Peach

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Scientific Name and Introduction: The peach, *Prunus persicae*, is native to China and Persia (Iran); at one time it was called "Persian apple." Chinese literature dates its cultivation in China to 1,000 B.C. Probably carried from China to Persia, the peach quickly spread from there to Europe. In the 16th century, it was established in Mexico probably by the Spanish. Spanish missionaries introduced the peach to California in the 18th century.

California is a major producer and shipper of peaches in the U.S. In recent years, an important development of white flesh peach cultivars has occurred. Current fresh peach shipments approach 19 million 10-kg (25-lb) packages from more than 155 cultivars. In the San Joaquin Valley, harvest of early cultivars starts in mid-May, and harvest of late cultivars is completed in early October. U.S. exports mainly to Canada, Taiwan, Hong Kong, Mexico, and South America.

Quality Characteristics and Criteria: There is high consumer acceptance of peaches with high SSC. TA and SSC:TA are also important factors in consumer acceptance. For mid-season peaches, a minimum of 11% SSC with a TA $\leq$ 0.7% is required to satisfy about 80% of consumers.

Fruit with 9 to 13.5 N (2 to 3 lb-force) flesh firmness are considered ready-to-eat. Fruit < 27 to 36 N (6 to 8 lb-force) measured on the fruit cheek have high consumer acceptance.

Horticultural Maturity Indices: In California, harvest date is determined by skin ground color changes from green to yellow in most cultivars. A color chip guide is used to determine maturity of each cultivar, except for white flesh cultivars. A two-tier maturity system is used in California: 1) U.S. Mature (minimum maturity) and 2) Well-Mature and/or Tree Ripe. Well-Mature and Tree Ripe are the same according to the California Department of Food and Agriculture, Division of Inspection Services.

Measurement of fruit firmness is recommended in cultivars where skin ground color is masked by full red color development before maturation. In these cases, a maximum maturity index can be applied. Maximum maturity is defined as the minimum flesh firmness (measured with a penetrometer with an 8-mm tip) at which fruit can be handled without bruising damage. Bruising susceptibility varies among cultivars.

Grades, Sizes and Packaging: Fruit are hand-picked into bags, baskets or totes. Fruit are then dumped into bins on trailers between tree rows in the orchard. If fruit are picked into totes, the totes are usually placed directly inside the bins. Peaches are transported from orchard to packinghouse and cooled as soon as possible after harvest.

At the packinghouse, fruit are dumped (mostly using dry bin dumps) and cleaned. Sorting is done to eliminate fruit with visual defects and sometimes to divert fruit of high surface color to a high-quality pack. Attention to details in sorting line efficiency is especially important with peaches, where a range of colors, sizes, and shapes of fruit are encountered. Sizing segregates fruit by either weight or size.

Most yellow-flesh peaches are packed into 2-layer (tray) boxes. Small size, yellow-flesh peaches are generally volume-fill packed. Most white-flesh and tree-ripe peaches are packed into 1-layer (tray) boxes. Limited volumes of high maturity fruit are "ranch packed" at the point of production. In a typical tree-ripe operation, high maturity and/or high quality fruit are picked into buckets or totes that are carried by trailer to the packing area. Packers work directly from buckets to select, grade, size, and pack fruit into plastic trays.

Optimum Storage Conditions: Optimum temperature -1 to 0 °C (30.5 to 32 °F). The freezing point varies, depending on SSC, from -3 to -1.5 °C (26.5 to 29.5 °F). RH should be 90 to 95% with an air velocity of approximately 50 ft^3 min^{-1} recommended during storage.

Fruit can be cooled in field bins using forced-air cooling or hydro-cooling. Forced-air cooling in side-vented bins can be by either the tunnel or serpentine method. Hydro-cooling is normally done by a conveyor-type hydro-cooler or *in situ*. Fruit in field bins can be cooled to intermediate temperatures of 5 to 10 °C (41 to 50 °F), provided packing will occur the next day. If packing is to be delayed beyond the next day, fruit should be thoroughly cooled in the bins to near 0 °C (32 ºF). In internal breakdown-susceptible cultivars, fast cooling (within 8 h), as well as maintaining fruit temperature near 0 °C (32 °F), are recommended. Peaches in packed containers should be cooled by forced-air cooling to near 0 °C (32 °F). Even peaches that were thoroughly cooled in the bins will warm substantially during packing and should be thoroughly re-cooled after packing.

