Avocados

Revised 2018

Thermal Properties

	English	Metric
Moisture, %	74.27	--
Protein, %	1.98	--
Fat, %	15.32	--
Carbohydrate, %	7.39	--
Fiber, %	5.00	--
Ash, %	1.04	--
Specific Heat Above Freezing	0.88 Btu/lb*°F	3.67 kJ/(kg*K)
Specific Heat Below Freezing	0.47 Btu/lb*°F	1.98 kJ/(kg*K)
Latent Heat of Fusion	107 Btu/lb	248 kJ/kg

Storage Conditions

	Fresh		Frozen (Puree)
Temperature	45-55°F (7-13°C)	40-50°F (4.4-10°C)	0°F (-18°C)
Storage Period	2-4 weeks	4-8 weeks	1 year
Atmosphere	Air	2-5% O_2 + 3-5% CO_2 (Fuerte and Hass) 1-2% O_2 + 9-10% CO_2 (Lula)	----
Relative Humidity	85-90%	85-90%	Air-tight container
Highest Freezing Point	31°F (-0.5°C)	31°F (-0.5°C)	----

The optimum transport and storage temperature depends upon the cultivar and transport and storage duration due to variable sensitivity of cultivars to chilling injury (CI). The chilling-tolerant cultivars such as Lula, Booth 1, Booth 8, and Taylor store best at 40°F (4.4°C). These chilling-tolerant cultivars can be held for 4 to 8 weeks in storage. All West Indian cultivars, which include Fuchs, Pollock, and Waldin, are chilling sensitive and store best at 55°F (13°C) and for a maximum period of 2 weeks. A few cultivars such as Fuerte, Hass, and Booth 7 are intermediate in sensitivity and store best at 45°F (7.2°C). Hass is

the leading cultivar grown in Mexico, California and Chile. Cultivars with intermediate chilling sensitivity can be held for only about 2-3 weeks in storage because they ripen slowly even at 45°F (7.2°C), which can cause chilling injury after about 5 weeks. Chilling injury may not show on immediate removal from low temperature, but develops later at warm temperatures.

Controlled atmosphere storage (CA), especially high CO_2 atmospheres, decrease chilling sensitivity of avocados, thus allowing storage at a lower temperature and for a longer period. An atmosphere containing 2-5% oxygen and 3-5% carbon dioxide delays the softening of Fuerte and Hass avocados held at 40 or 45°F (4.4 or 7.2°C) and reduces the rate at which they ripen when transferred to air at 59°F (15°C). An atmosphere containing 1% oxygen and 9% carbon dioxide at 50°F (10°C) maintains Lula avocados in acceptable eating quality and appearance for up to 9 weeks. Maintaining ethylene concentration below 1 ppm during storage and transport is recommended because ethylene can enhance chilling injury symptoms. Fully-ripe (ready to eat) avocados can be kept at 36°F (2°C) to delay further ripening and softening without danger of chilling injury.

Diseases and Injuries

Anthracnose	Circular black spots, 1/8" to 1" (3-25 mm) in diameter, covered with pinkish spore masses in later stages. Decay-causing fungi penetrate through the flesh to the seed. Affected flesh is greenish-black or brown, firm and rancid. **Control:** Copper and/or fungicide sprays in field; careful handling; postharvest hot water treatment.
Chilling Injury	Small to large sunken pits in skin, becoming brown or black in color: frequently accompanied by general browning of skin; light, smoky streaks in flesh often develop independently. Taste is bitter and rancid. **Control:** Avoid storage and transport below ideal temperatures.
Stem End Rot	Principally caused by Diplodia spp., but may include other organisms. Decay begins at the stem and advances toward the blossom end, finally involving the whole fruit. Causes dark brown to black discoloration of the surface and flesh. Affected flesh is soft and spongy at first, and later becomes firm. A short felt-like fungal growth develops on surface in advanced stages. **Control:** None known; discard fruit showing symptoms before storage.

Ripening

The best ripening temperatures for avocados are from 60 to 70°F (15.5 to 21°C), with 60°F (15.5°C) being ideal for best quality. At 60°F (15.5°C), however, ripening is comparatively slow. Ripening avocados at temperatures of 77°F (25°C) or higher can potentially result in accelerated softening, excessive decay,

discoloration, and off-flavors. Ethylene may be used to stimulate faster and more uniform ripening. Ethylene gas should be at a concentration of approximately 100 ppm for 24 to 48 hours, and relative humidity should be high (95%). Accumulation of carbon dioxide above 1% should be avoided because it negates the effects of ethylene on ripening avocados.

Freezing

The high oil content of avocados can lead to the onset of oxidative rancidity during freezing and highly active polyphenol oxidase in the products can cause rapid enzymatic browning. As a result, avocados are difficult to freeze properly, and are generally only frozen as a commercial pureed product.

Avocado halves and slices have been successfully frozen experimentally by 1) dipping the halves in a solution of citric and ascorbic acids (at least 0.05% citric and 1% ascorbic), and 2) freezing as rapidly as possible in a cryogenic or a rapid blast freezer. It is also recommended to use an air tight film or container with vacuum or with nitrogen in the headspace. Also the use of cultivars that are relatively low in fat and do not brown rapidly will further increase success of freezing. Storage time will depend on the control of the factors discussed and could vary from a few months to over 1 year.

Avocado puree has been held for at least 1 year in frozen storage when the product was modified by acidifying to a pH of 4.5 by adding larger amounts of lemon or lime juice and extra salt. It is also recommended to pack the puree in air tight containers under vacuum or with nitrogen in the headspace.

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