handling.

Cleaning programmes should be documented and ensure that processing, storage and handling facilities are cleaned in a manner that is sufficient to maintain feed safety at all times.

Cleaning and disinfection programmes should be monitored for their suitability and effectiveness. An authorised person should carry out inspections of cleaning and a record of all inspections should be kept.

Only food compatible cleaning and disinfectant / sanitising agents should be allowed to come into contact with feed products and should be used in accordance with manufacturers recommendations and safety data sheet requirements. Where cleaning agents and disinfectants / sanitizers come into contact with feed products, one must ensure that control systems provide the correct and effective dilution levels at all times.

Cleaning and disinfection / sanitising chemicals must be stored, where necessary, separately in clearly identified containers to avoid the risk of (malicious or accidental) contamination.

Maintenance

Equipment should be subject to a programme of planned maintenance that ensures it is kept in safe and effective working condition.

Records should be kept of any maintenance carried out on equipment critical to the production of safe feed, for example: essential measuring equipment, cookers, magnets, etc.

Engineers and contractors working on site should be controlled in such a way that maintenance and building works do not adversely affect feed safety. There should be a procedure in place to ensure that appropriate cleaning and tidying has been completed prior to recommencing activities in areas where maintenance or building works have been undertaken.

Pest control

Active measures should be taken to control and limit pest activity throughout all process, storage and handling areas. Risk assessment methods should be used to identify potential problems with all classes of animals (e.g. birds, insects, reptiles and mammals) whether they are wild, feral or domestic. Records should be maintained to show that risks from pests are adequately managed and consistently under control.

Animals should, wherever possible, be excluded from the grounds of feed manufacturing establishments, and the area surrounding stores and processing plants. Where the presence of pests is unavoidable, procedures should be implemented to protect feed products from potential contamination. Wherever there is a significant risk from pests, access points should be proofed against their entry. Doors should be kept closed whenever possible and be close-fitting and proofed against pests when closed.

Buildings should be kept in good repair and condition to prevent pest access and to eliminate potential breeding sites. Holes, drains and other places where pests are likely to gain access should be kept sealed wherever possible. Where sealing is not possible, measures such as wire mesh screens should be in place to reduce the possibility of pest entry.

Pest infestations should be dealt with promptly and any actions taken should be compatible with feed products.

Only appropriately qualified / trained personnel should carry out any control treatment required.

In cases where shooting is undertaken as part of the pest control programme, lead, or other toxic ammunition, should not be used.

All bait containers should be fixed in their intended position unless there is a specific reason why this is not appropriate. Open bait containers and loose baits should not be positioned in areas where their use may result in a hazard to feed products.

Pest control procedures should be documented and ensure that no materials designed to kill or deter pests can contaminate feed products. Pest control records should include:

- (i) Details of any poisons used, including safety data sheets;
- (ii) Qualifications of personnel involved in pest control activities;
- (iii) Map(s) indicating the location of any bait stations and the baits with which they are baited;

- (iv) Records of any pests found;
- (v) Details of corrective actions implemented.

Waste

Waste and material that is not appropriate for feed must be identified as such, kept separate and removed. Waste should not be allowed to accumulate in feed processing, handling and other working areas.

Waste should be collected and stored in clearly identified bins or containers and segregated to eliminate the likelihood of accidental or inadvertent use. Waste should be disposed of legally and according to any applicable environmental regulations.

Containers used to hold waste should not be used for feed products. Containers used to store waste that is attractive to pests should be covered. Such waste containers should also be stored away from processing and storage areas and removed from site as frequently as practical.

Waste stores must be kept appropriately clean and should be included in the cleaning and disinfection programmes.

Drains

All drains must be designed and maintained in a manner that ensures they do not present a hazard to any feed products.

No waste water or material recovered from waste water systems should be incorporated into feed ingredients.

Storage

Storage areas for raw materials and finished products should be separated to prevent cross-contamination. These facilities should be free of chemicals, fertilizers, pesticides and other potential contaminants.

Feed products should be stored in such a way that they can be identified easily and that confusion with other products is prevented.

Medications and medicated pre-mixtures should be stored in a secure place and with restricted access to authorized personnel only.

Any rejected products should be clearly identified and held in segregated areas to prevent their accidental use.

Finished feeds, which are approved and according to specifications, should be stored in suitable packaging materials or containers. Medicated feed should be stored in a separate and secure area.

Storage facilities should be designed and

constructed to prevent the entry of pests. Storage areas should be cleared completely and cleaned on a routine basis.

Raw materials and finished products should be kept cool and dry to prevent mould growth. Temperature and humidity should be controlled where necessary.

Stock control measures should be adequate to ensure that neither raw materials nor finished feeds deteriorate prior to use / despatch, or during storage. Wherever practical, raw materials must be used and feed materials must be supplied on a first in, first out basis.

Transport

Both raw materials and finished feeds should be adequately protected during transport. All means of transport, whether owned or contracted, bulk or packed and by water, rail or land should be appropriately cleaned to control and minimize the risk of contamination.

The most appropriate method of cleaning will depend on the nature of the loads being carried. As a general rule load compartments should be kept dry and sweeping or vacuuming used wherever this is effective. Where wet or sticky materials are being carried it will be necessary to use a pressure washer or steam cleaner.

Vehicles used for the transport of medicated feed and other materials that present a high risk (including those subsequently identified to be infested with insects or pathogens) should be cleaned completely, sanitized and dried before they are used again for the transport of feed products.

Attention should be paid to contracted transport and maintenance of clean transport should be a condition of hire. Compliance with this requirement should be checked regularly.

No materials from previous loading should remain in the tank trucks, boxes or other containers before being loaded with the feed products. Containers should be clean and dry prior to loading.

Checks should be made that the previous loads carried in any transport are compatible with the subsequent load being feed. The three previous loads carried should be confirmed and guarantees sought that no transport used to carry feed has been used to transport material likely to result in long-term contamination.

All vehicles used for transport of feed products should be subject to regular cleaning and sanitizing programmes to ensure clean transport conditions and no accumulation of residual material.

Products should be protected from contamination and kept dry. When transport in closed vehicles is not possible, loads should be covered. The cover should also be maintained in a clean, sanitized and dry condition.

Training

Good training is essential to ensure feed and food remain safe. Those engaged in feed manufacturing and handling operations should be trained in feed hygiene as well as production protocols and handling of feed products.

All personnel should be aware of their roles and responsibilities in maintaining feed safety. All training activities should be documented.

Periodic assessments of the effectiveness of training and instruction programmes should be made, as well as routine supervision and checks to ensure that procedures are being carried out effectively.

Managers and supervisors should have the necessary knowledge of feed and food hygiene principles and practices to be able to judge potential risks and take the necessary actions.

Training programmes should be regularly reviewed and updated.

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP)

A formal hazard analysis should be carried out with the aim of identifying and controlling hazards that might adversely affect the safety of any feed products to human health. Internationally recognized HACCP preliminary steps (items 1-5) and principles (items 6-12) are defined in Codex Alimentarius Commission in 'Recommended International Code of Practice General Principles of Food Hygiene – CAC/RCP 1- 1969, Rev. 4 – 2003'. (Box 13)

HACCP is plant-specific and firms that manufacture similar feeds can implement HACCP plans that differ in their identified hazards and control measures.

Prerequisites

Before undertaking the development of a HACCP plan, the HACCP team should have in place basic operating procedures validated as effective by internal auditing systems. These procedures are referred to as 'prerequisites' (i.e. 'required as a prior condition') for the HACCP.

The aforementioned Good Manufacturing Practices are examples of prerequisite programmes and include:

- Smoking, eating and drinking policy
- Cleaning schedules and hygiene audits
- Pest control program
- Supplier approval procedures
- Plant operating procedures and instructions
- Equipment maintenance
- Job descriptions and responsibilities
- Staff training

The validation of prerequisite programmes' effectiveness to control potential hazards allows the HACCP team to focus on those hazards not controlled by other means. Subsequent reviews must revisit prerequisites as well as the HACCP plan itself to ensure that changes in the process or previously unidentified hazards are controlled.

Prerequisite programmes to HACCP, including train-

ing, should be well established, fully operational and verified in order to facilitate the successful application and implementation of the HACCP plan.

HACCP team

The first preliminary step in developing a HACCP plan involves the formation of a HACCP Team.

The HACCP team should include personnel from all of the relevant operations and functions within the company and at least one member with demonstrably effective HACCP training.

The members of the HACCP team should be recorded within the HACCP Plan.

It is acceptable for individual personnel to fulfil multiple roles in the HACCP team or to utilise resources from outside of the company, provided that the role of the team remains effective.

In a classic HACCP team the following disciplines will be represented but not necessarily by different people in every case:

Team leader - This may be one of the people identified below and ideally will have been trained in HACCP principles and have experience of applying them.

Quality assurance/quality control/technical - This will require someone who understands the products under consideration and the historical hazards and critical issues associated with them.

Production - This will require someone who is closely involved with the production process and has an intimate knowledge of what happens where in the process.

Engineering - This will require someone who understands the mechanics of the processing plant, where material may accumulate inside machinery, where heat or moisture may be applied and how to gain access to machinery.

Additional, part-time expertise - This may require specialists who offer technical or specific expertise on purchasing, operational activities, distribution, microbiology, specific species requirements, etc.

It is essential that team members are familiar with what actually happens in the business and are not too removed from day to day activities.

Product Description and Intended Use

The HACCP team first describes the feed product through written specification that describes the product including a general description of the product, its ingredients and how it is to be used.

The method of product distribution could include internal use, further processing, retail or wholesale. The HACCP team also des-

BOX 13

HACCP Principles

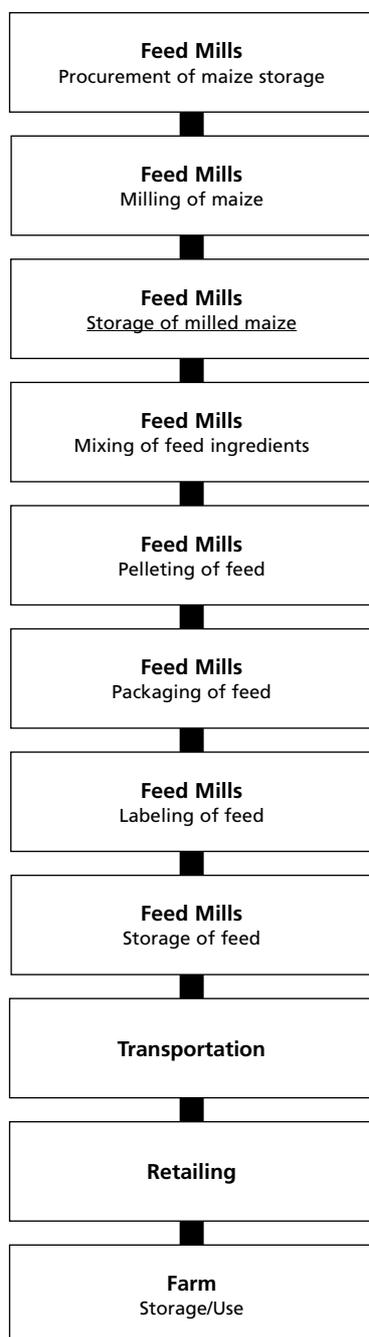
Logic sequence for the application of HACCP include:

1. Assemble HACCP Team
2. Describe Product
3. Identify Intended Use
4. Construct Flow Diagram
5. On-site Confirmation of Flow Diagram
6. Principle 1:
List all Potential Hazards
Conduct a hazard Analysis
Consider Control Measures
7. Principle 2:
Determine CCPs
8. Principle 3:
Establish Critical Limits for each CCP
9. Principle 4:
Establish a Monitoring System for each CCP
10. Principle 5:
Establish Corrective Actions
11. Principle 6:
Establish Verification Procedures
12. Principle 7:
Establish Documentation and Record Keeping

Note: The team members should be trained and work together with a common focus using the same approach and terminology

Source: Recommended International Code of Practice General Principles of Food Hygiene – CAC/RCP 1-1969, Rev 4 (2003)

Graph 1.



Source: Manual of Application of HACCP System in Mycotoxin Prevention and Control, FAO 2001, page 70, HACCP Flow Diagram - Maize Based Feed

cribes the normal expected use of the product. This information is used during the hazard analysis phase of HACCP plan development.

The written product specifications should be amended when any relevant changes take place. Additionally, the written specification developed

for the HACCP plan should include:

- i) Nutritional and analytical characteristics;
- ii) Hazards or limitations for intended use, where these apply.
- iii) Details of any medications included; and associated withdrawal period.

Definition of process steps

The HACCP team should identify and record all of the steps involved in their operations: from raw material procurement and supplier approval, through to the point at which any feeds produced are transferred to a purchaser (process analysis).

The process analysis should be illustrated using a flow diagram that shows each step of the process operation. Flow diagrams should include:

- (i) Clear identification of each step.
- (ii) The use of any processing aids and technological additives;

Flow diagrams should include (where relevant):

- All administrative processes such as order receipt and product formulation;
- All relevant inputs to the process flow, including raw materials and any products purchased for re-sale;
- All mechanical process steps;
- Passive equipment (such as stone traps and magnets);
- Recycle and return loops where fractions are returned to the process;
- Potential areas for cross-contamination;
- All areas where product is not enclosed;
- Storage, packing and transport steps;
- Steps where fractions are removed from the process (and do not return).

(This list is not necessarily exhaustive)

The HACCP team should confirm the details of any flow diagrams produced by physically checking them against the process being studied, prior to progressing to the next stage.

Hazard analysis /identification (CODEX Principle 1)

At each step of the process, the HACCP team should list all the potential hazards that might reasonably be expected to present a threat. At this stage all hazards should be listed and any that may be removed from the study as prerequisites can be identified at a later stage.

Key considerations are:

- Hazards inherent within the product;
- Hazards that may be introduced at the process step in question;

- Hazards that may increase at the process step in question.

The HACCP team should next undertake a hazard evaluation of all the hazards identified. The aim is to identify those that have the most impact on feed or food safety by assessing the likelihood of each occurring and the severity of its effect. Some practitioners find it helpful to use a simple model for scoring hazards but, whether or not a risk scoring method is used, it is necessary to ensure that the most significant risks receive the most attention.

Determination of control measures

It is important to apply a control measure or measures wherever there is a hazard that presents a significant risk and to eliminate it or reduce it to an acceptable level. The control measure(s) can take several forms but must be practical and achievable. When determining control measures the following considerations apply:

- Can the hazard be eliminated?
- Can the hazard be removed by engineering design?
- Can the hazard be managed by automated process control systems?
- Can the hazard be managed by personnel action?

Any controls applied should be validated to ensure they are effective. For example, this means demonstrating by analytical or other means that a statement made about a control is true and the control works as intended. Records of this should be kept for future reference.

Determination of critical control points (CODEX Principle 2)

The process step where control measures are essential to prevent, eliminate or reduce hazards to an acceptable level (i.e. the hazard would not be detected or removed at any later stage in the operation) are Critical Control Points (CCPs) and must be identified as such within the HACCP plan.

The process step that has been identified as a CCP should be clearly identified at its location within the processing plant on the HACCP plan flow diagramme.

Establishing critical limits (CODEX Principle 3)

The HACCP Team should detail the critical limits for the control measures at each of the CCPs. The critical limit is that which divides the acceptable from the unacceptable. Some critical limits

will be determined by legislative requirements, while others will be determined by experience or scientific research. The critical limits are defined as a maximum and/or minimum value to which a physical, biological, or chemical hazard must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of the identified safety hazard.

Monitoring (CODEX Principle 4)

The CCPs in the operation and the feed products themselves should be inspected and sampled (monitored) to ensure identified hazards remain under control.

Ideally, monitoring systems should be designed to identify as quickly as possible any controls that are becoming ineffective, prior to their failure. The frequency of any monitoring is therefore also important and should be specified in the HACCP plan.

Properly trained and authorized personnel undertake the monitoring activities specified in the HACCP plan. The HACCP plan should specify what will be monitored, how and where it will be monitored, the frequency of monitoring and who will perform the monitoring.

Preventive/corrective actions (CODEX Principle 5)

It is essential to take suitable, prompt and effective remedial action when information shows that control measure(s) are not within critical limits.

Any action taken should deal with both the cause of the problem as well as the consequences of the problem itself.

The HACCP team should specify the actions to be taken in the event of a CCP going out of control. Responsibilities for implementing corrective actions should be clearly assigned and documented.

It is important to ensure procedures also consider action to be taken with regard to any product processed since controls were last confirmed as operating within acceptable limits. This may require bonding of stock or even recall of product from customers or intermediaries. All corrective actions must be documented.

Verification (CODEX Principle 6)

Verification systems must be implemented by the HACCP team to ensure not only that all person-

nel are complying with the requirements of the HACCP Plan, but also that the Plan is effective (validation). Verification systems must review that the HACCP plan is followed and includes a review of associated records. There may be several control measures at a CCP in the HACCP Plan, each with its own appropriate monitoring. Principle 6 (verification) should include a validation that the control measure is effective and verification that the control measures are operating within the critical limits and that all monitoring activities are performed.

When establishing verification systems the following should be considered:

- Sampling and testing;
- Complaints monitoring;
- Internal auditing of the HACCP system;
- External auditing of the HACCP system.

External auditing of the HACCP System

The HACCP team should carry out regular reviews to verify the requirements of the HACCP plan are being met in practice and that the plan effectively and consistently ensures the safety of feed products. At least one complete HACCP review should be carried out each year and include any prerequisites established as part of the HACCP Plan. A record should be kept of HACCP reviews showing the HACCP team findings and any actions implemented.

Recordkeeping (CODEX Principle 7)

Records provide the written evidence that the HACCP plan is being followed and it also provides a means of tracing the history of the product as well as a mechanism to identify potential problems. Four common types of HACCP records include a summary of the hazard analysis, the HACCP plan, support documentation, and operating records.

Records provide a summary of the hazard analysis. It is good to document the deliberation of the HACCP team that supports the HACCP team's decision as to which hazards are identified as significant to humans and are included in the HACCP plan. Good documentation will include justification or discussion of the control measures that prevent, eliminate or reduce to an acceptable level that hazard.

The HACCP plan should include a record of the preliminary steps which include the HACCP team, the feed and its distribution, intended use, customers and process flow. On the process flow

designate where the critical control points occur at each of the appropriate process steps and then incorporate in your overall record keeping the HACCP summary table.

The supporting documents for HACCP principles include critical control points, critical limits, monitoring, corrective action and verification. Other supporting documents include SOPs that were developed for control measures at the CCPs.

