Peach

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Postharvest Quality Maintenance Guidelines

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Scientific Name and Introduction

The peach, *Prunus persicae*, is native of 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-pound) 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. Peach exports are mainly to Canada, Taiwan, Hong Kong, Mexico, and South America.

Quality Characteristics and Criteria

There is high consumer acceptance of peaches with high soluble solids concentration (SSC). Fruit titratable acidity (TA) and SSC:TA are also important factors in consumer acceptance. For mid-season peach cultivars a minimum of 11.0% SSC with a TA $\leq$0.7% is required to satisfy approx. 80% of the consumers.

Fruit with 9-13.5 N (2-3 pounds-force) flesh firmness is considered "ready to eat." Fruit below 27-36 N (6-8 pounds-force) measured on the 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) US Mature (minimum maturity); 2) Well-Mature and/or Tree Ripe. The Well-Mature and Tree Ripe have the same definition according to the California Department of Food and Agriculture, Division of Inspection Service.

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 fruits can be handled without bruising damage. Bruising susceptibility varies among peach cultivars.

Grades, Sizes and Packaging

Fruit are hand picked into bags, baskets or totes. Fruit are then dumped in bins that are 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 cooler as soon as possible after harvest. At the packinghouse the 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 of sorting line efficiency is especially important with peaches where a range of colors, sizes, and shapes of fruit can be encountered. Sizing segregates fruit by either weight or dimension.

Most of the yellow-flesh peaches are packed into two layer (tray) boxes. Small size yellow-flesh peaches are generally volume-fill packed. Most of the white-flesh and "tree ripe" peaches are packed into one layer (tray) boxes.

Limited volumes of high maturity peaches 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. The packers work directly from the buckets to select, grade, size, and pack fruit into plastic trays.

Optimum Storage Conditions

Fruit can be cooled in field bins using forced-air cooling or hydrocooling. Forced-air cooling in side-vented bins can be by either the tunnel or the serpentine method. Hydrocooling is normally done by a conveyor-type hydrocooler or "in situ".

Fruit in field bins can be cooled to intermediate temperatures (5^{o} to 10^{o}C (41^{o}-50^{o}F)) provided packing will occur the next day. If packing is to be delayed beyond the next day, then fruit should be thoroughly cooled in the bins to near 0^{o}C (32^{o}F). In internal breakdown (IB)-susceptible cultivars fast cooling (within 8 hours) and maintaining fruit temperature near 0^{o}C (32^{o}F) are recommended.

Peaches in packed containers should be cooled by forced-air cooling to near 0^{o}C (32^{o}F). Even peaches that were thoroughly cooled in the bins will warm substantially during packing and should be thoroughly re-cooled after packing.

Optimum Temperature

-1 to 0^{o}C (30.5-32^{o}F). Freezing point varies depending on SSC from -3 to -1.5^{o}C (26.5 to 29.5^{o}F).

Relative Humidity should be maintained at 90-95% and an air velocity of approximately 50 CFM is suggested during storage.

Controlled Atmosphere (CA) Considerations

The major benefits of CA during storage/ shipment are retention of fruit firmness and ground color. CA conditions of 6% O_2 + 17% CO_2 at 0^oC are recommended for reduction of internal breakdown during shipments, but the efficacy is related to cultivar, preharvest factors, temperature, market life and shipping time. Large size 'Elegant Lady' and 'O'Henry' peaches benefit from a 0^oC storage atmosphere of 6% O_2 + 17% CO_2.

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

Retail Outlet Display Considerations

If fruit firmness is below 27 N (6 pounds-force), peaches should be displayed on a cold table. If fruit firmness is higher than 27 N (6 pounds-force), fruit should be displayed on a dry table.

Chilling Sensitivity

Most of the mid-season and late-peach cultivars are susceptible to chilling injury or internal breakdown. Chilling injury symptoms develop faster and more intensely when fruit are stored at temperatures between about 2.2^o and 7.6^oC (36^o and 45^oF) than those stored at 0^oC (32^oF) or below.

