

POMEGRANATE AS A SOURCE OF NUTRACEUTICALS AND AS A FUNCTIONAL FOOD

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Summary

Pomegranate fruit is being used as a food and medicine since ancient age. This fruit is rich in antioxidant activity with potential health benefits. Many *invitro*, *invivo* and clinical trials on pomegranate juice, and its extracts are been conducted to examine its efficacy as antioxidant, anticancer, anti-atherogenic, antidiabetic and among others. Much of the work is related to its potent antioxidant activity contributed by polyphenols such as hydrozable tannins, anthocyanins and other compounds. This chapter covers the

nutritional qualities, bioactive compounds and health benefits of pomegranate obtained from various studies.

1. Introduction

Pomegranate (*Punica granatum* L.) belongs to the family *Punicaceae*. It is also referred affectionately as the “jewel of winter”. This fruit is native to the Middle East, Iran, Afghanistan, Northern India, Northern Pakistan and spread to North Africa, South Europe and America. The pomegranate plant is either considered a small tree or a large shrub growing in arid or semiarid zones and relatively resistance to drought and salinity conditions. The fruit is often referred as a ‘berry’ with a thick leathery skin of deep red/pink/yellow/light green and crowned by the pointed calyx (Figure 1). The edible portions of pomegranate fruit are the arils which constitute 45–60% of total fruit weight. Arils include seed coat and are fleshy or pulpy, sweet to sour in taste, white, pink or red in colour. Other portion of an aril is the seed consisting of the covering and the embryo inside.

This fruit is popularly consumed in the fresh form, i.e., separated arils or juice, or as food products, such as beverage, jam, jelly and paste. This fruit is nutritious and rich in sugars, organic acids, vitamins and polysaccharides. In addition, this fruit is also rich in anthocyanins, other polyphenolic compounds, fatty acids and sterols. Hence, this fruit has gained widespread popularity both as a functional food and as nutraceutical source. The beneficial effects of this fruit have been studied in relation to a variety of chronic diseases like cardiovascular disease, diabetes, and certain cancers obtained from various *invitro*, *invivo* and human clinical trials. The beneficial effects of pomegranate against various diseases have been related to its potent antioxidant activity due to the presence of high polyphenolic content, specifically in the form of tannins, punicalagin, punicalin and punicic acid (Faria & Calhau, 2011).

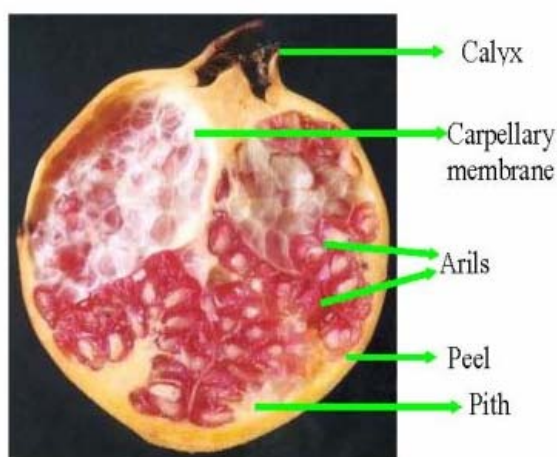


Figure 1. Pomegranate fruit

In the past few years the number of peer-reviewed articles on pomegranate about its nutritional composition, bioactive compounds, antioxidant activity, seed oil composition and beneficial/medicinal effects has tremendously increased from various *invitro*, *invivo*

and clinical trials. Results from these studies may indicate that this fruit is rich in phytonutrients with potential benefits towards human health. This chapter provides an overview of pomegranate chemical and nutritional composition, common bioactive compounds and health effects.

2. Origin and History

Archeobotanical investigations show that pomegranate is probably originated from Iran and Afghanistan, and has been cultivated in the Caucasus since 4000 years ago. The pomegranate is one of the oldest known edible fruits and was considered as a holy fruit since antiquity by many religions. This fruit is cited in *Ayurveda* – an ancient science of Indian medicine, in the Bible and in Koran as a medicinal fruit. The fruit was seen by ancient Egyptians as a symbol of wealth and ambition and parts of the tree were used to treat parasitic infections. Pomegranate has been used for centuries as a folk medicine by many countries, and as a therapeutic agent for the treatment of inflammatory diseases and disorders of the digestive tract. This fruit has been consumed and used as a medicinal food in the Middle East and is often associated to fertility. The plant was used in many ways, including juice, dyes inks, tannins for leather (bark) and a variety of remedies for various ailments. The fruit has a fairly long shelf life at room temperature, and hence was carried on long journeys through desert climates as a source of water and nourishment.

3. Botanical Classification

Pomegranate fruit is classified based on Engler and Prantl classification. Later on Hutchison, modified the classification. Both the systems on classifications are provided in Table 1.

Engler and Prantl's (1931)		Hutchinson (1959)	
Division:	Angiospermae	Phylum	Angiospermae
Class:	Dicotyledonae	Subphylum:	Dicotyledonae
Subclass:	Archichlamydeae	Division	Lignosae
Order:	Myrtiflorae	Order	Myrtales
Family:	Punicaceae	Family:	Punicaceae
Genus:	Punica	Genus:	Punica
Species:	<i>P. granatum</i> (Linn)	Species:	<i>P. granatum</i> (Linn)

Table 1. Botanical classification of pomegranate.