Daily operational records are an essential part of implement the HACCP plan and require monitoring, corrective action and verification records. These records provide evidence that the HACCP plan is being followed. Monitoring records provide the backbone of the HACCP system and are designed to document compliance with the plan. Continuous monitoring is likely recorded through automation, for example conditioned mash temperature is recorded through the mill automation system. Discontinuous monitoring requires accurate documentation and entails standardized forms. Corrective action documentation occurs when there is a failure to meet a critical limit, detected through monitoring. The records should include quantity and codes of product released, destroyed or reworked. Verification activities designated in the HACCP plan must be documented including calibration records, daily operation verification, any validation or reassessment of the HACCP plan and on-site audits.

PREREQUISITE PROGRAMMES

Approved Suppliers of Raw Material

To ensure raw materials are safe, it will be necessary to obtain the following information for each raw material (including additives and technological additives) utilised to produce feed:

- The name and address of the supplier of the raw material;
- Information of the production or process from which the raw material is derived;
- Ingredient definition or risk assessment that identifies potential ingredient hazard.

Where risk assessments identify the need for specific controls or limits to ensure the appropriate management of potential hazards, these should be included in the specifications agreed with suppliers of the affected raw materials.

Procedures should be implemented for ensuring that suppliers are controlled, such that:

- They are evaluated for their ability to meet contractual requirements and that the results of the evaluation are recorded;

- Written details are recorded of the technical requirements that suppliers are expected to fulfil;
- The specification of any raw material or service provided is agreed and recorded in writing;
- Records of the performance of suppliers are available and reviewed at least annually to determine their continued suitability.

Process control

Processing should be planned, scheduled and controlled by a designated and competent person, to ensure compliance with documented feed specifications and documented parameters for critical processes.

All process controls relevant to feed safety should be demonstrably effective and managed in accordance with prerequisite programs including GMPs and HACCP principles.

Procedures should include corrective actions to be taken in the event of critical process parameters being breached.

Where mixing or dispersion forms an essential part of the process, tests should be undertaken to establish initial effectiveness of equipment and, on a subsequent frequency determined by risk analysis, to ensure that no loss of efficiency occurs through the effects of wear and tear. Records should be kept of such tests.

In situations where breakdown or other unforeseen circumstances result in the production of feed that does not meet specification, the resulting products should be treated in accordance with non-conforming product procedures.

Use of additives and medicinal substances

Where additives or medicinal substances are used during manufacturing, these should be feed compatible and, where required, authorised by the competent authority.

Participants should ensure that control systems provide the correct and effective inclusion levels for feed additives and medicinal substances at all times.

Feed additives and medicinal substances should only be incorporated in a form (liquid, powder or granular) that ensures an homogenous mix can be achieved. When working with low inclusion products, ingredient suppliers should provide evidence that product particle size and concentration will provide uniform distribution.

All manual or automated addition systems should be calibrated by a competent person and calibration records maintained.

Wherever feed additives and medicinal substances are incorporated, effective controls should be in place throughout the scheduling and manufacturing processes to ensure the correct products are incorporated into the intended feed products.

Records should be kept of all feed additives and medicinal substances incorporated.

Where medicinal substances are incorporated, tests should be undertaken at least once every six months to demonstrate that control systems are effective in including these products into the correct feeds and that non-medicated feeds are not contaminated to levels exceeding those prescribed in law in the country of manufacture or the countries in which the feed products will be distributed.

Containers / packages of feed additives and medicinal products should be held in secure storage and under the control of an authorised and competent person. Only those products in current use should be present in manufacturing areas.

INSPECTION, SAMPLING AND ANALYSIS

Inspection

Participants should have inspection regimes in place that ensure the safety of all raw materials on arrival and feed products on despatch. Inspections should include, as appropriate, assessment of:

- Colour
- Physical form
- Odour
- Contamination by insect pests (droppings and other extraneous matter)
- Mould
- Excessive damage
- Compliance with specification

Sampling

Sampling schedules should be controlled by a suitably qualified designated person. Details of the location, method and frequencies for sampling should be documented and appropriate for the raw materials and feed products concerned.

All raw materials and feed products should be subject to a sampling regime. Sampling techniques and frequencies should be adequate to ensure the true representation of the materials concerned.

The sampling regime must be appropriate to both the volume and nature of the raw materials and feed products concerned.

Samples of both raw materials and feed ingredients should be retained for a minimum period of six months, unless risk assessment studies show that shorter periods are sufficient or longer periods required.

Samples should be kept in appropriate, airtight containers and labelled in such a way as to assist traceability.

Storage conditions for samples should be such that deterioration is minimised.

Disposal of samples should be controlled under formal procedures and, where they are incorporated back into feed products, controls should ensure this does not create any potential hazard.

PERSONNEL TAKING SAMPLES AND UNDERTAKING TESTS

Personnel involved in either taking samples or testing should be suitably qualified for these roles.

Analysis

Where analysis is carried out, it is important that adequate tests are undertaken using methodology that is appropriate to the raw materials and feed products concerned.

Testing schedules for analysis should be the responsibility of a suitably qualified designated person and include both chemical and microbiological testing, as identified by the HACCP plan.

Testing methodology should be robust enough to ensure both the safety of the raw materials used and feed products supplied. The nature and frequency of tests carried out should be based on the volume and potential risks associated with the raw materials and feed products concerned.

Undesirable substances

In addition to sampling and testing required to establish other analyses, evidence must be available to show that feed ingredients meet acceptable, and if applicable, statutory standards for levels of undesirable substances such as mycotoxins, dioxins, heavy metals, pesticide residues, bacteria and endoparasites.

Microbiological analysis

Sampling and testing schedules for microbiological analysis should be the responsibility of a suitably qualified designated person.

It should be possible to demonstrate that the level of microbiological sampling and testing carried out will ensure the safety of any feed products supplied.

Under some circumstances it is appropriate

for microbiological testing to be carried out on buildings and equipment. When this is the case, appropriate records should be kept to show that correct methods are being used and, where necessary, corrective action implemented.

Testing laboratories

The methods of analysis employed in laboratories should be appropriate for the raw materials and feed ingredients being tested.

The effectiveness of testing laboratories should be regularly reviewed and approved by one or more of the following methods:

- i) Accreditation by a nationally recognised accreditation authority according to ISO-17025 for the test under consideration;
- ii) Validation by participating in relevant ring tests;
- iii) Validation by other recognised means or comparison with results of a recognised laboratory with verified quality control procedures.

Formal validation of laboratory results is not required for testing facilities used solely for process checks, unless such checks are identified as critical in the HACCP study.

Test records

The parameters for acceptance or rejection of both raw materials and feed products should be clearly defined.

Test results for all raw materials and feed products should be recorded and include clear evidence of action in the event of results falling outside of acceptable parameters.

Test results should be reviewed by an authorised and appropriately qualified person(s) with responsibility for ensuring that both raw materials and feed products meet specified parameters.

Non-conforming products

Participants should establish a documented procedure for dealing with raw materials and feed products that do not comply with specifications. This procedure should include:

- i) Identification of batches / lots affected;
- ii) Documentation for managing and recording non-conforming products;
- iii) Evaluation of the cause of the non-conformance;
- iv) Segregation of batches / lots affected;
- v) Communication with relevant parties;
- vi) Preventive or corrective action to avoid repetition of the non-conformance.

Responsibility for review and disposal of non-conforming products should be clearly defined. All incidences of non-conforming raw materials or feed products should be recorded and decisions regarding actions to be taken only be made by authorised personnel.

Non-conforming feed ingredients should be dealt with in one of the following ways:

- i) Sent to waste;
- ii) Reworked (if it is safe to do so);
- iii) Accepted by concession (if agreed in writing by the customer);
- iv) Downgraded (if meeting the specification of another feed product).

Requirements for reprocessing non-conforming feed products should be documented and any affected feed products be re-evaluated on completion to ensure that the batch / lot concerned subsequently meets specified requirements.

The approval and use of reworks (e.g. from quality rejects, customer returns or spillage) should be considered within the HACCP plan. Those that are not approved should become waste and be disposed of accordingly.

Feed products that do not fully meet a customer specification should only be supplied if the customer is notified of the problem in writing and confirms in writing that he is prepared to accept them.

Recall procedure

There should be a documented recall procedure that ensures customers can be informed promptly in the event of any irregularity that may adversely affect feed product safety.

The recall procedure should detail responsibilities and include actions to be implemented in the event of a recall. Feed products should specifically be included in any recall procedures, whether or not supply of feed products is the main activity of the business.

As part of the recall procedure, all relevant contacts should be listed and kept up-to-date. Contacts listed should include the competent authorities to be notified in the following circumstances:

- i) In the event of a serious feed safety risk;
- ii) When legal limits are exceeded and national legislation requires notification.

Internal audits

It is important to check that all systems relating to feed safety are operating effectively. Consequently there should be a documented procedure for internal auditing.

Internal auditing procedures should require a programme of planned internal audits to check that internal systems are operating as intended and are also effective. Such internal audits should encompass:

- i) Compliance with the requirements of the HACCP Plan;
- ii) Compliance with formal company procedures;
- iii) Compliance with legislation pertaining to feed ingredient safety and quality;
- iv) Satisfaction of specified customer requirements.

The programme of internal audits should ensure that all relevant activities are audited at least once a year.

All personnel carrying out internal audits should be trained to carry out such audits and be able to demonstrate their effectiveness in the role.

The outcome of internal audits should be formally reported to those with responsibility for the area audited and record any aspects where the operations are not in compliance with operational requirements. Such areas of non-compliance should be corrected and audit report records signed off by an authorised person to indicate that problems have been corrected satisfactorily.

REFERENCES

- AFIA.** 2005. Feed Manufacturing Technology;
- Behnke, K. C. 2005. Mixing and uniformity issues in ruminant diets, 2005 Penn State Dairy Cattle Nutrition Workshop;
- Bellaver, C., Nones, K.,** 2000. A importância da granulometria, da mistura e da peletização da ração avícola in IV Simpósio Goiano de Avicultura, 27/4/2000, Goiânia, GO, Brazil;
- Bichara, R.,** 2007. Gestão da qualidade e da segurança na fábrica in Congresso Internacional sobre Nutrição Animal e Alimentos Seguros, CBNA, 12 a 14 de setembro de 2007, Campinas, SP, Brazil;
- Boloh, Y., Gill, C.,** 2006. Measuring cross contamination in feed manufacturing, Feed International, April 2006, pages 28-29;
- EC 1996. Council Directive 96/25/EC.** 1996. On the circulation and use of feed materials;
- EC-ASEAN.** 2005. Guidelines on HACCP, GMP and GHP for ASEAN Food SMEs;
- EC 183/2005.** 2005. Regulation of the European Parliament and of the Council laying down requirements for feed hygiene;
- EFMC.** 2007. European feed manufacturers guide, FEFAC;

- FAMI QS.** 2006. Code of Practice, version 4, 20 October;
- FAMI QS.** 2006. Annexes to FAMI QS Code of Practice, version 4, 20 October;
- FAO.** 2003. Recommended International Code of Practices of Food Hygiene, CAC/RCP 1-1969, Rev 4;
- FAO.** 1998. Food quality and safety systems – A training manual on food hygiene and the Hazard Analysis and Critical Control Point (HACCP) system;
- GLOBALG.A.P.**, 2005. Integrated Farm Assurance, Compound Feed Manufacturer Module, version 1.0, Dec-05;
- ISO 22000:2005.2005.** Food safety management systems – Requirements for any organization in the food chain;
- ISO 19011:2002. 2002.** Guidelines for quality and/or environmental management systems auditing;
- Harner, J.P., et al.** 1996. Avoiding drug carry over during feed processing and delivery at www.oznet.ksu.edu;
- Herrman T. J.** 1997. Quality assurance for on farm feed manufacturing at www.oznet.ksu.edu;
- Herrman, T.** 2002. Micro-Ingredient Optimization: Particle Size and Density Relationship on Mixing Uniformity. GRSI-1001, K-State Research and Extension Service. Kansas State University, Manhattan;
- Lara, M. A. M.** 2002. Mistura em Fábricas de Rações, SAPIA – Sistema de Aperfeiçoamento da Indústria de Alimentos: Equipamentos na Fabricação de alimentos para anmais;
- National Advisory Committee on Microbiological Criteria for Foods.** 1998. Hazard analysis and critical control point principles and application guidelines. J. Food Protection. 61:762-775;
- PDV.** 2006. GMP+ Certification Scheme Animal Feed Sector, Appendix 4; Minimum requirements for inspection and audits including protocol for the measurement of carry-over;
- PDV.** 2006. GMP+ Certification Scheme Animal Feed Sector, Appendix 14: Minimum requirements for road transport (version 16 November 2007);
- Sindirações.** 2006. Feed and Food Safety Manual– Gestão do Alimento Seguro;
- WHO.** 2006. Guidelines for drinking water quality.

SECTION 4

On-farm production and use of feed and feed ingredients

On-farm production and use of feed and feed ingredients

This section provides guidance on the cultivation, manufacture, management and use of feed and feed ingredients on farms and in aquaculture.

This section should be used in conjunction with the applicable requirements of Sections 4 and 5 of this Code.

To help ensure the safety of food used for human consumption, good agricultural practices¹ should be applied during all stages of on-farm production of pastures, cereal grain and forage crops used as feed or feed ingredients for food producing animals. For aquaculture the same principles should apply, where applicable. Three types of contamination represent hazards at most stages of on-farm production of feed and feed ingredients, namely:

- Biological, such as bacteria, fungi and other microbial pathogens;
- Chemical, such as residues of medication, pesticides, fertilizer or other agricultural substances; and
- Physical, such as broken needles, machinery and other foreign material.

Agricultural production of feed

Adherence to good agricultural practices is encouraged in the production of natural, improved and cultivated pastures and in the production of forage and cereal grain crops used as feed or feed ingredients for food producing animals. Following good agricultural practice standards will minimize the risk of biological, chemical and physical contaminants entering the food chain. If crop residuals and stubbles are grazed after harvest, or otherwise enter the food chain, they should also be considered as livestock feed. Most livestock will consume a portion of their bedding. Crops that produce bedding material or bedding materials such as straw or wood shavings should also be managed in the same manner as animal feed ingredients. Good pasture management practices, such as rotational grazing and dispersion of manure droppings, should be used to reduce cross-contamination between groups of animals.

Site selection

Land used for production of animal feed and feed ingredients should not be located in close proximity to industrial operations where industrial pollutants from air, ground water or runoff from adjacent land would be expected to result in the production of foods of animal origin that may present a food safety

risk. Contaminants present in runoff from adjacent land and irrigation water should be below levels that present a food safety risk.

Fertilizers

Where manure fertilization of crops or pastures is practised, an appropriate handling and storage system should be in place and maintained to minimize environmental contamination, which could negatively impact on the safety of foods of animal origin.

There should be adequate time between applying the manure and grazing or forage harvesting (silage and hay making) to allow the manure to decompose and to minimize contamination.

Manure, compost and other plant nutrients should be properly used and applied to minimize biological, chemical and physical contamination of foods of animal origin which could adversely affect food safety. Chemical fertilizers should be handled, stored and applied in a manner such that they do not have a negative impact on the safety of foods of animal origin.

Pesticides and other agricultural chemicals
Pesticides and other agricultural chemicals should be obtained from safe sources. Where a regulatory system is in place, any chemical used must comply with the requirements of that system.

Pesticides should be stored according to the manufacturer's instructions and used in accordance with Good Agricultural Practice in the Use of Pesticides (GAP)². It is important that farmers carefully follow the manufacturer's instructions for use for all agricultural chemicals.

Pesticides and other agricultural chemicals should be disposed of responsibly in a manner that will not lead to contamination of any body of water, soil, feed or feed ingredients that may lead to the contamination of foods of animal origin which could adversely affect food safety.

MANUFACTURING OF FEED ON-FARM

Feed ingredients

On-farm feed manufacturers should follow the applicable guidelines established in sub-section 4.1 of this Code when sourcing feed ingredients off the farm.

Feed ingredients produced on the farm should meet the requirements established for feed ingredients sourced off the farm. For example, seed treated for planting should not be fed.

Mixing

On-farm feed manufacturers should follow the applicable guidelines established in Section 5 of this Code. Particular attention should be given to sub-section 5.6 of this Code.

In particular, feed should be mixed in a manner that will minimize the potential for cross-contamination between feed or feed ingredients that may have an effect on the safety or withholding period for the feed or feed ingredients.

Monitoring records

Appropriate records of feed manufacturing procedures followed by on-farm feed manufacturers should be maintained to assist in the investigations of possible feed-related contamination or disease events.

Records should be kept of incoming feed ingredients, date of receipt and batches of feed produced in addition to other applicable records set out in sub-section 4.3 of the Code.

Good animal feeding practice

Good animal feeding practices include those practices that help to ensure the proper use of feed and feed ingredients on-farm while minimising biological, chemical and physical risks to consumers of foods of animal origin.

Water

Water for drinking or for aquaculture should be of appropriate quality for the animals being produced. Where there is reason to be concerned about contamination of animals from the water, measures should be taken to evaluate and minimise the hazards.

Pasture grazing

The grazing of pastures and crop lands

should be managed in a way that minimises the avoidable contamination of foods of animal origin by biological, chemical and physical food safety hazards.

Where appropriate, an adequate period should be observed before allowing livestock to graze on pasture, crops and crop residuals and between grazing rotations to minimise biological cross-contamination from manure. Where agricultural chemicals are used, operators should ensure that the required withholding periods are observed.

Feeding

It is important that the correct feed is fed to the right animal group and that the directions for use are followed. Contamination should be minimised during feeding. Information should be available of what is fed to animals and when, to ensure that food safety risks are managed.

Animals receiving medicated feed should be identified and managed appropriately until the correct withholding period (if any) has been reached and records of these procedures must be maintained. Procedures to ensure that medicated feed are transported to the correct location and are fed to animals that require the medication should be followed. Feed transport vehicles and feeding equipment used to deliver and distribute medicated feed should be cleaned after use, if a different medicated feed or non-medicated feed or feed ingredient is to be transported next.

Stable feeding and lot/intensive feeding units
The animal production unit should be located in an area that does not result in the production of food of animal origin that poses a risk to food safety. Care should be taken to avoid animal access to contaminated land, and to facilities with potential sources of toxicity.

Hygiene

The animal production unit should be designed so that it can be adequately cleaned. The animal production unit and feeding equipment should be thoroughly cleaned regularly to prevent potential hazards to food safety. Chemicals used should be

appropriate for cleaning and sanitising feed manufacturing equipment and should be used according to instructions. These products should be properly labelled and stored away from feed manufacturing, feed storage and feeding areas.