Rates of Ethylene Production and Sensitivity:

μl C_2H_4/kg.hr (range)[z]			
0°C (32°F)	5°C (41°F)	10°C (50°F)	20°C (68°F)
0.01-5	0.02-10	0.05-50	0.1-160

[z] The lower end of this range is for mature but unripe fruit; higher values are for ripe fruit.

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

Respiration Rates:

Temperature	0°C(32°F)	10°C(50°F)	20°C(68°F)
ml CO_2/kg.hr	2-3	8-12	32-55

To calculate heat production, multiply ml CO_2/kg.hr by 440 to get BTU/ton/day or by 122 to get kcal/metric ton/day.

Physiological Disorders

Internal Breakdown or Chilling Injury: The major physiological cause of deterioration 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^oC (32^oF). During transportation, if IB-susceptible cultivars are exposed to 5^oC (41^oF) their postharvest life can be significantly reduced.

Several treatments to delay and limit development of IB have been tested. Among them, pre-ripening fruit before storage, which is being successfully used commercially in California. The success of the controlled-atmosphere (17% CO_2+6%O_2) treatment depend on cultivar market life, shipping time and fruit size.

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

Postharvest Pathology

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

Gray Mold: Caused by *Botrytis cinerea, gray mold* can be a serious problem during wet spring weather. It can occur during storage if the fruit has been contaminated through harvest and handling wounds. Avoiding mechanical injuries and good temperature management are effective control measures.

Rhizopus Rot: Caused by *Rhizopus stolonifer, rhizopus rot* can occur in ripe or near ripe peaches kept at 20 to 25^{o}C (68 to 77^{o}F). Cooling the fruits and keeping them below 5^{o}C (41^{o}F) is very effective against this fungus.

Quarantine Issues

Because some insects such as Conotracherlus nenuphar (plum curculio), Cydia pomonella (codling moth), Rhagoletis pommonella (apple maggott), 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 the USDA Animal and Plant Health Inspection Service (USDA-APHIS). This agency provides information to assist exporters in targeting markets and defining what entry requirements a particular country might have for peaches. USDA APHIS, in cooperation with the State plant boards, developed a data base, called Excerpt, to track the phytosanitary requirements for each country. USDA APHIS also provides phytosanitary inspections and certifications that declare the peaches are 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 treatments, and “systems approach”.

A phytosanitary certificate is required to import California peaches into Taiwan. Peaches must be free of Anarsia ineatella (peach twing 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, then fruit must be treated with 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. PC should claim that fruit is free of *Cydia molesta* (oriental fruit moth). Also it should be clearly advertise that the fruit in this shipment were produced and inspected in accordance with the "systems approach guidelines" agreed to by USDA/APHIS/PPQ and the CFIA. Fruit imports are unrestricted to all of the other Canadian provinces.

Similar program, "systems approach" between USDA/APHIS/PPQ and SAGAR/CONASAG/Dgsv, was established with Mexico to facilitate import of peaches and nectarines and assure that 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 United States from other parts of the world are sometimes fumigated with methyl bromide, at arrival or shipping point, following treatment schedules issued by the USDA APHIS, to prevent the entry of insect pests.

Suitability as Fresh-cut Product

The optimal ripeness for preparing fresh-cut peach slices is when the flesh firmness reaches 13-27 N (3-6 lbs-force). These slices can be kept while retaining good eating quality for 2-8 days (depending on cultivar) at 5^{o}C (41^{o}F) and 90-95% relative humidity. Postcutting dips in ascorbic acid and calcium lactate or use of modified atmosphere packaging may slightly prolong the shelf-life of peach slices.

Special Considerations

Because peaches area a climacteric fruit, they are harvested when they reach a minimum or higher maturity, but are not completely ripe ("ready to eat"). Initiation of the ripening process must occur before consumption to satisfy consumers. Most consumers were be satisfied after eating ripe peaches, however, consumers eat even high quality but unripe fruit, they will not be satisfied. Detailed ripening protocols for shippers and retail handlers, and for warehouse and produce managers

have been developed.

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Acknowledgments

Some of the information included was from the University of California - Davis website on “Fresh Produce Facts” at http://postharvest.ucdavis.edu/produce/producefacts/