



## Citrus maxima: A Brief Review on the World's Largest Citrus Fruit

**Ayesha Nazeer\*, Ashoka Shenoy M., Karunakar Hegde, A. R. Shabaraya**

Srinivas College of Pharmacy, Valachil, Farangipete post, Mangalore, Karnataka, India- 574143.

\*Corresponding author's E-mail: [ayenazeer07@gmail.com](mailto:ayenazeer07@gmail.com)

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### ABSTRACT

Citrus fruits are well-known for their active constituents, *Citrus maxima* or Pomelo is one such fruit of the genus Citrus that is widely significant for its dietary and traditional values. Its array of phytoconstituents is highly regarded from pharmacological perspective. Its botanical description boasts of vibrant anatomical and morphological characteristics. Citrus maxima fruit is the largest Citrus fruit belonging to the family Rutaceae, native to south-east Asian countries. It's commonly called as Pomelo, Shaddock or Pummelo. In addition to its nutritional-value it has received wide-spread appreciation and acceptance for its phytochemical, ethnobotanical, pharmacological and medicinal properties. Various extracts of *Citrus maxima* have been scientifically evaluated in experimental animal models to be effective in treatment of microbial diseases, diabetes, oxidative-stress, hepatic damage, algisia, inflammation and as depressant in CNS etc. They are rich in several important vitamins, minerals and phytoconstituents such as carbohydrates, flavonoids, carotenoids, coumarins, monoterpenes, triterpenes, benzenoids, steroids and citric acid. This review paper presents an overview of the Citrus maxima fruit and its pharmacological actions.

**Keywords:** *Citrus maxima*, Pomelo, Pharmacological actions, Nutritional-value, Flavonoids, Oxidative-stress, Phytoconstituents.

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### INTRODUCTION

The fruits belonging to the genus *Citrus* are popularly cultivated in the tropical and temperate regions for their energy, nutrients and health supplements<sup>1,2</sup>. One such fruit belonging to the genus *Citrus* is *Citrus maxima* which is widely studied for its ethnobotanical, pharmacognostic, pharmacological and phytochemical properties<sup>3</sup>. *Citrus maxima*, the Pomelo also known as Pummelo or Shaddock in the Rutaceae Family is scientifically called *Citrus maxima* because it is the largest *Citrus* fruit<sup>4</sup>. It is an edible fruit belonging to a perennial tree. The fruit is big, round in shape. The peel and pulp can be easily separated from each other. The pulp is generally pink or white in colour and coarse with large juice sacks that are spindle in shape. It's also cultivated as an ornamental fruit due to its large shape and colourful peel when fully ripe<sup>5,6</sup>. *Citrus maxima* has been recommended in traditional herbal medicine as anti-diabetic agent in management of diabetes. It has been used as a folk medicine in several countries as antimicrobial, antioxidant, larvicidal, hepatoprotective, anticancer, antiplatelet, antidiabetic and anti-inflammatory<sup>7-9</sup>. Studies have demonstrated that the cytoprotective action of *Citrus* fruits such as the Pomelo is potentiated because of the presence of constituents such as vitamin C, phenolics,

carotenoids and flavonoids which have antioxidative properties<sup>10</sup>. In addition to this, fruits of Pomelo are also reported to be used in industries dedicated to perfume, cosmetics, food and pharmaceuticals as flavouring or fragrance-enhancing agents. Since the fruits and leaves are a rich source of essential oils, they are used as an ingredient in various toiletry products. Furthermore, the flowers are extremely aromatic and are commonly exploited by the perfume manufacturers<sup>11,12</sup>.

#### Local names<sup>4</sup>

English - Shaddock, Pummelo, Pomelo, Chinese grapefruit.

Hindi - Mahanimbu.

Kannada - Chakkota.

Marathi - Panis, Papanas.

Malayalam - Pamparamasan, Kambili narnga.

Sanskrit - Madhukarkati.

#### Taxonomical classification<sup>4</sup>

Kingdom - Plantae

Phylum - Tracheophyta

Division - Magnoliophyta

Class - Magnoliopsida

Subclass - Rosidae

Order - Sapindales

Family - Rutaceae

Subfamily - Aurantioideae



Genus - Citrus

Species - maxima

**Habitat**

The Pomelo is native to south-eastern Asia in countries like China, Japan, Indonesia, Philippines, Thailand and Malaysia. It may have been introduced into China around 100 B.C., it's presently cultivated in southern China. On the river banks of Fiji and Friendly Islands, it is known to grow wildly. It is a widely distributed indigenous plant found in the Indian subcontinent. It is commercially grown in India being indigenous to east of India. In Taiwan and southernmost Japan, southern India, New Guinea and Tahiti, Pomelos are said to be like unexpected guests that appear as a surprise and are quick to disappear<sup>4,13</sup>.

**Seasons**

The Pomelo is a tropical or near-tropical plant and flourishes naturally at low altitudes near the sea. Pomelos may flower approximately 2 to 4 times a year. The fruiting season of Pomelo varies in different regions of the world. In Vietnam, it extends from September to February (peak season is from November to January) in the southern parts. And in the northern parts it begins from August lasting up

to November (peak season being October). In India, these fruits are known to grow from November through December and sometimes in the middle of the year<sup>13,14</sup>.