A pest control system should be put in place to control the access of pests to the animal production unit to minimise potential hazards to food safety.

Operators and employees working in the animal production unit should observe appropriate hygiene requirements to minimise potential hazards to food safety from feed.

Aquaculture³

Aquaculture includes a wide range of species of finfish, molluscs, crustaceans, cephalopods, etc. The complexity of aquaculture is reflected in the wide range of culturing methods ranging from huge cages in open seas to culturing in small freshwater ponds. The diversity is further reflected by the range of stages from larvae to full grown size, requiring different feed as well as different culture methods. Nutritional approaches range from feeding only naturally occurring nutrients in the water to the use of sophisticated equipment and scientifically formulated compound feed.

To ensure food safety, necessary precautions should be taken regarding culturing methods, culturing sites, technologies, materials and feed used to minimize contamination in order to reduce food hazards.

¹ Guidelines on this definition are under development by FAO

² See *Definitions for the Purposes of the Codex Alimentarius (Procedural Manual of the Codex Alimentarius Commission)*

³ *Aquaculture producers should refer to relevant sections of the Code of Practice for Fish and Fishery Products for additional information (CAC/RCP 52-2003).*

Source: Code of practice on good animal feeding (CAC/RCP 54-2004).

INTRODUCTION

Four areas of on-farm activity have an effect on feed safety: the cultivation of home-grown feed stuffs (including cereals, pulses, forage crops and pasture); the purchase and use of bought-in feed stuffs; the processing, mixing and storage of feed on the farm; the feeding of livestock from which human food will be derived in the form of meat, milk, eggs, etc. The goal across all of these activities is to deliver the required nutrients to livestock at the best cost while avoiding contamination that could adversely affect food safety.

The production and use of safe feed will enhance animal performance and improve profitability. The first step is to obtain safe ingredients, as it is impossible to produce safe feed without safe ingredients.

This section covers: good agricultural practices for the production of feed; manufacturing of feed on-farm; and relevant elements of good animal feeding practices.

GOOD AGRICULTURAL PRACTICES FOR THE PRODUCTION OF FEED

Broadly defined, GAP applies available knowledge to addressing environmental, economic and social sustainability for on-farm production and post-production processes resulting in safe and healthy food. The concept of Good Agricultural Practices has evolved in recent years in the context of a rapidly changing and globalizing food economy and as a result of the concerns and commitments of a wide range of stakeholders about food production and security, food safety and quality, and the environmental sustainability of agriculture.

BOX 14

Contamination of feed

Contamination of feed and food is due to various sources, causes and processes, having direct impact on its quality and safety and also implying a risk to animal and human health. These include operations carried out in crop husbandry, manufacture, processing, preparation, treatment, packing, packaging, storage, and transport of such feed or as a result of environmental contamination.

Source: Codex Alimentarius Commission, Procedural Manual

BOX 15

Contaminant levels

Contaminant levels in foods shall be as low as reasonably achievable. The following actions may serve to prevent or to reduce contamination of foods and feeds:

- preventing food contamination at the source, e.g. by reducing environmental pollution.
- applying appropriate technology in food production, handling, storage, processing and packaging.
- applying measures aimed at decontamination of contaminated food or feed and measures to prevent contaminated food or feed to be marketed for consumption.

To ensure that adequate action is taken to reduce contamination of food and feed a Code of Practice shall be elaborated comprising source related measures and Good Manufacturing Practice as well as Good Agricultural Practice in relation to the specific contamination problem.

Source: Codex General Standard for Food

Contaminants and Toxins in Food (CODEX STAN 193-1995)

This section will mainly focus on those aspects of GAP which have an impact on the safety of feed, the term feed refers to both feed and feed ingredients, unless otherwise specified.

GAPs apply to the primary line of production including growing the crop material and primary processing. From that point on, the starting feed ingredient material is subject to production and processing according to GMPs.

GAPs eliminates or reduces the risks of microbiological or chemical contamination, misuse of crop protection products, and deterioration during primary processing and storage. Eliminating and reducing these risks enhances the reliability of the feed materials. Therefore, feed materials and ingredients should be furnished by suppliers that are able to follow Good Agricultural Practices to reduce the risks of contamination of the feed and food chain (Boxes 14 and 15).

The main elements of Good Agricultural Practices are:

- Agricultural sites/Production areas
- Seeds and propagation material
- Crop rotation and soil management
- Use of fertilizers
- Irrigation/Fertigation

- Integrated pest management
- Plant protection products
- Harvesting
- Storage and distribution
- Transport
- Equipment
- Documentation and record keeping
- Personnel health, safety and training

Agricultural sites/production areas

Feed and food safety is preserved once the production areas used are suitable and do not present risks for crop contamination, health of operators and the environment.

It is a good practice to identify the fields, orchards and yards to better locate and reference production areas (Box 16).

Safe production of feed and food as well as protection of environment are key parts of sustainable farming and include good management and control of risks such as pollution, water contamination, soil compaction, soil erosion and intensity of application of chemicals for plant protection.

Seeds and propagation materials

Use seeds of good quality, free from injurious pests, diseases, virus, etc. Recommended practices for the prevention and reduction of mycotoxins contamination in cereals as well as in raw materials and supplemental feedstuffs for milk producing animals include the growing of seed varieties developed for resistance to seed-infecting and insect pests⁸. Only seed varieties recommended for use in a particular area of the country should be planted in that particular area.

Monitor the plant health through controls signs of pests and diseases. When rootstocks are used, pay attention to their origin.

Crop planting should be timed avoiding high temperatures and drought stress during the period of seed development and maturation.

Crop rotation and soil management

Develop and maintain a crop rotation schedule to avoid planting the same commodity in a field

in two consecutive years. Crops such as potato, other vegetables, clover and alfalfa that are not hosts to *Fusarium* species should be used in rotation to reduce inoculums in the field. Wheat and maize have been found to be particularly susceptible to *Fusarium* species and they should not be used in rotation with each other⁹.

Prepare seed bed for the new crop by destroying old seed heads, stalks and other debris that may serve as substrates for the growth of mycotoxin-producing fungi.

Avoid overcrowding of plants by maintaining the recommended row and intra-plant-spacing for the species/varieties grown. Information on plant spacing may be provided by seed companies.

Adequate techniques should be used to

BOX 16

Cultivated land information

Important information that needs to be obtained about the history of the land includes prior use of the land:

- For animal feeding;
- For domestic animal production;
- As a garbage or toxic waste disposal site;
- As a sanitary waste management site;
- For mining activities, oil or gas extraction;
- For the disposal of incinerated material, industrial waste or if mineral residues exist on the site;
- For barns and/or if farm animals are being produced on land adjacent or a short distance from the cultivation site.

Other information that should be obtained include if the land has:

- Experienced any serious flooding;
- Been treated in an uncontrolled manner with organic or inorganic fertilizers and/or pesticides.

Source: Improving the Safety and Quality of Fresh Fruit and Vegetables: A Training Manual for Trainers, University of Maryland, 2000.

⁸ Codex Code of Practice for the Reduction of Aflatoxin B1 in Raw Materials and Supplemental Feedingstuffs for Milk-Producing Animals (CAC/RCP 45-1997); Codex Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals, including Annexes on Ochratoxin A, Zearalenone, Fumonisin and tricothecenes (CAC/RCP 51-2003)

⁹ Codex Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals, including Annexes on Ochratoxin A, Zearalenone, Fumonisin and tricothecenes (CAC/RCP 51-2003)

maintain soil structure, avoid soil compaction and erosion.

Where appropriate, an adequate rest period should be observed before allowing livestock to graze on pasture, crops and crop residuals and between grazing rotations to minimize biological cross-contamination from manure.

Use of agricultural chemicals

Agricultural chemicals should be obtained from reputable suppliers and be appropriately labeled. Agricultural chemicals should be stored safely in clearly labeled, secure containers in clean, dry areas separate from other materials and livestock feed. Herbicides, pesticides, fertilizers and other agricultural chemicals should be used for the indicated purpose, applied according to the quantities and frequencies as indicated by manufacturers. Records of the application should be maintained, including the name and content of the chemical used as well as all justifications for the application.

Withholding periods for harvesting, stocking, feeding or grazing should be strictly observed.

Pesticides and other agricultural chemicals should be disposed of responsibly in a manner that will not lead to contamination of any body of water, soil, feed or feed ingredients that may lead to the contamination of foods of animal origin which could adversely affect food safety.

It should be ensured that expired or defec-

tive chemicals and empty containers are safely disposed. Containers should go through a triple wash and the residual water should not be mixed with drinking and working waters. They should be broken or perforated so as not to be reused and, finally, kept them in closed bags to be delivered in the collecting centers.

Use of fertilizers

Determine if there is a need of fertilizers or soil conditioners to ensure adequate soil pH and plant nutrition to avoid plant stress, especially during seed development. Recommendations on the application of organic or inorganic fertilizers should be given by competent personnel. Record fertilizer applications indicating the date/month/year, type of fertilizer and concentrations.

Store fertilizers in a covered, clean and dry area separated from other plant protection products and in a manner that there is minimum risk of contamination of water sources and environment.

Purchase inorganic fertilizer from a reliable source in order to have a guaranteed content of the plant nutrients and the absence of chemical contamination such as heavy metals and fluorine.

No human sewage sludge should be used.

Manure

Manure, to be used in feed crops and pasture, should be appropriately handled and stored, in order to minimize environmental contamination, particularly to ground water and waterways through run-off. There should be adequate time between applying the manure and grazing, to allow the manure to decompose and to minimize biological contamination.

Similarly, manure applied to ponds to enhance productivity should be composted for an adequate period prior to use to attenuate the presence of pathogens.

The systems should comply with any regulatory requirement in place. Manure, compost and other plant nutrients should be properly used and applied to croplands, pastures and ponds to minimize biological and chemical contamination of crops and the environment.

The source and safety of manure or sludge sourced off-farm should be monitored and safety assured

Irrigation

Ensure that, when irrigation is used, an adequate supply of water is applied evenly to all

BOX 17

Irrigation practices

Irrigation practices with waste water or with other water sources are similar and depend on the local conditions, including climate, physical and chemical soil properties, drainage conditions and the salt tolerances of the crops to be grown. Good irrigation practices may vary, but are based on:

- Water quantity
- Water quality
- Soil characteristics (infiltration, drainage)
- Crop selection
- Irrigation techniques
- Leaching
- Management practices

Source: WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater, 2006

plants. The water used should be of adequate quality. When waste water is used, concentrations of chemicals and other information on water quality should be known and can be found in the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater, 2006. These Guidelines explain the concepts and practices for the safe use of wastewater, including health-based targets and minimum procedures. It also covers a substantive revision of approaches to ensuring the microbial safety of wastewater used in agriculture (Box 17).

Integrated pest management

Integrated Pest Management (IPM) is the coordinated use of pest and environmental information with available pest control methods to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to people, property, and the environment (EPA – Pesticides in Food – “What Integrated Pest Management Means”, 2007).

IPM should be a well planned program aiming to protect crops and including a variety of methods and tools to manage pests effectively and according to local conditions (Box 18).

BOX 18

Integrated pest management techniques

IPM techniques are divided into three broad categories:

- i) Prevention – The adoption of cultivation methods that could reduce the incidence and intensity of pest attacks, thereby reducing the need for intervention.
- ii) Observation and Monitoring – Determining when and to what extent, pests and their natural enemies are present, and using this information to plan what pest management techniques are required.
- iii) Intervention – In situations where pest attack will adversely affect the economic value of a crop, it may be necessary to intervene with specific pest control methods, including plant protection products. However, where possible, non-chemical approaches should be considered.

Source: Global G.A.P. – Control Points and Compliance Criteria – Integrated Farm Assurance – Crops Base – Annex CB.1 Integrated Pest Management, 2007

All insecticides, fungicides used to minimize insect damage and fungal infection as well as herbicides for the control of weeds in the crop, when mechanical methods do not suffice, should be registered and obtained from safe sources.

Store all pesticides according to manufacturer’s instructions and use them according to Good Agricultural Practice in the Use of Pesticides.

External technical assistance may be obtained when advice is needed for the implementation of IPM. A number of technical references are also available for specific crops and purposes on various IPM websites.

Plant protection products

When pests can not be controlled by non-chemical means and techniques, plant protection products may be necessary to be applied. These should be handled and stored correctly and according to label recommendations and should be suitable for the pest, disease and weeds considered (Box 19).

Only plant protection products that are registered in the country of use and for application in the specific crop should be used. FAO International Code of Conduct for the Use and Distribution of Pesticides (FAO Rome, 2002) sets out voluntary standards of conduct for all public and private entities engaged in or associated with the distribution and use of pesticides, particularly where there is inadequate or no national legislation to regulate pesticides.

The record keeping of plant protection products can be organized through:

- Invoices of products purchased;
- A list of products including their active ingredient composition;

BOX 19

Good agricultural practice in the use of pesticides

Practices include the nationally authorized safe uses of pesticides under actual conditions necessary for effective and reliable pest control. It encompasses a range of levels of pesticide applications up to the lightest authorized use, applied in a manner which leaves a residue that is the smallest amount practicable.

Source: Codex Alimentarius Commission, Procedural Manual

- Prescription from personnel with technical competence to advise on the use of chemicals;
- Training records of the personnel responsible for the handling and application of products;
- Record of application including:
 - Crop name and variety;
 - Location of application;
 - Date of application;
 - Justification of application;
 - Quantity/concentration of product applied;
 - Machinery used for application;
 - Preharvest interval.

Surplus mixes and tank washings should be disposed of according to the local regulations. Storage of plant protection products should be done in a clean and safe place, under appropriate conditions of temperature and ventilation. The location should be well lit and far from other materials. Only authorized personnel should have access to the storage facilities of products.

Empty plant protection product containers should not be reused and should be disposed of in a way that does not cause any contamination to human health and to the environment. In the case there is a local system for collection of empty containers, these should be kept secure until disposed. Local collection rules should be followed strictly.

Harvest

Harvest crops at full maturity unless allowing it continues to full maturity would subject it to extreme heat, rainfall or drought conditions.

Wagons, trucks and any other containers used for collection and transportation of the harvested grain should be clean, dry and free from insects and fungal growth. As much as possible, avoid mechanical damage to the grain and avoid contact during the harvesting operation.

Immediately after harvest, determine moisture levels of the crop and, where applicable, dry the crop to the recommended moisture content for storage. To reduce the variation of moisture content within a lot, the grain may be moved to another facility after the drying process.

Cereals should be dried in such a manner that damage to the grain is minimized and moisture levels are lower than those required to support mold growth during storage. This is necessary to prevent further growth of a number of fungal species that may be present on fresh grains, especially *Fusarium* species.

Storage and distribution

Harvested crop should be stored in cleaned areas, free from residues of previous crops. Where appropriate, storage facilities should be washed and insecticide treated prior to use to prevent insect infestation.

For bagged commodities, ensure that bags are clean and stacked on pallets or incorporate a water impermeable layer between the sacks and the floor.

Store harvested crops at the temperature best suited to control insect and mold development without compromising physical or physiological integrity of the stored product. Where possible aerate commodities stored in bulk through to maintain proper temperature and moisture.

Use of a suitable authorized preservatives such as organic acids (propionic acid), may be beneficial in that such acids are effective in killing moulds and fungi and preventing the production of mycotoxins. If an organic acid is used, it is important that the amounts added are sufficient to prevent fungal growth and are consistent with the product end use.

Handling of the harvested crops should follow all hygiene practices. Personal and clothing cleanliness, hand washing and personal behavior as no smoking, spitting, eating, chewing should be observed.

Transport

Transport containers should be dry and free of visible fungal growth, insects or any other contaminated material. As necessary, transport containers should be cleaned and disinfected before use and re-use and be suitable for the intended

BOX 20

Flagging potential contamination

General symptoms that flag an employee with the potential for causing microbial contamination:

- Diarrhea
- Vomiting
- Dizziness
- Abdominal cramps
- Exposed or open wounds
- Hepatitis or jaundice (yellow color of the skin)

Source: Improving the Safety and Quality of Fresh Fruit and Vegetables: A Training Manual for Trainers, University of Maryland, 2000

cargo. The use of registered fumigants or insecticides may be useful. At unloading, the transport container should be emptied of all cargo and cleaned as appropriate.

Shipments of grain should be protected from additional moisture by using covered or airtight containers or tarpaulins. Avoid temperature fluctuations and other measures that may cause condensation to form on the grain, which could lead to local moisture build-up and consequent fungal growth and mycotoxin formation.

Avoid insect, bird and rodent infestation during transport by the use of insect and rodent proof containers or insect and rodent repellent chemical treatments, if they are approved for the intended end use of the grain.

Equipment

Clean all machinery and equipment as well as trucks and trailers used to transport grains and other feed raw materials. Be particularly careful with the cleaning operation of trailers that are used to transport different types of materials and medicated feeds in order to prevent cross contamination. Make workers aware of all necessary cleaning procedures and records to be kept. Do not load bulk feed concentrates, ingredients, or pre-mixes into equipment that is also used to haul pesticides, insecticides, glass, or scrap metal.

Documentation and record keeping

Documentation of procedures and relevant farm practices ensure that producers have correctly developed, implemented and updated an effective feed production and management systems.

The recording of practices established in the procedures allows the demonstration of compliance to the statutory, regulatory and client requirements. Record keeping will facilitate the traceability of products and information, observation of legal requirements, external inspections/ audits and the availability of data to the competent authorities.

Personnel health, safety and training

Workers health, safety and hygiene are important for the efficiency and safety of production on the farm. Training and education will guarantee that personnel are competent to perform their duties and have good knowledge of risks and conditions that can contaminate or decrease safety and quality of products (Box 20).

Training programmes are to be conducted on a regular basis and will help people understand

production practices, handling of products and equipment as well as safely measures. Plant protection products, biocides and other chemical that can be hazardous are to be handled by workers that have been trained and can show competence for such.

Hygiene instructions are part of the workers training program and can be provided verbally or through signs and pictures assuring that:

- Hands need to be clean;
- Skin cuts should be covered;
- Smoking, eating and drinking are permitted only in defined areas;
- Sickness and infections should be informed;
- Protective clothing should be worn when required.

Visitors and subcontractors are also to be made aware of procedures related to personnel safety and hygiene.

Place signs to indicate the chemicals storage facilities and the treated crops.

Clean protective clothing and equipment regularly and separately from personnel clothing. Do not store protective clothing and equipment with chemicals and other plant protection products.

