TRENDS IN AGRICULTURE SCIENCE
Popular Article
Vol.2 Issue 10 October 2023, Page: 826-831

Effective Strategies for Safeguarding Feeds Against Insects, Rodents, and Microbial Spoilage

Trishna Das[1], Raj Sahoo[2], Sonali Namdeo[1], P. Bagavan Reddy[1], Narayana Rathode[1]
[1]Animal Nutrition Division, ICAR-Indian Veterinary Research Institute, Izatnagar, U.P 243122
[2]Division of Veterinary Biochemistry, ICAR-Indian Veterinary Research Institute, Izatnagar, U.P 243122
https://doi.org/10.5281/zenodo.10055528

Abstract

As the global population grows, food security becomes critical. However, significant cereals losses due to spoilage and inadequate storage persist. Efficient storage and marketing practices are vital for managing food shortages in both developed and underdeveloped countries. This article highlights the importance of minimizing storage losses by ensuring proper drying, using weatherproof structures, employing insecticides for pest control, and managing rodents. It discusses various types of losses and biological agents like insects, fungi, and rodents responsible for deterioration. Control measures include hygiene, better drying, and rodent control. Chemical and engineering factors are addressed, emphasizing proper storage designs. Additionally, the article discusses microbial damage and control measures, including mold-controlling agents in compound feeds.

Keyword: Fooder, storage, insects, fungi, rodents

Introduction

As the global population continues to grow, ensuring a stable food supply becomes an increasingly urgent priority. One critical yet often overlooked step in achieving this goal is the reduction of food losses that occur between the time of harvest and consumption. Despite technological advancements, significant quantities of cereals are wasted every year due to various forms of spoilage. Protecting food supplies through sound storage practices is of paramount importance. Efficient storage and marketing practices can make a significant contribution to both underdeveloped and developed countries where food and feed shortages are severe. Properly storing feeds and fodders for regular use within an efficient feeding system is essential. Fodders can be preserved either as silage or as hay, while concentrate feeds are typically procured in large quantities, stored, and used regularly. Common feed ingredients include cereal grains like sorghum, maize, and bajra, edible oil cakes such as groundnut oil cake, sesame oil cake, cottonseed cake, and deoiled rice bran, among others. Most of these ingredients are either direct

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023

agricultural products or by-products of agriculture or agro-industries. Losses can occur at the field level during harvesting and post-harvest operations, such as threshing, cleaning, and drying.

Storage losses are particularly significant for all feed ingredients and can manifest as either qualitative or quantitative losses. These losses are primarily caused by insects, fungi, and, notably, rodents, such as rats. The activity of these biological agents is heavily influenced by the storage environment. Fungal losses often result from the development of harmful metabolites like aflatoxin and zearalenone. Additionally, grains may decay or die due to fungal attacks. Rodents not only consume the feed but also contaminate it with their excretions. Moreover, they damage containers by gnawing holes, leading to leakage and waste of feed ingredients. To minimize storage losses, it is essential to take some precautions and control measures.

Precautions And Control Measures

1. Proper Drying: Thoroughly dry the fooder to reduce the moisture content to less than 10%. Low moisture levels discourage the growth of fungi and the proliferation of insects.
2. Weather-Proof Storage: Ensure that storage structures, such as sheds and buildings, are entirely weatherproof to prevent rainwater leakage. Controlled ventilation can help prevent the build-up of high temperatures and humidity.
3. Insect Pest Control: Use dust forms of insecticides like Malathion and lindane to control insect pests.
4. Rodent Control: Rodent control is crucial both during storage and in the fields. Employ rat traps, cats, and dogs to keep rodents at bay. Additionally, use poisoned baits to control rodent populations. In the fields, aluminum phosphide tablets can be placed in rat holes and plugged to control rodents. For storage, baits prepared using zinc phosphide (0.5%) are particularly effective in minimizing rodent infestations.

