Theme 3: Animal Nutrition and Feeding

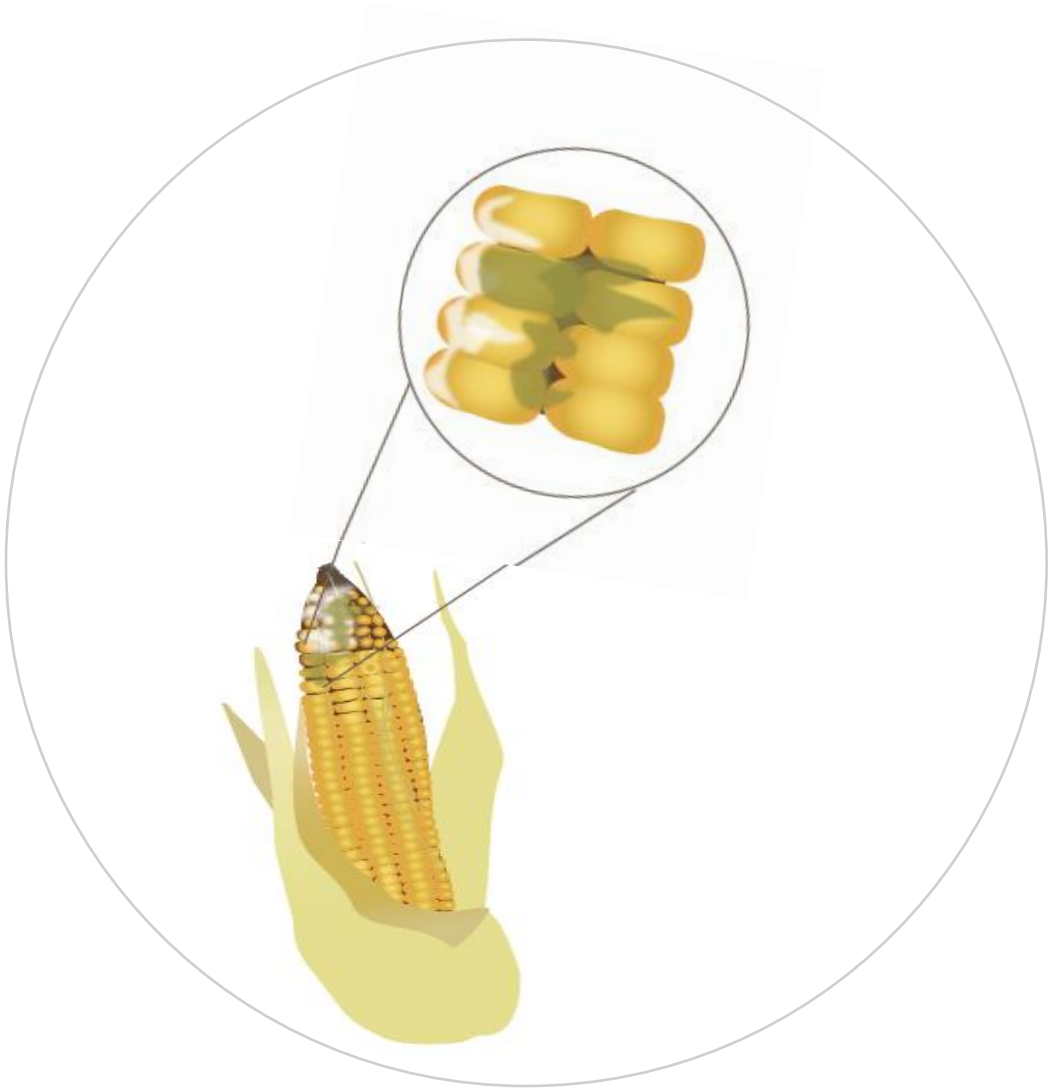
MYCOTOXIN IN DAIRY CATTLE NUTRITION

(Level 2)

Topic	Training & information Content
3.1	Estimating feeding value of fodder & feed on dairy farms
3.2	Sampling feeds & forages/analysis interpretation
3.3	Estimating Dry Matter intake for various breeds/age categories of dairy cattle in the tropics
3.4	Reviewing feed intake, rumen fill, Body Condition Scoring (BCS)
3.5	Life weight estimation of cows
3.6	Rumen fermentation
3.7	Mineral & vitamin requirement, guidelines
3.8	Manure scoring and evaluation
3.9	Guidelines for ration calculations for various breeds, heifers, lactation stage (Rumen8)
3.10	Use of Rumen8 software for ration calculation
3.11	Optimization of ration with Rumen8
3.12	Feeding management guidelines
3.13	Feeding management of dry cows/close-up
3.14	Feeding systems
3.15	Metabolic disorders
3.16	Scoring locomotion and hoof condition
3.17	Mycotoxin in dairy cattle nutrition
3.18	Heat stress in dairy cattle nutrition
3.19	Monitoring feeding management, using KPIs (based on Rumen8)

1. You will learn about (learning objectives):

- ❑ Sources of mycotoxins.
- ❑ Mycotoxins in animal feedstuffs.
- ❑ Examples of mycotoxins and their effects to dairy cattle nutrition.
- ❑ Management of mycotoxins at farm level.