Make available to workers a place where they can store their food and eat. Hand washing facilities and potable drinking water must be accessible at all times.

Provide living quarters in good and sound conditions having basic hygiene facilities and water.

MANUFACTURING FEED ON-FARM

Many livestock and poultry producers choose to manufacture all or a large part of the feed for their animals on farm. In order to produce feed with high quality and safety standards, manufacturers should consider following basic steps given in figure 1.

Feed ingredients

As stated by Johnston and Hawton (1991), the first step in manufacturing high quality feeds is to obtain high quality ingredients. It is impossible to manufacture high quality feed with poor quality ingredients. Grain should be free of molds, insects, dirt, stones and other miscellaneous debris when it is stored.

Feed ingredients should be obtained from safe sources. Monitoring of feed ingredients should include inspection and sampling and analysis for undesirable substances using risk-based protocols. Feed ingredients should meet acceptable and, if applicable, statutory standards for levels of pathogens, mycotoxins, pesticides and unde-

sirable substances that may give rise to consumers' health hazards.

Furthermore, feed ingredients produced on the farm should meet the requirements established for feed ingredients sourced off the farm.

Formulation

Accurate formulation is essential to producing animal diets that satisfy their nutrient requirements. Nutrient concentrations of feed ingredients can vary substantially from average values published in nutrient composition tables. The on-farm feed manufacturer should consider that the most accurate formulations result only from laboratory analysis of ingredients. The manufacturer should seek the help of trained professionals when not familiar with the calculations involved in the formulation process.

Special formulation should be followed exactly as any variation will alter nutrient content of the final feed and may compromise animal performance. Only supplements and premixes that have been formulated specifically for each animal species or category should be used.

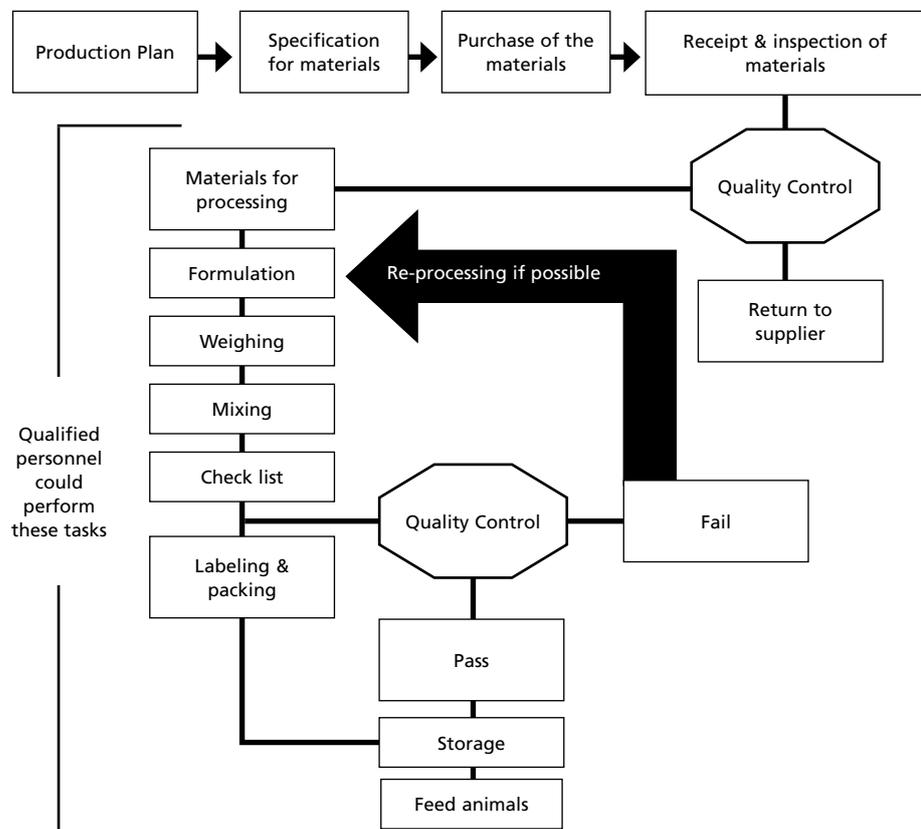
Particle size

To achieve optimal animal performance, it is necessary to process cereal grains through a hammer mill or roller mill to reduce particle size. In fact it well knows that reduction of particle size increases surface area of the grain that promote enzyme action improving efficiency of digestion and finally efficiency of body weight gain. Furthermore, particle size reduction allows uniform mixing of grain with protein, vitamin and mineral supplements. The optimal particle size will depend on the animal specie for which the feed is intended. A minimum physical structure should be maintained in ruminant feeds as compared to poultry feeds

Equipment

Feed equipment must be suitable for manufacturing animal feedstuffs. Manufacturer's recommendations on mixing time for the size and type of the mixer should be followed. Mixers should not be overfilled; ; efficiency of mixing is reduced when mixers are too full or too little material to

FIGURE 1: FLOW CHART OF MANUFACTURING FEED ON-FARM



Source: Avitech Animal Health Pvt. Ltd, adapted

permit adequate mixing action. They should be kept clean, free of any accumulated material and should be able to achieve an even mix.

Feed equipment should be stored in good and clean conditions as to avoid any kind of contamination. Visual checks should be carried out on a regular basis, maintenance and cleansing records should be kept.

If drugs or other additives have been mixed into the feed, all the equipment used should be cleaned between batches. Feed should be mixed in a manner that minimizes the potential for cross-contamination between feed or feed ingredients.

Adding ingredients

Basically, there are two types of feed mixing equipment:

Continuous flow (sometimes called mix-mills, volumetric or meter mills) – In this type of equipment, ingredients are added based on volume. This procedure takes into account that each ingredient has a constant bulk density. When the bulk density of ingredients changes and the same volume is still added, the mixture will no longer contain the right amount of ingredients. Consequently, bulk density of ingredients should be monitored and continuous flow mills checked periodically and adjusted if necessary, when appropriate.

Batch processing - In batch processing mixers, each ingredient is added individually by weight, not volume. This procedure increases the accuracy of feed manufacturing.

According to the FIFE Council Trading Standards Service, the below checklist can be used to help drawing up a control plan. The plan will

assist towards the assurance that ingredients used are:

- Wholesome
- Free from contamination
- Mixed/added in the correct proportions

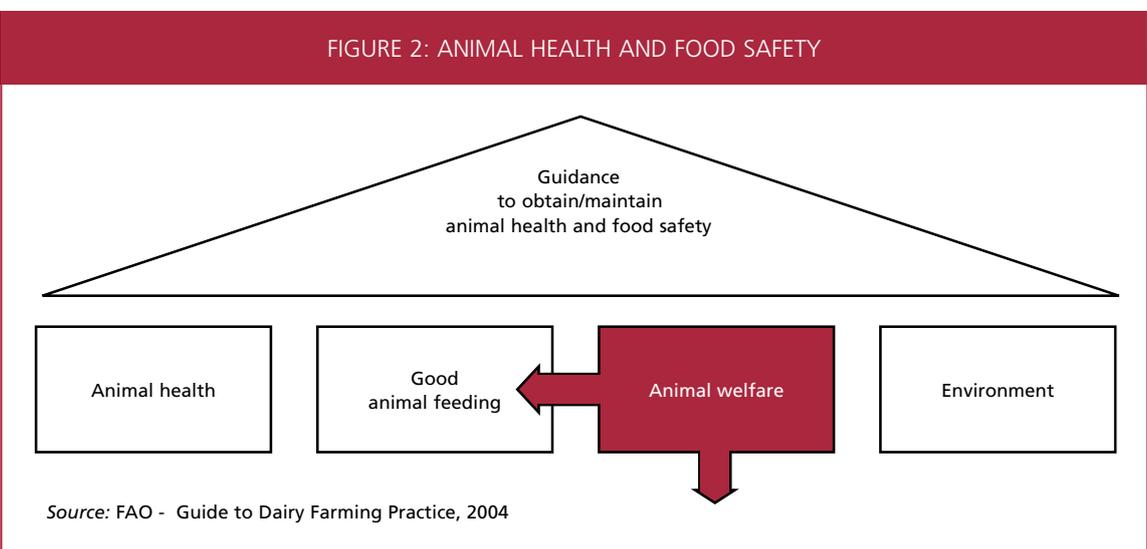
This control plan should address the following questions and be used regularly and especially when any changes are made to the mixing operation.

- Are ingredients from a known and reputable/reliable source?
- Are records of the source of bought-in ingredients kept?
- Are ingredients and the finished feed prevented from being contaminated?
- Are stored raw materials protected from birds and other pests?
- Are feed ingredients/feedstuffs stored separately? Are they identified?
- Is the equipment used to mix clean and serviceable?
- Are details of the manufactured feed kept?
- Is the equipment suitable for ensuring an even and uniform mix of ingredients?
- Is everyone involved in mixing feed aware of how to achieve an homogeneous mix?
- Where necessary, are samples of ingredients and complete feeds kept and retained?
- If using a mobile feed mixing contractor, is the work record available?
- Is there a record of all mixes?

Quality control

A competent person should be given the responsibility for production and quality control. Their designated responsibilities should be listed and recorded. If there is no one to designate the

FIGURE 2: ANIMAL HEALTH AND FOOD SAFETY



Source: FAO - Guide to Dairy Farming Practice, 2004

responsibility to, the farmer himself is the responsible individual.

Whoever the responsibility lies with, this person should produce a written quality control plan, which should be implemented and reviewed when necessary. The quality control program should include periodic laboratory analysis of ingredients and feed using suitable methods of sampling and analysis.

Labeling

Label should be consistent with any statutory requirements and should describe the feed and provide instruction for use.

Storage

Feed and feed ingredients should be clearly identified and be stored separately to preserve their identity and prevent cross-contamination, especially with medicated feeds. Feed ingredients that may require analysis to ensure food safety should be adequately identified and isolated until approval for their use is obtained.

Feed and feed ingredients should be stored in a manner so that stock occurs, observing validity dates to avoid microbial growth of contaminants and to ensure the proper activity of feed additives, including drugs.

Storage areas should be kept clean, dry and at an appropriate temperature and humidity to minimize microbial growth. Where appropriate, pathogen control procedures should be carried out. Effective pest control regimes should be implemented. Access by wildlife and other animals should be minimized.

Buildings and storage containers should be well ventilated and monitored to minimize contamination or deterioration of feed and feed ingredients.

Monitoring records

Appropriate records of feed manufacturing procedures followed by on-farm feed manufacturers should be maintained to assist in the investigations of possible feed-related contamination or disease events.

Records of incoming feed ingredients, date of receipt and batches of feed produced should be kept. A regular inventory of feed ingredients should be carried out to ensure that the correct feed ingredients have been used in the correct quantities. In some production systems, general feeding plans may be more appropriate.

Records should also be maintained of master

formulas and mixing instructions and the dates on which feeds were mixed and used. Where veterinary drugs or feed additives are used, there should be records of the procedures used for adding these ingredients in order to prevent contamination of other feed mixes.

Re-processing

When feed manufactured on-farm does not achieve the standard limits of quality, qualified personnel should evaluate if the material can be reprocessed.

Personnel training

Personnel should be familiar with and comply with all relevant national regulations and key industry standards/assurance schemes relating to product quality and safety. Personnel should ensure that records are maintained to demonstrate compliance with regulations or assurance schemes. People involved in animal management/ husbandry should keep themselves updated on technological developments that can prevent or correct welfare problems.

USE OF FEED

Good animal feeding practices include those practices that help to ensure the proper use of feed on-farm to promote animal health and productivity, while minimizing biological, chemical and physical risks to consumers of foods of animal origin and also reduce the impact on the environment.

Animal health and productivity depend on the quality and management of the feed and water. When feeding animals, they should be given sufficient feed and water of adequate quality, based on their physiological needs taking into account their age, body weight, stage of lactation, production level, growth, pregnancy, activity and climate.

Feed Distribution

The on-farm feed distribution system should ensure that the correct feed is sent to the right specie and group of animals. During distribution and feeding, feed should be handled so that biological and chemical contamination does not occur from contaminated storage areas and equipment. Non-medicated feeds should be handled separately from medicated feeds to prevent contamination.

Avoid overfilling the animals' feeding troughs, adapting the quantity to the physiological requi-

TABLE 3. **RECOMMENDED PRACTICES FOR ON-FARM PRODUCTION AND USE OF FEED AND FEED INGREDIENTS**

Adherence to Good Agricultural Practices and Good Manufactured Practices are encouraged in the production of natural, improved and cultivated pastures, forage and cereal grain crops used as feed or feed ingredients for food producing animals.
Producers who choose to manufacture feed on the farm also accept responsibility for maintaining feed quality and other duties that come with it, such as maintaining feed safety.
Quality control begins with purchase of feed ingredients, continues through the feed manufacturing process and does not end until the animals have consumed the feed.
Animals should be fed with sufficient feed, based on their physiological needs and according to their age, body weight, stage of lactation, production level, growth, pregnancy, activity and climate.
If the animals are on poor quality pasture, additional forage or any kind of supplementation may be required to meet the animals' needs.
Adjust stocking rates and/or supplementary feeding to ensure adequate water, feed and fodder supply.
The grazing of pastures, croplands, ponds or other water bodies should be managed in a way that minimizes the contamination of livestock by biological and chemical food safety hazards.
Protect animals from access to toxic plants. Do not feed animals moulded feeds.
Animals should have free access to a clean fresh water supply. Regularly clean water troughs or drinkers and inspect them to ensure they are fully functional. The water supply should be adequate to meet peak animal requirements that is, drinkers should fill sufficiently quickly to avoid any animals in a group remaining thirsty. All reasonable steps should be taken to minimize the risks of the water supply freezing or overheating, as appropriate.
Design and construct buildings to be free of obstruction and hazards. Provide competent animal husbandry skills and appropriate training.
Protect animals from adverse weather conditions and the consequences thereof. Provide non-slippery floors.
Ensure animals are free from pain, injury and disease.
Have an effective animal health management programme in place and inspect animals regularly.
Provide competent animal husbandry skills and appropriate training.

rements and remove any unused feed from the troughs before refilling.

Clean the troughs and automatic feeders regularly.

Water supplies should be protected from unintentional contamination which includes pathogenic microorganisms, toxic chemicals such as pesticides, solvents, and nitrates.

Medicated feeds

Medicated feeds should be transported to the correct location and are fed to animals that require the medication. Where medicated feeds are used, they could produce residues in animal tissues and food products. Correct withholding periods should be followed and records kept. Feed transport vehicles and feeding equipment used to deliver and distribute medicated feed should be cleaned after use, if a different medicated feed or non-medicated feed is to be transported next.

Animals receiving medicated feeds should be identified until the withholding period has expired.

REFERENCES

- CAC/GL 62-2007.** 2007. Codex Working Principles for Risk Analysis for Food Safety for application by Governments. http://www.codexalimentarius.net/download/standards/10693/CXP_062e.pdf ;
- CAC/RCP 45-1997.** 1997. Codex Code of Practice for the Reduction of Aflatoxin B1 in Raw Materials and Supplemental Feedingstuffs for Milk-Producing Animals. http://www.codexalimentarius.net/download/standards/331/CXP_045e.pdf ;
- CAC/RCP 51-2003.** 2003. Codex Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals, including annexes on Ochratoxin A, Zeralenone, Fumonisin and Tricothecenes. http://www.codexalimentarius.net/download/standards/405/CXC_050e.pdf ;

- CODEX STAN 193-1995.** 1995. Codex General Standard for Food Contaminants and Toxins in Food. http://www.codexalimentarius.net/download/standards/17/CXS_193e.pdf ;
- FAO.** 2004. International Dairy Federation and Food Agricultural Organization of the United Nation – Guide to good dairy farming practice. www.ipfsaph.org/En/default.jsp;
- FAO.** 2007. Guidelines Good Agricultural Practices for Family Agriculture. www.ipfsaph.org/En/default.jsp;
- FIFE Trading Standards Service.** 2000. Guidance for On-farm Mixers Producing Complete Feeds for their Own Use (also available at www.tradingstandards.gov.uk/fife/feedmix.htm);
- Hintz, R. W., Koegel, R. G., Kraus, T. J., Mertens, D. R.** 1997. Mechanical Maceration of Alfalfa. *Journal of Animal Science*, 77:187–193;
- Johnston, L.J.; Hawton, J.D.,** 1991. Quality Control of On-Farm Swine Feed Manufacturing. University of Minnesota Extension. www.extension.umn.edu/distribution/livestocksystems/DI5639.html;
- Jongbloed, A. W., Lenis, N. P.**1998. Environmental Concerns About Animal Manure. *Journal of Animal Science*, 76:2641–2648;
- OIE Animal Production Food Safety Working Group.** 2006. Guide to good farming practices for animal production food safety, *Rev. Sci. Tech. Off. Int. Epiz.*, 25(2), 823-836;
- USDA.** 2007. Guidelines for the Control of Aquatic Animal Health Hazards in Aquatic Animal Feeds, March 2007 (also available at www.aphis.usda.gov/import_export/animals/oie/aquatic.shtml).

Methods of sampling and analysis

Methods of sampling and analysis

Sampling

Sampling protocols should meet scientifically recognized principles and procedures

Analysis

Laboratory methods developed and validated using scientifically recognized principles and procedures should be used.¹⁵ When selecting methods, consideration should also be given to practicability, with preference given to those methods which are reliable and applicable for routine use. Laboratories conducting routine analyses of feed and feed ingredients should ensure their analytical competency with each method used and maintain appropriate documentation.¹⁶

Source: Code of practice on good animal feeding (CAC/RCP 54–2004).



INTRODUCTION

Important factors that determine the design and implementation of a sampling programme involve shipment size, ingredient variability, laboratory accuracy, cost of the assay and value of the ingredient. Therefore, when defining the sampling procedures one should consider the purpose of sampling, the laboratory analysis through which samples will undergo and the characteristic of the ingredients and finished products.

Sampling protocols should meet scientifically recognized principles and procedures.

Laboratory methods should be developed and validated according to scientifically recognized principles.

Sampling procedures will depend on the nature of the raw material, in process or finished product lots, conveying and sampling equipment. Prior knowledge of the product data and sampling resources allows the assignment of the appropriate sampling procedures.

The use of recognized international sampling methods will ensure a standardized administrative and technical approach and will facilitate the interpretation of results of analysis related to lots or consignments of feed.

