Oranges

Applies to Valencia and other round oranges

Revised 2018

Thermal Properties

	English	Metric
Moisture, %	82.30	--
Protein, %	1.30	--
Fat, %	0.30	--
Carbohydrate, %	15.50	--
Fiber, %	4.50	--
Ash, %	0.60	--
Specific Heat Above Freezing	0.91 Btu/lb*°F	3.81 kJ/(kg*K)
Specific Heat Below Freezing	0.47 Btu/lb*°F	1.96 kJ/(kg*K)
Latent Heat of Fusion	118 Btu/lb	275 kJ/kg

Storage Conditions

		Temperature		Relative Humidity	Storage Period
		°F	°C		
Florida and Texas		32-34	0-1	85-90%	8-12 weeks
California		41-45	5-7	85-90%	4-6 weeks
Arizona	Harvested in March	48	9	85-90%	3-4 weeks
	Harvested in June	37	3		

Oranges are arbitrarily grouped as to their maturation periods, but it is primarily the late, or Valencia, orange that is stored. This variety is normally marketed from March through June. If held on the tree too long for late shipment, the fruit often re-green, change in grade, or become soft or over-mature. Valencia oranges are of excellent quality and have high sugar content if picked at the right time. The freezing point of the flesh ranges from 26.4 to 28.4°F (-3 to -2°C) and that of the rind from 25.4 to 26.5°F (-4 to -3°C).

Most early season fall and winter varieties do not store as well as Valencia, and Navel oranges will develop off-flavors during long storage. Florida and Texas Valencia oranges can be stored successfully for 8-12 weeks at 32-34°F (0-1°C). California and Arizona oranges are more subject to rind disorders than Florida or Texas oranges at low temperatures, since Western oranges are more chilling sensitive. A temperature of 41-45°F (5-7°C) is suggested for most California oranges. However, Arizona and desert-grown California

Valencia oranges may be injured even at this temperature. A temperature of 48°F (9°C) has been found best for Arizona oranges harvested in March, and 37°F (3°C) for fruit harvested in June. Depending upon the state of production and time of year, California and Arizona Valencia oranges can be kept 6-8 weeks at 37°F (3°C), 4-6 weeks at 41-45°F (5-7°C), and 3-4 weeks at 48°F (9°C). California Navel oranges are sometimes stored 2-6 weeks at 41-45°F (5-7°C) to allow orderly marketing.

Care should be exercised to select prime fruit for commercial storage. The fruit should be in excellent eating condition and should not be picked too early or too late in the season. Emphasis should be placed on careful picking, handling, grading, and sorting out soft, over-mature, creased, bruised, and injured fruit. Fruit with long, sharp stems should not be packed, for such stems injure other fruits which become sites for decay development. There are no shortcuts in preparing oranges for successful long-term storage, and quality does not improve during storage.

Oranges should not be stored with apples, cheese, eggs, or butter, or in places where there is a possibility for the orange odor to penetrate into rooms holding these products. It is desirable that oranges in storage be examined frequently to detect peel breakdown and decay before they become serious. The length of storage should be based on the condition of the fruit, taking into consideration the need for a reasonable marketing period after removal from storage.

Controlled atmospheres (CA) of 5-10% oxygen and 0-5% carbon dioxide may aid in quality retention of oranges. However, CA is not commonly used because tolerable oxygen and carbon dioxide levels do not significantly inhibit decay, which limits orange shelf life the most. In addition, most citrus fruits are sensitive to anaerobiosis due to low levels of oxygen.

Decay Control

Decay may develop in the fruit during storage, and some fruits may develop various physiological disorders that further promote decay. The development of decay can be reduced by careful handling, chemical treatments in the packinghouse, and optimum temperature management during transit and storage. Decay control during storage can be accomplished by treatment with Thiabendazole (TBZ), sodium ortho-phenylphenate (SOPP), imazalil, pyrimethanil, and/or fludioxonil. Two biological pesticides, Aspire and BioSave-10, have been approved for decay control. A combination of these treatments is suggested for maximum benefit and to avoid development of fungal strains resistant to certain fungicides. Wax is also applied to the fruit to prevent shriveling and to improve appearance. In storage, unimpeded air circulation around the cartons of oranges is desirable. A relative humidity of 85-90% minimizes water loss and fruit shriveling.

Storage of Fresh Squeezed Orange Juice

A product that has recently become very popular with consumers is freshly squeezed orange juice with no further processing. In this process, the oranges are cleaned, squeezed under nearly sterile conditions for juice extraction in commercial machines, and finished to remove seeds and larger pieces of pulp by passing the juice under pressure through a screen. Such juice is then filled into sterile containers under sterile conditions similar to "aseptic packaging." Such juices are said to have better flavor quality and

nutrition due to lack of exposure to heat. However, they are very sensitive to fermentation and to "cloud loss" or clarification because they have not been pasteurized and their enzymes have not been deactivated by heat. Fermentation and associated off flavors, as well as clarification, occur much more rapidly as temperatures increase. Consequently, for best storage stability, it is recommended to store these juices as near the freezing point as possible until consumption. Shelf life for consumer acceptable products of this kind is about 14-20 days if the juices are kept at 32-35°F (0-2°C) and diminishes proportionately as storage temperature increases. Quality of such products is a reflection of the total thermal history the product has experienced, and quality deterioration from even short exposures to higher temperatures is additive, thus reducing the already short shelf life.