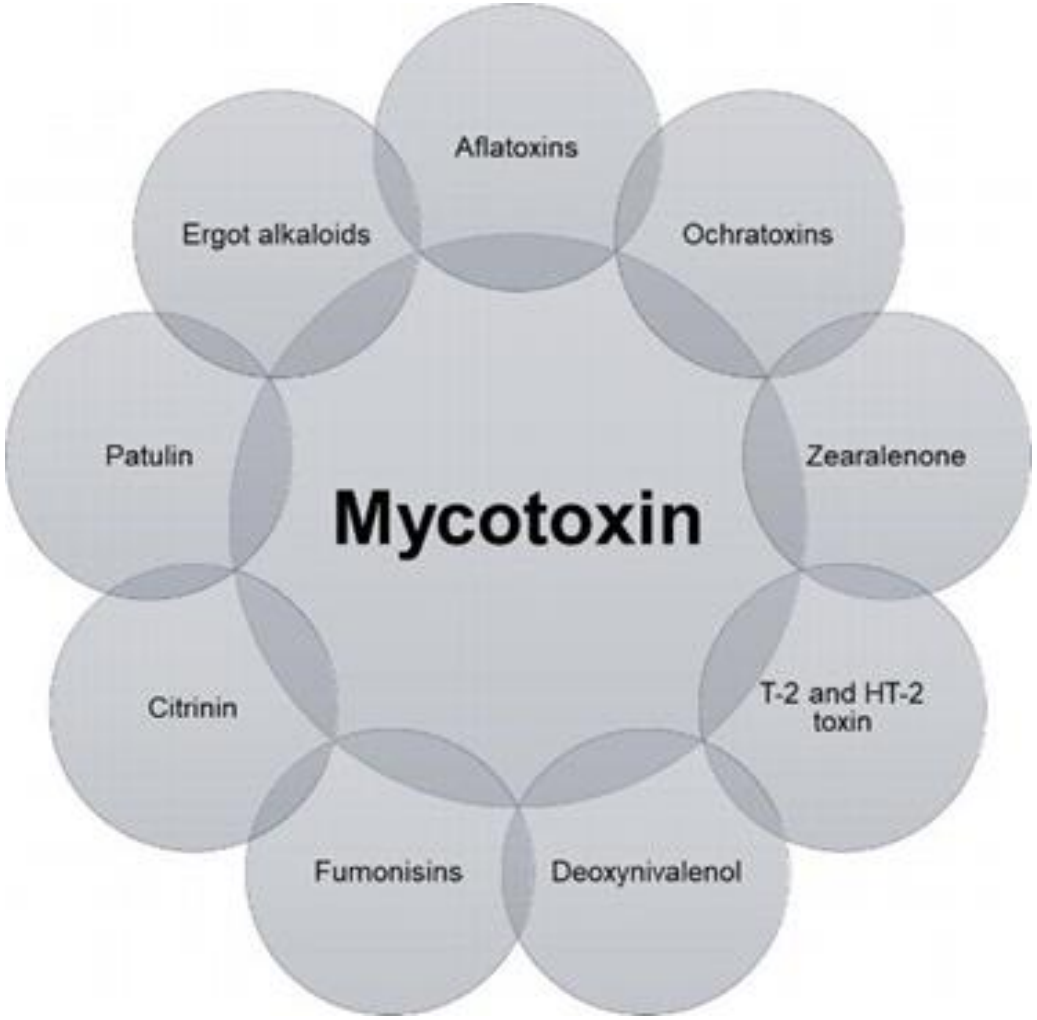


2. Introduction

- Mycotoxins are one of the key factors that affect feed safety.
- They are caused by fungi (molds) that attack crops in the field or during storage.
- Managing fungal growth aids in managing mycotoxins.
- Diseases resulting from mycotoxin toxicities are known as Mycotoxicosis.

2.1 Introduction cont'd: Mycotoxins

- Mycotoxin is a general cluster of various toxins found in animal feeds.
- Different fungi produce different toxin substances that have different molecular structures.
- Secondary metabolites are products produced by fungi/bacteria/plant which are not involved in normal growth, development or reproduction of the organism.

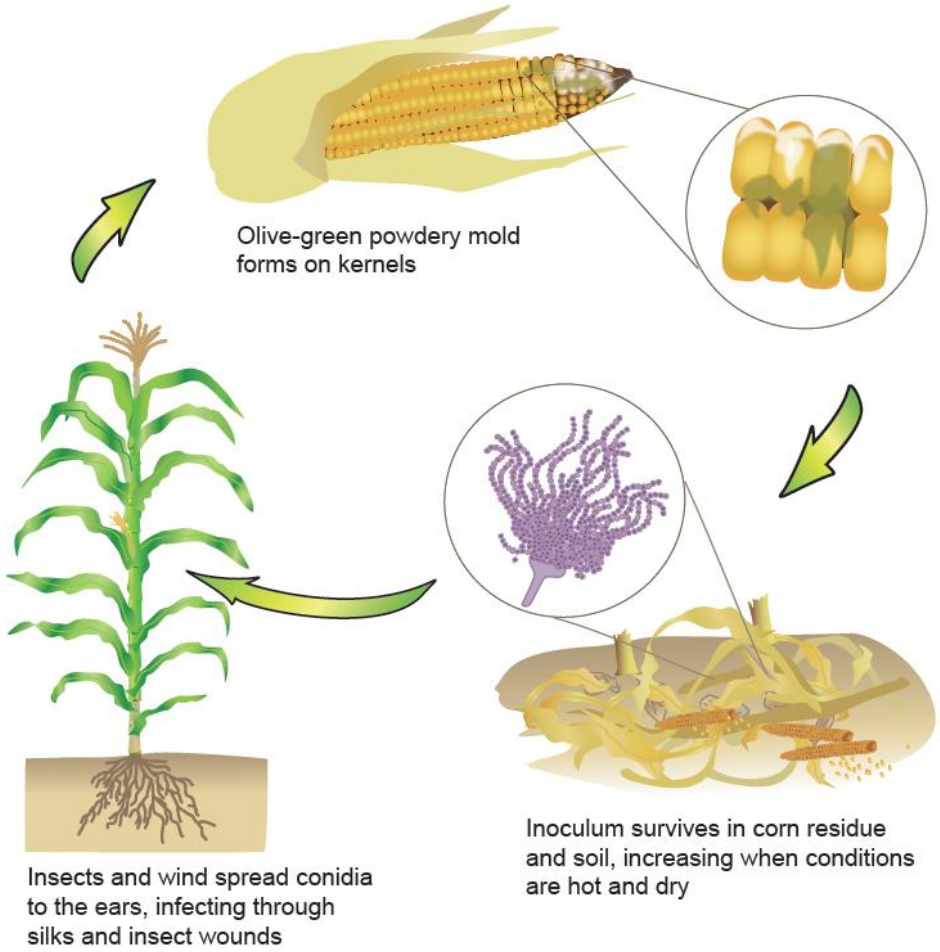


3. Conditions for fungal growth

- Mycotoxins are adapted to damp conditions.
- This is encouraged by;
    i. High humidity (wet condition) - Above 50%. This is a key mold growth factor.
    ii. High temperature - Encourages rate of mold production, hence mycotoxin contamination.

4. Insects and fungal growth

- Crops that are damaged provide place for fungi to enter and cause fungal infections.
- Damaged grains by insects allow seed to absorb more water from environment.
- This encourages fungal growth leading to mold growth.



