Animal Feed Production
GMP and HACCP

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Introduction

1. Introduction
2. Prerequisite programms / GMP
3. Hazards associated with animal feed
4. Hazard analysis and critical control points
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1. Introduction

- Safe and good quality feed and feed ingredients → important to livestock production.
- Safe feed → essential reduce and prevent food safety hazards entering the food chain.
1. Introduction

- feed chain partners: feed ingredient manufacturers, feed compounders, truckers, farmers etc.
- each partner is responsible for all activities that are under their direct control

GMP = good manufacturing practices = prerequisite programmes

Basic principle: feed and feed ingredients should be produced in facilities according to procedures which guaranty the safety of the product
1. Introduction

• HACCP = Hazard Analysis and Critical Control Points

Basic principle: identify and control hazards that may affect food/feed safety. The aim is to prevent, reduce or eliminate the hazards

2. PREREQUISITE PROGRAMS
GOOD MANUFACTURING PRACTICES
2. Prerequisite programs

- Pre-requisite
  - Established before the development of a HACCP plan
  - basic operating procedures
  - to prevent problems/hazards but not impact on CCP
  - simplify HACCP development and maintenance

2. Prerequisite programs/GMP’s

- Building and facilities
- Water supply
- Personnel hygiene facilities
- Air Quality, temperature and ventilation
- Lighting
- Equipment
- Personal Hygiene
- Cleaning
- Maintenance
- Pest control
- Waste handing
- Drains
- Storage
- Transport
- Training
- Approved supplier
- Process control
- Use of additives /medication
2.1. Building and facilities

- Protect products from contamination (polluted area, flooding, waste, …)
- Safe storage
- Safe production
- Easy access for maintenance and cleaning
- Location and design should prevent pests

2.2. Water supply

- Any water coming into contact with feed products should be of potable quality (WHO guidelines for drinking water)
- Separated from non-potable water.
2.3. personnel hygiene facilities

- To maintain an appropriate degree of personal hygiene
- When appropriate, facilities should include:
  - Adequate means of hygienically washing and drying hands,
  - A constant supply of potable water;
  - An adequate number of toilets of an appropriate hygienic design

- 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.
2.4. Air quality, temperature and ventilation

• Adequate means of natural or mechanical ventilation should be provided to:
  – Control of temperature, humidity and ventilation, where necessary.
  – Air flow from clean to contaminated areas
  – Minimize air-borne contamination of feed

2.5. Lighting

• Adequate artificial or natural lighting sources
  – Ensure hygienic and inspection conditions.
• Protected lighting fixtures
  – Protect food so that it is not contaminated by breakages
• Equipment and containers should be:
  – made of non toxic materials,
  – capable of being disassembled to allow proper maintenance, cleaning and inspections.
  – placed away from the walls to facilitate cleaning and maintenance and to prevent pest infestation.

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, hammers should be regularly checked for possible damage and to ensure their effective operation.

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.
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.

Feed handlers should maintain personal cleanliness.

Cleaning should remove residues and dirt that may be a source of contamination.

Sufficient standards of cleanliness should be employed to ensure that exposure to pests and pathogens is minimized at all stages of processing, storage and handling.

An authorised person should carry out inspections of cleaning.
2.9. Maintenance

- Equipment should be subject to a programme of planned maintenance that ensures it is kept in safe and effective working condition
  - Ex. Wear of hammers is a known problem, remove before breakage

- The maintenance should not adversely affect feed safety → inform technicians!

2.10. Pest control

Pests = birds, insects, reptiles and mammals whether they are wild or domestic.

Active measures should be taken to control and limit pest activity throughout all process, storage and handling areas.

Where the presence of pests is unavoidable, procedures should be implemented to protect feed products from potential contamination.
2.11. waste handling

Waste and material that is not appropriate for feed must be identified as such, kept separate and removed.

Waste should be collected and stored in clearly identified bins or containers.

Waste should not be allowed to accumulate in feed processing areas.

2.12. 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.
2.13 Storage

Separate storage areas for raw materials and finished products to prevent cross contamination. Facilities should be free of chemicals, fertilizers, pesticides and other potential contaminants.

- Feed products should be identified easily
- Prevent confusion with other products is prevented.
- Store medications and medicated pre-mixtures in a secure place and with restricted access
- Proper packaging material

2.14 Transport

Raw materials and finished feeds should be adequately protected during transport.

All means of transport, bulk or packed and by water, rail or land should be appropriately cleaned to control and minimize the risk of contamination.

