

Factor Affecting the Quality of Stored Grain and Grain Storage Management

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Stored grain refers to the grains (such as wheat, rice, corn, barley, oats, and others) that are harvested and kept for future use. The storage of grain is an essential component of agriculture, ensuring a steady supply of food and raw materials for various industries throughout the year, especially when harvests are out of season. Stored grain is a grain that is kept for human and animal consumption. It is an important step between harvesting and processing or consuming the grain. Proper grain storage also serves as a safeguard against crop failures and market fluctuations.



Grain storage can take place in different forms, ranging from simple traditional methods like sacks and granaries to advanced, large-scale storage systems such as silos and warehouses. The goal is to maintain the quality of the grain, prevent spoilage, and protect it from pests, rodents, and environmental conditions.

Key factors in effective grain storage include

- 1. Moisture Control:** Excess moisture in grain can lead to mold growth and spoilage. Thus, controlling humidity and maintaining optimal moisture levels is crucial to prevent deterioration during storage.
- 2. Temperature Management:** Grain is highly sensitive to temperature. Ideal storage temperatures reduce the growth of harmful microorganisms and preserve the grain for long periods.
- 3. Pest and Disease Control:** Stored grains are prone to infestation by insects, rodents, and fungi. Integrated pest management (IPM) practices and proper sealing of storage facilities are essential for keeping these threats at bay.
- 4. Aeration:** Aerating the stored grain helps in preventing the development of hot spots, which could cause spoilage or the growth of harmful bacteria.
- 5. Storage Facilities:** The type of storage facility used depends on the quantity of grain and the length of time it needs to be stored. Small-scale storage might involve bags or bins, while large-scale storage often uses modern silos, which are specially designed for bulk storage, aeration, and pest control.

Overall, stored grain plays a critical role in food security, providing a buffer between harvest seasons and ensuring that the supply of grains can meet consumer demand, even in times of drought, flood, or other natural disasters. However, improper storage practices can result in significant losses due to spoilage, pests, or diseases, making careful management of grain storage essential for economic stability and food safety.



Factor affecting quality of stored grain

The quality of stored grain can be influenced by several factors, ranging from environmental conditions to the handling practices. These factors affect the grain's physical, chemical, and biological properties, and can impact its nutritional value, taste, and marketability. Here are the key factors:

1. Moisture Content

- **Impact:** Moisture is one of the most critical factors affecting the quality of stored grain. High moisture content promotes the growth of moulds, fungi, and bacteria, leading to spoilage and reduced nutritional quality. Low moisture content is essential for preventing microbial growth and maintaining grain integrity.
- **Ideal Range:** Typically, the moisture content for safe storage is around 12-14% for most grains (depends on the grain type).

2. Temperature

- **Impact:** The temperature at which grains are stored significantly affects their quality. High temperatures (above 20°C) can accelerate respiration and the growth of microorganisms, leading to faster deterioration. Conversely, storing grains at lower temperatures can slow down these processes.
- **Ideal Range:** A temperature between 10-15°C is generally recommended for storage.

3. Relative Humidity

- **Impact:** High relative humidity can increase the moisture content of the grain, promoting the growth of fungi, mould, and insects. Low humidity is more beneficial in maintaining the grain's quality by reducing the chances of moisture absorption.
- **Ideal Range:** Relative humidity of around 50-60% is typically ideal.

4. Air Circulation and Ventilation

Impact: Poor ventilation can lead to the accumulation of heat and moisture within the storage area, which encourages mould growth and pest activity. Good air circulation helps maintain stable temperature and humidity, reducing spoilage risks.

Ideal Condition: Continuous air circulation should be ensured to avoid hot spots and moisture buildup.

5. Insect Infestation

1. **Impact:** Insects such as weevils, beetles, and mites can damage the grain, leading to loss of weight, contamination, and reduced quality. Insects can also cause the spread of diseases.
2. **Control Measures:** Use of insect-proof storage containers, fumigation, and regular monitoring for infestations.

6. Grain Cleanliness and Pre-storage Treatment

- **Impact:** Grains that are not properly cleaned before storage can harbor pests, dust, and debris, which can lead to contamination and spoilage. Pre-storage treatments such as drying, cleaning, and sometimes chemical treatments can help preserve grain quality.
- **Pre-treatment:** Thorough cleaning, drying to proper moisture levels, and the use of preservatives or insecticides.

7. Handling and Transportation

- **Impact:** Rough handling during harvesting, transport, or storage can damage the grain, leading to broken kernels, which are more vulnerable to pests, spoilage, and quality deterioration. Grain handling practices should aim to minimize damage.
- **Careful Practices:** Minimize grain exposure to rough surfaces, and avoid moisture contact during transport.

8. Storage Duration

- **Impact:** The longer the storage period, the higher the risk of quality degradation. Over time, even under ideal conditions, grains will naturally degrade due to the slow processes of respiration, oxidation, and enzymatic activity.