5. Fungal growth in dry fodder

- Dry forages while in the field are susceptible to fungal growth when it rains.
- Do not cut grass if there is possibility of rainfall during wilting or before baling.
- Bale hay at low moisture above 80% DM.
- Hay baled at high moisture content has an increased risk of fungal growth. This fungi will eventually produce mycotoxins.
- Forages should be properly dried before storage.
- Stores bales properly;
    - Above the ground and well spaced.
    - Area fully protected from rain damages. Hay bales stored on wet surfaces/under leaking roofs allow also prone to fungal growth.
- Do not feed moldy hay to dairy cows and their young stock.

6. Fungal growth in grains

- Fungi infect cereal/pulse crops while in the field.
- Fungi get to grains while in the field and storage.
- Fungi affects;
  - Disease-infested grains especially by fungi.
  - Damaged grains.
  - Grains that are not sufficiently dried before storage (high moisture content).
  - Grains with high moisture content above 12%-15%.

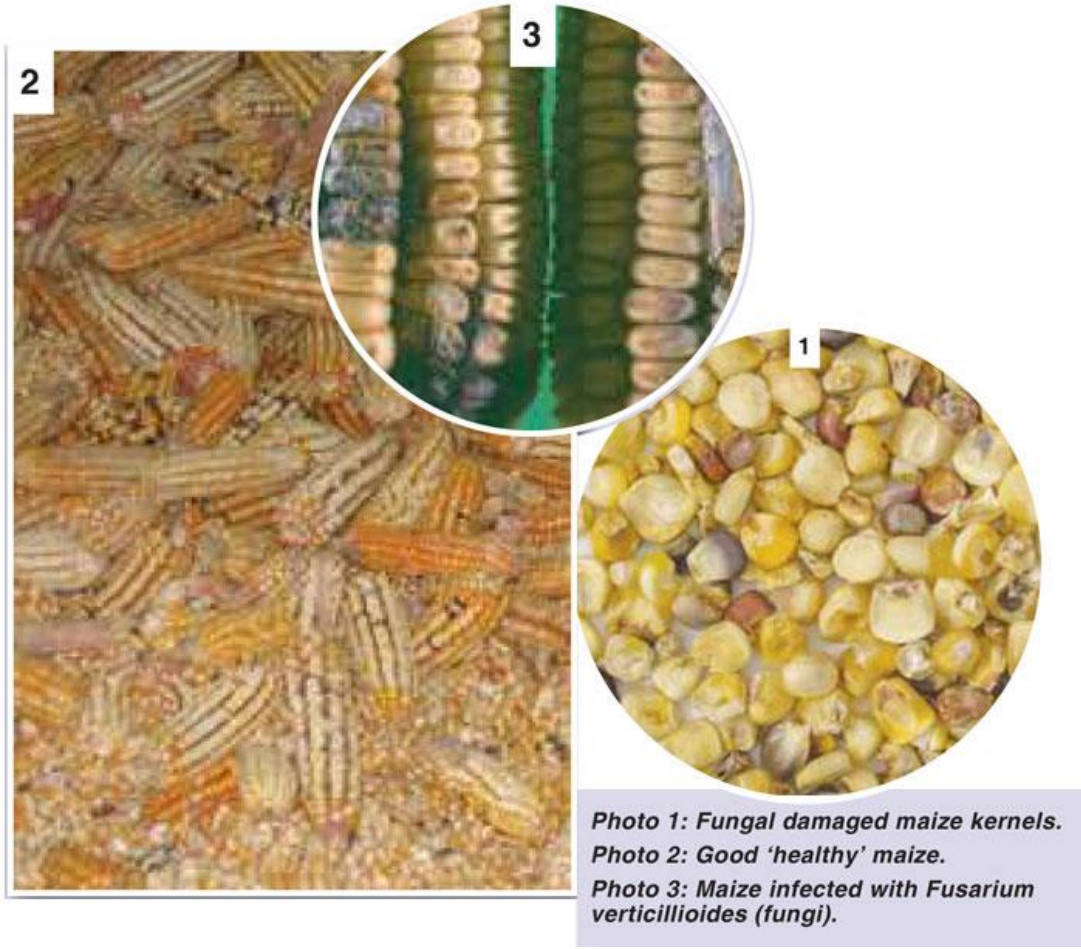


Photo 1: Fungal damaged maize kernels.
Photo 2: Good 'healthy' maize.
Photo 3: Maize infected with Fusarium verticillioides (fungi).

7. Fungal growth in wet forages (silage)

- Poor silage making & management encourages molding by fungi leading to mycotoxin contamination.
- These practices includes:
  i. Delayed and poor covering of pit allows air entry.
  ii. High chopping length of forage.
  iii. Poor compaction of silage.
  iv. Poor feed speed encouraging air entry.
  v. Poor closing of pit at feed out.

