

Postharvest Handling of Mango

Many slides from Adel Kader and Marita Cantwell, UCD, and Jeff Brecht, UF



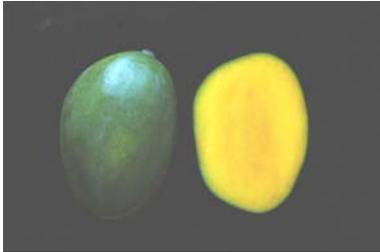


There are 100s of Mango Varieties

Assessing Maturity & Eating Quality Potential

- Climacteric Fruit
- Skin color
 - Dark green to light green in some cultivars
 - Red color is not related to maturity or ripeness
- Fruit shape
 - Fullness of cheeks
 - Shape of shoulders
- Internal flesh color
 - Greenish-white to yellowish-orange
- Maturity at harvest determines eating quality potential
 - Consider that advances in skin and flesh color should have occurred during transit

Skin Color



Skin color is not always related to internal color and ripeness!

Cultivar Differences



Tommy Atkins Mango



Kent Mango



Keitt Mango



Haden Mango



Ataulfo Mango

Fruit Shape



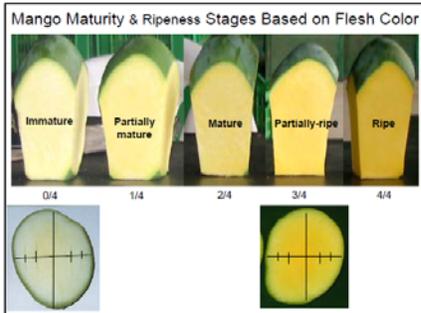
Immature



Mature

- Fullness of cheeks
- Elevation of shoulders above the stem attachment

Flesh Color



European (OECD) Standards. Mango Maturity



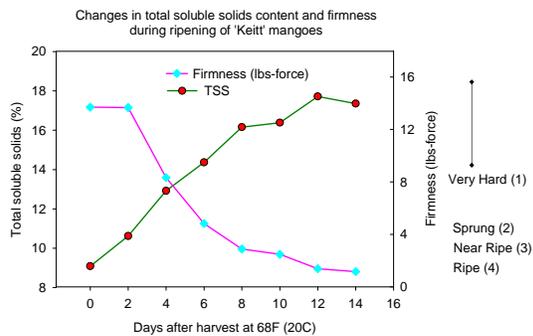
Changes Associated with Mango Ripening

- Skin color changes from green to yellow (in some cultivars)
- Flesh color changes from greenish-yellow to yellow to orange (in all cultivars)
- Decrease in flesh firmness and increased juiciness
- Starch is converted into sugars
- Increase in soluble solids content
- Increase in carotenoids and decrease in chlorophyll content
- Increase in characteristic aroma volatiles

Eating Quality

- Soluble solids content
 - Indication of sugar content
 - Minimum 7-9% at harvest; 16-20% in ripe fruit
 - Measure with refractometer
 - Increases with ripening from starch conversion
 - Affected by harvest maturity
- Firmness and texture
 - Degree of softening
 - Measured by hand feel or with penetrometer
- Aroma
 - Indication of ripening and eating quality

Changes with Ripening



Relationships Among Quality & Maturity Factors

- Upon fruit arrival, check internal color, firmness and soluble solids content
- Internal flesh should be at least yellow in color; better with 75% orangish-yellow color
- Soluble solids content will vary depending on stage of ripeness
 - Remember, soluble solids increases as the fruit soften
 - Very firm mangos should have minimum 7 to 9% SSC
 - Fully ripe mangos should have 16 to 20% SSC
- Check for defects

Harvest

- Mangos are harvested when the fruit have reached their full size and have begun to ripen, which starts inside the fruit
- The fruit are carefully detached so that they don't fall to the ground, and are collected in plastic field crates





Transport to Packinghouse

- The mangoes are transported from the farm to the packinghouse by truck
- The fruit may need to be covered to protect them from the sun.



Washing and Pre-sizing

- First the mangos are washed, then they are pre-sized according to guidelines for quarantine treatment, when required



Hot Water Quarantine Treatment

- Mangos exported to the U.S. must be immersed in 46°C/115°F water for 60 to 110 minutes depending on variety and fruit size in USDA APHIS-certified hot water treatment systems.



