Pomegranate

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Scientific Name and Introduction: *Punica granatum* L., the pomegranate belongs to the *Punicacea* family and is one of the oldest known edible fruits. It is sometimes called Chinese apple, and has been cultivated extensively in Mediterranean countries (Tunisia, Turkey, Israel, Egypt, Spain and Morocco) Iran, Afghanistan, India and to some extent in the U.S. (California), China, Japan and Russia. The pomegranate requires a long hot Summer for fruit to mature, can withstand low temperatures in the Winter and is drought and salt-tolerant. The fruit is nearly round with a prominent attached calyx and a hard, leathery skin. Surface color varies among commercial cultivars, from yellow with a crimson cheek, to solid brownish-red and also bright-red. The edible portion is the bright-red pulp (aril) surrounding the individual seed. The fruit is consumed fresh, or it can be processed into juice, syrup, jams, or wine. Fruit of the wild-type pomegranate is acidic, but cultivated cultivars bear fruit with a sweet-sour and sweet flavor. There are several types of edible pomegranate and there are ornamental types with double flowers, largely sterile, which are not grown for edible fruit. Several cultivars are grown commercially around the world, including: Wonderful in California and Israel; Mollar and Tendral in Spain; Schahvar and Robab in Iran; Hicaznar and Beynar in Turkey; Zehri and Gabsi in Tunisia; (LaRue, 1980; Morton, 1987; Patil and Karale, 1990; Onur and Kaşka, 1985; Llacer et al., 1994; Mars, 1994).

Quality Characteristics and Criteria: Fruit quality depends largely on sugar and acid content of the juice. A high quality pomegranate should also have an attractive skin, small seeds in the aril and should be free from sunburn, growth cracks, cuts, bruises, and decay. Skin color and smoothness are other quality indices. Sour and sour-sweet pomegranates have reddish skin, in contrast to sweet pomegranate, which have yellowish-green skin. Pomegranates have low ascorbate compared to many other fruits. Ascorbate ranges from 0.49 to 30 mg per 100 g juice, depending on cultivar (Hussein and Hussein, 1972; Küpper, 1995); skin thickness varies from 1.5 to 4.24 mm (Küpper, 1995). Juice content of pomegranates is 45 to 65% of the whole fruit or 76 to 85% of the aril. Skin contains 30% tannin, which is used in medical and dye industries.

Horticultural Maturity Indices: Pomegranates can be harvested when they reach a certain size and skin color. Other maturity indices are TA and SSC. Each pomegranate type requires a certain TA:SSC at harvest. TA of pomegranates varies between 0.13 and 4.98% at harvest (Küpper, 1995). The TA is < 1% in sweet cultivars, 1 to 2% in sweet-sour cultivars and > 2% in sour cultivars (Onur and Kaşka, 1985). SSC of pomegranates varies from 8.3 to 20.5% at harvest (Küpper, 1995). Thus, maturity indices depend on cultivar. For example, a TA < 1.85% and SSC ≥ 17% are recommended for California-grown 'Wonderful' fruit (Ben-Arie et al., 1984; Elyatem and Kader, 1984). Juice tannin content < 0.25% is preferred, and red juice color equal to or darker than Munsel color chart 5R-5/12 is desirable (Crisosto et al., 1996).

Grades, Sizes and Packaging: There are no U.S. grades; fruit are generally packed into 2-layer tray packs or bulk cartons. Pomegranates can be classified into four groups based on size. For the Turkish standard, sizes are defined as Small (150 to 200 g, 65 to 74 mm diameter, 25 to 34 fruit/5-kg carton); Medium (201 to 300 g, 75 to 84 mm diameter, 17 to 25 fruit/5-kg carton); Large (301 to 400 g, 85 to 94 mm diameter, 13 to 17 fruit/5-kg carton) and Extra Large (401 to 500 g, 94 to 104 mm diameter, 10 to 13 fruit/5-kg carton.

Pre-cooling Conditions: Not applicable.

