

Soybean Storage Temperature: Quality Impacts on Food, Oil and Meal

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Why Proper Storage Matters

- Soybeans are sensitive to temperature, humidity, and moisture
- Improper storage affects nutritional value, flavor, and texture
- Storage conditions impact food, feed, and oil quality



Factors Affecting Soybean Storage

- Temperature (ideal: 10-15°C)
- Humidity (ideal: 60-70%)
- Moisture content (ideal: 12-14%)
- Pests and insects- Aeration and ventilation

Prevention Measures for Soybean Safe Storage

- Soybean moisture level is critical for maintaining storage quality; It is important to prevent soybeans to gain moisture from the air if relative humidity is high
- Soybean's high oil content requires that soybeans be drier than corn or wheat to store safely under similar conditions
- Storage temperature plays an important role with moisture interaction. Warmer temperatures require drier beans in order to maintain the same quality
- Maximum moisture for safe storage varies with the length of the storage period
- Shorten the period of storage in warmer region, lengthen the period of storage in cooler region accordingly

Approximate Allowable Storage Time for Soybeans

Moisture Content (%)	---Grain Temperature (C) ---					
	0	5	10	15	20	25
Approximate Allowable Storage Time (Days)						
11	300+	300+	300+	300+	200	140
12	300+	300+	300+	240	125	70
13	300+	300+	230	120	70	40
14	300+	280	130	75	45	20
15	300+	200	90	50	30	15
16	300+	140	70	35	20	10
17	300+	90	50	25	14	7

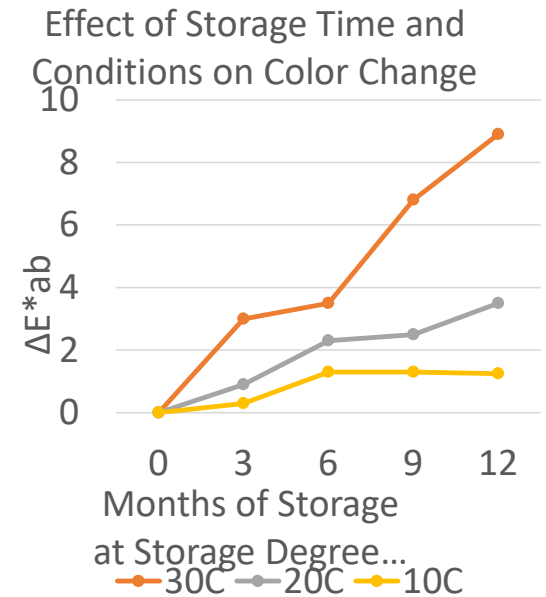
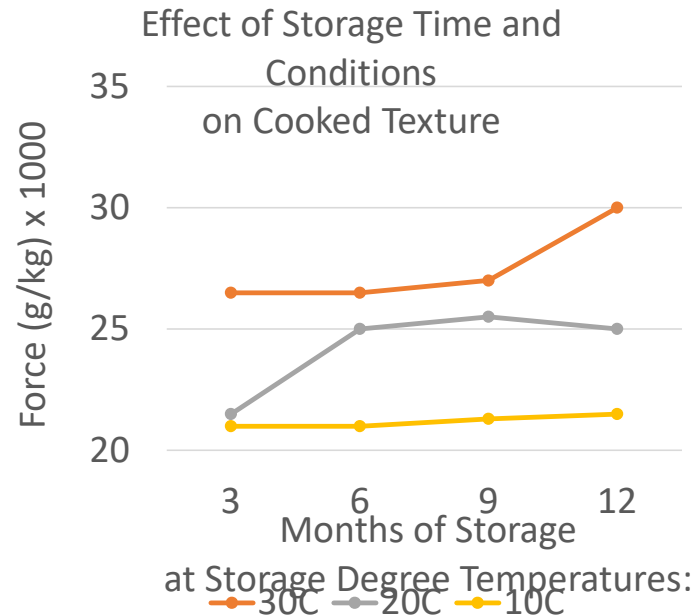
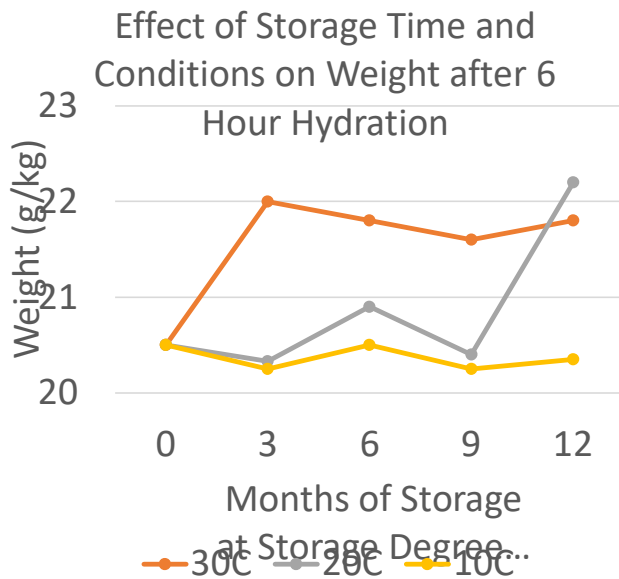
- Airflow through the soybeans permits maintaining the grain temperature but does not extend the allowable storage time beyond that listed in the table.
- Allowable storage time is cumulative. If 16% moisture soybeans were stored for 35 days at 10°C, one-half of the storage life has been used. If the soybeans are cooled to 5°C, the allowable storage time at 5°C is only 70 days.