Losses In Storage

Loss is measured as reduction in weight in the amount of feed available for consumption. Loss may be Quantitative, Qualitative, Economical, Nutritional and Germinative**.** The loss can be prevented or reduced by better management at pre-harvesting stage, during harvesting, threshing and shelling, drying and by applying sound storage practices. Grains stored under favourable conditions for many years undergo relatively minor changes in composition and can be used as a source of nutritious and palatable food or animal feed, but under unfavourable conditions result in complete spoilage of grain for food or feed purpose within a few days.

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023

Principle Biological Agents That Cause Deterioration During Storage

Insects

At a temperature of 32°C, the rate of insect species multiplication increases by a factor of fifty. Insects share similar nutritional requirements with vertebrates, making crops with high nutritive value more susceptible to insect damage. The presence of dead and live insects, as well as their excreta, can render a commodity unpalatable and unacceptable.

To control insect infestations, the following measures should be taken:

1. Maintain Good Hygiene: Keep the storage area clean and free from debris. Regular cleaning and inspection of storage containers and stored food items are essential.
2. Segregate New and Old Grain: Store new, dry grain separately from older grain to prevent the spread of infestations.
3. Remote Storage: Position storage facilities at a distance from the fields to reduce the risk of infestation from the outset.
4. Traditional Pest Control Methods: Promote the use of traditional pest control methods, such as the use of local herbs, mixing ash with grain, and smoking. These methods have proven to be effective and should be encouraged.
5. Use of Grain Storage Insecticides: Employ appropriate grain storage insecticides as needed such as
    - Contact Poisons: Utilize contact poisons in the form of dust, dispersible powders, and emulsions. Malathion is one such example.
    - Fumigants: Implement fumigants, which are gases capable of penetrating the bulk of the grain. However, these should be used by trained personnel to ensure safety and effectiveness.

Rodents

Rodents not only consume food but also foul with their excretions. Further they destroy containers by gnawing holes that results in leakage and wastage of grain.

Control

- Rodent exclusion efforts in store construction.
- Fumigation with phosphine and other gasses.
- Trapping and hunting.
- Use of cats and dogs.
- Rodent repellants.

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023

- Poison baiting with chlorofacinone, warfarrin, coumarin, zinc phosphate, barium carbonate etc.

In acute case: Zinc phosphide,Calcium cyanide 0.5%,Aluminium phosphide,

In chronic cases: Warfarin 0.05%**, Coumarin**

Microbial damage

Micro-organisms are biological contaminants of the natural environment and are present in all feedstuffs. They persist after crops have been harvested from the fields and in animal carcasses prior to rendering. Because bacterial and field fungi do not thrive at moisture levels below 20 percent, post-harvest processing of commodities and animal renderings involving heat, chemical and mechanical extraction, and dehydration eliminate most of the original contaminating microflora. Fungi spores, which are resistant to harsh processing treatment, may remain dormant in the processed feedstuff until more favourable conditions once again permit their proliferation.

Factors Affecting Fungal Growth in Feedstuffs

Recontamination of feedstuffs by adventitious micro-organisms during storage is of primary concern to the feed processor. Adventitious storage fungi grow at moisture content (15 to 20 percent) in equilibrium with a relative humidity of 70 to 90 percent and are considered the principal spoilers of feedstuffs in storage. When the relative humidity falls below 65 percent no growth occurs. Under favourable conditions, fungi can raise the temperature in their immediate environment to 55°C with con commit tent increase in moisture content of the affected feedstuff to as high as 20 percent. When this occurs, secondary spoilage by bacteria takes place. The most common fungi involved in the spoilage of feedstuffs belong to the Aspergillus spp. and the Penicillium spp. These grow at temperatures up to 55°C and at a minimum, relative humidity of 65 percent. They are most destructive when temperatures exceed 25°C and relative humidity exceeds 85 percent.