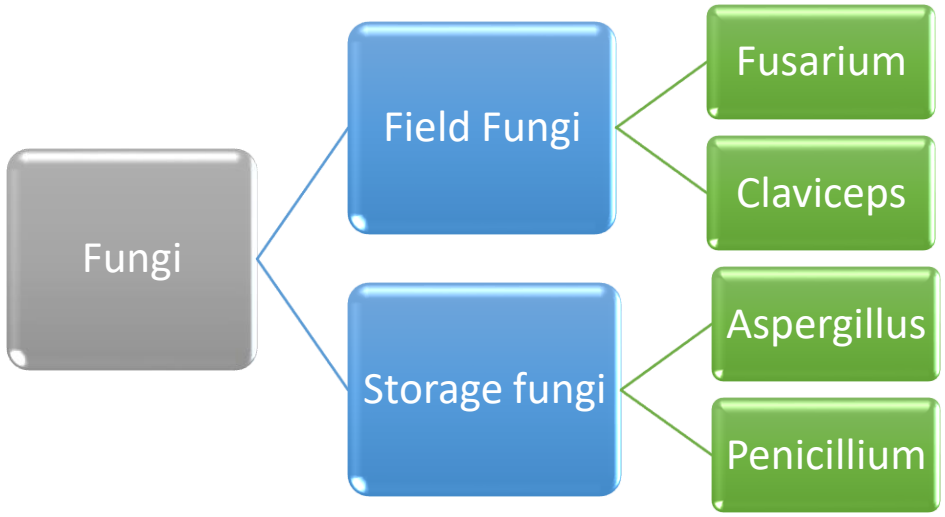
Silage attacked with mold

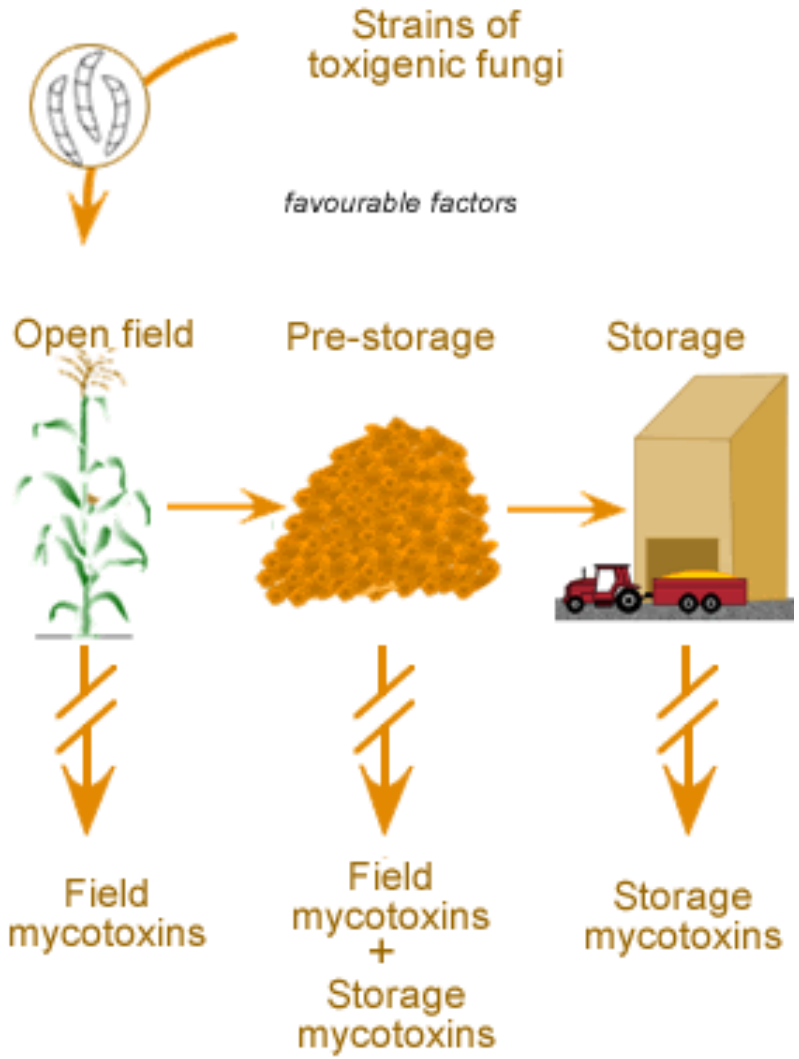
8. Fungal spores

- Fungal spores are microscopic (not visible by the naked eye) biological particles that allow fungi to be reproduced.
- Fungal spores invade both grains and forage plant parts.
- Forages are invaded through soil contamination during seedling stage affecting plant tissue, causing diseases.
- Physical damage to parts of the plant by insects is an entry path for fungal spores.

9. Types of Fungi

- Fungi-producing mycotoxins get in contact with plants at different stages in the fields.
- These fungi are clustered into:
  1. Field fungi
  2. Storage fungi





9.1 Field Fungi

- These fungi invade crops before and after harvest.
- Examples of field fungi include;
  - Fusarium
  - Claviceps
  - Neotyphodium
- Many plant diseases are produced by fungi. Examples of diseases are: Ear rot, stalk rot, anthracnose, smut disease.

9.2 Storage Fungi

- These fungi invade forages and grains during storage.
- Mostly affects forages and silages.
- Examples of storage fungi include;
  - Aspergillus
  - Penicillium
- Aspergillus is responsible for production of aflatoxins.

10. Identifying mycotoxins in forages & feeds

Grains

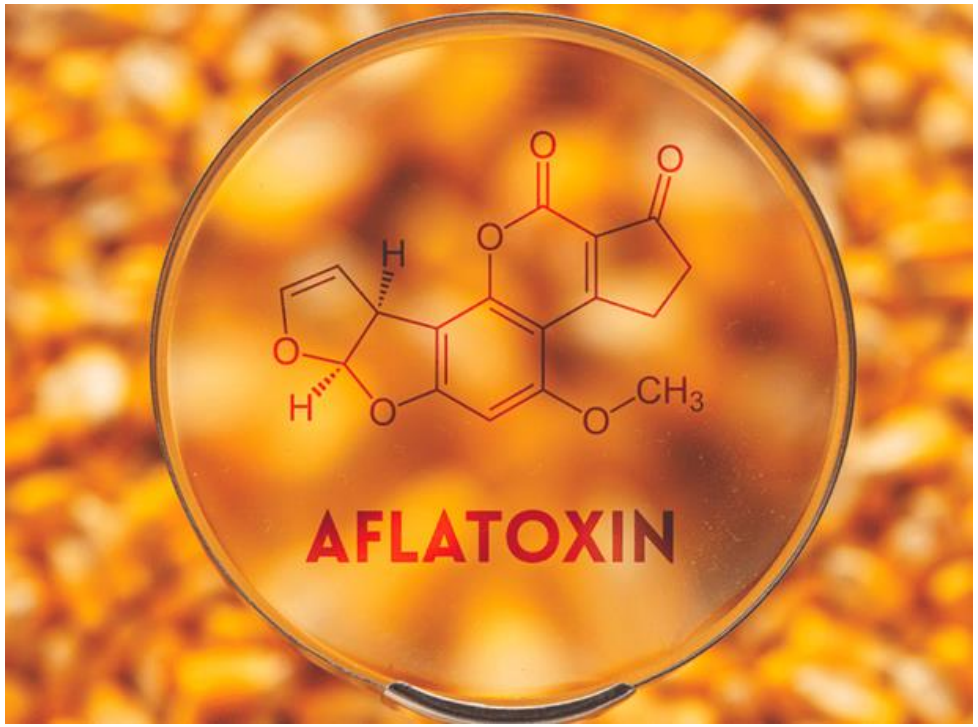
- Light weight of grains.
- Soft seedcoat.
- Easily breakable grains that seem moist.
- Discoloration of grain by mold, grey-green mold is associated with Aspergillus and white-pinkish with Fusarium.
- Musty smell in some cases.

Forages

- Discoloration by molds on forages white, reddish to dark brown color.
- Dump forages.
- Musty to no smell in some cases especially silage.

