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Control Of Mycotoxins

Plan of Talk

- Mycotoxins co-contamination
- Sampling for mycotoxins diagnosis
- Feeding strategies
- Mycotoxin adsorbents and binders

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Mycotoxins Co-contamination

- Contaminated feeds or ingredients typically contain **more than one mycotoxins at the same time.**
- When more than one mycotoxin is present in the feed, the **clinical signs of mycotoxicosis are complex and diverse.**
- For this reason, **typical symptoms of mycotoxicosis are often seen** in poultry despite analyses of the feed indicating only very low or zero concentrations of individual mycotoxins.

Cont. …

- **Co-contamination of mycotoxins exerts greater negative effects** on health and productivity than do single mycotoxins.
- Synergistic interactions between different mycotoxins **exaggerates the toxicity symptoms.**

Cont. …

- **Mycotoxicosis risk depends on:**
  1. The level of the major mycotoxins in the feed.
  2. The co-occurrence and level of other mycotoxins.
  3. Avian species, age and health status.

- Therefore, strictly speaking, it is not possible to define safe levels of mycotoxins.
- This complex situation makes it critical to take the necessary precautions.

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Sampling For Mycotoxins Diagnosis

- When clinical signs of mycotoxicosis are observed, it is important to properly collect feed sample and send it to a laboratory to determine the presence and level of the suspected mycotoxin(s).

- The sampling process accounts for 80 - 90% of the error associated with measuring mycotoxins in feed.

Cont. …

Proper sample collection:

1. Contact the laboratory for specific sampling requirements.
2. Collect 10 to 30 samples.
3. Collect samples from several locations within a batch of feed and combine them thoroughly to provide a composite sample for submission.
4. Samples can also be collected periodically from feed.
5. Use paper bags to transport sample(s), since plastic bags retain moisture and therefore can promote additional fungal growth.

Testing For Mycotoxins

Mycotoxins are difficult to measure for a number of reasons:

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Cont. …

1. Many different mycotoxins can be present simultaneously, making analysis difficult and expensive.
   - Under commercial conditions analysis is normally limited to a couple of indicator mycotoxins.
2. Sampling of bulk feeds is difficult.
   - Mycotoxins are present in 'hot' spots and are not evenly distributed throughout the feed.
   - Therefore, strict sampling procedures should be followed with many samples taken from a particular batch to get a realistic reading.
3. Latest research has identified complexes of mycotoxins and their metabolites for which there is no accurate analysis method.

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Feeding Strategies

- As the risk of mycotoxicosis is very difficult to predict or evaluate.
- Prevention strategies should be initiated when assessing even a low risk situation.
- Prevention strategies must primarily aim at minimizing mycotoxin formation in the field and during storage.

Feeding strategy is divided into 2 parts:

1. During cultivation
2. During storage

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1- During Cultivation

- A significant reduction in mycotoxin formation can be achieved by good agronomic practices, for example:
  1. Selection of crop varieties that are more resistant to fungal foliar diseases.
  2. Ploughing up harvest residues.
  3. Avoiding no-till soil management practices.
  4. Proper crop rotation and avoiding monoculture.

2- During Storage

- During storage of dry feed ingredients, mycotoxin formation can be successfully controlled by monitoring the moisture content of the feed.
- If the moisture content is below 12%, moulds become metabolically inactive, and the risk of mycotoxin formation is strongly reduced.

To Avoid Mycotoxin Formation

Consider the following:

1. Moisture content below 12%.
2. Relative humidity below 60%.
3. Storage temperature below 20 °C.
4. Clear grain, avoid broken kernels.
5. Control insects and rodents.
6. Avoid stress (frost, heat, pH changes).
7. The incorporation of technical mould inhibitors enhances stability of feed and ingredients during storage.

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Mycotoxin Adsorbents and Binders

- **Mycotoxin adsorbents or binding agents, are the most common approach to prevent and treat mycotoxicosis in animals.**
  - They bind to the mycotoxin preventing them from being absorbed.
  - Both, the mycotoxins and the binding agent are excreted in the manure.

Cont. …

- **A broad binding capacity of mycotoxin adsorbents or binding agents will:**
  1. Ensure at least some fraction of all the mycotoxins will be rendered non-bioavailable and the bioavailable mycotoxins will be below the threshold of biological activity.
  2. Minimize the potential for toxicological synergy between mycotoxins.

- **Level of mycotoxin adsorbents dietary inclusion depends on:**
  1. The mycotoxin binding capacity of the adsorbent.
  2. The degree of contamination of the feed in question.

Cont. …

High binding capacity / Low inclusion rate capacity will:

1. Minimize the level of inclusion.
2. Minimize the reduction in nutrient density caused by the feeding of the adsorbent.

Low binding capacity / High inclusion rate capacity will:

1. Alter the physical properties of the feed which might impair feed processing such as pellet formation.
2. Altering the actual diet specification.

Cont. …

- **Mycotoxin binding is achieved through both:**
  1. **Physical adsorption**
     - Relatively weak bonding involving van der Waals interactions and hydrogen bonding
  2. **Chemical adsorption:**
     - (Chemisorption) is a stronger interaction which involves ionic or covalent bonding.

Cont. …

- **An effective binding agent is one that:**
  1. Prevents or limits mycotoxin absorption from the gastro-intestinal tract of the animal.
  2. Free from impurities and odours.

- **Note**
  - Many can impair nutrient utilization and are mainly marketed, based on *in-vitro* data only.

Types Of Mycotoxin Adsorbent

- **There are two types of mycotoxin adsorbent/binder:**
  1. Inorganic binders
  2. Organic adsorbents

Inorganic binders

- **Inorganic mycotoxin binders are silica based polymers.**
- **Examples could include:**
  1. Zeolites
  2. Bentonites
  3. Bleaching clays from the refining of canola oil
  4. Hydrated sodium calcium aluminosilicates (HSCAS)
  5. Diatomaceous earth
  6. Numerous clays

Cont. …

- **They can be grouped into two categories:**
  1. Phyllosilicates
  2. Tectosilicates

Cont. …

- **Advantages:**
  1. **Inexpensive and easy to handle**
     - Costs are cheap but require a high inclusion rate in animals.
     - They can be mixed with compound feed at a mill or mixed on farm for home mixers.
- **Disadvantages:**
  1. Adsorb specific mycotoxins.
  2. Bind minerals and vitamins.
  3. May cause health complications due to the high inclusion rate.
  4. Too expensive for industrial applications.
  5. They are non-biodegradable.
     - They can present disposal problems when fed at high levels of dietary inclusion.

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Organic Adsorbents

Organic mycotoxin adsorbents are carbon based polymers, such as;

- Fibrous plant sources such as:
  - Extracts of yeast cell wall
  - Cellulose
  - Hemi-cellulose
  - Pectin
  - Oat hulls
  - Wheat bran
  - Alfalfa fibre

Cont. …

- **Advantages:**
  1. They are biodegradable.
  2. Benefits of yeast cell wall are:
     1. Low inclusion
     2. High surface area
     3. No toxic contaminants

Characteristics of Mycotoxin Binder

1. Proven efficacy *in vivo* as well as *in vitro.*
2. Low effective inclusion rate.
3. Stable over a wide pH range.
4. High affinity to adsorb low concentrations of mycotoxins.
5. High capacity to adsorb high concentrations of mycotoxins.
6. Ability to act rapidly before the mycotoxin can be absorbed into the blood stream.

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