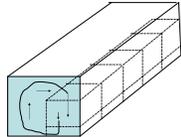
Hydro-cooling & Staging for Packing

- After their hot bath, the mangos are cooled in water that is no cooler than 21°C/70°F as prescribed by APHIS
 - cool enough to guard against hot water injury
 - not too cool to counteract the hot water treatment's effectiveness against fruit flies
- Fruit should be packed immediately or placed temporarily in cold room at 12C



Forced Hot Air Treatment

Heat fruit to 117F (47C), hold 20-30 min



Irradiation for Control of Fruit Flies

Common Name	Scientific Name	Min. Dose (Gy)
Oriental fruit fly	<i>Bactrocera dorsalis</i>	250
Med. fruit fly	<i>Ceratitidis capitata</i>	225
Melon fly	<i>Bactrocera cucurbitae</i>	210
Caribbean fruit fly	<i>Anastrepha suspensa</i>	150
Mexican fruit fly	<i>Anastrepha ludens</i>	150
West Indian fruit fly	<i>Anastrepha oblique</i>	150
Sapote fruit fly	<i>Anastrepha serpentine</i>	150
Queensland fruit fly	<i>Bacterocera tryoni</i>	150
No common name	<i>Bacterocera jarvisi</i>	150

Indian Mangoes Exported to US since May 2007

Shashi Tharoor, whose "The Great Indian Novel" features one of the best descriptions of India's love affair with the mango: "After years of penury, where what passed for mangoes in American supermarkets was a travesty of the term, we at last have the real thing! I used to believe that true mango lovers could sue American groceries for false advertising -- the tasteless, fibrous, tart and flavor-challenged fruit they sold did not deserve the name of mango. Now we should urge every American we know to try a real Indian mango. They'll never think of mangoes the same way again."

http://www.sajaforum.org/2007/05/usindia_affairs.html



Mango handling at wholesale market
Bangalore India, 2007

Packing

- The mangos may be coated with carnauba wax for appearance and for protection from water loss
- The mangos are sorted and graded to remove the fruit that are not good enough to satisfy the market
- Most mangos are hand sized as the cartons are filled







Forced-air cooling & Refrigerated Storage

- Mangos are cooled to their optimum storage and transport temperature of 12°C/54°F
- Mangos may be stored at 12°C/54°F, but only long enough to accommodate shipping schedules



Common Defects

- Latex staining (only affects appearance, not eating quality)
- Hot water injury
- Decay
 - Anthracnose
 - Stem-end rot
- Chilling injury

Latex Staining



Hot Water Injury



Heat Injury Symptoms - 2



Anthracnose Decay



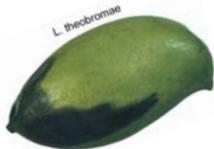
Decay Control

- Hot water immersion
 - 50 to 55°C for 1 to 5 minutes
- Fungicides, may be included in hot water
- Bagging before harvest
- Irradiation not very effective at doses allowed

Heat Treatment Reduces Anthracnose Incidence and Severity on Mangoes



Stem-End Rot



Chilling Injury

Chilling Injury Symptoms on Mangoes

- Uneven ripening
- Poor color and flavor development
- Surface pitting
- Grayish scald-like skin discoloration
- Flesh browning in severe cases



Mango Storage Temperatures

- **Mature green mangos**
 - Store/ship at 54°F (12.2°C)
- **Ripe mangos**
 - Store/ship at 46°F (7.8°C) to 50°F (10°C)



Limit allowed for
surface blemish due
to rubbing, abrasion



Limit allowed for
resin exudate

Class 1



Class 1 fruit must be of good quality and well presented. Although the Class 1 requirements are less strict than Extra Class, Class 1 fruit must be carefully selected and presented.



Limits allowed for surface blemish due to windrub, abrasion

Limit allowed for resin exudate



Class 2

Fruit in Class 2 must be of marketable quality and suitably presented.....
Fruit must be ripe but not over-ripe so as to have off-flavors or insufficient
Shelf-life to satisfy market requirements. The fruit may have moderate defects.

Ripening Temperatures

- Ripening at 16-18°C (60-65F) results in attractive skin color but flavor is tart; these fruit require an additional 2-3 days at 20-24°C (68-75F) to attain sweet flavor.
- Ripening at 27-30°C (80-86F) may result in mottled skin color and strong flavor; above 30°C (86F) ripening is retarded.
- Best ripening temperature is 20-22°C (68-70F)

Ripening Conditions for Mangoes

Ethylene treatment accelerates ripening

Fruit temperature:	20 to 22°C (68-72°F)
Relative humidity:	90-95%
Ethylene concentration:	100-150ppm
Duration of exposure to ethylene:	12-48 hours
Carbon dioxide:	<1%

After ethylene treatment for 24 hours, mangos are ripe in 5-9 days at 18-22°C. Once ripe, can be held at 10-13°C for up to 1 week.

Flesh Firmness vs. Ripeness Stage of Mangos

Ripeness stage	Flesh firmness (lb-force with 5/16 inch tip penetrometer)	Notes
Mature-green	>14	Treat with ethylene for 48 hours
Partially-ripe	10-14	Treat with ethylene for 24 hours
Firm-ripe	6-10	Best stage to send to retail stores
Soft-ripe	2-6	Best stage for eating
Over-ripe	<2	Good for juice



National Mango Board
Orlando, FL USA