Pomegranate

M. Pekmezci and M. Erkan
Pekmezci and Erkan are with the Department of Horticulture, Faculty of Agriculture, Akdeniz University, Turkey.

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 United States (California), China, Japan, and Russia. The pomegranate requires a long, hot summer for fruit to mature, but it can withstand low temperatures in winter and is drought- and salt-tolerant.

Pomegranate 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 or 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, and ‘Zehri’ and ‘Gabsi’ in Tunisia (LaRue 1980, Onur and Kaşka 1985, Morton 1987, Patil and Karale 1990, 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 and small seeds in the aril and should be free from sunburn, growth cracks, cuts, bruises, and decay. Skin color and smoothness are also quality indices. Sour and sour-sweet pomegranates have reddish skin, in contrast to sweet pomegranates which have yellowish-green skin. Skin thickness varies from 1.5 to 4.24 mm (Küpper 1995). Skin contains 30% tannin, which is used in medical and dye industries.

Pomegranates are low in vitamin C, an important nutritional quality component, compared to many other fruits. Vitamin C content ranges from 0.49 to 30 mg per 100 g juice depending on cultivar (Hussein and Hussein 1972, Küpper 1995). Juice content of pomegranates is 45 to 65% of the whole fruit or 76 to 85% of the aril.

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, 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 Munsell color chart 5R 5/12 is desirable (Crisosto et al. 1996).

Grades, Sizes, and Packaging

There are no U.S. grades. Only a small number of pomegranates have been grown historically in the U.S., mostly in California and Arizona. Therefore, most fruit are imported for the U.S. market. Pomegranates are classified into four groups based on size. Under Turkish standards, sizes are defined as—

Small	150 to 200 g	65 to 74 mm diameter	25 to 34 fruit per 5-kg carton
Medium	201 to 300 g	75 to 84 mm diameter	17 to 25 fruit per 5-kg carton
Large	301 to 400 g	85 to 94 mm diameter	13 to 17 fruit per 5-kg carton
Extra Large	401 to 500 g	94 to 104 mm diameter	10 to 13 fruit per 5-kg carton

Fruit are generally packed into 2-layer tray packs or bulk cartons.

Optimum Storage Conditions

Optimum storage temperature varies by cultivar, production area, and postharvest treatment (Mercantilia 1989, Hardenburg et al. 1990, Köksal 1989, Snowdon 1990, SeaLand 1991, Onur et al. 1995). The recommended conditions for storage of 'Hicaznar' are 6 °C (43 °F) with 90% RH (Onur et al. 1992, 1995, Pekmezci et al. 1998). Storage of 'Wonderful' at <5 °C (41 °F) resulted in chilling injury, and 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 levels for pomegranate storage are 3% O_2 and 6% CO_2 (Küpper et al. 1995). 'Hicaznar' fruit can be stored for 6 mo at 6 °C (43 °F) under CA (Pekmezci et al. 1998).

Retail Outlet Display Considerations

Pomegranates should not be water-sprinkled or top-iced.

Chilling Sensitivity

Pomegranates are susceptible to chilling injury and should not be stored at <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: <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 (50 to 68 °F) (Elyatem and Kader 1984). Fruit are not particularly sensitive to ethylene exposure, though 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 nonclimacteric 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

Data from Crisisto et al. (1996).

To get mL CO_2 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 ton^{-1} day^{-1} or by 61 to get kcal $tonne^{-1}$ day^{-1}.

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 discoloration 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 of storage at 2 °C (36 °F).

Splitting and cracking occur in 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 by using regular irrigation; the last irrigation must be done 15 to 20 days before harvest.

Internal breakdown is another physiological disorder in pomegranate fruit. 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 rot *(Botrytis cinerea)*, green mold rot *(Penicillium digitatum)*, 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; it 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

There are no known quarantine issues.

Suitability as a Fresh-Cut Product

Possibly, but 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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