Subtropical Fruits

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Some of these fruits are grown in tropical areas.
These fruits are diverse in:
- Morphology
- Composition
- Postharvest physiology
- And in their optimum postharvest handling requirements

Subtropical Fruits Include
- Atemoya
  ![Atemoya](http://www.2ndlight.com/forum42ndlight/attachments/Atemoya901ASIT.jpg)
- Avocado
  ![Avocado](http://www.cookbookwiki.com/images/e/ef/Carob.jpg)
- Carob (Chinese date)
  ![Carob](http://www.2ndlight.com/forum42ndlight/attachments/Atemoya901ASIT.jpg)
Subtropical Fruits Include

- Cherimoya
  ![Cherimoya Image](http://bigy.com/content/prod/i/var/cherimoya.jpg)

- Citrus
  ![Citrus Image](http://www.wegmans.com/kitchen/agrilink/produce/fruits/images/date.jpg)

- Date

Subtropical Fruits Include

- Fig
  ![Fig Image](http://bulletin.coa.gov.tw/htmlarea_graph/web_articles/5761/jujube01.jpg)

- Jujube

Subtropical Fruits Include

- Kiwifruit
  ![Kiwifruit Image](http://media.apn.co.nz/webcontent/image/jpg/kiwifruit.JPG)

- Longan
  ![Longan Image](http://www.khmerkromrecipes.com/photo_recipes/longan.jpg)

- Loquat
  ![Loquat Image](http://darkwing.uoregon.edu/~iinaasim/Hist%20410/Loquat.jpg)
Subtropical Fruits Include

- Lychee
- Olive
- Persimmon
- Pomegranate

Groupings

- **Highly Perishable:**
  - Fresh figs, loquat, lychee
- **Moderately Perishable:**
  - Avocado, cherimoya, olive, persimmon
- **Less Perishable:**
  - Citrus, carob (dry), dried figs, date, jujube, kiwifruit, pomegranate

### Class (mg CO₂/kg-hr) at 5 °C (41 °F) Commodities

<table>
<thead>
<tr>
<th>Class</th>
<th>(mg CO₂/kg-hr)</th>
<th>Commodities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>&lt; 5</td>
<td>Dates, dried fruits and vegetables, nuts</td>
</tr>
<tr>
<td>Low</td>
<td>5 - 10</td>
<td>Apple, beet, celery, citrus fruits, cranberry, garlic, grape, honeydew melon, kiwifruit, onion, papaya, persimmon, pineapple, potato (mature), sweet potato, watermelon</td>
</tr>
<tr>
<td>Moderate</td>
<td>10 - 20</td>
<td>Apricot, banana, blueberry, cabbage, cantaloupe, carrot (topped), celeriac, cherry, cucumber, fig, gooseberry, lettuce (head), mango, nectarine, olive, peach, pear, plum, potato (immature), radish (topped), summer squash, tomato</td>
</tr>
<tr>
<td>High</td>
<td>20 - 40</td>
<td>Avocado, blackberry, carrot (with tops), cauliflower, leeks, lettuce (leaf), lima bean, radish (with tops), raspberry</td>
</tr>
<tr>
<td>Very High</td>
<td>40 - 60</td>
<td>Artichoke, bean sprouts, broccoli, Brussels sprouts, cut flowers, endive, green onions, kale, okra, snap bean, watercress</td>
</tr>
<tr>
<td>Extremely High</td>
<td>&gt; 60</td>
<td>Asparagus, mushroom, parsley, peas, spinach, sweet corn</td>
</tr>
</tbody>
</table>
MA or CA

- 2-5% O₂ and 5-10% CO₂ (MA or CA) or hypobaric storage can:
  - Reduce respiration and ethylene production
  - Reduce sensitivity to ethylene
  - Delay ripening
  - And extend the storage life of tropical fruits by 25 to 100%

Ripening Patterns

- Climacteric:
  - Avocado, Cherimoya, Fig, Kiwifruit, Persimmon
  - Avocados do not ripen on the tree.
- Non-climacteric:
  - Citrus, Date, Jujube, Longan, Loquat, Lychee, Olive, Pomegranate

Compositional Characteristics

- Citrus:
  - Good source of vitamin C (#1 contributor of vitamin C to human diet in U.S.)
- Avocados:
  - High energy value (higher than meat of equal weight)
  - (along with olives) have the highest protein and fat content of any tree fruit (excluding nuts)
  - Good source of niacin and thiamin
Maturity & Quality Standards

- Includes:
  - Internal quality attributes (sugars, acids, ratio, etc.)
  - Avocado (CA): minimum dry weight (19 to 25% depending on cultivar)
  - Citrus: juice content, sugars, acids, sugar/acid ratio
  - Exterior attributes (color, shape, size, freedom from defects, etc.)
  - Avocado (FL): days after full bloom