No materials from previous loading should remain in trucks or tanks before being loaded with the feed products. Containers should be clean and dry prior to loading.
2.15. Training

Good training → essential to ensure feed and food remain safe.

Training in feed hygiene as well as production protocols and handling of feed products

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.

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

2.16. Approved supplier

To ensure raw materials are safe, it will be necessary to obtain information on the source of the raw material (including additives), the control measures taken by the supplier

Ex. Respects good agricultural practices, respects good transportation practices, Purity of additives, Concentration of mycotoxins
2.17. Process control

Production of animal feed should be planned, scheduled and controlled.

If there are any production steps which are critical for feed safety, they should be controlled and the control should be effective.

2.18. Use of additives

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

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

Products should be held in secure storage.
1. Introduction

What is HACCP

Hazard analysis and critical control points is
- a systematic preventive approach to food safety and biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe, and
- Establishes measurements to reduce these risks to a safe level
**1. Introduction**

**What is a hazard?**

Food safety hazards associated with animal feed can be
- biological,
- chemical
- physical.

Each hazard is associated with particular sources and routes of contamination and exposure.

**How hazards are introduced?**

Source:
- Raw materials
- Via carryover
- Contamination of products during handling, storage and transportation
- Accidental or deliberate contamination (e.g. fraud – Melamin in milk powder – mineral fat)
2. Chemical hazards

- Dioxins
- Mycotoxins
- Heavy Metals
- Veterinary drug residues

Dioxins, dibenzofurans, and dioxin-like PCBs

dioxins may be
- inherent to a product (e.g. clay minerals),
- introduced during processing (e.g. lime in citrus pulp),
- introduced if contaminated fuels are used in the drying of feed products; for example treated wood, poor quality coal or contaminated fuel oil.
- Present in forage crops grown in the vicinity of certain industrial processes (e.g. incinerators).

- 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 animal fat during life time → result in unacceptable residues in human foods such as meat, milk, and eggs.
Mycotoxins

Mycotoxins are secondary metabolites produced by moulds occurring on crops during growth or storage. Most frequently occurring mycotoxins (aflatoxin B1, ochratoxin A, zearalenone, fumonisin B1, deoxinivalenol, T-2 and HT-2) are currently considered for their effects on animal health.

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.

Aflatoxin B1 → most important

Introduction in Feed Technology

Milk is contaminated with aflatoxin M1, following exposure of lactating animals to aflatoxin B1 present in feedstuffs.
Aflatoxins

- All products for humans, except milk 20 ppb
- Corn for immature animals and dairy cattle 20 ppb
- Corn or peanut pdts. for breeding beef cattle, swine, mature poultry 100 ppb
- Corn or peanuts pdts. for finishing swine 200 ppb
- Corn or peanut pdts. for finishing beef cattle 300 ppb
- Cottonseed meal (as feed ingredient) 300 ppb
- All other feedstuffs 20 ppb
- Milk (Aflatoxin M₁) 0.5 ppb

Heavy metals

Most of the heavy metals are widespread in the environment and thus contaminate forages and raw material.

In animal products there is bioaccumulation ex. Arsenic in fish and Cadmium in dairy products.
Veterinary drug residues

Veterinary drug residues may be found in food products as a result of the carryover of veterinary drugs in feed during feed production.

Measures to prevent are flushing, sequencing, cleaning equipment (mixers) when feed for food-producing animals is produced after the production of a medicated feed.

Organochlorine pesticides

- 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.

- 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.
3. Microbiological hazards

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

**Brucella**

- infected ruminants can abort in fields that are grazed or from which pasture is harvested and used for animal feed.
- placentas of infected animals contain high levels of Brucella micro-organisms.
- If contaminated forage is fed to dairy cattle, 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

- *Taenia saginata*, also known as *Taeniarhynchus saginata* or the beef tapeworm, is a parasite of both cattle and humans, causing *taeniasis* in humans.
- These pathogens can colonize/infect farm animals, and may pose a threat to human health if infected or contaminated products are ingested.
4. HAZARD ANALYSIS AND CRITICAL CONTROL POINTS

1. The HACCP – plan

• HACCP - preliminary steps (1-5)

Followed by

• HACCP Principles (6 – 12) = Logic sequence for the application of HACCP
1. The HACCP team

Establishing an HACCP system is not an easy job
→ Scientific base
→ knowledge on hazards, technology,....

The HACCP team should include personnel from all of the relevant operations and functions – knowledge on HACCP.

