**Avocado**

Recommendations for Maintaining Postharvest Quality

Adel A. Kader¹ and Mary Lu Arpaia²

¹Department of Plant Sciences, University of California, Davis
²Department of Botany and Plant Sciences, University of California, Riverside

**MATURITY INDICES**

Percent of dry matter is highly correlated with oil content and is used as a maturity index in California and most other avocado production areas; minimum dry matter required ranges from 19 to 25%, depending on cultivar (19.0% for 'Fuerte', 20.8% for 'Hass', and 24.2% for 'Gwen').

Florida-grown avocado cultivars have lower oil content and are harvested on the basis of a calendar date (days after full bloom).

**QUALITY INDICES**

Size (range of consumer preference); shape (cultivar-dependent); skin color; freedom from defects such as misshapen, sunburn, wounds and skin blemishes (rubs, insect damage, hail, and wind scars), rancidity and flesh browning; and freedom from disease, including anthracnose and stem-end rot.

Some cultivars are held on the tree for extended periods after achieving horticultural maturity. On-tree storage may result in development of off-flavors or rancidity with over maturity. Off-flavors may also develop when fruit are harvested during periods of hot weather.

**OPTIMUM TEMPERATURE**

5-13°C (41-55°F) for mature-green avocados, depending on cultivar and duration. 2-4°C (36-40°F) for ripe avocados.

**OPTIMUM RELATIVE HUMIDITY**

90-95%

**RATES OF RESPIRATION**

<table>
<thead>
<tr>
<th>Temperature</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>10-25</td>
<td>25-80</td>
<td>40-150</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.

**RATES OF ETHYLENE PRODUCTION**

Avocado fruits do not ripen on the tree and ethylene production begins after harvest and increases greatly with ripening to > 100µl C₂H₄/kg·hr at 20°C (68°F).
### RESPONSES TO ETHYLENE

Treatment with 100 ppm ethylene at 20°C (68°F) for 48 hours (early-season fruits), 24 hours (mid-season fruits), or 12 hours (late-season fruits) induces avocados to ripen in 3-6 days, depending on cultivar and maturity. Ripening indices include flesh softening and change of skin color from green to black in some cultivars such as 'Hass'. Ripe (soft) avocados require care in handling to minimize physical damage.

### RESPONSES TO CONTROLLED ATMOSPHERES (CA)

- Optimum CA (2-5% O\(_2\) and 3-10% CO\(_2\)) delay softening and skin color changes and reduce respiration and ethylene production rates
- CA reduces chilling injury of avocado. Mature-green 'Hass' avocado can be kept at 5-7°C (41-45°F) in 2% O\(_2\) and 3-5% CO\(_2\) for 9 weeks, then ripened in air at 20°C (68°F) to good quality. Exclusion and/or removal of ethylene from CA storage are recommended
- >10% CO\(_2\) may increase skin and flesh discoloration and off-flavor development, especially when O\(_2\) is <1%

### PHYSIOLOGICAL DISORDERS

**Chilling injury.** Skin pitting, scalding, and blackening are the main external chilling injury symptoms on mature-green avocado kept at 0-2°C (32-36°F) for more than 7 days before transfer to ripening temperatures. Avocados exposed to 3-5°C (37-41°F) for more than two weeks may exhibit internal flesh browning (grey pulp, pulp spot, vascular browning), failure to ripen, and increased susceptibility to pathogen attack. The timing of chilling injury development and its severity depend on cultivar, production area, and maturity-ripeness stage.

### PATHOLOGICAL DISORDERS

**Anthracnose.** Caused by *Colletotrichum gloeosporioides* and appears as the fruit begins to soften as circular black spots covered with pinkish spore masses in later stages. Decay can penetrate through the flesh and induce browning and rancid flavor.

**Stem-end rot.** Caused by *Botryodiplodia theobromae* and appears as dark-brown to black discoloration which begins at the stem and advances toward the blossom end, finally covering the entire fruit. *Dothiorella gregaria* is another cause of stem-end rot in ripe avocados.

Control methods include good orchard sanitation, effective preharvest fungicide application, careful handling to minimize physical injuries, prompt cooling to optimum temperature for the cultivar and maintaining that temperature during marketing.

### INSECT CONTROL

- Cold treatment (1°C for 14 days) can be tolerated without chilling injury if avocados are conditioned for 12-18 hours at 38°C before the cold treatment.
- Avocados do not tolerate heat treatments and/or controlled atmospheres needed for insect control.
POSTHARVEST PHOTO GUIDE

DISORDERS

ANTHRACNOSE

CHILLING INJURY

DOTHIORELLA STEM END ROT

ABRASION DAMAGE

LASIODIOPLODIA STEM END ROT

Avocado

Postharvest Technology Center
University of California, Davis

Avocado Produce Facts
Source: Perishables Handling #97, February 1999
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 participants 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.