4. Vernacular Names of Pomegranate

Pomegranate fruit is called by different names worldwide. In Table 2, few examples of pomegranate vernacular names are provided.

International	Vernacular name	Indian	Vernacular name
Chinese	Shiliu	Bengali	Dalim
French	Grenade	Gujrati	Dadam
German	Granatapfel	Hindi	Anar
Malay	Delima	Kannada	Dalimbe
Italian	Melogranate	Malayalam	Matalam
Japanese	Zakuro	Oriya	Dalimba
Romanian	Rodie	Punjabi	Anar
Russian	Granatnik	Sanskrit	Darimba
Spanish	Granada	Tamil	Madulam
Swedish	Granatäpple	Telugu	Dhanimmapandu

Table 2. Vernacular names of pomegranate

5. Commercial Varieties/Cultivars/Genotype.

Pomegranate fruit is grown worldwide, especially in temperate and tropical areas. This fruit grows well in hot, humid as well as dry conditions. For convenience varieties, cultivars and genotypes are combined into the same group (Table 3). However, description for each is not provided due to lack of data.

Country	Cultivars/varieties/genotypes
America	Wonderful
China	Tianhongdan, Jingpitian, Sanbaitian, Suanshiliu
Egypt	Succari red (smooth), Succari red, Succari white
India	Agra Khandari, Mathura Alandi, Delhi Muscat, Lucknow Muscat, Jhansi Bedana, Ruby, Kabul, Ganesh, Arakta
Iran	Syah, Alak-e-Shirin, Bihasteh, Shirin Malase, Torsh Malase, Gardan Togh, Alak-e-Torsh, Tabestani, Malase Yazdi, Pusat Sefeede Torsh, Pust Syahe Yazd
Israel	Shani-Yonay
Italy	Sour Triggiano, Sour Molfetta, Sour Ninetta Ostuni, Sour S Glorgio, Common Triggiano, Modugno Triggiano, Common Molfetta
Saudi Arabia	Taifi
Spain	Mollar de Elche, Mollar de Albetera, Mollar de Orihuela, San Felipe de Blanca, Albar de Blanca, Agridulce de Ojos, Borde de Albatera, Borde de Blanca
Tunisia	Gabsi, Tounsi, Chetoui, Mezzi, Zehari
Turkey	Cekirdeksiz, Kuru Kabuk, Siyah Nar, Nuz Eksi, Yesil Kabuk, Kirli Hanim, Dikenli Incekabuk, Eksi, Kan Katirbasi, Serife, Tatli

Table 3. Commercial varieties/cultivars/genotypes of pomegranate

6. Primary Metabolite Composition

Arils are the edible part of the pomegranate fruit and can be consumed fresh. They are used in the preparation of juice, jams, jellies and canned beverage. Juice obtained from the arils ranged from 26 ml/100 g to 85 ml/100 g arils with pH ranging from 4.5-2.7 (Table 4). To get an indication of variation in the taste of arils obtained from various places, commonly total soluble solids (TSS) and titrable acidity (TA) are evaluated. Determination of TSS/TA is not only important to establish the organoleptic quality of the juice, but also it establishes the commercial quality of the fruit. Higher the TSS value, sweeter is the juice. TSS content is also depended on fruit maturation and the climate. Cold climate promotes accumulation of sugars or compounds promoting higher TSS values. Colder countries like Turkey, America and Italy have higher TSS values, while India, Egypt, Saudi Arabia have lower values since the climate is hot. Strong correlation is reported from many fruits between TSS and sugar content. Hence, determination of sugar levels is also important.

Country	Juice content (ml/100 g)	pH	TSS (°Brix)	Titrateable Acidity (TA g/L)	Vitamin C (mg/100 g)
America	-	-	16.5	1.0	-
Egypt	75-43	4.5-2.9	12.4	2.8	58
India	-	-	15.3	-	72-55
Iran	55.5-26.9	4.1-3.1	18.3-11.3	4.1-0.3	20.9-10.5
Israel	75-36	-	17.8-13.7	7.6-0.2	110-65
Italy	72.2-65.5	3.5-3.1	18-14.8	4.3	0.23-0.08
Saudi Arabia	31.2	3.4	16.5	-	-
Tunsia	73.9-51.7	4.5-2.6	16.6-12.9	2-0.6	-
Turkey	85-76	3.9-2.7	19-15.4	2.9-0.4	-

Table 4. Chemical composition of pomegranate juice

Country	Source	Fructose	Glucose	Sucrose	Maltose	Total sugars
Iran	Juice	5.9-3.5	6.4-3.4	-	-	12.3-7.2
Israel	Juice	6.6	4.8	-	0.02	-
	Peel	6.6-0.9	4.8	Trace	0.8	-
Saudi Arabia	Juice	6.5	7.5	-	-	-
Spain	Seeds	7.04-5.9	6.45-5.6	0.39-0.01	Traces	13.5-11.4
	Peel	46.3	27.1	Trace	-	-
Tunsia	Juice	7.4-4.2	8.8-4.4	-	-	-

Table 5. Sugar contents of pomegranate (g/100 g)

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