- **Optimal Time:** Grain should be consumed or processed within the time frame specified for that particular variety to prevent quality loss.

9. Fungal and Bacterial Growth

- **Impact:** The presence of moisture and warmth can lead to the growth of fungi like *Aspergillus* and *Fusarium*, which produce mycotoxins. Bacteria can also cause the spoilage of grain.
- **Prevention:** Good sanitation practices, moisture control, and proper ventilation are essential to reduce the risk of fungal and bacterial contamination.

Grain storage management

Grain storage management is a critical component of the agricultural supply chain, ensuring that harvested grain is stored safely and efficiently to maintain its quality, prevent spoilage, and minimize losses. Effective grain storage helps maintain the grain's value until it can be processed or sold. Here are some key aspects of grain storage management:

1. Storage Structures

- **Silos:** Large vertical structures used to store grains like wheat, corn, rice, etc. They can be made of steel, concrete, or other materials.
- **Bins:** Smaller than silos, bins can be made of metal, wood, or plastic and are typically used for shorter-term storage.
- **Warehouses:** These are large buildings used for bulk storage and may be used for grains that don't require specific environmental controls.
- **Outdoor Storage:** Sometimes, grains are stored in piles covered with tarps or in temporary storage structures, but this increases the risk of spoilage.

2. Environmental Control

Grain quality can deteriorate if exposed to extreme conditions, so controlling the environment is critical:

Temperature Control: Grain should be stored at temperatures that prevent mould and pests. Ideal temperatures vary but are typically between 10°C to 15°C (50°F to 59°F).

- **Humidity Control:** Excess moisture promotes Mold and insect growth. Grain should have a moisture content of 12-14% for long-term storage. Grain dryers are used to reduce moisture levels before storage.
- **Ventilation:** Proper airflow in storage facilities helps control humidity and temperature, reducing the risk of mould and pest infestations.

3. Pest Control

- **Insects:** Grain pests, such as weevils and moths, can infest stored grains. Regular inspections and fumigation (chemical or natural methods) are necessary to prevent infestation.
- **Rodents:** Mice and rats can damage stored grain and spread diseases. Secure storage facilities and the use of traps or poisons may be necessary.
- **Birds:** In some regions, birds can damage grain in outdoor storage. Netting or other deterrents may be used.

4. Grain Monitoring

- **Regular Inspections:** Stored grain should be inspected regularly for signs of spoilage, pest infestations, and moisture buildup.
- **Grain Temperature Sensors:** Many modern storage systems use temperature sensors and data loggers to monitor the grain's internal temperature. This allows for early detection of hot spots, which could indicate microbial activity or insect infestations.
- **Moisture Meters:** These devices are used to measure the moisture content of stored grain to ensure it's within safe limits.

5. Grain Quality Preservation

- **Aeration:** The use of aeration systems (fans or ventilation) is essential for maintaining the quality of stored grain, particularly for large quantities. It helps ensure the grain doesn't heat up and spoils.
 - **Cleaning and Sorting:** Grain should be cleaned before storage to remove foreign matter, damaged kernels, or diseased grains that could lead to spoilage. Sorting can also help ensure uniformity in the stored batch.
 - **Periodic Movement:** Occasionally moving or turning the grain can help ensure even airflow and prevent the buildup of moisture or pests.
- 6. Record Keeping and Inventory Management**
- **Tracking Grain:** Proper documentation of grain type, quantity, storage location, and condition is essential for inventory management. This can include digital tracking systems, such as grain management software.
 - **FIFO (First-In, First-Out):** To prevent older grains from deteriorating, it's important to implement a FIFO system, ensuring that older grain is used or sold first.
- 7. Transportation and Handling**
- **Loading and Unloading:** Grain should be handled gently during transportation and storage to prevent bruising or breakage, which can lower its value.
 - **Bulk Handling Equipment:** Conveyor belts, augers, and other bulk handling equipment are essential to move large quantities of grain efficiently.
- 8. Safety Protocols**
- **Fire Prevention:** Grain dust is highly flammable, so proper ventilation, maintenance, and cleaning of storage areas are crucial to prevent fires.
 - **Training for Workers:** Proper training for those involved in grain storage, handling, and pest control can help avoid accidents, contamination, and spoilage.
- 9. Long-Term Storage Considerations**
- **Grain Conditioning:** Before storing grain for extended periods, conditioning (drying, cooling) is necessary to stabilize the grain and prevent deterioration.
 - **Storage Duration:** The longer the storage period, the more attention is required to ensure the grain doesn't degrade. Some grains, like wheat, can be stored for several months or even a year, while others, like maize, may require more frequent checks.

By managing storage conditions effectively, farmers and grain handlers can protect the quality of the grains and minimize losses due to pests, spoilage, or environmental factors. This ultimately improves the profitability and sustainability of grain storage operations.

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