Source: Hellevang, Ken, (2018, September 5). *Better Soybean Storage Starts with Good Harvest Moisture*. Retrieved from www.cropwatch.unl.edu

Ideal Storage Conditions

(13% moisture soybean)

Legume grain storage time and conditions have been found to affect the grain seed coat color along with a strong correlation with grain textural strength and cooking quality. Other factors include seed hardness, permeability, moisture content, and humidity of storage conditions.



Source: Yousif, Adel M., (2013, April 15). Soybean Grain Storage Adversely Affects Grain Testa Color, Texture, and Cooking Quality. *Journal of Food Quality*, 37(2014), 18-28.

Effects of Poor Storage

- Reduced functional properties
- Reduced germination rate
- Decreased protein content
- Increased fatty acid oxidation
- Contamination by molds and mycotoxins
- Reduced oil quality and shelf life

Impact on Food Quality

Soybeans stored at high temp may lead to:

- Nutrient degradation
- Off-flavors and textures
- Reduced shelf life, elevated mold growth, and increased risk of foodborne illnesses
- May produce poorer-quality soy milk, tofu, and edible oils, while also impacting the texture and flavor of soy-based meat alternatives

Optimal storage temp (10-15°C) preserves soybean's integrity ensuring:

- Better emulsification properties in food processing
- Improved protein extraction for functional ingredients
- Enhanced flavor and texture profiles for final products

Impact on Feed Quality

- Protein Degradation: High temperatures break down proteins, reducing nutritional value
- Amino Acid Loss: Heat-sensitive amino acids (e.g., lysine, methionine) degrade
- Enzyme Activation: Heat activates enzymes, leading to nutrient degradation
- Nutrient Bioavailability Reduction: Heat-induced changes reduce bioavailability of essential nutrients

Impact on Feed Quality cont..

- Color and Texture Changes: Heat causes darkening and texture changes in soy meal
- Increased Fungal Growth: High temperatures and moisture create ideal conditions for fungal growth
- Moisture Absorption: High temperatures increase moisture absorption, causing hydrolysis
- Reduced Pelletability: Heat-damaged soy meal becomes difficult to pelletize

Impact on Oil Quality

- Fatty Acid Oxidation: High temperatures accelerate oxidation of unsaturated fatty acids, reducing oil quality and shelf life
- Increased FFA Content: Heat causes lipase activation, breaking down triglycerides into FFAs, affecting oil stability and refining costs
- Lipoxygenase Activation: High temperatures activate lipoxygenase enzymes, catalyzing oxidation reactions and forming off-flavor compounds
- Phospholipid Degradation: Heat causes phospholipid breakdown, affecting oil emulsification and stabilization properties
- Reduced Oil Yield and Quality: High-temperature storage reduces oil yield and quality during crushing, resulting in lower oil extraction efficiency and decreased oil clarity

Impact on Germination

- High Temperature (above 25°C): Accelerates seed deterioration, reduces germination rate, and increases electrical conductivity, indicating membrane damage
- Low Temperature (below 10°C): Slows down metabolic processes, maintaining seed viability, but prolonged storage at low temperatures can lead to chilling injury



Impact on Germination cont..

- Temperature Fluctuations: Alternating temperatures (e.g., 15°C to 25°C) cause more damage than constant high or low temperatures, accelerating seed aging
- Extreme Temperature Effects: Storage above 30°C or below 5°C can cause irreversible damage, leading to:
 - Reduced germination rate
 - Decreased seedling vigor
 - Increased seed mortality
 - Altered seed composition

Best Practices for Soybean Storage

- Clean and dry storage facilities
- Proper ventilation and aeration
- Regular monitoring of temperature and humidity
- Pest control measures
- Rotation of stock



Navigating the Heat and Humidity Challenges

(Short Term Solutions)

- Improved storage facilities: Use of galvanized iron or concrete silos
- Aeration systems: Install fans and ventilation systems
- Moisture control: Use desiccants or moisture-absorbing materials
- Pest management: Regular monitoring and fumigation
- Temperature monitoring: Install temperature sensors

Navigating the Heat and Humidity Challenges

(Long Term Solutions)

- Modern storage technologies: Adopt cold storage, controlled atmosphere storage
- Warehouse management: Implement First-In-First-Out (FIFO) inventory system
- Training and capacity building: Educate farmers, traders on storage best practices
- Infrastructure development: Invest in rural storage infrastructure
- Policy support: Encourage government initiatives for storage infrastructure development

Indian Innovations

- Low-cost storage solutions: Use of locally-made, affordable storage structures
- Solar-powered aeration: Harness solar energy for aeration systems
- Indigenous storage materials: Utilize natural materials like neem leaves, turmeric
- Mobile storage units: Develop portable storage solutions

Conclusion

- Proper soybean storage is crucial for maintaining quality
- Adverse storage conditions have significant economic and health implications
- Implementing best practices ensures optimal food, feed, oil quality, and germination rate

Thanks !!

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