Walnut Storage

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Benefits of Proper Storage

- Slow development of rancidity and kernel darkening.
- Prevent mold.
- Stop insect damage.
- Maintain uniform nut moisture content.

Factors Controlling Quality

- Temperature
- Water activity (moisture content)
- Time
- Variety
Water Activity

Relative humidity equilibrates with nuts

65% rh = 0.65 Aw

Placentia Perfection walnuts stored for 7 months at 72°F

Rockland, 1957

Taste

Hedonic Scale

Storage Humidity (%)

Odor

Flavor

Low quality

High quality

Pedro

Serr

Lopez et al., 1995

Kernel Darkening

Dark Kernels (%)

Storage Time (mo)

Serr

Pedro

Lopez et al., 1995
Storage Goals

- Keep walnuts below 65% EMC (8% MC).
- Store below 50°F as long as possible.
Nut Temperature in Storage

- Warm air rises and then cools near top of bin causing wet nuts
- Cold metal causes high humidity and wet nuts
- Cold air entering through fan causes high humidity and wet nuts

Average Air Temperature

- Sacramento
- Red Bluff

Aeration

- Regularly ventilate storage with outside air to maintain uniform nut moisture in storage.
Aeration Advantages

- Finish drying in the fall
- Precise control of nut moisture for improved shelling.
- Prevent mold growth (control MC).
- Prevent insect activity until late spring (control nut temperature).

Average Air Temperature

Grain Aeration Components

- Perforated floor
- Metal grain bins
- Ventilation fan
Aeration

- Fan capacity
  - 4 cfm/ton for bins
  - 8 cfm/ton for warehouses
- At 4 cfm/ton a cooling front moves through a bin in 100 to 120 hrs.
- Doubling fan capacity halves aeration time.

Aeration Method 1
Outside air temperature

- Provide one complete aeration per month.
- Operate fans when air temperature is close to the historic average monthly temperature.
- No fan operation during periods of high humidity (rain, fog) or low humidity (North wind)

Aeration Method 1
Outside air temperature

- Simple control strategy.
- Usually causes some MC loss.
- Proper air conditions may be during night or early morning hours.
Cost of Over Drying

• Lose saleable weight
• Increased moisture variability
• Poor shelling

| Nut MC | Weight loss (%)
|--------|----------------
| 14     | 0              
| 13     | 1.1            
| 12     | 2.3            
| 11     | 3.4            

Aeration Method 2
Temperature & Relative Humidity

• One aeration per month.
• Operate fans when air temperature is close to average for month AND when relative humidity is ± 4 percentage points of the equilibrium RH.
• Acceptable RH can be ± 7 percentage points if fan operation time is low.

Aeration Method 2
Temperature & Relative Humidity

• Maintains nut moisture content.
• Fans may need to operate at night or early morning when operators are not available.
• Can be implemented with an aeration controller.
Aeration Method 3
Automatic Control

Storage Goals
• Keep walnuts below 65% EMC (8% MC).
• Store below 50°F as long as possible.
• Aerate to keep uniform MC.

Sanitation & Monitoring
• Clean out nuts from previous season.
• Disinfest storage
  – Insecticides
  – Heat
Inspect Walnuts Regularly

• More often when walnuts are warm.
• After big storms.
• Look where wet spots were in past.

Areas with Poor Airflow

- Leveled product produces uniform airflow
- Peaked product causes a dead air zone

Areas with Poor Airflow

- Low airflow and high moisture
Temperature Monitoring

• 20'-30' between cables
• Two - three cables in bins > 40' diameter.

Fumigation

• Usually needed in the late spring when nuts warm above 70°F.

Key Concepts

• Keeping nuts cool and at optimum MC slows quality loss and prevents insect and decay damage.
• Use aeration to control nut temperature and MC.
• Start with a clean facility in the fall and fumigate as necessary.
• Measure and record nut quality during storage.