GUIDELINES ON SAMPLING

The objectives and sampling purposes to be achieved should be clear when developing the sampling procedures to be adopted. Examples of objective that should be taken into consideration are the following:

- Acceptance of consignments;
- Testing for batch release;
- Control of raw materials;
- Control of in process products;
- Finished products controls;
- Release of non-conforming products;
- Obtaining of retention sample;
- Legal disputes;
- Inter-laboratory trials;
- Validation of analytical methods;
- Validation of control measures.

Sampling should be done in a well defined area in order to avoid difficulties in the executing of procedures, reduce the risk of contamination and cross contamination, enable the proper execution of laboratory analysis and include all necessary safety and health precautions to the sampler and environment.

Personnel responsible for the sampling activities should be trained on the applicable pro-

cedures and have the necessary knowledge of products to be sampled, tools used in the sampling process, adequacy and cleanliness of the environment and sample storage container not to allow contamination or deterioration of the sample.

Sampling process and equipment

For the execution of the sampling procedures proper tools and materials need to be available to allow:

- The opening of bags, packages, barrels, drums, containers, trucks, etc;
- The re-closing of containers;
- The labeling to indicate that a sample has been removed;
- The storing, retaining and preservation of the sample;
- The labeling of the storage and retention container;
- The sampling precautions required by the chemical and microbiological methods of analysis.

All tools and auxiliary materials should be inert, and in a clean condition before and after their use. In the same manner, cleaning of the containers to be sampled is to be considered prior to sampling.

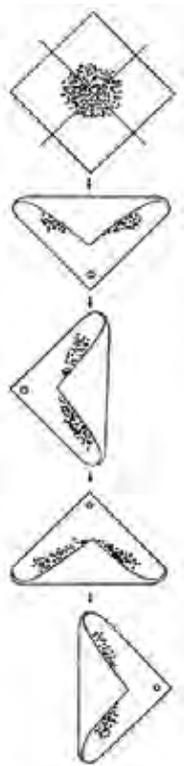
The feed industry uses a combination of tools for collecting samples. Bulk trucks and rail shipments of grains or soybean meal are frequently sampled using a hand probe. Bulk containers may be stratified and multiple samples collected if different portions of the grain are to be sampled.

Slotted grain probes may be used to collect a representative sample from grain, soybean meal or finished feed. The grain probe should be long enough to penetrate at least $\frac{3}{4}$ of the depth of the feedstuff. Official grain samples are collected using a 4.13cm diameter probe that consists of two tubes, one inside the other. The inner tube is divided into compartments that enable the individual collecting the sample to detect inconsistencies in grain quality across the profile of the carrier. This procedure is more labor intensive since the contents of the probe must be emptied onto a tarp or trough and inspected before the grain is transferred into a container. Open handled grain probes, in which the inner-tube is not divided into compartments may be used for sampling feed ingredients including grain. The probe's contents are emptied from the handle and mixing will occur, making it difficult to perform a visual inspection for load inconsistencies by depth. An open handled spiral probe

is designed such that openings on the inside tube rotate around so it opens first at the bottom and then in gradual steps to the top. This assures a fair portion of the sample is collected across the profile of the material.

However, incorrect use of this probe can result in the opposite effect if the inside tube is rotated in the opposite direction, resulting in a disproportionate amount of sample collected from the top. The probe should be inserted into the grain or feed ingredient at a 10-degree angle from the vertical, with the slots facing upward and completely closed. A 10-degree angle is used to obtain a cross section of the material, while placing the end of the probe as close to the bottom of the carrier as possible. The slots must be kept closed until the probe is inserted as far as it will go. If the probe's slots are open as it enters the grain, a disproportionate amount of material from the top will fill the probe. After the probe is fully inserted, the slots should be opened and the probe moved up and down quickly in two motions. The slots are then closed completely, the probe grasped by the outer tube and withdrawn from the grain.

FIGURE 3. Manual Quartering



Source: *Compêndio Brasileiro de Alimentação Animal*, 2005, SINDIRAÇÕES

The Pelican grain sampler is used for on-line grain sampling. The probe is a leather pouch, approximately 0.46m long, with a band of iron inserted along the edge to hold the pouch open. The pouch is attached to a long pole. Pelicans are designed to catch grain as the pouch is swung or pulled through a falling stream of grain. The Pelican grain sampler is useful for sampling grain, soybean meal or complete feed samples while a truck is unloading.

Bag shipments of base mixes, premixes and medicated feeds should be sampled with a bag probe. Tapered bag triers are used to sample closed bags of powdered and granular commodities. Double-tube bag triers are constructed of stainless steel or chrome plated brass. These triers are available in various lengths and diameters, in both close ended and open ended models and may be used to sample closed and opened bags of powdered and granular ingredients. Single tube, open ended bag triers are constructed of stainless steel tubing and are used to sample opened bags of dry, powdery commodities when removal of a core material is desired.

Fat, molasses and other liquid ingredients stored in drums or barrels can be sampled using a tube of glass or stainless steel. Bulk shipments of liquid ingredients may require a pump sampler. In all cases, the liquid should be subject to stirring prior to the withdrawal of the sample to ensure ingredient distribution.

Forage samples should contain substantial amount of material. The sampling procedure and sample preparation will vary depending on whether the material is a dry forage, silage, pasture, green chopped forage or forage in the field. Sample should be collected in twenty different locations using a core sampler. If this tool is not available, hand sampling can be used. Care should be taken to avoid leaf loss when using this latter procedure.

Collecting silage samples should be performed by removing a column of 0.15m deep by 0.30m wide on the open face. Silage should be mixed, placed in a plastic bag, tightly packed and sealed to exclude the air.

Pasture and field storage sampling is subject to variations in soil fertility and moisture content, therefore should be exercised with care. Eight to ten locations should be selected for sampling, removing approximately 0.1m square of forage at grazing height at each location. The composite of the sub samples should be mixed and material reduced to 1kg of working sample. Samples of

green pasture should be immediately dried to prevent chemical changes.

Water samples may be collected directly into a clean sample container from ponds, lakes, tanks or other sources. The container should be immersed, holding it neck down to 0.30m below the surface. Then, turned mouth up to be filled with sample. Water after extended pumping should be sampled for two to four minutes to ensure it has not been standing in pipes. When bacterial examination is performed, a sterile container should be used for the water sampling.

Finished feed can be sampled as it is transferred to the delivery vehicle if the feed is in the bulk form. In the case of cattle feed that is mixed during transport, collecting the sample from the feed bunk is an acceptable practice.

Any sign of non uniform material, which includes differences in shape, size or color of particles in crystalline, granular or powdered solid substances, moist crust on hygroscopic substances, deposits of solid material or stratification in liquid products should be detected during the sampling procedure. Portions of the material that are non-homogeneous should be sampled separately and should not make a composite as it can mask quality problems.

Sample reduction

Sample reduction may be performed by quartering the sample to a convenient amount for analysis. The mixed composite sample should be spread on clean plastic or paper to form an even layer. The paper is marked into quarters and the two opposite quarters are taken and mixed. The process is repeated until the two quarters selected give the desired sample size. The end result of this process should produce a working sample of 0.5 to 1kg.

Complete feed and feed ingredients may be partitioned into uniform sub samples using a riffler. The sample is poured into the hopper, which is divided into equal portions by two series of chutes that discharge alternately in opposite directions into separate pans.

Heavy plastic bags, zip lock bags, plastic bags or plastic containers make excellent sample containers for dry ingredients or finished feed. The container should protect the sample from light, air, moisture as required by the storage conditions.

Sampling frequency and retention

With few exceptions, all incoming ingredients should be sampled upon arrival and inspected

for identity, physical purity and compared with a reference sample and standard specifications. The sampling procedure should include inspection of the carriers paperwork to ensure the correct material is being delivered and documentation of receipt of the ingredients, which may include a certificate of analysis. When receiving bulk materials, the shipping documents should be inspected for identification of mill, supplier and the name of the individual hauling the cargo. A receiving report that documents receipt of raw materials will augment a sampling programme. This report should include the date, raw material identification, supplier name, carrier name, bill of lading, purchase order, invoice number, time of receiving, weight, bin number where the ingredient was placed, number of the supplier certificate of analysis, sensory and physical properties verified on the receipt of goods and signature of the person responsible for the receiving inspection.

Samples should be retained until the complete feed has been consumed by the animal or as long as liability exists. Commercial feed mills should collect and retain a sample of complete feed for each run of a given product. Medicated feed sampling and evaluation must conform to regulatory requirements.

Sampling plans for raw materials and finished products

International methods of sampling should be used to ensure that valid sampling procedures are applied when feed is being tested for compliance to a particular standard or objective. The Codex General Guidelines on Sampling – CAC/GL 50-2004 (FAO/WHO, 2004) provides information to facilitate the implementation of these goals (Box 21).

Numerous sampling plans are available and none can ensure that every item in a lot conforms to the studied parameters. They are nevertheless useful for guaranteeing an acceptable quality level agreed by the parties for the specified controls.

A sampling procedure should stipulate the conditions based on which a lot should be inspected and classified. These conditions include the inspection procedures (normal, tightened or reduced inspection), switching procedures (normal to tightened, tightened to normal and normal to reduced) inspection level (I, II and III, S-1, S-2, S-3, S-4), Acceptance Quality Levels (AQLs), number of items to be randomly selected from the lot and that will comprise the sample, acceptance and rejection numbers.

BOX 21**Recommendations for the selection of sampling plans**

The following enumerates the essential points that users should address for the selection of appropriate sampling plans

1. Existence (or not) of international reference documents on sampling of the considered products.
2. Nature of the control
 - Characteristic applicable to each individual item of the lot;
 - Characteristic applicable to the whole lot (statistical approach).
3. Nature of characteristic to control
 - Qualitative characteristic (characteristic measured on a pass/failed or similar basis, i.e. presence of pathogen micro-organism);
 - Quantitative characteristic (characteristic measured on a continuous scale, for example a compositional characteristic).
4. Choice of the quality level (AQL or LQ)
 - In accordance with the principles laid down in the Codex Manual of Procedures and with the type of risk: critical/non-critical non-conformities.
5. Nature of the lot
 - Bulk or pre-packed commodities;
 - Size, homogeneity and distribution concerning the characteristic;
 - control.
6. Composition of the sample
 - Sample composed of a single sampling unit;
 - Sample composed of more than one unit (including the composite sample).
7. Choice of the type of sampling plan
 - Acceptance sampling plans for statistical quality control;
 - For the control of the average of the characteristic;
 - For the control of per cent non-conforming items in the lot
 - Definition and enumeration of non-conforming items in the sample (attribute plans)
 - Comparison of the mean value of the items forming the sample with regards to an algebraic formula (variable plans)

Source: The Codex General Guidelines on Sampling – CAC/GL 50-2004 (FAO/WHO, 2004)

A number of ISO standards are available in the case of control situations not dealt with by The Codex General Guidelines on Sampling – CAC/GL 50-2004 (FAO/WHO, 2004). The standards provided are:

ISO 2854:1976: Statistical interpretation of data

- Techniques of estimation and tests relating to means and variances

ISO 2859-1:1999: Sampling procedures for inspection by attributes

- *Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 2859-2:1985: Sampling procedures for inspection by attributes

- *Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*

ISO 2859-3:2005: Sampling procedures for inspection by attributes

- *Part 3: Skip-lot sampling procedures*

ISO 2859-4:2002: Sampling procedures for inspection by attributes

- *Part 4: Procedures for assessment of declared quality levels*

ISO 2859-5:2005: Sampling procedures for inspection by attributes

- *Part 5: System of sequential sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 2859-10:2006: Sampling procedures for inspection by attributes

- *Part 10: Introduction to the ISO 2859 series of standards for sampling for inspection by attributes*

ISO 3494:1976: Statistical interpretation of data

- Power of tests relating to means and variances

ISO 3951-1:2005: Sampling procedures for inspection by variables

- *Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ISO 3951-2:2006: Sampling procedures for inspection by variables

- *Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics*

ISO 3951-3:2007: Sampling procedures for inspection by variables

- *Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO/WD 3951-4: Sampling procedures for inspection by variables

- *Part 4: Procedures for assessment of declared quality levels*

ISO 3951-5:2006: Sampling procedures for inspection by variables

- *Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation)*

ISO 5725-1:1994: Accuracy (trueness and precision) of measurement methods and results

- *Part 1: General principles and definitions*

ISO 7002:1986: Agricultural food products

- Layout for a standard method of sampling from a lot

ISO 8422:2006: Sequential sampling plans for inspection by attributes

ISO 8423:1991: Sequential sampling plans for inspection by variables for percent nonconforming (known standard deviation)

ISO/TR 8550-1:2007: Guidance on the selection and usage of acceptance sampling systems for inspection of discrete items in lots

- *Part 1: Acceptance sampling*

ISO/TR 8550-2:2007: Guidance on the selection and usage of acceptance sampling systems for inspection of discrete items in lots

- *Part 2: Sampling by attributes*

ISO/TR 8550-3:2007: Guidance on the selection and usage of acceptance sampling systems for inspection of discrete items in lots

- *Part 3: Sampling by variables*

ISO 10725:2000: Acceptance sampling plans and procedures for the inspection of bulk materials

ISO 11648-1:2003: Statistical aspects of sampling from bulk materials

- *Part 1: General principles*

ISO 11648-2:2001: Statistical aspects of sampling from bulk materials

- *Part 2: Sampling of particulate materials*

ISO 14560:2004: Acceptance sampling procedures by attributes

- Specified quality levels in nonconforming items per million

BOX 22

Selection of methods

- Methods that have been applied to the matrix of interest should be preferred over methods that have been applied to other matrices or methods that apparently have not been tested on authentic samples.
- Methods documented by published inter-laboratory validation data should be selected over those that are not.
- Methods that have been tested and validated over the concentration range of interest should be chosen over methods tested at other levels. Methods that perform quite well at one level may be totally inadequate to a lower level.
- Methods that are widely used should be chosen over methods not in wide use.
- Methods that are simple, low cost, or rapid should be chosen over methods that are complex, more costly, or slower.
- Preference should be given to methods for which reliability has been established in collaborative studies in several laboratories.
- Preference should be given to methods that have been recommended or adopted by relevant international organizations.
- Preference should be given to methods of analysis that are uniformly applicable to various substrates over those that apply to individual substrates.

Source: Garfield, F.M. Quality Assurance Principles for Analytical Laboratories, 1994.

ANALYSIS

Methods of analysis

Knowledge of feed composition is of utmost importance for determining the nutritional requirements of livestock, to produce balanced compound feeds, to control production process and to manage the final quality of products.

Accuracy, precision, specificity, sensitivity, dependability and practicality should be considered when choosing the most appropriate method. Furthermore, the selection of appropriate methods must take into account matters other than the listed attributes. Depending on their purpose and administrative propriety, methods can be classified in (Garfield, 1994):

- Official methods
- Reference methods
- Screening or rapid methods
- Routine methods
- Automated methods
- Modified methods

Official methods are those required by law or regulation and used in regulatory analyses by a government agency or an industry regulated by a government agency.

Reference methods are developed by organizations or groups that use collaborative studies to validate them.

Screening or rapid methods are used as expedient means to determine, for a large number of samples, whether any of them should be subjected to additional testing by a more accurate method.

Routine methods are used on routine analysis and can be official or standard or even modified to be more convenient when a large number of samples need to be processed.

Automated methods use automated equipment and may be official or screening methods.

Modified methods are usually official or standards methods that were modified for simplification, to remove interfering substances or to be applicable to different types of samples.

Laboratory quality assurance program

One of the main goals of the laboratory is the production of high quality analytical data obtained through analytical measurements that are accurate, reliable and adequate for the intended purpose. This can be achieved with the implementation of a well established quality assurance program ensuring analytical competency and maintenance of proper documentation.

Quality assurance programmes will require the implementation of elements such as: management quality policy statement, program objectives, control of samples and records, equipment maintenance, methods evaluation, measurement principles, training, methods selection, intra- and

inter-laboratory testing, reference standards, field and lab sampling, statistical considerations, audits, corrective actions, program revision and update.

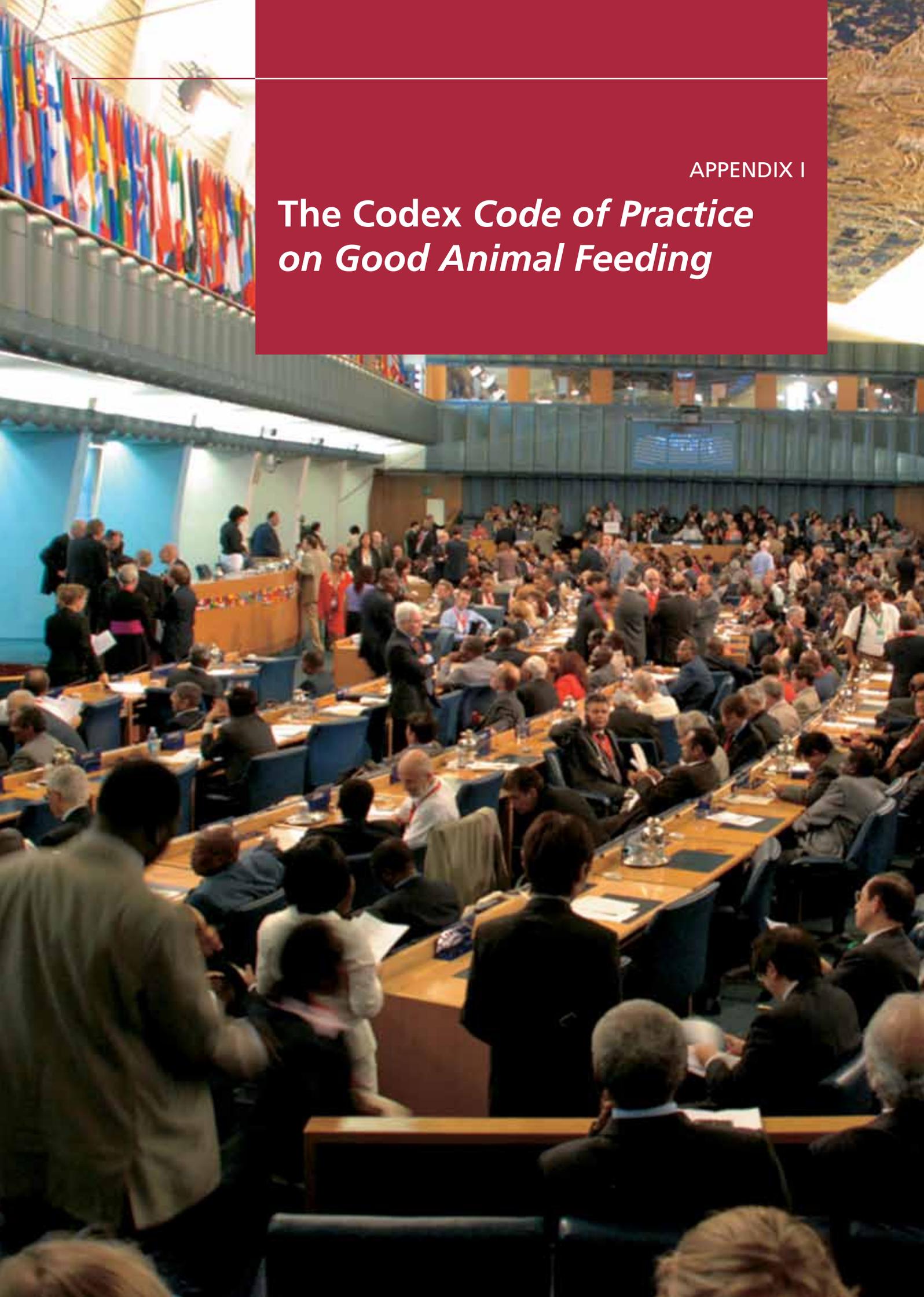
Laboratories operating under a recognized quality standard should seek independent approval of their quality assurance arrangements preferably by accreditation which will allow them to demonstrate competency and reliability. Quality standards are available such as ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Equipment and applied by the accreditation organization on the evaluation of the compliance of the laboratory.

