

# **Factors affecting spoilage in stored rice and shrinkage**

Zhongli Pan

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# Storage Methods

- Silos
- Flat storage facility



# Factors Affecting Spoilage

- **Moisture content:** Rice that is not properly dried or stored in humid conditions can develop mold or fungal growth, leading to spoilage.
- **Storage conditions:** Proper storage is crucial; exposure to moisture, sunlight, or air can lead to deterioration. Improperly sealed containers or bags can also allow insects or rodents to access the rice.
- **Temperature:** Rice should be stored in cool and dry conditions. Higher temperatures can accelerate chemical reactions that affect the quality of rice, such as lipid oxidation.
- **Pests and insects:** Rice can be infested by insects such as rice weevils, which can lead to physical damage and contamination, making it unfit for consumption.

# Factor Affecting Spoilages

- **Packaging materials:** The quality and type of packaging used for storing rice can affect its shelf life. Properly sealed, moisture-proof packaging helps to protect rice from spoilage.
- **Length of storage:** Rice has a shelf life, and storing it for too long can lead to quality deterioration, even if stored under optimal conditions.
- **Quality of raw rice:** The initial quality of the rice, including its cleanliness and whether it was properly processed and dried, can affect how long it can be stored without spoiling.
- **Microbial contamination:** Bacteria, yeasts, and molds can all grow on rice if it is not stored properly, especially if it is exposed to moisture or stored in warm conditions.
- **Chemical contaminants:** Rice can absorb chemicals from its environment, such as pesticides or cleaning agents, which can affect its safety and quality.

# Temperature Management

- **Storage Location:** Choose a cool and dry storage location for rice. Ideally, the temperature should be around 15-25°C (59-77°F). Avoid places that are too warm or fluctuate in temperature, such as near stoves, ovens, or direct sunlight.
- **Air Circulation:** Ensure good air circulation around the stored rice. This helps in maintaining a consistent temperature and prevents pockets of warm air from developing.
- **Use of Containers:** Store rice in airtight containers that are moisture-proof and protect against pests. This helps in maintaining the quality and prevents exposure to humidity or temperature changes.
- **Avoid Temperature Fluctuations:** Minimize temperature fluctuations by keeping rice away from areas that experience drastic changes in temperature, such as near windows, doors, or heating vents.

# Temperature Management

- **Refrigeration (optional):** While not necessary for short-term storage, refrigeration can extend the shelf life of cooked rice. If storing cooked rice for more than a day, cool it quickly and store it in a tightly sealed container in the refrigerator at or below 4°C (39°F).
- **Monitoring:** Regularly monitor the storage area to ensure that the temperature remains consistent and within the recommended range. Use a thermometer if necessary to check the temperature.
- **Proper Handling:** Handle rice carefully to avoid exposure to heat during transportation or distribution. Ensure that rice is not left in direct sunlight or in hot vehicles for extended periods.

# Insect Activity Management

- **Proper Storage Containers:** Store rice in tightly sealed containers that are made of durable materials such as glass, metal, or thick plastic. Ensure lids fit securely to prevent insects from entering.
- **Clean Storage Area:** Keep the storage area clean and free of spilled grains, dust, and debris that can attract insects. Regularly vacuum and sweep the area to remove any potential food sources.
- **Temperature Control:** Maintain a cool temperature (around 15-25°C or 59-77°F) in the storage area. Insects are less active and reproduce slower in cooler temperatures, reducing the likelihood of infestation.
- **Use of Desiccants:** Place desiccants such as silica gel packs or food-grade diatomaceous earth in storage containers to absorb moisture. This helps in creating unfavorable conditions for insect growth and development.
- **Bay Leaves or Herbs:** Place bay leaves or other insect-repelling herbs (like cloves or mint) inside storage containers. These natural repellents can help deter insects without affecting the taste of the rice.

# Insect Activity Management

- **Regular Inspection/Early detection:** Inspect stored rice regularly for signs of insect activity, such as webbing, larvae, or adult insects. If any infested rice is found, discard it immediately and thoroughly clean the storage container before refilling.
- **Freezing (optional):** For long-term storage, you can freeze rice for several days before transferring it to airtight containers. Freezing kills any existing insect eggs or larvae and helps in preventing infestation.
- **Rotate Stock:** Use the oldest stock of rice first (first in, first out method) to minimize the time rice spends in storage, reducing the risk of insect infestation over time.
- **Professional Pest Control:** If infestation persists despite preventive measures, consider consulting a professional pest control service to effectively manage and eliminate insects.



# Insect Early Detection

- **Prevent Infestation Spread:** Identifying insects early allows for immediate action to prevent the spread of infestation to other batches or containers of rice. This containment minimizes potential losses and ensures that only a small portion of the stored rice may be affected.
- **Preserve Product Quality:** Prompt detection and intervention help maintain the quality of the rice. Insects can introduce contaminants and affect the flavor, texture, and nutritional value of the rice. By addressing the issue early, you can preserve the overall quality of the stored rice.
- **Reduce Economic Losses:** Early detection helps minimize economic losses associated with infested rice. It allows for targeted treatment or disposal of affected portions, preventing the need for large-scale disposal or damage to a significant portion of the stored rice.

# Insect Early Detection

- **Maintain Food Safety:** Insects can carry pathogens or contaminants that pose health risks if consumed. Early detection helps maintain food safety by preventing contamination of the rice with harmful substances that insects may introduce.
- **Minimize Pesticide Use:** Early detection enables timely intervention using methods such as targeted insecticides or natural repellents. This approach minimizes the need for widespread pesticide application, reducing potential environmental impact and ensuring safer handling of the rice.
- **Enhance Storage Practices:** Detecting insects early prompts a review of storage practices and conditions. It encourages adjustments to improve storage hygiene, temperature control, and container sealing to prevent future infestations and maintain quality standards.
- **Customer Satisfaction:** By ensuring that rice remains free from pests and contaminants, early detection contributes to customer satisfaction. Consumers expect high-quality, safe food products, and proactive pest management measures help meet these expectations.

