**Postharvest Handling**

**Banana & Pineapple**

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**Maturity and Ripeness Stages**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Chompak</th>
<th>Premium Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids (%)</td>
<td>16.0 ± 0.9</td>
<td>22.2 ± 0.8</td>
</tr>
<tr>
<td>Soluble solids (%)</td>
<td>12.7 ± 1.2</td>
<td>16.0 ± 0.3</td>
</tr>
<tr>
<td>Titratable acidity (%)</td>
<td>0.67 ± 0.1</td>
<td>0.54 ± 0.0</td>
</tr>
<tr>
<td>pH</td>
<td>3.60 ± 0.1</td>
<td>3.02 ± 0.0</td>
</tr>
<tr>
<td>Total ascorbic acid (mg/100g FW)</td>
<td>8.5 ± 0.7</td>
<td>10.8 ± 1.0</td>
</tr>
<tr>
<td>Beta carotene (µg/g FW)</td>
<td>323.3 ± 94.2</td>
<td>929.9 ± 84.2</td>
</tr>
<tr>
<td>Total phenolics (mg/g FW)</td>
<td>31.4 ± 0.9</td>
<td>62.3 ± 4.7</td>
</tr>
<tr>
<td>Antioxidant activity [DPPH] (µM/100g FW)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascorbic acid equivalent</td>
<td>63.0 ± 9.8</td>
<td>217.0 ± 22.2</td>
</tr>
<tr>
<td>Trolox equivalent</td>
<td>58.4 ± 9.8</td>
<td>206.8 ± 22.2</td>
</tr>
</tbody>
</table>

LSD.05 0.01 0.17 0.67 0.08 0.5 0.2


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**Intercultivar differences in composition of pineapples**

**Indian Kew Pineapples and Composition at Different Stages of Ripeness**

<table>
<thead>
<tr>
<th>Days from Anthesis</th>
<th>Shell Color</th>
<th>Chl mg/g</th>
<th>Dry wt. %</th>
<th>Soluble solids %</th>
<th>Titratable acidity %</th>
<th>Total sugar %</th>
<th>Vit C mg/100g</th>
<th>Sensory score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>115-120</td>
<td>Green</td>
<td>0.77</td>
<td>12.97</td>
<td>7.9</td>
<td>0.66</td>
<td>6.49</td>
<td>13.7</td>
<td>3.0</td>
</tr>
<tr>
<td>133-140</td>
<td>1/8</td>
<td>0.76</td>
<td>18.26</td>
<td>12.6</td>
<td>0.74</td>
<td>8.87</td>
<td>13.9</td>
<td>4.6</td>
</tr>
<tr>
<td>141-145</td>
<td>1/4</td>
<td>0.63</td>
<td>16.09</td>
<td>18.2</td>
<td>0.77</td>
<td>11.23</td>
<td>14.4</td>
<td>3.4</td>
</tr>
<tr>
<td>146-150</td>
<td>1/2</td>
<td>0.55</td>
<td>17.68</td>
<td>18.9</td>
<td>0.77</td>
<td>11.99</td>
<td>14.9</td>
<td>4.0</td>
</tr>
<tr>
<td>151-155</td>
<td>2/3</td>
<td>0.21</td>
<td>17.76</td>
<td>18.0</td>
<td>0.83</td>
<td>12.44</td>
<td>15.3</td>
<td>5.3</td>
</tr>
<tr>
<td>156-160</td>
<td>Full</td>
<td>0.14</td>
<td>17.99</td>
<td>18.9</td>
<td>0.96</td>
<td>12.79</td>
<td>14.6</td>
<td>5.7</td>
</tr>
<tr>
<td>350.00</td>
<td></td>
<td>0.06</td>
<td>17.97</td>
<td>18.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Sensory determined by panel of 10 untrained members based on nine point hedonic scale

Initial Quality Evaluation of Pineapples at the Packinghouse

Water dumping and washing pineapples

Air turbines to remove excess water
Application of chlorinated water to butt
Forced air drying

Wax application to fruit

Pineapple Handling

- Importance of wax application
  - Improve fruit appearance
  - Reduce internal browning- modified atmosphere created
  - Reduce water loss
  - Reduce pathogen growth

- Importance of dry crown
  - Reduce decay
Endogenous Brown Spot

Blackheart symptoms in Hawaiian Gold (HG) and Smooth Cayenne (SC) pineapple fruit following chilling. 10 fruit were incubated at 23, 10, 6, 4, 2 and 0°C for 14 d followed by 23°C for 7 d. Stewart et al., 2002

Selvarajah et al., 2001 showed removing crown had no effect, but others have shown that removing 1/3 of plant leaves reduces translucency.