References

- FAMI-QS. 2007. EU Guide to Good Practice for Feed Additives and Premixtures Operators, Version 2, 17 January 2007;
- FAO. 2004. Assessing Quality and Safety of Animal Feeds;
- FAO/WHO. 2004. The Codex General Guidelines on Sampling – CAC/GL 50-2004;
- FAO/WHO. 2006. Guidelines for Food Import Control Systems;
- Garfield, F.M. 1994. Quality Assurance Principles for Analytical Laboratories;
- ISO/IEC 17025:2005. General Requirements for the Competence of Testing and Calibration Equipment;
- SINDIRAÇÕES. 2005. Compêndio Brasileiro de Alimentação Animal. Guia de Métodos Analíticos, pages 5 - 9.

TABLE 4. **RECOMMENDATIONS FOR SAMPLING AND ANALYSING**

When defining the sampling procedures one should consider the purpose of sampling, the laboratory analysis through which samples will undergo and the characteristic of the ingredients and finished products.
The objectives and sampling purposes to be achieved should be clear when developing the sampling procedures to be adopted.
Sampling should be done in a well defined area in order to avoid difficulties in the executing of procedures, reduce the risk of contamination and cross contamination, enable the proper execution of laboratory analysis and include all necessary safety and health precautions to the sampler and environment.
Personnel responsible for the sampling activities should be trained on the applicable procedures.
All tools and auxiliary materials should be inert, and in a clean condition before and after their use.
Portions of the material that are non homogeneous should be sampled separately and should not make a composite as it can mask quality problems.
With few exceptions, all incoming ingredients should be sampled upon arrival and inspected for identity, physical purity and compared with a reference sample and standard specifications.
International methods of sampling should be used to ensure that valid sampling procedures are applied when feed is being tested for compliance to a particular standard or objective.
A sampling procedure should stipulate the conditions based on which a lot should be inspected and classified.
Accuracy, precision, specificity, sensitivity, dependability and practicality should be considered when choosing the most appropriate method.
Laboratories operating under a recognized quality standard should seek independent approval of their quality assurance arrangements preferably by accreditation which will allow them to demonstrate competency and reliability.

A large, multi-level conference room filled with people seated at long wooden tables. The room is brightly lit, and the walls are lined with numerous national flags. A large screen is visible in the background, displaying a presentation. The overall atmosphere is professional and busy.

APPENDIX I

***The Codex Code of Practice
on Good Animal Feeding***



CODE OF PRACTICE ON GOOD ANIMAL FEEDING

CAC/RCP 54-2004

SECTION 1. INTRODUCTION

1. This Code is to establish a feed safety system for food producing animals which covers the whole food chain, taking into account relevant aspects of animal health and the environment in order to minimize risks to consumers' health. This Code applies in addition to the principles of food hygiene already established by the Codex Alimentarius Commission¹, taking into account the special aspects of animal feeding.

SECTION 2. PURPOSE AND SCOPE

2. The objective of this Code is to help ensure the safety of food for human consumption through adherence to good animal feeding practice at the farm level and good manufacturing practices (GMPs) during the procurement, handling, storage, processing and distribution of animal feed and feed ingredients for food producing animals.
3. This Code of Practice applies to the production and use of all materials destined for animal feed and feed ingredients at all levels whether produced industrially or on farm. It also includes grazing or free-range feeding, forage crop production and aquaculture.
4. Those issues of animal welfare other than food safety related animal health are not covered. Environmental contaminants should be considered where the level of such substances in the feed and feed ingredients could present a risk to consumers' health from the consumption of foods of animal origin.
5. While recognizing that, in its totality, a feed safety system would address animal health and environmental issues, in addition to consumers' health, this Code of Practice, in fulfilling the Codex mandate of consumer protection, only addresses food safety. Notwithstanding this, best efforts have been made to ensure that the recommendations and practices in this Code of Practice will not be detrimental to the more general animal health and environmental aspects of animal feeding.

SECTION 3. DEFINITIONS

6. For the purpose of this Code:

Feed (Feedingstuff): Any single or multiple materials, whether processed, semi-processed or raw, which is intended to be fed directly to food producing animals.

Feed Ingredient: A component part or constituent of any combination or mixture making up a feed, whether or not it has a nutritional value in the animal's diet, including feed additives. Ingredients are of plant, animal or aquatic origin, or other organic or inorganic substances.

Feed Additive²: Any intentionally added ingredient not normally consumed as feed by itself, whether or not it has nutritional value, which affects the characteristics of feed or animal products.

Medicated Feed: Any feed which contains veterinary drugs as defined in the Codex Alimentarius Commission Procedural Manual.

Undesirable Substances: Contaminants and other substances which are present in and/or on feed and feed ingredients and which constitute a risk to consumers' health, including food safety related animal health issues.

¹ Recommended International Code of Practice – General Principles of Food Hygiene (CAC/RCP 1-1969).

² Micro-organisms, enzymes, acidity regulators, trace elements, vitamins and other products fall within the scope of this definition depending on the purpose of use and method of administration.

SECTION 4. GENERAL PRINCIPLES AND REQUIREMENTS

7. Feed and feed ingredients should be obtained and maintained in a stable condition so as to protect feed and feed ingredients from contamination by pests, or by chemical, physical or microbiological contaminants or other objectionable substances during production, handling, storage and transport. Feed should be in good condition and meet generally accepted quality standards. Where appropriate, good agricultural practices, good manufacturing practices (GMPs) and, where applicable, Hazard Analysis and Critical Control Point (HACCP) principles³ should be followed to control hazards that may occur in food. Potential sources of contamination from the environment should be considered.

8. Parties that produce feed or feed ingredients, those that rear animals for use as food and those that produce such animal products need to collaborate to identify potential hazards and their levels of risk to consumers' health. Such collaboration will enable the development and maintenance of appropriate risk management options and safe feeding practices.

4.1 Feed ingredients

9. Feed ingredients should be obtained from safe sources and be subject to a risk analysis where the ingredients are derived from processes or technologies not hitherto evaluated from a food safety point of view. The procedure used should be consistent with the *Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius*.⁴ Manufacturers of feed additives in particular should provide clear information to the user to permit correct and safe use. Monitoring of feed ingredients should include inspection and sampling and analysis for undesirable substances using risk-based protocols. Feed ingredients should meet acceptable and, if applicable, statutory standards for levels of pathogens, mycotoxins, pesticides and undesirable substances that may give rise to consumers' health hazards.

4.2 Labelling

10. Labelling should be clear and informative as to how the user should handle, store and use feed and feed ingredients. Labelling should be consistent with any statutory requirements and should describe the feed and provide instructions for use. Labelling or the accompanying documents should contain, where appropriate:

- information about the species or category of animals for which the feed is intended;
- the purpose for which the feed is intended;
- a list of feed ingredients, including appropriate reference to additives, in descending order of proportion;
- contact information of manufacturer or registrant;
- registration number if available;
- directions and precautions for use;
- lot identification;
- manufacturing date; and
- "use before" or expiry date.

11. This sub-section does not apply to labelling of feed and feed ingredients derived from modern biotechnology.⁵

4.3 Traceability/product tracing and record keeping of feed and feed ingredients

12. Traceability/product tracing of feed and feed ingredients, including additives, should be enabled by proper record keeping for timely and effective withdrawal or recall of products if known or probable adverse effects on consumers' health are identified. Records should be maintained and readily available regarding the production, distribution and use of feed and feed ingredients to facilitate the prompt trace-back of feed and feed ingredients to the immediate previous source and trace-forward to the next subsequent recipients if known or probable adverse effects on consumers' health are identified.⁶

4.3.1 Special conditions applicable to emergency situations

13. Operators should, as soon as reasonable, inform the competent authorities in the country if they consider that a feed or feed ingredient does not satisfy the feed safety requirements established in this Code. The information should be as detailed as possible and should at least contain a description of the nature of the problem, a description of the feed or feed ingredients, the species for which it is intended, the lot identifier, the

³ Hazard Analysis and Critical Control Point, as defined in the Annex to the *Recommended International Code of Practice on General Principles of Food Hygiene* (CAC/RCP 1-1969).

⁴ Procedural Manual of the Codex Alimentarius Commission.

⁵ Whether and how to label animal feed and feed ingredients derived from modern biotechnology awaits developments on food labelling, being considered by the Codex Committee on Food Labelling.

⁶ Development of detailed measures on traceability/product tracing should take into the account: *Principles for Traceability/Product Tracing as a tool within a Food Inspection and Certification System* (CAC-GL 60-2006).

name of the manufacturer and the place of origin. The competent authorities and operators should immediately take effective measures to ensure that those feed or feed ingredients do not pose any danger to consumers' health.

14. As soon as it becomes likely that a particular feed or feed ingredient is to be traded internationally and may pose a danger to consumers' health, the competent authorities of the exporting countries should notify, at least, the competent authorities of the relevant importing countries. The notification should be as detailed as possible and should at least contain the particulars indicated in the previous paragraph.

4.4 Inspection and control procedures

15. Feed and feed ingredients manufacturers and other relevant parts of industry should practice self-regulation/auto-control to secure compliance with required standards for production, storage and transport. It will also be necessary for risk-based official regulatory programmes to be established to check that feed and feed ingredients are produced, distributed and used in such a way that foods of animal origin for human consumption are both safe and suitable. Inspection and control procedures should be used to verify that feed and feed ingredients meet requirements in order to protect consumers against food-borne hazards.⁷ Inspection systems should be designed and operated on the basis of objective risk assessment appropriate to the circumstances.⁸ Preferably the risk assessment methodology employed should be consistent with internationally accepted approaches. Risk assessment should be based on current available scientific evidence.

16. Monitoring of feed and feed ingredients, whether by industry or official inspection bodies, should include inspection and sampling and analysis to detect unacceptable levels of undesirable substances.

4.5 Health hazards associated with animal feed

17. All feed and feed ingredients should meet minimum safety standards. It is essential that levels of undesirable substances are sufficiently low in feed and feed ingredients that their concentration in food for human consumption is consistently below the level of concern. Codex Maximum Residue Limits and Extraneous Maximum Residue Levels set for feed should be applied. Maximum residue limits set for food, such as those established by the Codex Alimentarius Commission, may be useful in determining minimum safety standards for feed.

4.5.1 Feed additives and veterinary drugs used in medicated feed

18. Feed additives and veterinary drugs used in medicated feed should be assessed for safety and used under stated conditions of use as pre-approved by the competent authorities.
19. Veterinary drugs used in medicated feed should comply with the provisions of the *Codex Recommended International Code of Practice for the Control of the Use of Veterinary Drugs*.⁹
20. Borderlines between feed additives and veterinary drugs used in medicated feed may be set to avoid misuse.
21. Feed additives should be received, handled and stored to maintain their integrity and to minimise misuse or unsafe contamination. Feed containing them should be used in strict accordance with clearly defined instructions for use.

22. Antibiotics should not be used in feed for growth promoting purposes in the absence of a public health safety assessment.¹⁰

4.5.2 Feed and feed ingredients

23. Feed and feed ingredients should only be produced, marketed, stored and used if they are safe and suitable, and, when used as intended, should not represent in any way an unacceptable risk to consumers' health. In particular, feed and feed ingredients contaminated with unacceptable levels of undesirable substances should be clearly identified as unsuitable for animal feed and not be marketed or used.

24. Feed and feed ingredients should not be presented or marketed in a manner liable to mislead the user.

4.5.3 Undesirable substances

25. The presence in feed and feed ingredients of undesirable substances such as industrial and environmental contaminants, pesticides, radionuclides, persistent organic pollutants, pathogenic agents and toxins such as mycotoxins should be identified, controlled and minimised. Animal products that could be a source of the

⁷ *Principles for Food Import and Export Inspection and Certification* (CAC/GL 20-1995).

⁸ *Guidelines for the Design, Operation, Assessment and Accreditation of Food Import and Export Inspection and Certification Systems* (CAC/GL 26-1997).

⁹ CAC/RCP 38-1993.

¹⁰ *WHO Global Principles for the Containment of Antimicrobial Resistance in Animals Intended for Food*, June 2000, Geneva, Switzerland.

Bovine Spongiform Encephalopathy (BSE) agent¹¹ should not be used for feeding directly to, or for feed manufacturing for, ruminants. Control measures applied to reduce unacceptable level of undesirable substances should be assessed in terms of their impact on food safety.

26. The risks of each undesirable substance to consumers' health should be assessed and such assessment may lead to the setting of maximum limits for feed and feed ingredients or the prohibition of certain materials from animal feeding.

SECTION 5. PRODUCTION, PROCESSING, STORAGE, TRANSPORT AND DISTRIBUTION OF FEED AND FEED INGREDIENTS

27. The production, processing, storage, transport and distribution of safe and suitable feed and feed ingredients is the responsibility of all participants in the feed chain, including farmers, feed ingredient manufacturers, feed compounders, truckers, etc. Each participant in the feed chain is responsible for all activities that are under their direct control, including compliance with any applicable statutory requirements.
28. Feed and feed ingredients should not be produced, processed, stored, transported or distributed in facilities or using equipment where incompatible operations may affect their safety and lead to adverse effects on consumers' health. Due to the unique characteristics of aquaculture, the application of these general principles must consider the differences between aquaculture and terrestrial-based production.
29. Where appropriate, operators should follow GMPs and, where applicable, HACCP principles to control hazards that may affect food safety. The aim is to ensure feed safety and in particular to prevent contamination of animal feed and food of animal origin as far as this is reasonably achievable, recognising that total elimination of hazards is often not possible.
30. The effective implementation of GMPs and, where applicable, HACCP-based approaches should ensure, in particular, that the following areas are addressed.

5.1 Premises

31. Buildings and equipment used to process feed and feed ingredients should be constructed in a manner that permits ease of operation, maintenance and cleaning and minimises feed contamination. Process flow within the manufacturing facility should also be designed to minimise feed contamination.
32. Water used in feed manufacture should meet hygienic standards and be of suitable quality for animals. Tanks, pipes and other equipment used to store and convey water should be of appropriate materials which do not produce unsafe levels of contamination.
33. Sewage, waste and rain water should be disposed of in a manner which avoids contamination of equipment, feed and feed ingredients.

5.2 Receiving, storage and transportation

34. Chemical fertilizers, pesticides and other materials not intended for use in feed and feed ingredients should be stored separately from feed and feed ingredients to avoid the potential for manufacturing errors and contamination of feed and feed ingredients.
35. Processed feed and feed ingredients should be stored separately from unprocessed feed ingredients and appropriate packaging materials should be used. Feed and feed ingredients should be received, stored and transported in such a way so as to minimize the potential for any cross-contamination to occur at a level likely to have a negative impact on food safety.
36. The presence of undesirable substances in feed and feed ingredients should be monitored and controlled.
37. Feed and feed ingredients should be delivered and used as soon as possible. All feed and feed ingredients should be stored and transported in a manner which minimizes deterioration and contamination and enables the correct feed to be sent to the right animal group.

¹¹ Joint WHO/FAO/OIE Technical Consultation on BSE: public health, animal health and trade, OIE Headquarters, Paris, 11–14 June 2001.

38. Care should be taken to minimize deterioration and spoilage at all stages of handling, storage and transport of feed and feed ingredients. Special precautions should be taken to limit fungal and bacterial growth in moist and semi-moist feed. Condensation should be minimized in feed and feed ingredient manufacturing and processing facilities. Dry feed and feed ingredients should be kept dry in order to limit fungal and bacterial growth.

39. Waste feed and feed ingredients and other material containing unsafe levels of undesirable substances or any other hazards should not be used as feed, but, should be disposed of in an appropriate manner including compliance with any applicable statutory requirements.

5.3 Personnel training

40. All personnel involved in the manufacture, storage and handling of feed and feed ingredients should be adequately trained and aware of their role and responsibility in protecting food safety.

5.4 Sanitation and pest control

41. Feed and feed ingredients, processing plants, storage facilities and their immediate surroundings should be kept clean and effective pest control programmes should be implemented.

42. Containers and equipment used for manufacturing, processing, transport, storage, conveying, handling and weighing should be kept clean. Cleaning programmes should be effective and minimise residues of detergents and disinfectants.

43. Machinery coming into contact with dry feed or feed ingredients should be dried following any wet cleaning process.

44. Special precautions should be taken when cleaning machinery used for moist and semi-moist feed and feed ingredients to avoid fungal and bacterial growth.

5.5 Equipment performance and maintenance

45. All scales and metering devices used in the manufacture of feed and feed ingredients should be appropriate for the range of weights and volumes to be measured, and be tested regularly for accuracy.

46. All mixers used in the manufacture of feed and feed ingredients should be appropriate for the range of weights or volumes being mixed and be capable of manufacturing suitable homogeneous mixtures and homogeneous dilutions, and be tested regularly to verify their performance.

47. All other equipment used in the manufacture of feed and feed ingredients should be appropriate for the range of weights or volumes being processed, and be monitored regularly.