11. Competitive advantages of mycotoxins

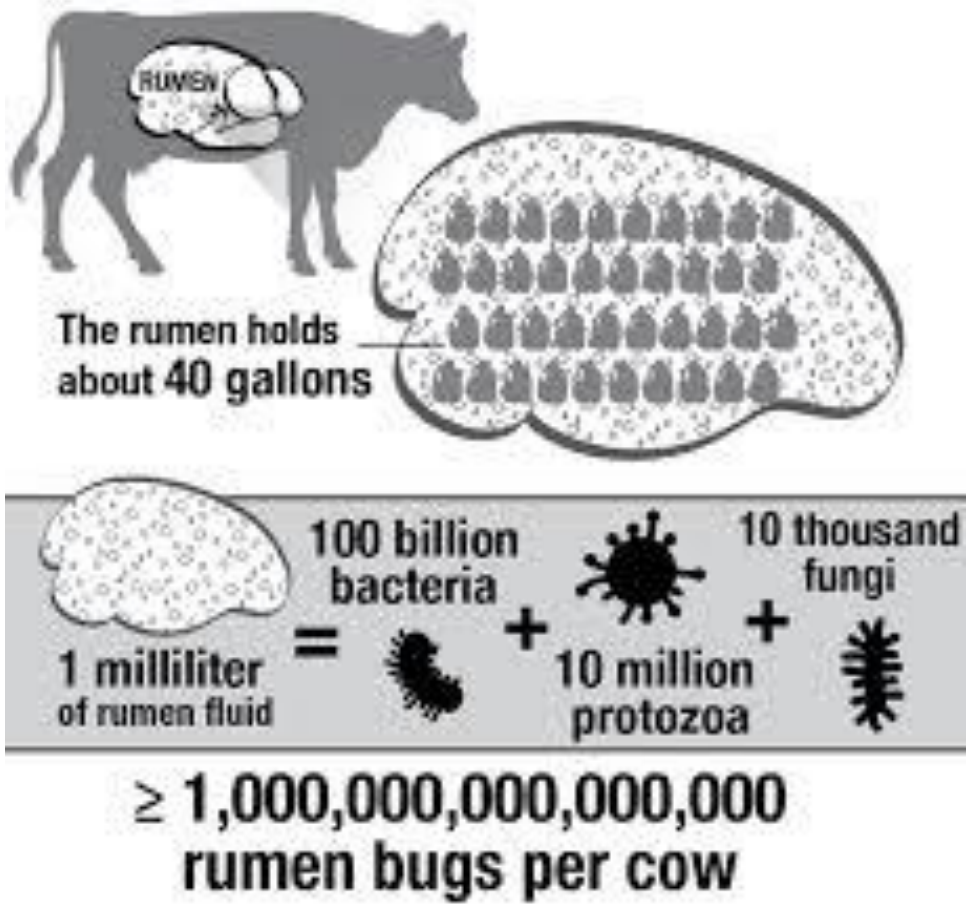
- Mycotoxins in farms are not easy to detect for a couple of reasons:
  i. Difficult to detect with naked eyes.
  ii. Fungicides only act on the fungi but not the toxins produced.
  iii. They are tasteless.
  iv. They are chemically stable and temperature resistant.
- This means that manufacturing processes do not destroy/incapacitate mycotoxins.



Mycotoxins are chemically stable

12. Rumen as a toxin filter

- Ruminants are able to detoxify mycotoxins i.e. the rumen acts as a toxin filter so to speak.
- This is because the rumen microbes (protozoa) degrade toxins to a certain extent.
- The degraded toxins are excreted mostly through faeces.



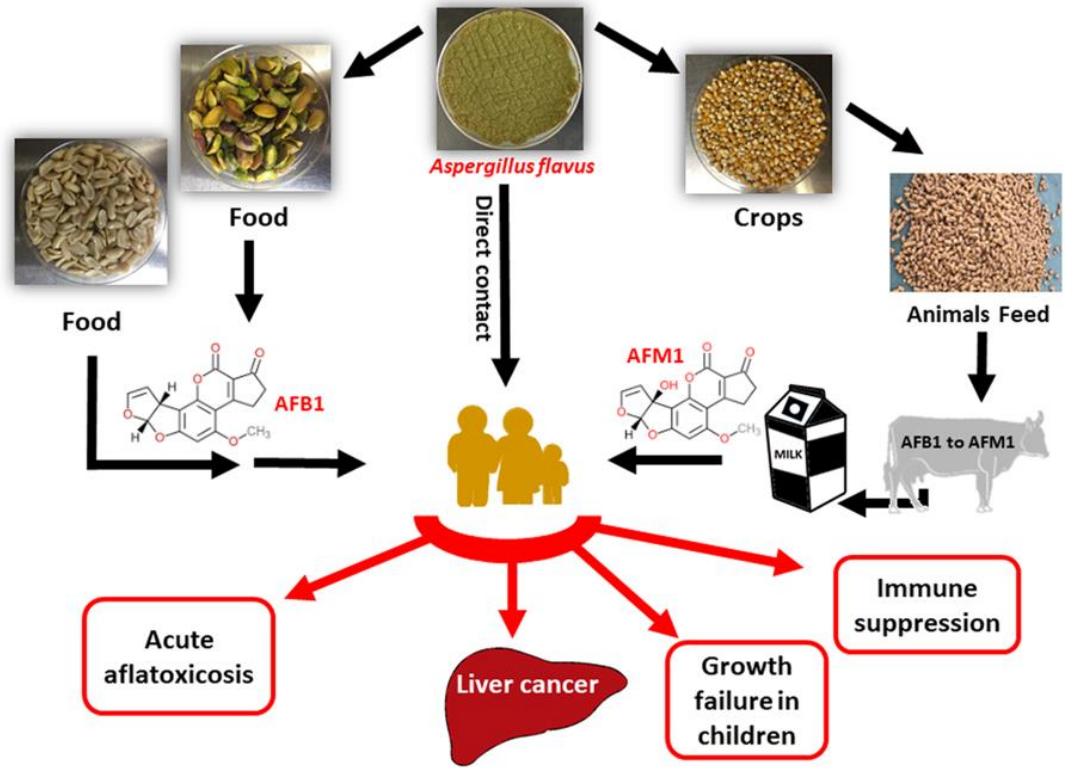
13. Penicillium fungus

- This fungus is mostly found in silages because it can tolerate low pH unlike other fungus species.
- When silage is poorly made and air penetrates stored silage, it encourages growth of yeast. This leads to production of yeasty silage.
- The yeasts consume lactic acid in the silage raising the pH and causing heating up.
- Heated silage has an increased risk of fungal growth.