# Milling Quality Loss & Economic Effect

California Rice Research Board (CRRB) Report- 2016

Storage Facility	Storage type	Rice category	Milling quality		
			TRY (%)	HRY (%)	WI
<b>A</b>	Metal (Bin 47)	Infested rice	64.81±0.32 a	58.12±0.18 a	40.10 ±0.20 a
		Clean rice	67.57±0.17 b	60.88±0.15 b	40.23±0.33 a
	Metal (Bin 48)	Infested rice	64.16±0.25 a	57.18±0.47 a	39.53±0.24 a
		Clean rice	67.57±0.17 b	60.88±0.15 b	40.23±0.33 a
<b>B</b>	Flat warehouse	Clean rice	66.02±0.69 a	59.88±0.62 a	39.63±0.36 a
		Clean rice	66.91±0.51 a	60.86±0.31 a	39.67±0.04 a

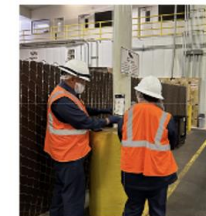
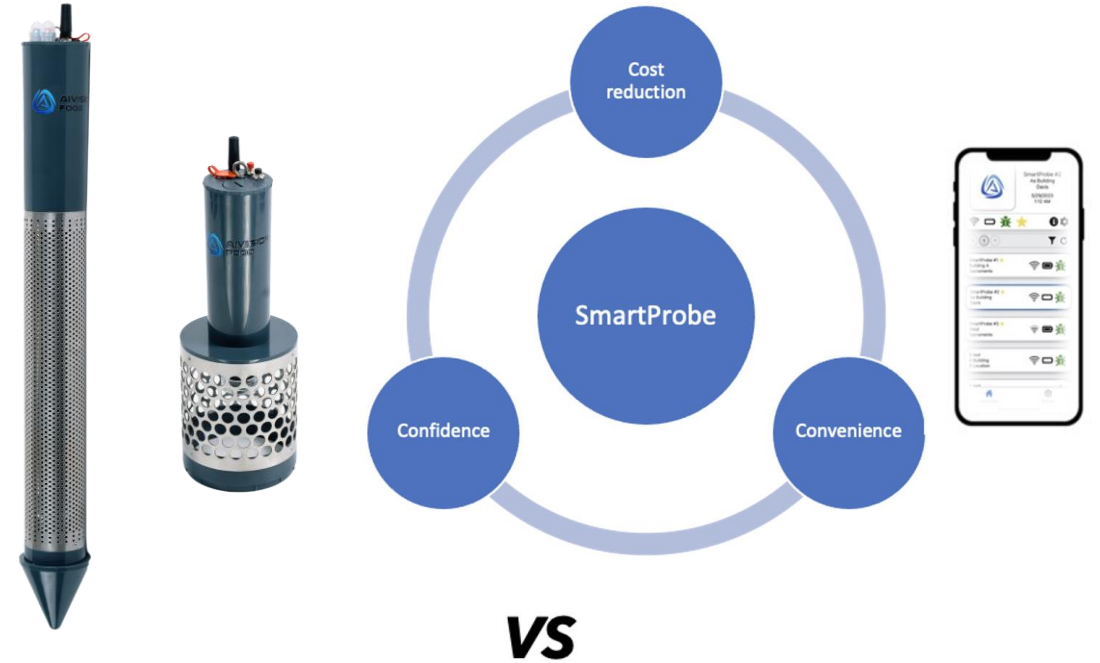


- \$5.5 loss per ton of paddy rice due to 2.5% milled rice reduction\*
- Chemical fumigation cost: \$2.5 per ton
- \$770 for each 100t storage

\*based on the rice price in 2021

# Benefits of SmartProbe Technology

- Eliminate human inspection
- Early detection
- Maintain product quality
- Reduce chemical fumigation and associated costs
- Reduce food safety risk
- Lower health and environmental concerns
- Make food production sustainable
- Reduce food loss and hungers



# Commercial Demonstration in Rice Warehouses

10:09



Close

# Factors Affecting Shrinkage

- Dockage and Moisture
  - Variety,
  - Farm location
  - Harvest moisture and time
  - Drying conditions
  - Dropping
  - Weather events
    - Wind and rainfall
  - Type of harvesters

# Shrinking Chart

- Shrink charts or formula are normally used by grain dryers to calculate final dried rice weight
- Dockage is defined as the proportion of materials other than grains in the harvested rice and commonly expressed as a percentage.

$$\text{Dockage} = 100 \times (\text{Weight of larger materials} + \text{Weight of fine materials}) / (\text{Weight of rice sample})$$

- Dockage is typically assumed as 2% of harvested rice at dryers
- Weight loss due to change in moisture can be determined accurately for rice based on its initial moisture information

# Shrink Chart

- Shrink charts or formula are normally used by grain dryers to calculate final dried rice weight
- Shrinking factor (%)

$$S = \frac{W_i - W_f}{W_i} \times 100$$

$W_i$  (lbs.) is the weight of rough rice received at dryers and  $W_f$  (lb.) is corresponding dried rough rice weight.

$$W_f = W_i - W_i \times \frac{S}{100} = W_i \left( 1 - \frac{S}{100} \right)$$



# Shrink Chart

- Dockage is  $d$  (%) and invisible loss is  $k$  (%) then the final shrink factor will become:

$$S = (d + k) + (100 - d - k) \cdot \frac{M_i - M_f}{100 - M_f}$$

# Dockage values

