



Animal Feed Production GMP and HACCP

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content

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



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1. INTRODUCTION



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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.



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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



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1. Introduction

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



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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



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2. PREREQUISITE PROGRAMS GOOD MANUFACTURING PRACTICES



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



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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



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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.



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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



2.3. personnel hygiene facilities

- 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



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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



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2.6. Equipment

- 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.

2.6. Equipment

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.

2.6. Equipment



Pictured from left to right: Buffalo, Hardox 450, AR-400

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.

2.6. Equipment



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.

2.7. Personal hygiene



Germ Farm



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



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2.8. Cleaning



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.

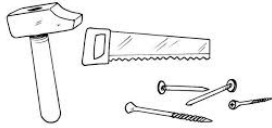
An authorised person should carry out inspections of cleaning



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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



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.



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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.



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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.



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

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.



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



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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



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4 FOOD SAFETY HAZARDS ASSOCIATED WITH ANIMAL FEED



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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



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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.



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1. Introduction

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)



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2. Chemical hazards

- Dioxins
- Mycotoxins
- Heavy Metals
- Veterinary drug residues



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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.



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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



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Mycotoxins

Feed materials 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.

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.

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



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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 M ₁)	0.5 ppb

Heavy metals

Cadmium
Arsenic
Lead
Mercury

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.



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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.



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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..



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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.



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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.



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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.



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4. HAZARD ANALYSIS AND CRITICAL CONTROL POINTS



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1. The HACCP – plan

- HACCP - preliminary steps (1-5)

Followed by

- HACCP Principles (6 – 12) = Logic sequence for the application of HACCP



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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



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2. Describe the product + 3. identify use

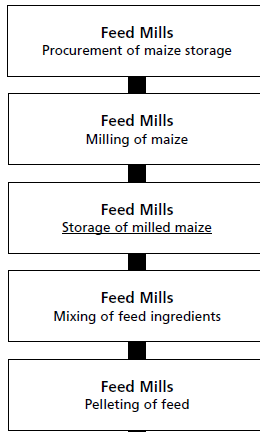
The HACCP team first describes the feed product through written specification that describes the product including a general description of the product, its ingredients and how it is to be used.



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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

Determination of control measures

- 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

- **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.



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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.



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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

Does the HACCP plan works ???

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



12. Documentation

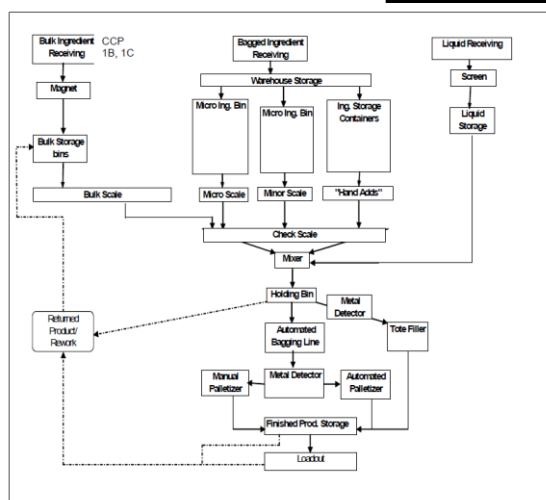
= record keeping

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



2. Example

Product Description Form

Product Category: Medicated Dairy Cattle Feed

1. Product name(s)	Turbo-charged Golden Fluff
2. Product safety properties (Moist., Pro., etc)	Monensin concentration Iodine concentration Selenium concentration Low moisture to avoid mycotoxin
3. How is the product to be used (intended use) and who is the intended consumer?	Feed to dairy cattle per instructions on label or under nutritionist directions
4. Type of packaging	Bag & bulk
5. Shelf life	Do not feed moldy or insect infested feed. Do not exceed 75 days storage. Two weeks or less is optimum.
6. Where will the product be sold?	Retail or wholesale



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2. Example

List of Product Ingredients and Incoming Materials Form

Product Category: Medicated Dairy Cattle Feed

Bulk Ingredients	Micro, Bag, and Hand Add Ingredients	Medications/Drugs
Corn, fine-ground Distillers Dried Grains By-Pass Protein Supplement Soybean Hulls Dried Bakery Product Limestone Sodium Bicarbonate Yeast culture Potassium Chloride EDDI Salt	Magnesium oxide Monocalcium/Dicalcium phosphate Vitamin E premix Dairy TM Zinc Proteinate Vitamin ADE Premix	Monensin Premix
Liquids	Packaging Materials	
Molasses		



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2. Example

Hazard Analysis Form

Product Category: Supplement for ruminants

Ingredient or Processing Step	Potential hazards introduced, increased or controlled at this step	Is this a significant hazard? severity:likelihood		Justification for Significance		Control measures to prevent, eliminate or reduce animal and human hazard	Is this step a CCP?
		Animal	Human	Animal	Human		
Bulk ingredient receiving	Chemical Aflatoxin	Y	Y	Hepatotoxicity and carcinogenesis	Passed through milk as M1 carcinogen	Test ingredients that can contain aflatoxin per Receiving Bulk Ingredients SOP	1C
	Heavy Metals (Cd, Pb, Hg, As)	Y	N	Chronic toxicity to animal may occur	Unlikely to accumulate in significant levels in human food	Approve supplier program	



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2. Example

Product Category: Medicate Dairy Cattle Feed

Process Step and CCP	Hazards	Critical Limits for each CCP	Monitoring				Corrective Action	Verification Activities	Record-keeping procedure
			What	How	Frequency	Who			
Bulk Ing. Receiving Pit, 1C	Aflatoxin	20 ppb	Approved supplier, Aflatoxin \leq 20 ppb	Visual Use of USDA-FGIS quick test	Every load received into the facility	Receiving employee	-Reject load if test failure, or non-approved supplier -Notify supplier that grain contained aflatoxin in excess of 20 ppb -Potential removal of supplier from Approved Supplier List	- Daily review of receiving log and paperwork by QA/QC department - Operational audit performed by designated management personnel to make sure Receiving Bulk Ingredients SOP is followed	Receiving Bulk Ingredients SOP, Receiving log, Approved supplier list, Record of testing, Training log (for purchasing personnel if product came from a non-approved supplier)

FPI 1999 Approved _____ Date: _____



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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.

Feed Industry Hazard Analysis and Critical Control Point (HACCP) Plan Auditor Manual - May 2011 - Office of the Texas State Chemist
Texas A&M System

PDF versions free available on the internet

6. REFERENCES



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