Chen and Paull, 2001 showed removing crown had no effect, but others have shown that removing 1/3 of plant leaves reduces translucency.
Banana

Delaying harvest until the full mature-green stage results in higher yield and better eating quality when ripe.

Preparing a banana bunch for harvest

System for transporting banana bunches to packing station

Delivering Bananas to Packinghouse

Initial Washing of Bananas at Packinghouse

Some of the banana handling slides were provided by Eduardo Kerbel
Cutting and Placing Banana Hands into Water

Banana Packinghouse

Banana Packing

Surface abrasions
Internal bruising due to drops

Some common postharvest pathogens on bananas

Crown rot caused by several fungi:
- Fusarium oxysporum
- Lasiodiplodia theobromae
- Thielaviopsis paradoxa
- Colletotrichum musae

Lasiodiplodia stem-end rot
(L. theobromae)

"Cigar-End" rot

http://postharvest.ucdavis.edu/PFfruits/BananaPhotos/
Weighing and Alum Spray

Banana Packaging Options

Package Type – Green Life
Polypak – thin PE (28d)
Banavac – thick PE with slight MA (47d)
- must open bags before ripening

Consumer packages

Single fingers

Bananas are usually not cooled prior to loading CA or MA often used to extend green life during transit

Break bulk and marine container shipment to markets

Symptoms of Chilling Injury
- Skin discoloration (dull color)
- Browning of the inner side of peel
- Failure to ripen
- Browning of the flesh (in severe cases)

<table>
<thead>
<tr>
<th>Type</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavendish types</td>
<td>13-15°C (56-58°F) for storage and transport</td>
</tr>
<tr>
<td>Plantains</td>
<td>9-12°C (48-54°F) for storage and transport</td>
</tr>
<tr>
<td>Petite</td>
<td>11°C (52°F) for up to 7 days storage</td>
</tr>
<tr>
<td></td>
<td>12.5-14°C (54.5-57°F) for longer than 7 days</td>
</tr>
<tr>
<td>Red Macabu</td>
<td>10°C (50°F) for up to 7 days</td>
</tr>
<tr>
<td></td>
<td>12.5-14°C (54.5-57°F) for longer than 7 days</td>
</tr>
</tbody>
</table>

http://postharvest.ucdavis.edu; USDA handbook 66
Respiration of Ripening Bananas

Ethylene is used to control the ripening of most bananas

Ethylene peak precedes CO2 peak
Sugar formation very high at climacteric
(Beaudry et al. 1989. Plant Physiology 91:1436)

Ripening Conditions for Bananas

- Fruit temperature: 14 to 18°C (57-65°F)
- Relative humidity: 90-95%
- Ethylene: 100-150 ppm
- Duration ethylene: 24-28 hours
- Carbon dioxide: Adequate air exchange to prevent accumulation >1%

Forced air ripening rooms
Single, double and triple tier
Source of ethylene:
Banana gas (ethylene in CO2)
Ethylene from catalytic generator

What is this nonuniform ripening due to?

Scheduling Ripening to Meet Retail Needs

- Stage 2: Green, trace yellow
- Stage 3: More green than Yellow
- Stage 4: More Yellow than Green
- Stage 5: Yellow, Green Tips & Neck
- Stage 6: All Yellow, No Green Tips; slight Green on Neck
- Stage 7: Yellow flecked with Brown “sugar spots”

Banana Ripening Stages

http://www.chiquita.com/

Reduce Retail Losses
Delay or Extend Ripening of Bananas

- Hold at 13°C (56°F)
- Modified atmospheres
  - 2 - 5% O2 + 2 - 5% CO2 at 15°C (59°F)
- Treat with 200-300 ppb 1-MCP (15°C)

After ethylene, treat with 1-MCP at 2.5-3.5 color stage

Temperature Control Retards Sugar Spots

Mitcham, Beth "Tropical Fruits - Banana, Pineapple: Postharvest Handling Systems"
Postharvest Technology of Horticultural Crops Short Course 2015
(c) Postharvest Technology Center, UC Regents
Extending the Yellow-life of Bananas

From A.A. Kader

General appearance and sugar spotting

- 1-MCP treatment was evaluated under commercial conditions at a major retailer.
- Quality was tracked over 7 days.

Questions?

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