Ripening Tomatoes

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Tomato Quality Attributes

Color
Firmness
Composition (sugars, acids, volatiles)
Ripening physiology

Quality of Tomatoes
Types and varieties
Conventional & ESL
MG & VR stages
Growing areas
Growing seasons

All Impact Final Quality

Tomato Type & Composition, U.S. Retail

<table>
<thead>
<tr>
<th>Tomato Type</th>
<th>% Soluble Solids</th>
<th>% Titratable Acidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grape</td>
<td>7.05</td>
<td>0.32</td>
</tr>
<tr>
<td>Cherry</td>
<td>6.25</td>
<td>0.67</td>
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<tr>
<td>Green Cluster</td>
<td>4.72</td>
<td>0.44</td>
</tr>
<tr>
<td>Round</td>
<td>4.65</td>
<td>0.33</td>
</tr>
<tr>
<td>Roma</td>
<td>4.25</td>
<td>0.31</td>
</tr>
<tr>
<td>Round Cluster</td>
<td>4.15</td>
<td>0.35</td>
</tr>
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<tbody>
<tr>
<td>Grape</td>
<td>7.15</td>
<td>0.37</td>
</tr>
<tr>
<td>Campari</td>
<td>6.30</td>
<td>0.58</td>
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<tr>
<td>Romanina</td>
<td>5.30</td>
<td>0.48</td>
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<tr>
<td>Grape</td>
<td>5.60</td>
<td>0.51</td>
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<tr>
<td>Round greenhouse</td>
<td>4.90</td>
<td>0.36</td>
</tr>
<tr>
<td>Roma</td>
<td>4.30</td>
<td>0.27</td>
</tr>
<tr>
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<td>3.75</td>
<td>0.44</td>
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Maturity & Ripening Stages

MG: ethylene and temperature to ripen
VR: manage ripening with temperature

Green
The tomato surface is completely green. The shade of green may vary from light to dark.

Breakers
There is a definite break of color from green to bruised fruit. Tannish-yellow, pink or red or 10% or less of the tomato surface.

Turning
Tannish-yellow, pink or red color shows on over 10% but not more than 30% of the tomato surface.

Pink
Pink or red color shows on over 30% but not more than 90% of the tomato surface.

Light Red
Pinkish-red or red color shows on over 60% but red color covers not more than 90% of the tomato surface.

Red
Red means that more than 90% of the tomato surface, in aggregate, is red.

Checker boarding
Should never be a problem with vine ripe tomatoes!

At Packhouse

At Distribution

TOV at harvest
and after 4 days
at distribution center
Likely these green fruit will not ripen

Tomato mature-green and breaker stages; fruit with internal color will ripen well without ethylene treatment. For good eating quality, need at least stage MG3

MG1  MG2  MG3  MG4  Br
Ethylene Treatment for Ripening MG fruit

- Ethylene concentration: 10-100 ppm
- Temperature: 15-25°C (60 to 77°F)
- Relative humidity: 90-95%
- Duration: 24 to 72 hours
- Air circulation: sufficient for distribution of ethylene in ripening room
- Ventilation: sufficient to prevent accumulation of CO2 over 3%
Tomatoes ripen into similar quality in temperature range from 12.5-20°C

<table>
<thead>
<tr>
<th>Temp.</th>
<th>Initial color</th>
<th>Days to TR</th>
<th>Weight loss</th>
<th>Firmness N</th>
<th>Red color</th>
<th>SS %</th>
<th>Sugar</th>
<th>TA %</th>
<th>Vit. C mg/ml</th>
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<tbody>
<tr>
<td>20</td>
<td>1</td>
<td>13</td>
<td>4.3</td>
<td>27.0</td>
<td>35.0</td>
<td>4.0</td>
<td>18.3</td>
<td>26.7</td>
<td>21.8</td>
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<tr>
<td>12.5</td>
<td>3</td>
<td>32</td>
<td>4.2</td>
<td>28.2</td>
<td>38.3</td>
<td>4.0</td>
<td>17.8</td>
<td>26.3</td>
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<td>20</td>
<td>3</td>
<td>11</td>
<td>3.4</td>
<td>23.0</td>
<td>35.9</td>
<td>4.0</td>
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<td>26.4</td>
<td>27.4</td>
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<tr>
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<td>22</td>
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<td>39.4</td>
<td>4.2</td>
<td>19.5</td>
<td>26.9</td>
<td>29.9</td>
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<tr>
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<td>4</td>
<td>7</td>
<td>2.2</td>
<td>25.5</td>
<td>37.2</td>
<td>4.0</td>
<td>20.2</td>
<td>26.6</td>
<td>26.2</td>
</tr>
<tr>
<td>12.5</td>
<td>4</td>
<td>18</td>
<td>2.2</td>
<td>26.3</td>
<td>37.6</td>
<td>4.1</td>
<td>19.0</td>
<td>27.0</td>
<td>30.3</td>
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<td>20</td>
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Average 20C: 9 = 3.0 24.6 37.8 4.0 19.7 0.27 25.8
Average 12.5C: 22 = 2.9 32.4 38.2 4.1 20.0 0.27 28.4

LSD 0.05: 0.5 3.7 1.8 0.2 2.9 ns 3.5

Cantwell, 2003 MCP#7; cv Bobcat

Tomatoes were handled very carefully; therefore minimal decay

Storage of Tomatoes

- 12.5°C (55°F) - will continue to ripen slowly
- No lower than 10°C (50°F)
- 2-3 weeks
- Controlled atmospheres
  - 3% O₂, <3% CO₂
  - Relative humidity ~85%

Could the tomatoes reach final full red color?
Subjective scoring based on USDA color scale

Cv Bobcat, round field-grown variety
2006 Ara and Cantwell

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Most of the fruit stored longer than 1 week at 5 and 7.5°C (41 and 45°F) had decay and did not ripen. Fruit stored at 5°C and 7.5°C that did not decay, lacked the ability to develop red color.

Lower the hue value, redder the fruit

Higher the lycopene content, redder the fruit

Tomatoes and 1-MCP (SmartFresh™)
- 300ppb 1-MCP at 20°C ~ 12.5°C Storage
- 1-MCP is a powerful regulator of tomato fruit ripening
- Easy to overdose and have poor final quality (red fruit)
- Important to determine where 1-MCP can add value to the tomato category

Effect of 1-methylcyclopropene on tomato flavour components, shelf life and decay as influenced by harvest maturity and storage temperature. E. Baldwin et al., 2011, J Sci Food Agric 91: 969–980.

Aroma and Sensory
- Harvested tomatoes green, breaker, turning and pink +/- treatment with 1-MCP
- Ethylene turns on aroma synthesis in tomato
- Stored/ripened 18 or 13 °C, better aroma profile at 18°C
- Found no real difference between breaker, turning and pink, but aroma volatiles and sensory scores generally higher for fruit harvested with more color
- Minimal effect on flavor due to 1-MCP, slightly less aroma volatile development

from work of Elizabeth Baldwin, USDA, Florida SCRI workshop, Feb 2011

Ripe Tomato quality
- Variety and maturity at harvest
- Minimize physical injury
- Storage: temperature & duration
  - 12.5°C (55°F), No lower than 10°C (50°F)
  - 2-3 weeks
- Ripening conditions
  - Temperature 15-20°C
  - High humidity
  - If MG fruit, 100 ppm ethylene 3 days