14. Aspergillus fungus

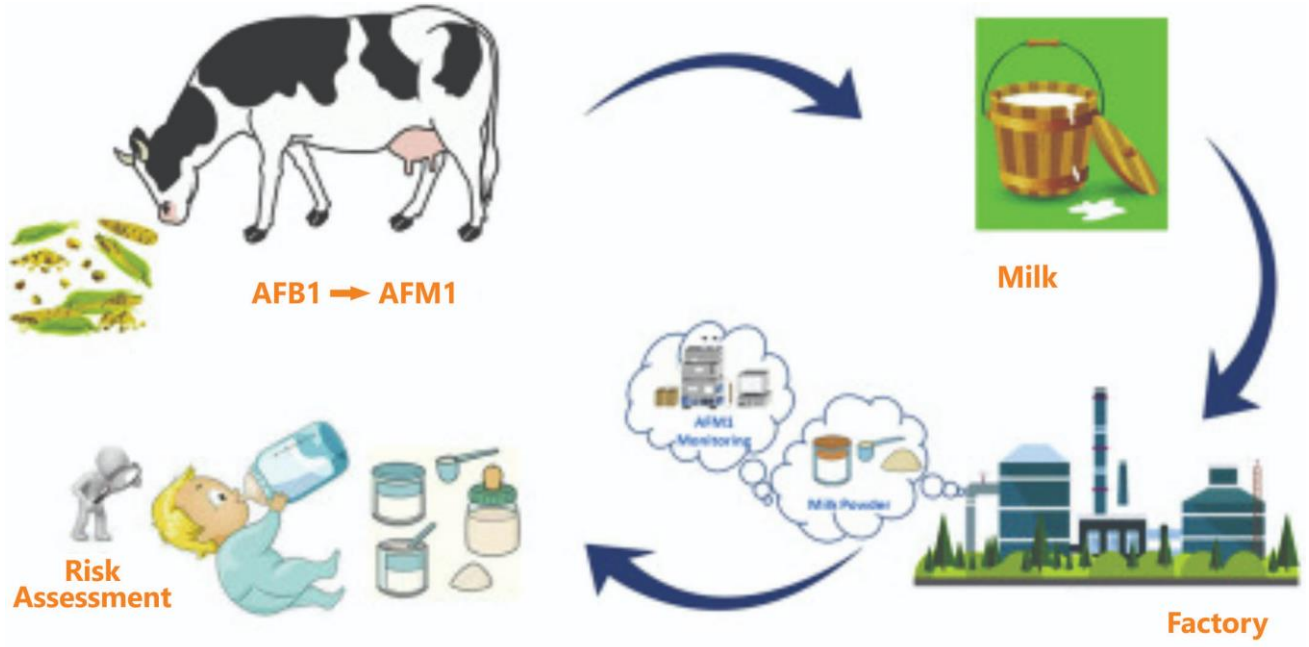
- There are various types of aspergillus namely:
  - *Aspergillus favus*
  - *Aspergillus parasiticus*

- These fungus produce aflatoxins (AFLA B1,B2, G1 and G2).
- Another form of aflatoxins is AFLA M1 and M2.
- It is identified by yellow-green spore masses.



15. Aflatoxin in milk

- When cows take AFLA B1 through contaminated feeds, the liver metabolizes it to AFLA M1. Therefore AFLA M1 and M2 are metabolic by-products.
- After metabolism the AFLA M1 makes way into milk.
- Consumption of this milk passes effects to humans and calves.



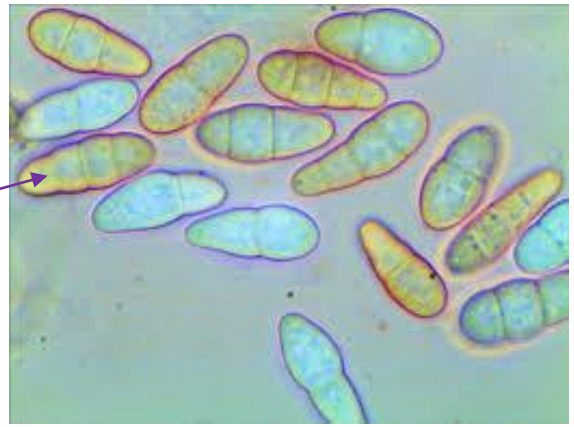
16. Fusarium fungi

Fusarium roseum

- Produces zearalenone (ZEA) toxin.
- Identified by pink mold.
- Zearalenone toxin is known to cause reproductive problems and mammary changes.

Fusarium graminearum

- Fusarium graminearum produces vomitoxin or deoxynivalenol (DON).
- Causes pink ear rot in maize grain and stalk rot.