The chief effects of storage fungi on feedstuffs are: Mycotoxin production, Heating, Moisture increase, and Mustiness (staleness).

FUNGI/ mould infestation

Mold infestation in animal feed materials remains a common and ongoing challenge. Despite efforts, there is no foolproof method to entirely prevent it. Fungi produces metabolites like aflatoxin, zeara-lenone. The fungus development occurs in the stored feed ingredients in cases of inadequate drying, due to high humidity and due to wetting. For feed millers and farmers, whether in dairy, poultry, or swine, mold control in raw materials is a continuous and demanding task. Mold contamination not only compromises the nutritional quality of feed materials but also poses health risks to both animals and humans. Animals consuming highly mold-contaminated feed can excrete

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023

mycotoxins in their urine, feces, and milk, further underscoring the importance of effective mold management.

Important Reasons for Mold Growth in Feed Raw Materials and Animal Feeds:

1. Nutrient Encapsulation: Mold growth on intact grains is slow because it requires nitrogen and energy, which are trapped inside the grain.
2. Environmental Factors: Molds thrive under specific temperature and moisture conditions. Aspergillus and Penicillium flourish in tropical climates with high temperatures and humidity, while Fusarium prefers colder climates.
3. Oxygen Requirement: Molds are obligate aerobic organisms, dependent on oxygen for growth. Control mold proliferation by maintaining anaerobic conditions.
4. Water Activity (Aw): High Aw values (greater than 0.6) indicate an increased risk of mold growth, making it essential to monitor water activity in feed materials.

Steps to Prevent Mold Proliferation in Feed Raw Materials:

1. Enhance Awareness: Collaborate with technical institutes and government agencies to raise awareness among agriculturists about better post-harvest measures.
2. Quality Control: Extend analytical measures to raw materials in quality control labs to identify and address mold contamination issues.
3. Vendor Standards: Ensure vendors maintain high-quality grains to procure good feed raw materials.
4. Conscious Efforts: Promote awareness and conscious efforts in both feed millers and during raw material procurement.
5. Quality Control Norms: Implement good quality control standards in feed milling operations.
6. Screening on Arrival: Screen raw materials upon arrival to assess their quality and make acceptance or rejection decisions.
7. Storage Management: Prioritize the storage area to prevent nutrient loss, a significant economic concern.
8. Moisture Control: Avoid high moisture ingredients to minimize additional storage costs.
9. Inventory Management: Implement FIFO and batch systems to prevent the accumulation of old materials that could lead to contamination.
10. Pest and Mold Management: Adopt global standard practices for pest, insect, and mold control in raw materials.

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023

11. Regular Audits: Conduct periodic internal and external audits to improve quality systems based on feedback.
12. Moisture Optimization: Utilize modern feed moisture optimization programs to control moisture levels and mold inhibitors effectively.
13. Mold Inhibitors: Choose mold inhibitors carefully, considering buffered organic acids, activated propionates, and surfactants for preservation.
14. Toxin Management: Use quality toxin binders to mitigate the risk of mycotoxins in the end product.
15. Maintenance and Compliance: Routinely review HACCP compliance and conduct scheduled maintenance of the feed mill to address critical areas.
16. Silage Preparation: Dairy farmers making their own silage should be aware of pre-harvest and post-harvest mold contamination risks.
17. Silage Preservatives: Use proper silage preservatives and ensure effective packing of the silage pit to prevent mold growth and mycotoxin contamination.

Control

The prevention of mould contamination of stored feedstuffs depends mainly on the successful control of insect infestation, because the destructive activities of insects often create conditions favourable to mould; viz., increased moisture and temperature and the destruction of the protective hulls of feed grains expose their moist interiors. There is no effective way of eliminating mould, although effective measures have been developed to control their growth in compound feeds. These measures include the use of propionate and, more recently, gentian violet.

Official Website: trendsinagriculturescience.com
Email Address: trendsinagriculturescience@gmail.com
Published: 30 Oct 2023