Controlled Atmosphere (CA) Considerations: The major benefits of CA during storage and shipment are retention of fruit firmness and ground color. CA of 6% O_2 + 17% CO_2 at 0 °C is recommended for reduction in internal breakdown during shipping, but the efficacy is related to cultivar, pre-harvest factors, temperature, market life and shipping time. Large size 'Elegant Lady' and 'O'Henry' peaches benefit from a 0 °C storage atmosphere of 6% O_2 + 17% CO_2.

Fruit size, storage atmosphere, and temperature all affect chilling injury development. Small peaches stored in air at 0 °C have a longer market-life than large fruit. At both temperatures, large size 'Elegant Lady' and 'O'Henry' fruit have a longer market-life under CA than under air storage. However, at 3.3 °C (38 ºF) small size 'Elegant Lady' fruit in CA showed flesh browning.

Retail Outlet Display Considerations: If fruit firmness is < 27 N (6 lb-force), fruit should be displayed on a cold table. If firmness is > 27 N (6 lb-force), fruit should be displayed on a dry table.

Chilling Sensitivity: Most mid-season and late-peach cultivars are susceptible to chilling injury or internal breakdown. Chilling injury develops faster and more intensely when fruit are stored at 2.2 to 7.6 °C (36 to 45 °F) than those stored at 0 °C (32 °F) or below.

Ethylene Production and Sensitivity: The lower end of this range is for mature but unripe fruit; higher values are for ripe fruit.

Temperature	µl C_2H_4 kg^{-1} h^{-1}
0 °C	0.01 to 5
5 °C	0.02 to 10
10 °C	0.05 to 50
20 °C	0.10 to 160

In general, peaches harvested Well-Mature (higher than U.S.-Mature) will ripen properly without exogenous ethylene application. In most cultivars, ethylene application to fruit harvested at U.S.-Mature will ripen the fruit more uniformly without speeding up the rate of ripening.

Respiration Rates:

Temperature	mg CO_2 kg^{-1} h^{-1}
0 °C	4 to 6
10 °C	16 to 24
20 °C	64 to 110

To get mL kg^{-1} h^{-1}, divide the mg kg^{-1} h^{-1} 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^{-1} h^{-1} by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day.

Physiological Disorders: *Internal breakdown or chilling injury* is the major physiological cause of deterioration. It is a low-temperature or chilling injury problem generically called internal breakdown (IB). The disorder can manifest itself as dry, mealy, woolly, or hard textured fruit, flesh or pit cavity browning, or flesh translucency usually radiating through the flesh from the pit. An intense red color development of the flesh ("bleeding") usually radiating from the pit may be associated with this problem in some peach cultivars. In all cases, flavor is lost before visual symptoms are evident. However, there is large variability in IB susceptibility among peach cultivars. In general, peach cultivars are more susceptible to IB than nectarine and plum cultivars. At the shipping point, fruit should be cooled and held near or below 0 °C (32 °F). During transportation, if IB-susceptible cultivars are exposed to 5 °C (41 °F), their postharvest life can be significantly reduced. Several treatments to delay and limit IB have been tested. Among them, pre-ripening fruit before storage, which is being used successfully in California. The success of CA (17% CO_2 + 6% O_2) depends on cultivar market-life, shipping time and fruit size.

Inking (black staining) is a cosmetic problem affecting only the skin. This disorder is characterized by black/brown spots or stripes. These symptoms appear generally 24 to 48 h after harvest. Inking occurs as a result of abrasion damage, in combination with heavy metal (iron, copper and aluminum) contamination. This occurs usually during harvesting and hauling operations, although it may occur in other steps during postharvest handling. Gentle handling of fruit, short hauling, avoiding foliar nutrient sprays within 15 days of harvest, and following suggested pre-harvest fungicide spray interval guidelines will reduce inking.