Fusarium roseum

Reproductive problem
caused by Zearalenone toxin

17. Claviceps purpurea fungus

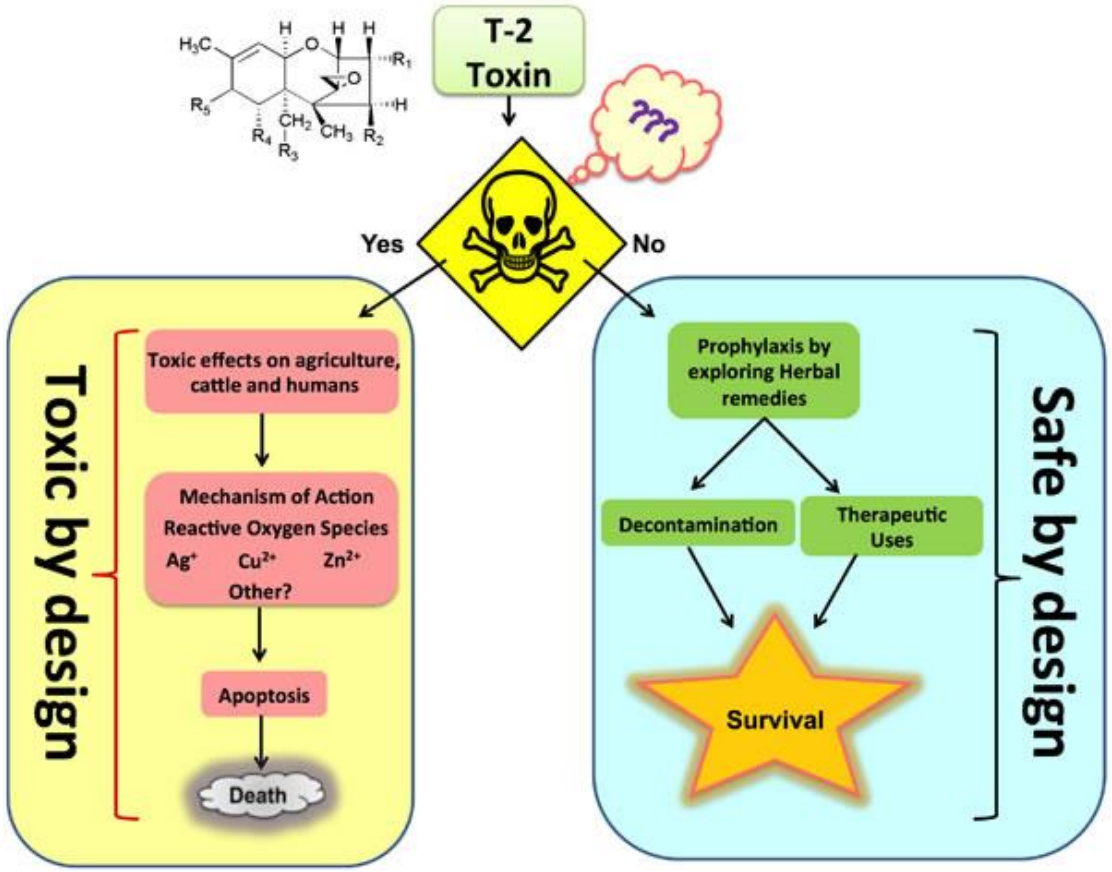
- *Claviceps purpurea* produces Ergot alkaloids.
- Mainly affects grains like wheat and barley.
- Farmers can easily spot this in the field or at harvesting.
- It comprises of a dark brown to black growth on grain heads extending outwards.

18. T-2 toxin

- *Fusarium sporotrichioides* produces T-2 toxin.
- It is identified mostly by white mold or other times pink/reddish mold.

Effects of T-2 toxin

- Diarrhea.
- Bloody gut and hemorrhages.
- Causes immune suppression in calves.
- Increases incidences of disease occurrences.
- In fatal conditions may lead to death.

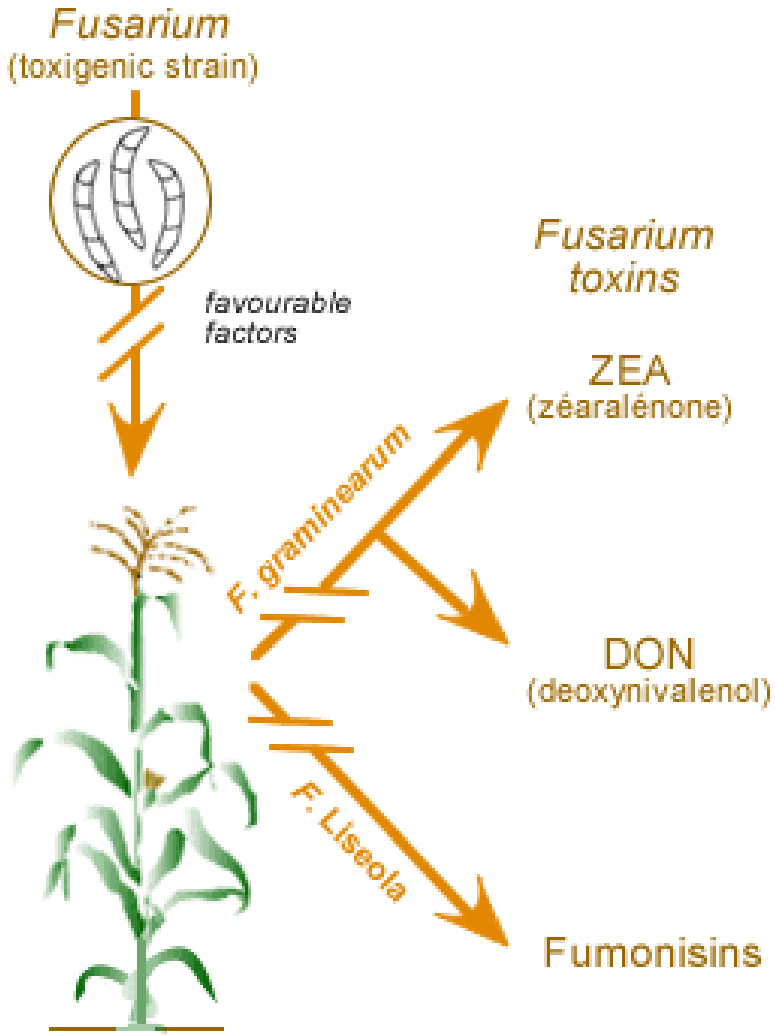


19. Fusarium verticillioides fungus

- *Fusarium verticillioides* (= *Fusarium moniliforme*) produces fumonisins.
- Causes disease especially to corn ears.
- Known to affect horses the most.
- Identified by white-pink mold.

Effects

- Interferes with metabolism of lipids
- Causes nerve degeneration.
- Causes liver and kidney lesions.

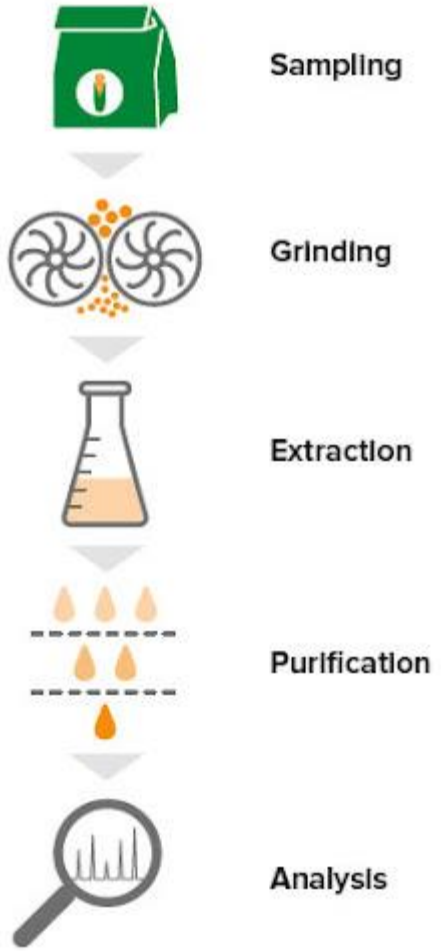


20. Effects of Mycotoxins

- Signs of mycotoxin toxicities are hard to identify but they;
  i. Reduce feed intake and utilization.
  ii. Influence mastitis in the farm.
  iii. Influence incidence of metabolic disorders.
  iv. Cause reproductive problems (ZEA).
  v. Cause immune suppression. Some are known to have carcinogenic effect.
  vi. Cause hemorrhaging of organs and can lead to death.