2. Describe the product
+ 3. Identify 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.
4. Identification of process steps + 5. on site verification

Flow diagram = Detailed description of all the process steps (technology) → to detect sources of hazards related to processing.

Ex.

Weighing, dosing
Mixing (cross contamination)

6. Hazard analysis

List all Potential Hazards related to:
- raw material
- Production process

Conduct a hazard Analysis
- Frequency / severity
Consider Control Measures
5. Hazard analysis

- 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.

7. Determination of CCP

- **Determination of critical control points**

  → Critical Control Points (CCPs) = 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)
8. Critical limits

The HACCP Team should detail the critical limits for the control measures at each of the CCPs.

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.

9. Monitoring

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

- 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.
10. Preventive / corrective actions

- Remedial actions should be taken 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.

11. Verification

To verify that all personnel are complying with the requirements of the HACCP Plan, but also that the Plan is effective (validation).
12. Documentation

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,
- operating records.

2. Example

[Diagram of feed technology process]
# 2. Example

## Product Description Form

<table>
<thead>
<tr>
<th>Product Category: Medicated Dairy Cattle Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Product name(s)</strong></td>
</tr>
<tr>
<td><strong>2. Product safety properties</strong>&lt;br&gt;(Moist., Prm., etc.)</td>
</tr>
<tr>
<td><strong>3. How is the product to be used (intended use) and who is the intended consumer?</strong></td>
</tr>
<tr>
<td><strong>4. Type of packaging</strong></td>
</tr>
<tr>
<td><strong>5. Shelf life</strong></td>
</tr>
<tr>
<td><strong>6. Where will the product be sold?</strong></td>
</tr>
</tbody>
</table>

## List of Product Ingredients and Incoming Materials Form

<table>
<thead>
<tr>
<th>Product Category: Medicated Dairy Cattle Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulk Ingredients</strong>&lt;br&gt;(Dry)</td>
</tr>
<tr>
<td>Corn, fine-ground&lt;br&gt;Distillers Dried Grains&lt;br&gt;By-Pass Protein Supplement&lt;br&gt;Soybeans Hulls&lt;br&gt;Dried Bakery Product&lt;br&gt;Limestone&lt;br&gt;Sodium Bicarbonate&lt;br&gt;Yeast culture&lt;br&gt;Potassium Chloride&lt;br&gt;EDDI&lt;br&gt;Salt</td>
</tr>
<tr>
<td><strong>Liquids</strong></td>
</tr>
<tr>
<td>Molasses</td>
</tr>
</tbody>
</table>
### 2. Example

#### Hazard Analysis Form

<table>
<thead>
<tr>
<th>Ingredient or Processing Step</th>
<th>Potential Hazards Introduced, Increased or Controlled at This Step</th>
<th>Is this a significant hazard?</th>
<th>Severity/Likelihood</th>
<th>Justification for Significance</th>
<th>Control Measures to Prevent, Eliminate or Reduce Animal and Human Hazard</th>
<th>Is this step a CCP?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Ingredient Receiving</td>
<td>Chemical Aflatoxin</td>
<td>Y</td>
<td>Y</td>
<td>Hypotoxicity and carcinogenesis</td>
<td>Passed through milk as M1 carcinogen</td>
<td>Test ingredients that can contaminate feed</td>
</tr>
<tr>
<td></td>
<td>Heavy Metals (Cd, Pb, Hg, As)</td>
<td>Y</td>
<td>N</td>
<td>Chronic toxicity to animal may occur</td>
<td>Unlikely to accumulate in significant levels in human food</td>
<td>Approve supplier programs</td>
</tr>
</tbody>
</table>

#### Process Step and CCP

<table>
<thead>
<tr>
<th>Process Step and CCP</th>
<th>Hazards</th>
<th>Critical Limits for Each CCP</th>
<th>Monitoring</th>
<th>Corrective Action</th>
<th>Verification Activities</th>
<th>Record Keeping Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Ingredient Receiving</td>
<td>Aflatoxin 30 ppm</td>
<td>Approved supplier, Aflatoxin ≤20 ppm</td>
<td>Visual Use of USDA-FTS quick test</td>
<td>Every load received into the facility</td>
<td>Receiving employee</td>
<td>Receiving Bulk Ingredients SOP is followed</td>
</tr>
</tbody>
</table>

FPI 1690 Approved by: ___________________________ Date: ___________________________


PDF versions free available on the internet

6. REFERENCES