5.6 Manufacturing controls

48. Manufacturing procedures should be used to avoid cross-contamination (for example flushing, sequencing and physical clean-out) between batches of feed and feed ingredients containing restricted or otherwise potentially harmful materials (such as certain animal by-product meals, veterinary drugs). These procedures should also be used to minimise cross-contamination between medicated and non-medicated feed and other incompatible feed. In cases where the food safety risk associated with cross-contamination is high and the use of proper flushing and cleaning methods is deemed insufficient, consideration should be given to the use of completely separate production lines, transfer, storage and delivery equipment.

49. Pathogen control procedures, such as heat treatment or the addition of authorised chemicals, should be used where appropriate, and monitored at the applicable steps in the manufacturing process.

5.7 Recalls

50. Records and other information should be maintained as indicated in sub-section 4.3 of this Code to include the identity and distribution of feed and feed ingredients so that any feed or feed ingredient considered to pose a threat to consumers' health can be rapidly removed from the market and that animals exposed to the relevant feed can be identified.

SECTION 6. ON-FARM PRODUCTION AND USE OF FEED AND FEED INGREDIENTS

51. This section provides guidance on the cultivation, manufacture, management and use of feed and feed ingredients on farms and in aquaculture.

52. This section should be used in conjunction with the applicable requirements of Sections 4 and 5 of this Code.
53. To help ensure the safety of food used for human consumption, good agricultural practices¹² should be applied during all stages of on-farm production of pastures, cereal grain and forage crops used as feed or feed ingredients for food producing animals. For aquaculture the same principles should apply, where applicable. Three types of contamination represent hazards at most stages of on-farm production of feed and feed ingredients, namely:
- Biological, such as bacteria, fungi and other microbial pathogens;
 - Chemical, such as residues of medication, pesticides, fertilizer or other agricultural substances; and
 - Physical, such as broken needles, machinery and other foreign material.

6.1 Agricultural production of feed

54. Adherence to good agricultural practices is encouraged in the production of natural, improved and cultivated pastures and in the production of forage and cereal grain crops used as feed or feed ingredients for food producing animals. Following good agricultural practice standards will minimize the risk of biological, chemical and physical contaminants entering the food chain. If crop residuals and stubbles are grazed after harvest, or otherwise enter the food chain, they should also be considered as livestock feed. Most livestock will consume a portion of their bedding. Crops that produce bedding material or bedding materials such as straw or wood shavings should also be managed in the same manner as animal feed ingredients. Good pasture management practices, such as rotational grazing and dispersion of manure droppings, should be used to reduce cross-contamination between groups of animals.

6.1.1 Site selection

55. Land used for production of animal feed and feed ingredients should not be located in close proximity to industrial operations where industrial pollutants from air, ground water or runoff from adjacent land would be expected to result in the production of foods of animal origin that may present a food safety risk. Contaminants present in runoff from adjacent land and irrigation water should be below levels that present a food safety risk.

6.1.2 Fertilizers

56. Where manure fertilization of crops or pastures is practised, an appropriate handling and storage system should be in place and maintained to minimize environmental contamination, which could negatively impact on the safety of foods of animal origin. There should be adequate time between applying the manure and grazing or forage harvesting (silage and hay making) to allow the manure to decompose and to minimize contamination.

57. Manure, compost and other plant nutrients should be properly used and applied to minimize biological, chemical and physical contamination of foods of animal origin which could adversely affect food safety.

58. Chemical fertilizers should be handled, stored and applied in a manner such that they do not have a negative impact on the safety of foods of animal origin.

6.1.3 Pesticides and other agricultural chemicals

59. Pesticides and other agricultural chemicals should be obtained from safe sources. Where a regulatory system is in place, any chemical used must comply with the requirements of that system.

60. Pesticides should be stored according to the manufacturer's instructions and used in accordance with Good Agricultural Practice in the Use of Pesticides (GAP)¹³. It is important that farmers carefully follow the manufacturer's instructions for use for all agricultural chemicals.

61. Pesticides and other agricultural chemicals should be disposed of responsibly in a manner that will not lead to contamination of any body of water, soil, feed or feed ingredients that may lead to the contamination of foods of animal origin which could adversely affect food safety.

6.2 Manufacturing of feed on-farm

6.2.1 Feed ingredients

62. On-farm feed manufacturers should follow the applicable guidelines established in sub-section 4.1 of this Code when sourcing feed ingredients off the farm.

63. Feed ingredients produced on the farm should meet the requirements established for feed ingredients sourced off the farm. For example, seed treated for planting should not be fed.

6.2.2 Mixing

¹² Guidelines on this definition are under development by FAO.

¹³ See Definitions for the Purposes of the Codex Alimentarius (Procedural Manual of the Codex Alimentarius Commission).

64. On-farm feed manufacturers should follow the applicable guidelines established in Section 5 of this Code. Particular attention should be given to sub-section 5.6 of this Code.

65. In particular, feed should be mixed in a manner that will minimize the potential for cross-contamination between feed or feed ingredients that may have an effect on the safety or withholding period for the feed or feed ingredients.

6.2.3 Monitoring records

66. Appropriate records of feed manufacturing procedures followed by on-farm feed manufacturers should be maintained to assist in the investigations of possible feed-related contamination or disease events.

67. Records should be kept of incoming feed ingredients, date of receipt and batches of feed produced in addition to other applicable records set out in sub-section 4.3 of the Code.

6.3 Good animal feeding practice

68. Good animal feeding practices include those practices that help to ensure the proper use of feed and feed ingredients on-farm while minimising biological, chemical and physical risks to consumers of foods of animal origin.

6.3.1 Water

69. Water for drinking or for aquaculture should be of appropriate quality for the animals being produced. Where there is reason to be concerned about contamination of animals from the water, measures should be taken to evaluate and minimise the hazards.

6.3.2 Pasture grazing

70. The grazing of pastures and crop lands should be managed in a way that minimises the avoidable contamination of foods of animal origin by biological, chemical and physical food safety hazards.

71. Where appropriate, an adequate period should be observed before allowing livestock to graze on pasture, crops and crop residuals and between grazing rotations to minimise biological cross-contamination from manure.

72. Where agricultural chemicals are used, operators should ensure that the required withholding periods are observed.

6.3.3 Feeding

73. It is important that the correct feed is fed to the right animal group and that the directions for use are followed. Contamination should be minimised during feeding. Information should be available of what is fed to animals and when, to ensure that food safety risks are managed.

74. Animals receiving medicated feed should be identified and managed appropriately until the correct withholding period (if any) has been reached and records of these procedures must be maintained. Procedures to ensure that medicated feed are transported to the correct location and are fed to animals that require the medication should be followed. Feed transport vehicles and feeding equipment used to deliver and distribute medicated feed should be cleaned after use, if a different medicated feed or non-medicated feed or feed ingredient is to be transported next.

6.4 Stable feeding and lot/intensive feeding units

75. The animal production unit should be located in an area that does not result in the production of food of animal origin that poses a risk to food safety. Care should be taken to avoid animal access to contaminated land, and to facilities with potential sources of toxicity.

6.4.1 Hygiene

76. The animal production unit should be designed so that it can be adequately cleaned. The animal production unit and feeding equipment should be thoroughly cleaned regularly to prevent potential hazards to food safety. Chemicals used should be appropriate for cleaning and sanitising feed manufacturing equipment and should be used according to instructions. These products should be properly labelled and stored away from feed manufacturing, feed storage and feeding areas.

77. A pest control system should be put in place to control the access of pests to the animal production unit to minimise potential hazards to food safety.

78. Operators and employees working in the animal production unit should observe appropriate hygiene requirements to minimise potential hazards to food safety from feed.

6.5 Aquaculture¹⁴

79. Aquaculture includes a wide range of species of finfish, molluscs, crustaceans, cephalopods, etc. The complexity of aquaculture is reflected in the wide range of culturing methods ranging from huge cages in open seas to culturing in small freshwater ponds. The diversity is further reflected by the range of stages from larvae to full grown size, requiring different feed as well as different culture methods. Nutritional approaches range from feeding only naturally occurring nutrients in the water to the use of sophisticated equipment and scientifically formulated compound feed.
80. To ensure food safety, necessary precautions should be taken regarding culturing methods, culturing sites, technologies, materials and feed used to minimize contamination in order to reduce food hazards.

SECTION 7. METHODS OF SAMPLING AND ANALYSIS

7.1. Sampling

81. Sampling protocols should meet scientifically recognized principles and procedures.

7.2 Analysis

82. Laboratory methods developed and validated using scientifically recognized principles and procedures should be used.¹⁵ When selecting methods, consideration should also be given to practicability, with preference given to those methods which are reliable and applicable for routine use. Laboratories conducting routine analyses of feed and feed ingredients should ensure their analytical competency with each method used and maintain appropriate documentation.¹⁶

¹⁴ Aquaculture producers should refer to relevant sections of the Code of Practice for Fish and Fishery Products for additional information (CAC/RCP 52-2003).

¹⁵ *General Criteria for the Selection of Methods of Analysis Using the Criteria Approach* (Procedural Manual of the Codex Alimentarius Commission).

¹⁶ For example, through quality assurance systems such as ISO 17025.

APPENDIX II

National codes of practice





RELEVANT NATIONAL CODES OF PRACTICE

Europe

- European Union** - European Feed Manufacturers Federation (FEFAC): Various Codes of Practice including the European Feed Manufacturers' Guide - EFMC and the International Feed Safety Alliance (IFSA): IFSA Feed Ingredients Standard (IFIS) (www.fefac.org/code.aspx)
- European Union** - EU Feed Additives and Premixtures Association (FEFANA) European Code of Practice for the Feed Additive and Premixture Operators (www.fami-qs.org/documents.htm)
- Portugal** - (IACA) Guia de Boas Práticas para os Industriais de Pré-Misturas e de alimentos compostos para animais destinados à produção de géneros alimentícios (www.iaca.pt/index.jsp?page=boas_praticas)
- The Netherlands** - (Productschap Diervoeder): GMP+ - certificatieschema diervoedersector 2006 - Productie & bewerking diervoeders voor lanbouwhuisdieren – GMP+ standaard B1 (EN) (www.pdv.nl/Imbinaries/gmp_b01-nl.pdf)
- Belgium** - (OVOCOM): Code GMP général pour le secteur de l'alimentation animale (NL) (www.ovocom.be/GMP2008.aspx?lang=fr)
- Luxembourg** - (OVOCOM): Code GMP general pour le secteur de l'alimentation animale (www.ovocom.be/GMP2008.aspx?lang=fr)
- Italy** - (ASSALZOO): Codex-Assalzo di buone pratiche per la produzione e la commercializzazione di alimenti composti per animali da reddito (www.assalzo.it/default.asp?Sez=DOCU&SSez=COD)
- France** - (SNIA/SYN COPAC): Guide de Bonnes Pratiques de la Fabrication des Aliments Composés pour Animaux (www.nutritionanimale.org/)
- Germany** - (QS): QS Leitfaden für die Futtermittelwirtschaft (www.q-s.info/Handbuch.109.0.html)
- UK** - (Agricultural Industries Confederation): AIC Feed Assurance Scheme (UFAS) - Code of Practice for the Manufacture of Safe Compound Animal Feedingstuffs (www.agindustries.org.uk/content.output/93/93/Trade%20Assurance/Trade%20Assurance%20Schemes/UFAS.msp)
- Spain** - (CESFAC): Alimentacion Animal Certificada (www.cesfac.com/inf.asp?idi=&id=297)
- Czech Republic** - (CMSO ZZN): Pravidla správné výrobní hygienické praxe pro výrobce premixů a krmiv s použitím premixů nebodoplnkových krmiv určených k výživě hospodářských zvířat (EN) (www.cmsozzn.cz/praxe/2003%20Pravidla%20spravne%20a%20hygienicke%20praxe.pdf)
- Denmark (DAKOFO)**: - EFMC has been translated in the national language and will serve as the reference code for the organization members (www.dakofo.dk)
- Ireland** - Irish Feed Assurance Scheme - Code of Practice for the Manufacture of Safe Compound Animal Feedingstuffs (www.agindustries.org.uk/content.output/93/93/Trade%20Assurance/Trade%20Assurance%20Schemes/UFAS.msp)
- Austria** - (VFÖ): Austrian Feed Manufacturers Code (http://portal.wko.at/wk/startseite_dst.wk?AngID=1&DstID=323)
- Slovenia** - (GZS): Slovenian Feed Manufacturers Code (www.gzs.si/eng/Article.asp?IDpm=501)
- Poland** - (IZBA Gospodarcza): EFMC has been translated in the national language and will serve as the reference code for the organization members (<http://acn.waw.pl/grain/index.html>)
- Slovakia** - (AFPWTC): Slovak Feed Manufacturers Code (www.gzs.si/eng/Article.asp?IDpm=501)
- Finland** - (FFDIF): Finish Feed Manufacturers Code (www.etl.fi/english/about/staff.asp)
- Switzerland** - (VSF): SFPS Schweizerischer Futtermittel Produktions-Standard (Leitlinien für eine gute Verfahrenspraxis für die Herstellung von Futtermitteln (FR) (www.vsf-mills.ch/de/vsf/Leitli_1286.asp)
- Croatia** - (CFIA): Croatian Feed Industry Association (EFMC has been translated in the national language and will serve as the reference code for the organization members (<http://www2.hgk.hr/en/contacts.asp>)

North America

- USA** - (AFIA) American Feed Industry Association's Safe Feed/Safe Food Certification Program (www.safefeedsafefood.org/main/home.cfm)
- Facility Certification Institute's HACCP Certification Program (www.certifiedfacility.org/Certification_Programs/HACCP.cfm)
- Feed Industry Technology V (www.afia.org)
- USA** - (FDA) Federal Food, Drug and Cosmetic Act of 1938 (www.fda.gov/opacom/laws/fdact/fdctoc.htm)
- USA** - (AAFCO) AAFCO Verification Program for a Voluntary Hazard Analysis and Critical Control Point (HACCP) Plan (www.aafco.org)
- Model Feed Bill (www.aafco.org)
- Feed Industry HACCP, Texas A&M University (<http://agonline.tamu.edu/haccp>)
- USA** - (NAP): Mineral Tolerance of Domestic Animals (<http://www.nap.edu/openbook.php?isbn=0309030226>)

Latin America

- Brazil** - (SINDIRAÇÕES): SINDIRAÇÕES - Feed and Food Safety Program (www.sindiracoes.org.br/index.php?option=com_content&task=blogsection&id=11&Itemid=76)
- Mexico** - (CONAFAB): Consejo Nacional de Fabricantes de Alimentos Balanceados y de la Nutrición Animal AC
NOM 012 ZOO Regulación de productos químicos, farmacéuticos, biológicos y alimenticios
- NOM 025 ZOO Especificaciones de instalaciones, equipo y operación de establecimientos
- NOM 060 ZOO Especificaciones de transformación de despojos animales y su empleo en la alimentación animal.
- NOM 061 ZOO Especificaciones de los alimentos para consumo animal. (www.conafab.org/legislacion_y_normalizacion.html)

Asia & Pacific

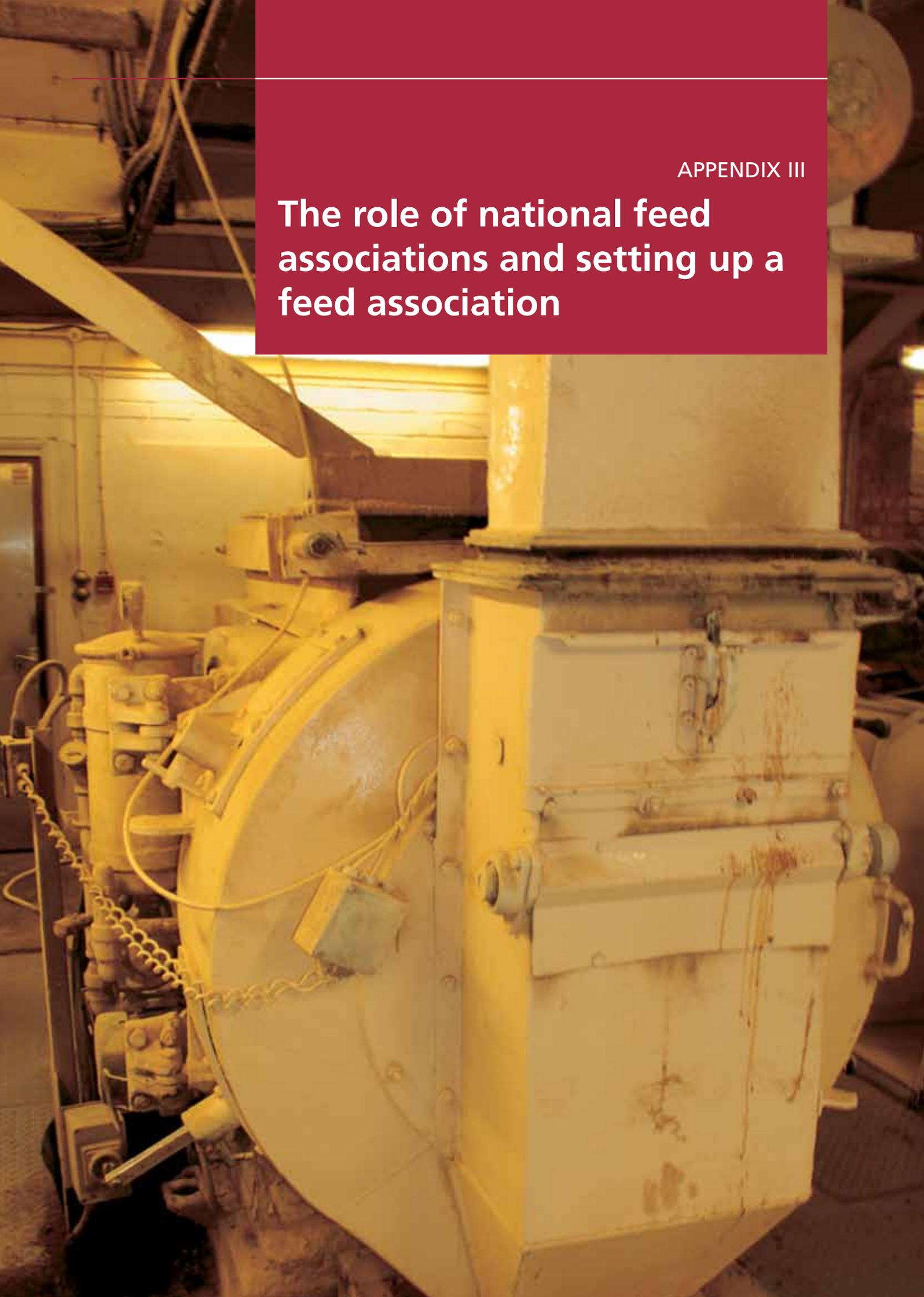
- Australia** - (SFMCA): FeedSafe QA Accreditation Program (www.sfmca.com.au/feedsafe/about_feedsafe/)
- Code of Good Manufacturing Practice for the Feed Industry (www.sfmca.com.au/info_centre/documents/185/)
- New Zealand**- Code of Good Manufacturing Practice for Compound Feeds, Premixes and Dietary Supplements (www.nzfma.org.nz/codes/codes_of_practice.php)

Africa

- South Africa** - (AFMA): 2.1 Code of Conduct for AFMA members (www.afma.co.za/CodesofPractice.htm)
- 2.2 Code of Conduct - Early Warning System (www.afma.co.za/CodesofPractice.htm)
- 2.2b Appendix 1 - to EWS (www.afma.co.za/CodesofPractice.htm)
- 2.3 Code of Practise for the control of Salmonella (www.afma.co.za/CodesofPractice.htm)
- 2.3b Salmonella Critical Raw Materials. (www.afma.co.za/CodesofPractice.htm)
- 2.4 Code of practise for the control of Mycotoxin in (www.afma.co.za/CodesofPractice.htm)
- 2.5 Guideline for monitoring of Salmonella. (www.afma.co.za/CodesofPractice.htm)
- 2.6 Sampling protocol for animal feeds and raw materials. (www.afma.co.za/CodesofPractice.htm)

Draft codes

- 2.7 GMP as a national standard for animal feed production (<http://www.afma.co.za/CodesofPractice.htm>)
- 2.8 Protocol for the Transport of raw materials. (www.afma.co.za/CodesofPractice.htm)



APPENDIX III

The role of national feed associations and setting up a feed association



INTRODUCTION

Every country, or region, with a sizable feed industry usually has a feed association. These associations are created by the industry to cooperate on many issues for and on behalf of the industry. The associations serve in many roles. Most associations are organised to respond to government inquiries and pressures. The associations provide the opportunities for the industry to speak to the governments in a single voice so that its issues and needs are more clearly understood. Many associations have education and training as an objective, thus allowing industry experts the opportunity to teach the entire feed sector.

