Factors to consider when ripening avocado

Why Ripen Avocados?

Increase Uniformity
Decrease Checkerboarding

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Untreated, fruit ripening may range from a few days to even weeks within a carton.
History of commercial ripening

- J. Biale first described avocado ripening process (1941)
- I. Eaks outlined proper ripening protocols (1966)
- Lee and Coggins outline feasibility of commercial ripening and enhanced purchasing (1982)
- Henry Avocado and V. Tokar begin first large scale CA avocado ripening program (1983)
- **US consumption climbs from < 1.0 lb/person (1980) to 4.5 lb/person (2011)**

What we know about the avocado and why it responds to ethylene

- A climacteric fruit showing an increase in respiration and ethylene production during ripening
- Influenced by maturity, time after harvest, temperature and atmosphere

Adapted from Eaks (1978) for ‘Hass’
Relationship between dry matter (maturity) and final peel color

Final Peel Color = 3.06261 - 0.00264DW + 0.0020DW²
where DW = Dry weight
R² = 0.621 ***

Ethylene hastens ripening regardless of stage of maturity
Time after harvest

- Ethylene has maximum benefit within 1-2 weeks of harvest
- Imported fruit if conventional shipment will need less time (24 hours or less)
- Imported fruit if CA shipped or 1-MCP treated may need longer treatment times

Time after harvest decreases the impact of ethylene
Note the affect of **maturity**, **storage** (3 wks @ 5C) and **ethylene** (50ppm) on the amount of days to ripe to <1.5 lbf at 20C as well as the variability of the data (checkerboarding)

Even within lots of fruit there is variability in ripening – a way to control this is sorting by degree of ripeness into different categories
Suggested treatment times for California 'Hass' avocados

- Early season fruit (November - February): 36 - 72 hours
- Mid-season fruit (March - June): 24 - 36 hours
- Late season fruit (July - October): 8 - 24 hours +/- ethylene

Management Issues

- Temperature
- Ventilation/Air exchanges
- Careful Monitoring
- Prompt Movement of fruit
- What is the proper stage of ripeness?
- Where do you ripen the fruit?
Factors under your control

Educate yourself about the potential differences between varying sources of fruit – there are differences

- Pre-ripening inspection
- Ripening management
- Postripening management

Ripening Management

- Uniform heating and cooling is ABSOLUTELY ESSENTIAL
- Refrigeration needs to control the heat (6000 BTU per pallet)
- Forced air ripening is critical (1000 cfm/pallet)
- Venting (preferably flow through, keep CO₂ below 1%)
- Source of Ethylene – as low as possible; physiologically you only need ~10 ppm but practically use 100ppm
- Fruit needs to be easily accessible in ripening room for monitoring; especially if fruit is of varying arrival condition or multiple lots of fruit
- Keep good records
Can I use a banana ripening room for avocado ripening?

Some considerations

Peak Respiration (mg/kg-hr)

- Banana at 14C
- Banana at 18C
- Avocado at 20C

Refrigeration Load (BTU/T-day)

- Banana at 14C
- Banana at 18C
- Avocado at 20C
Can I use a banana room….. With some practical modifications

Refrigeration during ripening and cooling of fruit likely to be insufficient in a banana room
– Hot spots within pallet
– Uneven ripening
Do not to overload the room

Ethylene dose considerations

• Ethylene concentration
  - >20 ppm; no more than 100 ppm
• Fruit Maturity
  - Less mature; longer treatment
• Time after Harvest
  - With increasing time after harvest; shorter durations needed
How much to apply?

Short exposures to ethylene can trigger ripening; threshold is believed to be around 10 ppm

Commercial application of 20 - 100 ppm is recommended

Source: I. L. Eaks, UC, Riverside

Temperature Management

• Avocados have a VERY high rate of respiration during ripening = HEAT
• Efficient warming/cooling of fruit essential
• Airflow essential to maintain proper pulp temperature (20C)

Impact of high temperatures
  - Delayed/uneven ripening
  - Increased decay
The impact of Temperature (24 or 48 hours) on ripening performance of ‘Hass’ avocado

- High temperatures are DETRIMENTAL
- The outcome is delayed or inhibited ripening and increased decay
- Keep temperatures below 21°C

No significant difference due to duration

Ripening temperature influences final peel color

Ripening Management
When do you turn off the gas?

- You don’t need the gas until ripe; a short duration treatment will “trigger” ripening
- Fruit may soften but may not color – maturity and other factors involved
- The best way to gauge the rate of softening is with a penetrometer...not your fingertips or buttons “popping”
- Fruit maturity is an important variable

The penetrometer is a tool to judge the relative stage of ripeness
Ripening Management

What should you do with ripe fruit?

• Cool immediately; ideally within ripening room
• How long can you hold the fruit? Depends on the stage of ripeness
• Ripe fruit (<2 lbf) can be held at lower temperature generally than unripe/partially ripe fruit; minimize peel damage
• Fruit will continue to soften in storage but has minimal impact on fruit flavor
• Risk of decay increases with longer holding periods

Managing Ripe Fruit

• Decay increases with increasing ripeness; accelerates in “overripe” fruit
• Don’t hold fruit for long periods of time that are partially ripe – increased chilling injury
• Bruising increases with advancing ripeness – Protect fruit
• Peel color at “slicing” or “guacamole” ripe does not necessarily mean the fruit needs to be completely black!

These are issues wherever fruit are ripened
The outcome of “ripe” fruit

Ripe fruit at retail level has greatly increased consumption, HOWEVER…..

- Greater challenge in temperature management
- Fruit sensitivity to damage greatly enhanced
Example of fruit shriveling

Example of an overripe fruit with stem end rot, body rot and internal bruising

Example of a stem end rot

Example of body rots

A. Fruit with no bruising under the peel.
B. Fruit which is very overripe and is exhibiting bruising under the peel.

A. Very ripe fruit compressed by other fruit on display.
B. Example of internal bruising.
C. Very ripe fruit showing severe internal damage.
Considerations for successful avocado ripening

- **Temperature management** is CRITICAL
  - Too high: ripening inhibited and increased decay
  - Too low: ripening is slowed and lose benefit
- **Fruit Maturity**
  - More mature: less time
- **Time after Harvest**
  - After storage: less time
- **Avoids delays in marketing**
- **Minimize fruit handling**

**Checklist**
- Know the history of the fruit
- Quality: don't use stressed fruit
- Standardize fruit size and maturity
- Uniform warming and cooling
- Careful monitoring: don't overripen

**CONSUMER/MARKET Education**

Additional information

- **Contact me**
  mlarpaia@ucanr.edu
- **UC Davis Postharvest Center website**
  http://postharvest.ucdavis.edu/
- **California Avocado Commission website**
  http://www.californiaavocado.com/ripening-and-handling/
- **General information on avocados**
  www.avocadosource.com