Diseases and Disorders

Aging	Aging is characterized by wilting, shriveling, and browning of rind around the stem "button" or elsewhere on upper parts of fruit. Oil cells in affected rind may collapse, thus resembling pitting. The fruit flavor may have a pronounced aged taste. **Control:** Avoid prolonged storage.
Black Rot (Alternaria)	A black core rot at stem end following long (12-14 week) storage, which may or may not be evident without cutting. **Control:** The stored fruit should be marketed before significant amounts of black rot develop. Market promptly after removal from storage.
Blue Mold and Green Mold	These rots are identified by characteristic soft, watery, discolored areas or spots, which later produce easily distinguished blue or green spores. Infections usually begin at wound sites created during harvesting, handling, and packing. **Control:** Use of postharvest fungicides and careful handling to minimize injury are primary means of control. Maintenance of temperatures below 50°F (10°C) greatly slows its growth, and between 40 and 45°F (4.4 and 7°C) rot growth is so slow as to be practically negligible during usual commercial handling time for oranges. Blue mold will grow slowly at low temperatures that prevent green mold development. Blue mold can spread from one fruit to another by direct contact.
Chilling Injury	Chilling injury (CI) is characterized by areas of the peel that collapse and darken to form pits. The pitting is not targeted to the oil glands. Less severe symptoms may show up as circular or arched areas of discoloration or scalding. Symptoms of CI are typically more pronounced after fruit are warmed to room temperature following exposure to the chilling temperature. **Control:** Store and transport fruit at recommended storage temperatures.
Freezing	In frozen fruit, membranes between segments are water-soaked. Rind may be discolored brown or gray in severe cases, or both rind and flesh may become soft and mushy. Oranges may taste bitter for a time after defrosting. Fruit frozen on the tree is soft and light in weight, exhibits woodiness in pulp, and has cavities within or between segments.

	Control: Avoid freezing temperatures.
Granulation	Juice sacs become dry but do not separate from each other or from segment walls. Affected fruit feels firm but light in weight. This disorder is favored by drought conditions and is most common in over-ripe fruit. **Control:** This orchard disorder is sorted out in packing houses by flotation or other devices that separate fruit based on fruit density.
Oil Spotting (Oleocellosis)	Caused by the release of oil from oil glands when turgid fruit receive even slight bumps and abrasions. The oil is toxic to the surrounding cells. Symptoms appear as irregularly shaped green, yellow, or brown areas. **Control:** Avoid harvesting turgid fruit, such as when dew is present or immediately after rain or irrigation. Conditioning the fruit at ambient temperatuire and high humidity immediately after harvest and before storage or packing will help
Postharvest Pitting	Pitting is characterized by clusters of collapsed oil glands (often 5 to 20) scattered over the fruit surface that can begin to develop two days after packing. Collapsed regions turn bronze/brown or brown/black over time. This disorder is associated with low oxygen levels within the fruit following application of low-oxygen permeable wax coating and holding at warm temperatures. **Control:** Rapidly cool fruit after packing and use wax coatings with good gas permeability.
Stem End Rind Breakdown (SERB)	Characterized by the collapse of rind tissue around the stem end of citrus fruit. The affected area is irregular in shape and becomes dark and sunken. A thin ring of unaffected tissue immediately around the stem (button) is a distinctive symptom of SERB. Symptoms usually develop after harvest and during storage within 2-7 days after packing. SERB is more common and severe on small fruit and on well-colored fruit. Thinner-skinned fruit from humid growing environments tend to be more prone to SERB than thicker-skinned fruit grown in arid environments. Fruit with SERB are much more prone to decay. **Control:** SERB is primarily associated with conditions promoting fruit water loss. Postharvest practices that reduce water loss such as maintaining high humidity during degreening, rapid handling, and wax application are currently the best means for reducing SERB.
Stem End Rot	Usually caused by infection with either *Diplodia* or *Phomopsis*, the principal decay organisms in areas with abundant summer rainfall (e.g. Florida). Decay develops primarily from preharvest infections of the button at the stem end of the fruit. Infected areas soften and turn tan or brown. Affected fruit do not shrivel and usually show no surface fungus growth. Affected fruit taste flat and bitter; affected tissues have a rancid odor. **Control:** Use of postharvest fungicides. Rapidly reduce fruit temperature and store fruit at the lowest safe temperature will hold decay in check.

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