Optimum Storage Conditions

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Temperature (°F)</th>
<th>Temperature (°C)</th>
<th>RH (%)</th>
<th>Max. Shelf Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>32-34</td>
<td>04</td>
<td>85-90</td>
<td>56 wk</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>58-60</td>
<td>15-16</td>
<td>85-90</td>
<td>68 wk</td>
</tr>
<tr>
<td>Tangerine (mandarin)</td>
<td>40</td>
<td>4</td>
<td>90-95</td>
<td>24 wk</td>
</tr>
<tr>
<td>Lemon</td>
<td>50</td>
<td>10</td>
<td>85-90</td>
<td>14 mo</td>
</tr>
<tr>
<td>Lime</td>
<td>50</td>
<td>10</td>
<td>85-90</td>
<td>68 wk</td>
</tr>
<tr>
<td>Kumquat</td>
<td>39</td>
<td>4</td>
<td>90-95</td>
<td>24 wk</td>
</tr>
<tr>
<td>Pummelo</td>
<td>45-48</td>
<td>7-9</td>
<td>85-90</td>
<td>12 wk</td>
</tr>
<tr>
<td>Avocado</td>
<td>40-55</td>
<td>4-13</td>
<td>85-90</td>
<td>46 wk</td>
</tr>
<tr>
<td>Cherimoya</td>
<td>55</td>
<td>13</td>
<td>90-95</td>
<td>24 wk</td>
</tr>
<tr>
<td>Dates</td>
<td>32</td>
<td>0</td>
<td>75</td>
<td>612 mo</td>
</tr>
<tr>
<td>Figs (fresh)</td>
<td>33-32</td>
<td>1-0</td>
<td>85-90</td>
<td>740 days</td>
</tr>
<tr>
<td>Kiwifruits</td>
<td>32-36</td>
<td>02</td>
<td>90-98</td>
<td>35 mo</td>
</tr>
<tr>
<td>Loquat</td>
<td>32</td>
<td>0</td>
<td>90</td>
<td>3 wk</td>
</tr>
<tr>
<td>Lychee</td>
<td>35</td>
<td>2</td>
<td>90-95</td>
<td>35 wk</td>
</tr>
<tr>
<td>Olive</td>
<td>41-50</td>
<td>5-10</td>
<td>85-90</td>
<td>46 wk</td>
</tr>
<tr>
<td>Persimmon</td>
<td>30</td>
<td>4</td>
<td>90</td>
<td>34 mo</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>41</td>
<td>5</td>
<td>90-95</td>
<td>23 mo</td>
</tr>
</tbody>
</table>
MA or CA

• Avocado:
  – Potential use of 2-5% O₂ and 3-10% CO₂

• Citrus:
  – Potential use of 5-10% O₂ and 0-10% CO₂

Physiological Disorders

• Most are sensitive to chilling injury
  – Wide differences in susceptibility
  • E.g. Florida oranges vs. grapefruit
  – Those not sensitive to chilling injury include those that are harvested fully ripe (date and figs), and ‘Hachiya’ persimmons
  – ‘Fuyu’ persimmons are chilling sensitive

Physiological Disorders

• Freezing injury
  – Freezing injured fruit can be separated at the packinghouse based on density, or using X-ray or light transmission methods
Physiological Disorders

- Citrus fruit have a variety of physiological disorders (besides CI)
  - Postharvest Pitting
  - Stem-end Rind Breakdown (SERB)
  - Aging
  - Stylar-end Russetting
  - Blossom-end clearing
  - Creasing
  - Blue Albedo
  - Zebra Skin

Decay Control

- **Avocado:**
  - Anthracnose – esp. in humid Florida. Not serious in California
  - Dothiorella gregaria – important in California
  - Stem-end rots (Diplobia natalesis, Phomopsis citri) – serious in Florida and other humid places

Decay Control

- **Citrus:**
  - Stem-end rots (Diplobia natalesis, Phomopsis citri) – serious in Florida and other humid places
  - Anthracnose – esp. in humid Florida. Not serious in California
  - Sour rot (Geotrichum candidum).
  - Green & Blue mold (Penicillium digitatum & italicum)
Harvest & Transport

<table>
<thead>
<tr>
<th>Harvest &amp; Transport</th>
<th>Dry</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungicide Drench</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degreening?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dump</td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td>Pre-size &amp; Pre-grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet</td>
<td>Wash</td>
<td>Transport to Market</td>
</tr>
</tbody>
</table>

Postharvest Handling of Citrus

Before & After

Harvest

Pre-size & Pre-grade

Wax

Wash
### Degreening

<table>
<thead>
<tr>
<th>Florida</th>
<th>California</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td>28 to 29°C (82 to 85°F)</td>
</tr>
<tr>
<td><strong>Ethylene</strong></td>
<td>5 ppm</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>90 to 96%</td>
</tr>
<tr>
<td><strong>Ventilation (keep below 0.1% CO₂)</strong></td>
<td>1 air change per hour</td>
</tr>
<tr>
<td><strong>Air Circulation</strong></td>
<td>100 CFM per 900 lb. bin</td>
</tr>
</tbody>
</table>

(CFM = cubic feet per minute)
Cooling & Storage