

On-farm production and use of feed and feed ingredients

Section 4 - 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 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;
- Skins 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.

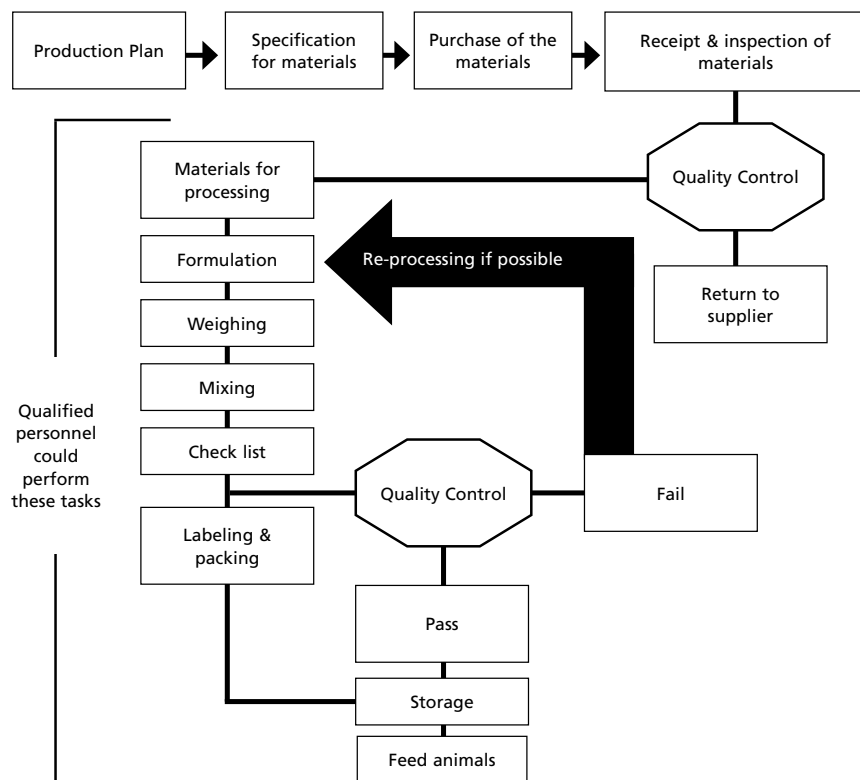
Particle size

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

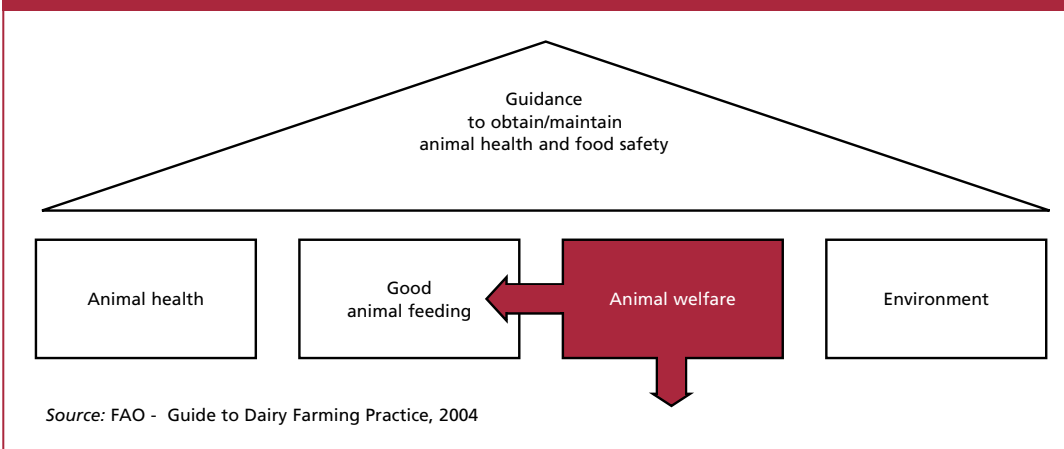
This control plan should address the following questions and be used regularly and especially when any changes are made to the mixing operation.

- 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



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 Manufacturing 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.

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