Optimum Storage Conditions: Optimum storage temperature varies by cultivar, production area and postharvest treatment (Hardenburg et al., 1990; Mercantilia, 1989; Onur et al., 1995; Snowdon, 1990; SeaLand, 1991). The recommended conditions for storage of 'Hicaznar' are 6 °C (42.8 °F) with 90% RH (Onur et al., 1992, 1995; Pekmezci et al., 1998). Storage of 'Wonderful' < 5 °C (41 °F) resulted in chilling injury; severity of symptoms increased with time and temperature below 5 °C (Elyatem and Kader, 1984). Control of RH is critical in storage, because skin desiccates readily at low RH, resulting in hard, darkened rinds, which are unattractive and reduce marketability. RH of 90 to 98% is preferred for storage (Salunkhe and Desai, 1984). Waxing fruit and storage in plastic liners can reduce weight loss (Küpper, 1995).

Controlled Atmosphere (CA) Considerations: CA storage has the advantage of reducing loss of TA and Vitamin C (Küpper et al., 1995). Optimal CA-storage for pomegranate are 3% O_2 + 6% CO_2 (Küpper et al., 1995). 'Hicaznar' fruit can be stored for 6 mo at 6 °C (42.8 °F) under CA (Pekmezci et al., 1998).

Retail Outlet Display Considerations: Do not water sprinkle or top ice.

Chilling Sensitivity: Pomegranates are susceptible to chilling injury and should not be stored < 5 °C (41 °F). External symptoms include rind pitting, brown discoloration of the skin and increased susceptibility to decay. Internal symptoms include a pale aril color and brown discoloration of the white segments separating the arils (Elyatem and Kader, 1984).

Ethylene Production and Sensitivity: Pomegranates produce very low amounts of ethylene at < 0.1 μL kg^{-1} h^{-1} at up to 10 °C (50 °F) and < 0.2 μL kg^{-1} h^{-1} from 10 to 20 °C (Elyatem and Kader, 1984). Fruit are not particularly sensitive to ethylene exposure, although ethylene at ≥ 1 μL L^{-1} stimulates respiration and autocatalytic ethylene. Ben-Arie et al. (1984) reported that ethylene treatment of 'Wonderful' pomegranates caused a rapid but transient rise in CO_2, but no change in SSC, TA, or fruit and juice color. Pomegranates do not ripen after harvest and must be picked fully-ripe.

Respiration Rates: Pomegranate is a non-climacteric fruit and has a very low respiration rate that declines with time in storage.

Temperature	mg CO_2 kg^{-1} h^{-1}
5 °C	4 to 8
10 °C	8 to 16
20 °C	16 to 36

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. Data are from Crisisto et al., 1996.

Physiological Disorders: Chilling injury (CI) is the most common physiological disorder during storage. Incidence and severity of CI depend on temperature and duration. Symptoms are especially apparent upon removal of fruit from cold storage to 20 °C (68 °F). External CI symptoms include surface pitting, skin discoloration, scald and dead skin tissues. Internal symptoms include dead tissues, brown discolouration of the white segments separating the arils and pale aril color (Elyatem and Kader, 1984).

Husk scald (brown superficial discoloration) is another manifestation of CI in pomegranate; it is a restricted to the husk. At advanced stages, scalded areas became moldy. Scald symptoms become evident after 8 weeks storage at 2 °C (35.6 °F).

Splitting and cracking are physiological disorders that occur to fruit on the tree. The rind shows various degrees of cracking, which often serves as entry points for decay organisms (Salunkhe and Desai, 1984). Splitting and cracking can be prevented using regular irrigation; the last irrigation must be done 15 to 20 days before harvest.

Internal breakdown is another physiological disorder in pomegranate fruit in which the pulp-bearing seeds (arils) do not develop their typical red color and are somewhat flattened rather than plump (Ryall and Pentzer, 1974).

Postharvest Pathology: Gray Mold (*Botrytis cinerea*) rot, Green Mold (*Penicillium digitatum*) rot and *Cladosporium* spp. are the main postharvest diseases of pomegranate fruit. Gray Mold usually starts at the calyx. As it progresses, the skin becomes light-brown, tough and leathery. Heart rot is another disorder that may be caused by *Aspergillus* spp. and *Alternaria* spp. Affected fruit show slightly abnormal skin color and a mass of blackened arils; disease develops while fruit are on the tree (Salunkhe and Desai, 1984).

Quarantine Issues: None.

Suitability as a Fresh-cut Product: None are fresh-cut at this time.

Special Considerations: Pomegranates do not ripen after harvest and must be picked fully-ripe to ensure the best eating quality.

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