The role of national feed associations in feed/food safety, auditing and regulations

Feed associations worldwide, along with governments; have assumed the role of leading their industry in developing feed/food safety programmes. These feed/food safety programmes may include government regulations and self or third-party audits.

Consumers everywhere are entitled to a safe food supply. The animal protein sector has in recent years been called upon to prove its ability to produce safe feed to make safe food. The BSE outbreak of the late 1980s and 1990s brought to the forefront the issue that safe feed produces safe food. Additional issues such as dioxin, salmonella and GMOs all focused the public attention on the livestock feed industry and its ability to produce safe feed to make safe food.

Feed trade associations have worked with their governments to develop regulations and auditing programmes to give consumers the confidence they need to eat foods of animal protein origin.

Trade associations are formed to serve their members' political, educational and social or public relations needs in ways that individuals or single companies cannot. The feed industry has been served by trade associations for almost 100 years. The mission and purpose of the associations is to collectively accomplish things together more effectively than individually.

Principle goals and objectives for feed associations should include:

- Establish a forum to promote industry dialogue;
- Establish political influence;
- Craft policies which are beneficial to the industry;

- Create industry standards to gain customer and consumer confidence;
- Provide industry specific education opportunities;
- Present networking opportunities for companies or individuals;
- Collaborate on public relations messages to influence public opinion;
- Pool resources to find new products or markets;
- Liaise with government officials;
- Mediate industry disputes;
- Coordinate research projects;
- Organize conferences and forums for discussions and dialogue;
- Offer opportunities to put buyers and sellers together.

To create a feed association, leader representatives must come together at a non-threatening, neutral site to discuss the needs and benefits of forming such an association.

Writing a 'mission statement' for the new association is usually the best way to achieve consensus. The 'mission statement' should be short, clear and concise. For example, the 'mission statement' for a new feed association could be: "The mission of this feed association is to establish a dialogue of feed industry entities so that their common interests can be served."

After there is agreement on the need to establish a feed association, the formation process begins.

The formation process includes creating a corporate legal entity, probably determined by the legal system. The association may be a 'not-for-profit' entity, which usually has a specific legal status.

Once the mission and purpose has been established, more specific goals and objectives need to be written, agreed and clearly understood by all prospective members. It is best to keep the goals or objectives of the new association very simple and limited. As with all new entities, over burdening them with high expectations may prove to be their downfall.

A new feed association will require bylaws and organizational structure. The bylaws should include the following sections:

- Name
- Objectives and purpose
- Membership
- Authorization of committees
- Dues structure
- Meeting requirements
- Election of directors and officers

- Duties, powers and terms of the directors and office holders
- Voting or corporate decision provisions
- Indemnification
- Amendments

Suggested details for each of the sections:

Name - The name should be descriptive of the industry and the scope, such as Feed Association of (name of country, group or region). Consideration should be given to what the acronym would be as most associations are labelled and known for their acronym.

Objectives and purpose - The objectives should be understandable, simple and achievable. For example: "The objectives of the Association shall be to provide industry representation to government agencies, to develop and present industry positions to consumers and customers. It will also be an objective to provide industry specific education opportunities."

Membership - The membership can be as broad or as narrow as necessary to achieve the objectives. If the membership base is very broad the political influence and dues base is greater but consensus may be harder to achieve. If the membership base is narrow, the political influence is less, the dues base is less but agreement of industry policy will likely come easier.

A narrow membership base may be an association that allows as members only feed manufacturers that sell feed. A broad membership base is an association with membership that makes feeds for sale and private use and suppliers of macro and micro feed ingredients, equipment manufacturers and service providers.

Authorization of committees - The Bylaws should allow for the establishment of committees. The committees can be for single specific purposes or for long term technical purposes. The Bylaws should give authority to form, fill and disband the committee.

Dues structure - The dues structure will need to be determined after the membership base is established. Fairness and equitable are keys in any dues structure. Large members should be expected to carry a larger share of the needed dues than small members; however, small members should expect to contribute a fair and equitable portion of the dues and all members must take ownership in the association through their active involvement, beyond their dues contribution. Suppliers to the feed industry should be treated with the same fairness and equitability.

Meeting requirements - Meeting requirements

are frequently determined by corporate laws. If an annual meeting is necessary, this bylaw provision must set forth those provisions. Time, place, frequency and who has the authority to call meetings are all part of this bylaw section.

Election of directors and office holders - This section sets forth the number of directors, how they are selected and their length of board term. Depending on the membership, there may need to be provisions on equal representation of membership segments, such as feed manufacturers, ingredients suppliers, equipment suppliers, etc. This Bylaw section should establish what officers are necessary (Chairperson, President, Secretary, Treasurer, etc) and how they are selected, elected and replaced.

Duties and powers of directors and office holders - This section is to state who has the authority to call meetings, preside over meetings, record the actions, hire staff, open bank accounts, sign checks, etc. This section should also set forth quorum requirements.

Voting or corporate decision provisions - This section should address how members can vote, by mail, email, telephone, in person or by proxy etc. If more than a majority vote is necessary for any decisions, this section should state those instances.

Indemnification - This section should state the provision whereby the association will indemnify any director, officers, staff or member-to-member legal disputes, including the legal fees.

Amendments - Conditions on how the bylaws can be amended or changed. Once the feed association has been established, business can be conducted. Most feed associations are initially run and operated by volunteers from the membership. Keeping the membership informed about what and how the association is serving the membership is important. The association should consider having written policies and procedures for each of the following:

Policy making - Who and how the official policies are made and communicated. This is usually done by the Board of Directors.

Government action plan - This plan would state what issues are important to the industry and how the association should communicate and attempt to influence the government.

Membership plan - Written plans to attract, recruit, and retain prospective members. The plan would state how and when and by whom dues billing is conducted.

Communications plan - A written plan for com-

munication with the membership, the government and consumers. The plan would include who is to write, and send the communication and how often these should be done. This may be included in the Membership Plan. This plan would include provisions for a membership directory, annual report, web site and leadership listings, etc

Corporate governance - This plan would detail the bylaw provisions as to whom, how and when the leadership of the association is elected, where and when the meetings are held and how the leadership is responsive to the industry.

Employee manual - An employee manual would give employees the rules as well as the benefits of employment.

A feed association offers the feed and feed ingredient industry many opportunities to advance the purpose of the industry. Developing an influential feed association is hard work but also very rewarding for the leadership and the prospective membership. Lifelong friendships will be established, consumer confidence in the feed industry will be gained and the safety of meat, milk and eggs for consumers are all benefits of a feed association.

In addition, feed trade associations can be established on a regional multi-nation basis, particularly when the countries or the feed industry or feed ingredient industry readily crosses borders. Most of the decision making processes for establishing a multi-nation feed association are the same as for a national feed association. However, additional factors need to be considered. They include:

- Language
- Country of domicile
- Legal and corporate structure
- Communication issues – postal, phone, email, etc.
- Meeting locations to prevent dominant country appearances
- Cost of international travel
- Dues structure with different currencies
- Units of measures for comparative base lines
- Political differences between countries

The mission, purpose and objectives of the multi-nation association needs to be very clearly established because the assumed norms may well be different between the countries. It is important that no countries feed sector is given disproportionate influence as this will create an imbalance of power and the effectiveness and harmony the association that was intended will be lost.

Transparency and communication are most important when establishing a multi-nation association. The complexities of starting a multi-nation association are numerous, the time to be deal with the unique issues are during creation. However, the benefits to the industry, for having a multi-nation association are enormous.

Draft Bylaws for a National Feed Association

Introduction and bylaws

The recall of feed raw ingredients or feeds for safety reasons can often be most efficiently carried out via a trade association. For this reason all countries should be encouraged to establish a suitable association.

Bylaws of a National Feed Association must abide by relevant laws or regulations within a country. Below is an outline of bylaws that may be useful when setting up a National Feed Association.

Article 1: Name

Section 1. The name of the association will be the (country name) _____ National Feed Association (NFA). The Association shall be incorporated under the laws of (your country)

Article 2: Mission, objective and purpose

Section 1. The mission of the National Feed Association is: The mission of the National Feed Association is to establish a dialogue of feed industry entities, so that their common interests can be served and feed safety issues addressed.

Section 2. The objectives and purpose of the National Feed Association shall be:

- a) Present to the industry a forum for dialogue and discussion;
- b) To provide industry representation to government agencies;
- c) To develop and present industry positions to consumers and customers;
- d) To give industry specific education opportunities;
- e) To give the authorities a route for dissemination of feed safety information to industry.

Article 3: Membership

Section 1. Eligibility any company, who manufactures feed or feed ingredients, distributes feed or feed ingredients, or supplies the livestock, poultry or aquaculture feed industry, is eligible.

Section 2. Voting: Each member shall be eli-

gible to one vote. Each member shall designate to the NFA corporate secretary the official voting representative.

Section 3. The membership shall by a fixed date each year, elect a Board of Directors. A simple majority vote will win the election.

Section 4. Duration of membership: Membership of NFA will continue as long as the member continues to pay the authorised dues as approved by the Board of Directors

Article 4: Directors and Officers

Section 1. The membership of NFA shall elect a Board of Directors to govern the Association.

Section 2. The Board of Directors shall be specified in number (at least three).

Section 3. The Board terms will be for three years. Board members can serve more than one term, but normally not more than two successive terms.

Section 4. Officers: The NFA will have a President, a Secretary and a Treasurer. A single individual may hold more than one position but the President and the Secretary cannot be the same person.

Section 5. The Board of Directors will elect the officers.

Section 6. The Board of Directors may from time to time add additional officers.

Article 5: Duties and Powers of the Board and Officers

Section 1. Duties of the Board of Directors: The Board of Directors shall be the governing body of the NFA. The Board of Directors shall be responsible for the property, business affairs and policies of the association. The Board shall authorise the creation of Committees. The Board shall hire and discharge the staff and officers.

Section 2. Board meetings: The Board of Directors shall meet at least once a year in a place agreed to by majority vote of the Board. The Board meeting shall be convened by the President. The meeting of the Board of Directors shall be called by either the President, the secretary or by any other two members of the Board of Directors

Section 3. Quorum: A majority of the board will constitute a quorum. A quorum can be achieved by in-person votes or by proxy.

Section 4. Duties of President: The President or his deputy shall preside over board meetings.

Section 5. Duties of the Secretary: The secretary shall keep the official records of the Association

including but not limited to, Board Minutes, membership roster and corporate documents. The Secretary shall perform additional duties as assigned by the President.

Section 6. Duties of the Treasurer: The Treasurer shall be responsible for the funds received by the association. The Treasurer shall make a periodic and full accounting of all income and expenditures. The Treasurer shall perform additional duties as assigned.

Section 7. Duties of other Officers. Any other duly elected officers shall perform such duties as assigned by the President or the Board of Directors.

Note: All sections below need simplifying in order to account for countries with small numbers of companies in the trade and do not need a large formal structure.

Article 6 - Committees & Meetings

Section 1. There shall be a Board and Officer Nominating Committee. The Board and Officer Nominating committee shall consist of at least three and not more than seven members. The majority of the Nominating Committee members shall be individuals who are not currently serving on the Board or as an officer of the Association.

Section 2. The Board and Officer Nominating Committee shall nominate members to serve on the Board of Directors and shall provide the slate of nominees 15 days prior to the election.

Section 3. Independent nominations for the Board of Directors will be taken, however, these nominations must be submitted 10 days prior to the election.

Section 4. Any other committee approved by the Board of Directors shall also be given the authority to serve the Association.

Section 5. The Chairman of the Board or the President will select the Chairman of the Committees and initial committee members.

Section 6. Committees shall meet at a time and place agreeable to the majority of the committee.

Section 7. There will be an annual meeting convened at a time and place approved by the Board of Directors. The membership shall have at least 30 days notice of its time and place.

Section 8. Mail, email, fax or phone messages will constitute notice of meetings.

Section 9. Ten percent of the total membership will constitute a quorum.

Article 7: Dues

Section 1. The rate and basis of dues for each member class shall be determined by the Board of Directors.

Section 2. A member who fails to pay its dues will be given written notice of delinquency 60 days after they are due. If the delinquency is not satisfied in the next 60 days, they will be terminated from the membership roles.

Article 8: Indemnification

Section 1. The Association shall indemnify any Board, officer or staff who is party or threaten to be made party to a suit as long as that person was speaking for, or acting for the Association and authorised by the Board.

Section 2. The Association shall defend or pay for the legal defense for the person as described in Section 1 above.

Article 9 - Miscellaneous

Section 1. Seal: The Association may have a seal of such design by or for the Board of Directors. The seal shall be used to identify the Association as necessary.

Section 2. Year: The year of the Association will be January 1 - December 31.

Section 3. Amendments: These bylaws may be amended, repealed or altered by a two-thirds vote of the Board of Directors. A 20-day notice must be given to all Board member prior to any changed, amendment or alternation of the Bylaws.

FAO ANIMAL PRODUCTION AND HEALTH MANUALS

1. Small-scale poultry production, 2004 (E, F)
2. Good practices for the meat industry, 2006 (E, F, S, Ar)
3. Preparing for highly pathogenic avian influenza, 2006 (E, Ar, S^e, F^e, M^e)
3. Revised version, 2009 (E)
4. Wild bird HPAI surveillance – a manual for sample collection from healthy, sick and dead birds, 2006 (E, F, R, Id, S^e, Ar^e, C^e, Ba^{**})
5. Wild birds and avian influenza – an introduction to applied field research and disease sampling techniques, 2007 (E, F, R, Id, Ba, S^{**})
6. Compensation programs for the sanitary emergence of HPAI-H5N1 in Latin American and the Caribbean, 2008 (E^e, S^e)
7. The AVE systems of geographic information for the assistance in the epidemiological surveillance of the avian influenza, based on risk, 2009 (E^e, S^e)
8. Preparation of African swine fever contingency plans, 2009 (E)
9. Good practices for the feed industry – implementing the Codex Alimentarius Code of Practice on good animal feeding, 2009 (E)

Availability: January 2010

Ar – Arabic	Multil – Multilingual
C – Chinese	* Out of print
E – English	** In preparation
F – French	^e E-publication
P – Portuguese	
R – Russian	
S – Spanish	
M – Mongolian	
Id – Bahasa	
Ba – Bangla	

The *FAO Animal Production and Health Manuals* are available through the authorized FAO Sales Agents or directly from Sales and Marketing Group, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

FAO ANIMAL HEALTH MANUALS

1. Manual on the diagnosis of rinderpest, 1996 (E)
2. Manual on bovine spongiform encephalopathy, 1998 (E)
3. Epidemiology, diagnosis and control of helminth parasites of swine, 1998
4. Epidemiology, diagnosis and control of poultry parasites, 1998
5. Recognizing peste des petits ruminant – a field manual, 1999 (E, F)
6. Manual on the preparation of national animal disease emergency preparedness plans, 1999 (E)
7. Manual on the preparation of rinderpest contingency plans, 1999 (E)
8. Manual on livestock disease surveillance and information systems, 1999 (E)
9. Recognizing African swine fever – a field manual, 2000 (E, F)
10. Manual on participatory epidemiology – method for the collection of action-oriented epidemiological intelligence, 2000 (E)
11. Manual on the preparation of African swine fever contingency plans, 2001 (E)
12. Manual on procedures for disease eradication by stamping out, 2001 (E)
13. Recognizing contagious bovine pleuropneumonia, 2001 (E, F)
14. Preparation of contagious bovine pleuropneumonia contingency plans, 2002 (E, F)
15. Preparation of Rift Valley fever contingency plans, 2002 (E, F)
16. Preparation of foot-and-mouth disease contingency plans, 2002 (E)
17. Recognizing Rift Valley fever, 2003 (E)

This manual provides updated comprehensive information and practical guidelines to assist producers and all stakeholders along the production and distribution chain to comply with the regulatory framework, which have or will come into force in response to the Codex Alimentarius Code of Practice on Good Animal Feeding. The application of this Code is an important step for the expansion of international trade in feed products as well as in products of animal origin. Both food exporting and importing countries can benefit from a more level playing field to support the trade of safe food products. This publication is intended to guide managers of feedmills and the feed industry as a whole.

It will also be of value to officers engaged in feed inspection, with their supervisory roles in feed safety. This manual is targeted at the commercial feed industries and farm-based feed mixers in developing countries and emerging economies in their endeavour to meet the rising quality and safety requirements of both the export and domestic markets, with the increasing participation of large-scale retailers everywhere.

ISBN 978-92-5-106487-0 ISSN 1810-1119



11379E/1/01.10/630