Postharvest Pathology: Brown Rot is caused by *Monilinia fructicola*. It is the most important postharvest disease of peaches. Infection begins during flowering. Fruit rot may occur before harvest, but often occurs postharvest. Orchard sanitation to minimize infection sources, pre-harvest fungicide application, and prompt cooling after harvest are among control strategies. Also, postharvest fungicide treatment may be used.

Gray Mold is caused by *Botrytis cinerea*. It can be a serious problem during wet, Spring weather. It can occur during storage if fruit have been contaminated through harvest and handling wounds. Avoiding mechanical injuries and good temperature management are effective controls.

Rhizopus Rot is caused by *Rhizopus stolonifer*. It can occur in ripe or near-ripe peaches kept at 20 to 25 °C (68 to 77 °F). Cooling and keeping fruit below 5 °C (41 °F) is an effective control.

Quarantine Issues: Because some insects, such as *Conotracherlus nenuphar* (plum curculio), *Cydia pomonella* (codling moth), *Rhagoletis pommonella* (apple maggott), and *tetranychus pacificus* are not present in some of our import markets, phytosanitary restrictions have been established. Issues associated with exotic pest quarantines, either addressing imported or exported peaches, can change rapidly. Rules regarding import requirements are issued by APHIS. They provide information to assist exporters in targeting markets and defining entry requirements countries have. APHIS, in cooperation with the State plant boards, developed a database called "Excerpt" to track phytosanitary requirements for each country. APHIS also provides phytosanitary inspections and certifications that declare peaches free of pests to facilitate compliance with foreign regulatory requirements.

For peaches, there are three main ways to deal with these phytosanitary requirements: inspection prior to shipment (including use of screened crates transported in sealed containers), methyl bromide fumigation, and a systems approach. A phytosanitary certificate is required to import California peaches into Taiwan. Peaches must be free of *Anarsia ineatella* (peach twig borer), *Conotracherlus nenuphar* (plum curculio), *Cydia pomonella* (codling moth), *Erwinia amylovora* (fire bright), *Rhagoletis pomonella* (apple maggott), *Tetranychus pacificus* (Pacific spider mite), and *Ceratitis capitata* (Mediterranean fruit fly). If these conditions can not be met, fruit must receive an appropriate treatment prior to shipment. Details of the treatment must be recorded on the phytosanitary certificate.

A phytosanitary certificate (PC) is required to import California peaches into the British Columbia province in Canada. The PC should claim that fruit is free of *Cydia molesta* (oriental fruit moth). Also, it should clearly state that fruit were produced and inspected in accordance with the systems approach

guidelines agreed to by APHIS and the CFIA. Fruit imports are unrestricted to all other Canadian provinces.

A similar program between APHIS and SAGAR/CONASAG/DGSV, exists with Mexico to facilitate import and assure peaches and nectarines are free of *Cydia molesta* (oriental fruit moth), *Conotracherlus nenuphar* (plum curculio), *Rhagoletis pomonella* (apple maggott), and fruit flies (tephritdae). Peaches imported into the U.S. from other parts of the world are sometimes fumigated with methyl bromide, at arrival or shipping point, following treatment schedules issued by APHIS, to prevent entry of insect pests.

Suitability as Fresh-cut Product: The optimal ripeness for preparing fresh-cut peach slices is when flesh firmness reaches 13 to 27 N (3 to 6 lb-force). These slices can be kept while retaining good eating quality for 2 to 8 days (depending on cultivar) at 5 °C (41 °F) with 90 to 95% RH. Post-cutting dips in ascorbate and calcium lactate, or use of MAP may slightly prolong shelf-life.

Special Considerations: Because peaches area a climacteric fruit, they are harvested when they reach a minimum or higher maturity, but are not completely ripe, ie., ready-to-eat. Initiation of ripening must occur before consumption in order to satisfy consumers. Most consumers are satisfied after eating ripe peaches. However, if consumers eat unripe fruit, even if high quality, they are not be satisfied. Detailed ripening protocols for shippers, retail handlers, warehouse managers and produce managers have been developed.

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