21. Mycotoxin analysis in forages & feeds

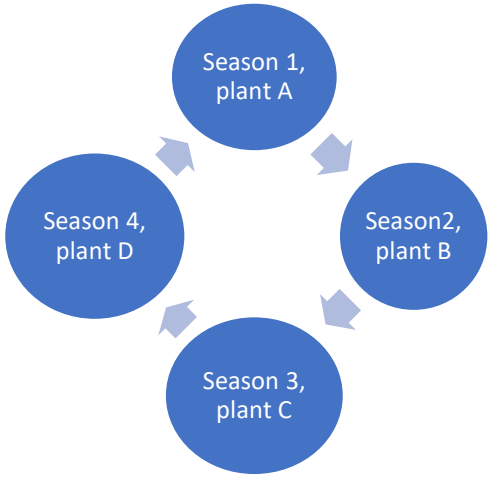
- Concentration level of mycotoxins during analysis are measured in parts per billion (ppb).
- Forage analysis measures concentration level of mycotoxin in the dry matter of forage in ppb.
- Mycotoxins taken in small amounts may cause sub-clinical effects only.
- However, continuous intake leading to high concentration of mycotoxins in the body causes clinical effects.



22. Managing fungi in farms

Crop management practices

- Enhance crop management strategies through;
  - Crop rotation
  - Growing hybrid crop varieties. Example: Fusarium resistant crops (hybrid) to break the cycle of diseases (Fusarium ear rot).
  - Spraying fungicides to control fungi that cause diseases to crops.
  - Timely crop harvesting

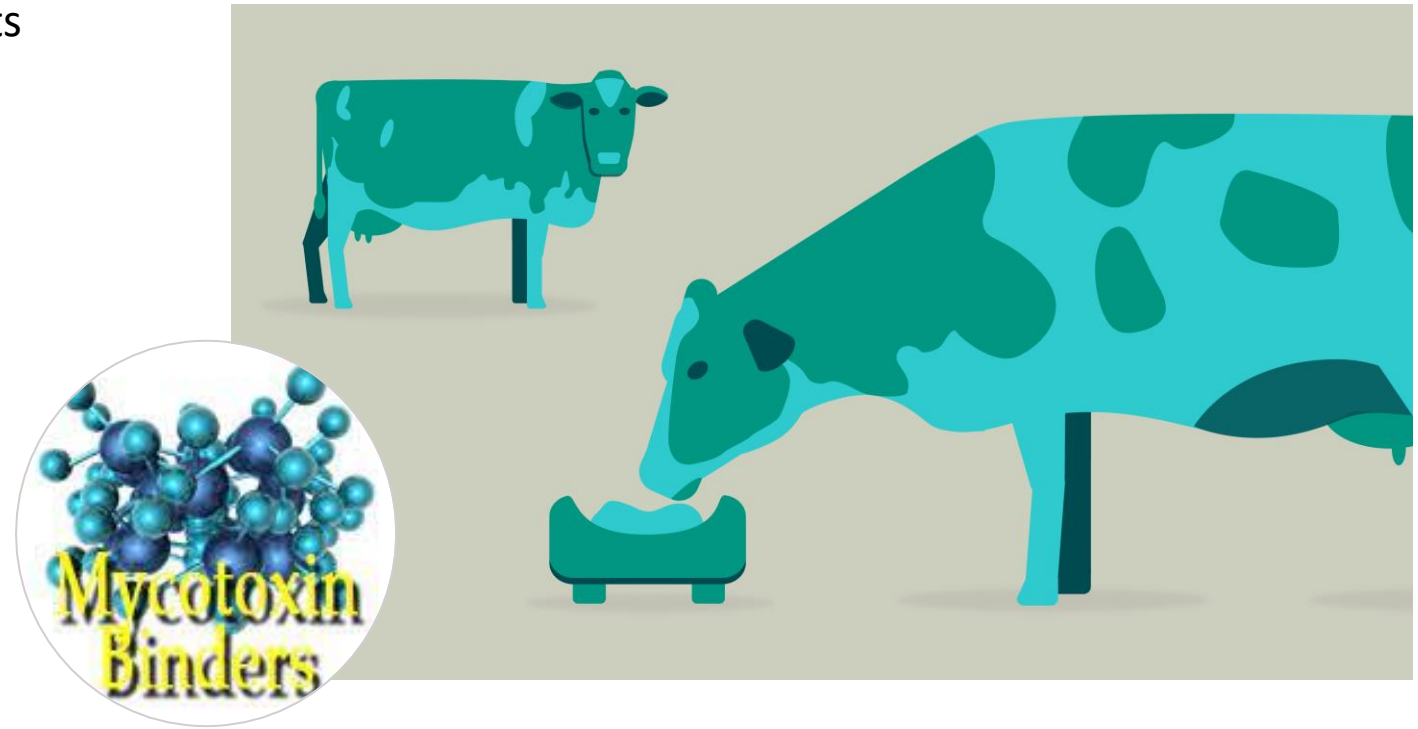


- Remove and avoid feeding moldy feeds to cows.
- Store feeds dry (low moisture content, well ventilated and intact roof and walls).
- Avoid damages to the silage covers, exposure to air and heating of the silage.
- Enhance rumen fermentation to reduce the effect of toxins by;
  - Feeding adequate fiber buffers (roughages).
  - Introducing microbials to feeds.
- Add adsorbents that bind toxins to feed (mycotoxin binders).

Damages on silage cover

23. Mycotoxin binders

- Mycotoxin binders are substances added to feeds in small quantities to prevent serious harm of toxins.
- The use of binders should be as per instructions of the manufacturers or nutritionist.
- These binders can either be;
  - Clay based compounds
  - Yeast cell extracts



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