

# Persimmon

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**Scientific Name and Introduction:** Persimmon is the species *Diospyros kaki*, a tree belonging to the family Ebenaceae and native to the Far East. Originally cultivated in China and Japan, it is also known as Chinese date plum. Fruit are grown throughout warmer parts of the world, including southern France, other Mediterranean countries and the U.S. Fruit are a good source of carotenoids, dietary fiber and Vitamins A and C.

The fruit is a berry, but the seeds are large, almond-shaped and few in number. The epidermis is thin and an enlarged calyx adheres to the base of the fruit. Persimmon has a delicious flavor and may be eaten fresh as a dessert, or may be consumed dried or candied. In the U.S., a native species *Diospyros virginiana* occurs, but its fruit are inferior to *D. kaki*. Another well known species is *D. lotus*, yielding fruit called date plums and grown in the Orient and Italy.

**Quality Characteristics and Criteria:** Medium to large in size, with uniform skin color from yellow to orange. Fruit should be firm, i.e., penetration force (8-mm tip) > 5 lb-force (22.2 N) for 'Fuyu' and similar cultivars. Fruit should be free from growth cracks, mechanical injuries and decay. SSC of 21 to 23% in 'Hachiya' and 18 to 20% in 'Fuyu' and similar non-astringent cultivars are recommended. Astringent cultivars must be treated to remove astringency (by polymerizing tannins).

**Horticultural Maturity Indices:** Minimum maturity is based on skin color change from green to orange or reddish-orange ('Hachiya') or to yellow or yellowish-green ('Fuyu,' 'California Fuyu,' 'Jiro'). In California, the minimum maturity for 'Hachiya' persimmon are a blossom-end color of orange or reddish equal to or darker than Munsell color chart 6.7 YR - 5.93/12.7 on at least 1/3 of the fruit's length with the remaining 2/3 a green color equal to or lighter than Munsell color chart 2.5 GY-5/6. For other varieties, fruit must have attained a yellowish-green color equal to or lighter than Munsell color chart 10Y-6/6.

**Optimum Storage Conditions:** The optimum is 0 °C ± 1 °C (32 ± 2 °F). The freezing point is -2 °C (28.4 °F), but may vary depending on SSC. RH should be maintained at 90 to 95%.

**Controlled Atmosphere (CA) Considerations:** Low O<sub>2</sub> of 3 to 5% delays ripening. CO<sub>2</sub> at 5 to 8% helps retain firmness and can reduce chilling injury symptoms on 'Fuyu' and similar cultivars. Postharvest life under optimum temperature and RH in ethylene-free air is 3 mo, whereas fruit can be stored up to 5 mo using ethylene-free CA (3 to 5% O<sub>2</sub> + 5 to 8% CO<sub>2</sub>).

**Retail Outlet Display Considerations:** Cold table display.

**Chilling Sensitivity:** Sensitivity varies by cultivar. 'Hachiya' is not chilling-sensitive while 'Fuyu' and similar non-astringent cultivars are at temperatures between 5 °C and 15 °C (41 °F and 59 °F); they will exhibit flesh browning and softening. Exposure to ethylene aggravates chilling injury at these temperatures.

**Ethylene Production and Sensitivity:** Persimmons produce < 0.1 μL kg<sup>-1</sup> h<sup>-1</sup> at 0 °C (32 °F) and 0.1 to 0.5 μL kg<sup>-1</sup> h<sup>-1</sup> at 20 °C (68 °F). They are very sensitive to ethylene. Exposure to 1 and 10 μL L<sup>-1</sup> ethylene at 20 °C (68 °F) accelerates softening to less than 4 lb-force (17.8 N), the limit of marketability, after 6 and 2 days, respectively. Thus, ethylene removal and/or exclusion from transport and storage facilities is recommended.

**Respiration Rates:**

Temperature	mg CO <sub>2</sub> kg <sup>-1</sup> h <sup>-1</sup>
0 °C	4 to 8
20 °C	20 to 24

To get mL kg<sup>-1</sup> h<sup>-1</sup>, divide the mg kg<sup>-1</sup> h<sup>-1</sup> rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg<sup>-1</sup> h<sup>-1</sup> by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day.

