Apple: Red Delicious

Recommendations for Maintaining Postharvest Quality

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MATURITY INDICES

Firmness of 18 pounds-force, core clear of starch. Firmness (lbs-f) x soluble solids (%) x starch score (1 to 6 scale) should equal 250 at initiation of harvest.

QUALITY INDICES

- Firmness, crispness, lack of mealiness
- Flavor, including soluble solids, titratable acidity and flavor volatiles
- Freedom from defects such as bruising, decay, stem or blossom-end cracks, bitter pit, scald, internal browning, shrivel or watercore
- Red skin color intensity and uniformity

OPTIMUM TEMPERATURE

0°C ± 1°C (32°F ± 2°F); Freezing temperature: -1.7°C (29°F)

OPTIMUM RELATIVE HUMIDITY

90-95% RH

RATES OF RESPIRATION

<table>
<thead>
<tr>
<th>Temperature</th>
<th>0°C (32°F)</th>
<th>5°C (41°F)</th>
<th>10°C (50°F)</th>
<th>20°C (68°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ml CO₂/kg·hr</td>
<td>2-5</td>
<td>3-7</td>
<td>5-10</td>
<td>12-25</td>
</tr>
</tbody>
</table>

To calculate heat production multiply ml CO₂ /kg·hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

1 Higher rates for riper apples.

RATES OF ETHYLENE PRODUCTION

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>µl/kg·hr</td>
<td>1-10</td>
<td>2-20</td>
<td>5-40</td>
<td>20-125</td>
</tr>
</tbody>
</table>

2 Higher rates for riper apples.

RESPONSES TO ETHYLENE

Ethylene stimulates ripening. Mixed results on the benefits of scrubbing ethylene from storage rooms, depending on harvest maturity and type of storage (air or CA).
**RESPONSES TO CONTROLLED ATMOSPHERES (CA)**

Fruit to be stored longer than 1 month benefit from CA storage in terms of retention of acidity and firmness and reduction of scald incidence and severity. CA storage potential is up to 10 months (vs. 6 months in air).

Recommended atmosphere: 1 to 2% $O_2 + 2$ to 4% $CO_2$

**PHYSIOLOGICAL DISORDERS**

**Bruising.** Can be excessive. Gentle handling is important.

**Watercore.** Can be important later in the harvest season. Water-soaking of the flesh near the core due to an accumulation of sorbitol in the intercellular spaces. Market promptly to avoid internal browning and breakdown.

**Bitter Pit.** Sunken brown spots on the skin, especially at the calyx end, related to low calcium concentration in the apple. Best controlled by calcium sprays prior to harvest and calcium dips prior to cold storage. Reduced incidence with controlled atmosphere storage.

**Superficial Scald.** Browning of the skin which develops in cold storage. High susceptibility. Use diphenylamine at label rates. Controlled atmosphere storage delays onset. Ultra-low oxygen CA storage has been effective in some growing areas.

**Controlled Atmosphere Damage.** Oxygen concentrations below 1% and/or $CO_2$ levels above 10% may induce off-flavor associated with fermentative metabolites. Elevated $CO_2$ injury symptoms include partially sunken brown lesions on skin and/or internal browning and cavities. Low $O_2$ injury can result in a purple cast to the skin of Red Delicious apples.

**PATHOLOGICAL DISORDERS**

**Moldy Core.** Caused by several fungi including *Alternaria sp.*, *Fusarium sp.*, *Aspergillus* and *Penicillium*. Red Delicious apples are particularly susceptible because of the open or deep sinus cavity. Drenching can increase the incidence of moldy core.

**Blue Mold and Grey Mold.** The two most important postharvest diseases of Red Delicious apples are caused by *Penicillium expansum* and *Botrytis cinerea*. Both fungi are wound pathogens. Sanitation is critical to control of these diseases. Drenching can spread spores of *Penicillium* and *Botrytis* to wounds from harvest operations. Use of fungicides during drenching may reduce decay.
POSTHARVEST PHOTO GUIDE

MATURITY AND QUALITY

STARCH STRAINING PATTERN

DISORDERS

LOW O₂ INJURY
It is the policy of the University of California not to engage in discrimination against or harassment of any person, employed by or seeking employment with the University, or in any of its programs or activities, on the basis of race, color, national origin, religion, sex, gender, gender expression, gender identity, pregnancy, physical or mental disability, medical condition (cancer-related or genetic characteristics), genetic information (including family medical history), ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services, as well as state military and naval service. This policy is intended to be consistent with the provisions of applicable state and federal laws and University policies. University policy also prohibits retaliation against any employee or person seeking employment for bringing a complaint of discrimination or harassment pursuant to this policy. This policy also prohibits retaliation against a person who assists someone with a complaint of discrimination or harassment, or participates in any manner in an investigation or resolution of a complaint of discrimination or harassment. Retaliation includes threats, intimidation, reprisals, and/or adverse

In addition, it is the policy of the University of California to undertake affirmative action, consistent with its obligations as a Federal Contractor, for minorities and women, for persons with disabilities, and for covered veterans. The University commits itself to apply every good faith effort to achieve prompt and full utilization of minorities and women in all segments of its workforce where deficiencies exist. These efforts conform to all current legal and regulatory requirements, and are consistent with University standards of quality and excellence. In conformance with Federal regulations, written affirmative action plans shall be prepared and maintained by each campus of the University of California, by the Lawrence Berkeley National Laboratory, by the Office of the President, and by the Division of Agriculture and Natural Resources. Such plans shall be reviewed and approved by the Office of the President and the Office of the General Counsel before they are officially promulgated. Inquiries regarding the University’s equal employment opportunity policies may be directed to the Affirmative Action Contact, University of California, Agriculture and Natural Resources, 2801 Second Street, Davis, CA 95618 (530) 750-1318.

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