**Physiological Disorders:** Chilling injury is the main physiological disorder. The incidence and severity depend on temperature, cold temperature duration, and the cultivar. For example, ‘Fuyu’ is chilling-sensitive while ‘Hachiya’ is not. Chilling injury can be a major cause of deterioration of ‘Fuyu’ persimmons during marketing. Symptom development is greatest at 5 to 7 °C (41 to 45 °F) and slowest at 0 °C (32 °F), which is the recommended storage and transport temperature for persimmons. ‘Fuyu’ fruit exhibit symptoms if held between 2 °C (36 °F) and 15 °C (59 °F). Upon transfer to higher temperatures, symptom severity (flesh softening, browning, and water-soaked appearance) increases and renders fruit unmarketable. Respiration and ethylene production rates of chilled ‘Fuyu’ persimmons are higher than those of non-chilled fruits. Exposure to ethylene at 0.1 μL L<sup>-1</sup> or higher aggravates chilling symptoms of ‘Fuyu’ persimmons, while CA ameliorates symptoms. To control chilling injury, avoid exposure of ‘Fuyu’ fruit to temperatures between 2 °C (36 °F) and 15 °C (59 °F). The optimum storage and transport temperature is 0 °C (32 °F). Avoid exposure to ethylene > 1 μL L<sup>-1</sup> during postharvest handling. Use of CA of 3 to 5% O<sub>2</sub> + 5 to 8% CO<sub>2</sub> at temperatures < 5 °C (41 °F) reduce chilling injury.

Exposure to O<sub>2</sub> levels < 3% during storage for longer than 1 mo can result in failure of fruit to ripen and development of off flavors. Exposure to CO<sub>2</sub> > 10% during storage for longer than 1 mo can cause brown discoloration of the flesh and lead to development of off-flavors.

Calyx separation is a problem with some cultivars. It has caused losses in New Zealand. Growing conditions are all-important, and excessive N fertilization should be avoided. If the trees are thinned early in the season, this will enhance calyx growth and help prevent the disorder.

**Postharvest Pathology:** Alternaria rot is caused by *Alternaria alternata* which attacks developing fruits. Infections remain quiescent until after harvest, when black spots become apparent during ripening. Wound infection results in earlier appearance of symptoms. Other causes of decay in persimmons include species of *Botrytis*, *Cladosporium*, *Colletotrichum*, *Mucor*, *Penicillium*, *Phoma* and *Rhizopus*.

**Quarantine Issues:** Currently, there is a limited trade exchange for persimmons. The U.S. exports persimmons to the Mid-East and Mexico and imports persimmons from Chile without specific requirements. APHIS issues rules regarding import requirements and provides information to assist exporters in targeting markets and defining what entry requirements a particular country has. APHIS, in cooperation with State plant boards, developed a database called “Excerpt” to track phytosanitary requirements for each country. APHIS also provides phytosanitary inspections and certifications that declare fruit are free of pests to facilitate compliance with foreign regulatory requirements.

**Suitability as a Fresh-cut Product:** Non-astringent persimmon cultivars can be prepared as fresh-cut wedges or slices. Wright and Kader (1997) reported that the shelf-life of ‘Fuyu’ persimmon slices was 7 days in air and 8 days in a CA of 2% O<sub>2</sub> + 12% CO<sub>2</sub> at 5 °C (41 °F). A longer shelf-life can be expected at 0 to 2 °C (32 to 36 °F). Protecting slices from ethylene helps firmness retention.

**Special Considerations:** The best method of harvesting fruit is to cut them from the tree, leaving the calyx attached to the fruit. It is possible to snap fruit from the tree by hand, but this practice is not recommended as it can injure the fruit and adjoining shoot. Fruit must be handled very carefully to avoid bruising, likely to result in marking which becomes unsightly as fruit ripen. Two to three harvests are usually required, depending on fruit size and color, to harvest the crop. A desirable size for 'Fuyu' is 230 to 250 g; 200 g is the minimum marketable size.

Removal of astringency from 'Hachiya' persimmons can be accomplished using 10  $\mu\text{L L}^{-1}$  ethylene at 20 °C (68 °F), but the excessive softening that results can make it difficult to market fruit. Exposure to air enriched with 80% CO<sub>2</sub> for 24 h at 20 °C (68 °F) is effective in removing fruit while maintaining firmness.

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