**BOTANICAL DESCRIPTION OF THE FRUIT**

The Pomelo is the biggest fruit among the *Citrus* family. The fruit ranges from nearly round to oblate or pear-shaped; 10-30 cm wide; the peel, clinging, easily removed, greenish yellow or pale yellow, minutely hairy, dotted with tiny green glands. Pomelo peel is the largest and the thickest of all *Citrus* fruits weighing up to 30% of the fresh fruit's weight. Pulp Varies from greenish yellow or pale yellow to pink or red and it is divided into 11 to 18 segments, it can range from being very juicy to quite dry. The segments are easily skinned, and the sacs may adhere to each other or be loosely joined. The flavour of the pulp varies from mildly sweet and bland to subacid or rather acidic, sometimes with a hint of bitterness. The flavedo present in the rind of the fruit is green with oil glands appearing as spots all over the fruit peel, and the albedo is white with a spongy texture (Fig.1). The segments of the fruit are covered with a tough skin called the lamella. Seeds are few, large, yellowish white seeds, white inside, seldom some fruits may be quite seedy<sup>4</sup>.

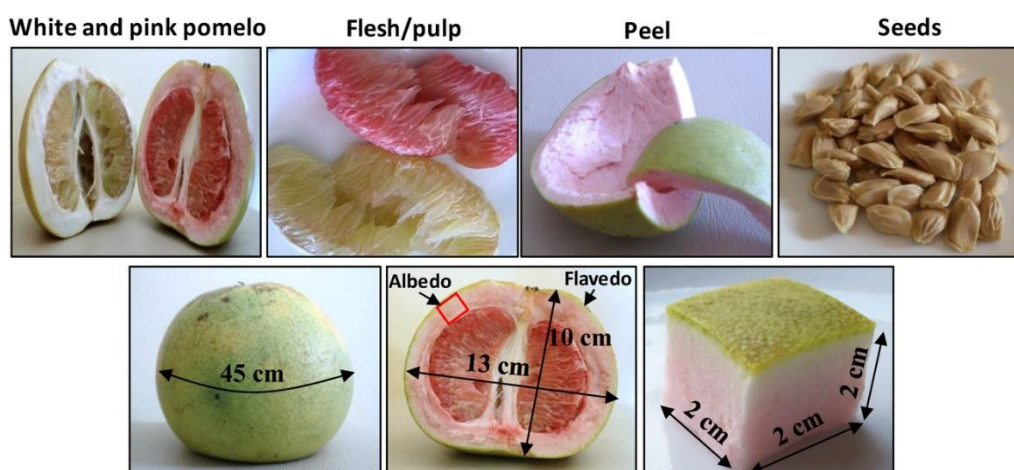


Figure 1: Anatomy of typical Pomelo fruit

**NUTRITIVE VALUE OF THE *Citrus maxima* FRUIT<sup>4,13</sup>**

The nutritional value of the Pomelo fruit has been found to be meritorious with various pivotal compositions as listed below (Table 1, Table 2 & Table 3).

**Table 1:** Proximate composition Per 100 g of Edible Portion (Fruit juice) of *Citrus maxima*

Proximate Composition	Value / 100g
Moisture	84.82-94.1 g
Energy	38 kcal
Protein	0.76 g
Fat	0.04 g
Carbohydrates	9.62 g
Dietary Fibre	1 g

**Table 2:** Mineral composition per 100 g of Edible Portion (Fruit juice) of *Citrus maxima*

Minerals	Value/ 100g
Sodium	1 mg
Phosphorus	17 mg
Iron	0.11 mg
Magnesium	6 mg
Manganese	0.017 mg
Potassium	216 mg
Zinc	0.08 mg
Calcium	21-30 mg

**Table 3:** Vitamin composition per 100 g of Edible Portion (Fruit juice) of *Citrus maxima*

Vitamins	Value/ 100g
Vitamin A	20 I.U.
Thiamine (B1)	0.034 mg
Riboflavin (B2)	0.02 mg
Niacin (B3)	0.22-0.3 mg
Ascorbic acid	61 mg
Vitamin B6	0.036 mg

### PHYTOCHEMICAL CONSTITUENTS

There are plenty of reports about the constituents in the different parts of *Citrus maxima* including alkaloids, amino acids, benzenoids, carbohydrates, carotenoids, coumarins, flavonoids, monoterpenes, sesquiterpenes and steroids. The study and comparison of constituents of essential oil derived from the *Citrus maxima* fruit peel by cold pressing, vacuum steam distillation and supercritical carbon dioxide extraction has reported it to contain Carbohydrates such as glucose, pectin; Carotenoids such as carotene and roseoside; Coumarins such as auraptene, bergamottin, umbelliferone; Flavonoids such as apigenin, hesperidin, naringin, rutin, sinensetin; Monoterpenes such as  $\alpha$ -pinene,  $\beta$ -pinene, camphene, citral, limonene; Triterpenes such as limonin, nomilin; Steroids such as  $\beta$ -sitosterol, campesterol. Miscellaneous constituents such as  $\alpha$ -tocopherol, chlorophylls, decyl acetate, octan-1-ol and citric acid.

In addition to this, studies have reported the fruit juice to contain Benzenoid such as Diphenylamine; Flavonoids such as diosmin, hespeidin, luteolin, naringin, narirutin, neodiosmin, neoeriocitrin, neohesperidin, neoponcirin, quercetin, rhoifolin and sinensetin. Triterpenes such as limonin, deoxylimonin, nomilin and obacunone were found in seeds, fruit pulp and juice. Miscellaneous compounds such as ascorbic acid and citric acid were also found in the fruit juice<sup>15</sup>.

### Medicinal Uses

Studies have shown that *Citrus maxima* fruit juice and peel are very nutritive and have good medicinal properties<sup>16</sup>. The Pomelo pulp and peels are used as appetizer, stomach- tonic, cardiac stimulant in cardiovascular conditions and also in coughs. The fruit-juice has potential in enhancing weight loss and promoting cholesterol reduction<sup>15,17</sup>. The Pomelo peel extracts were isolated and were evaluated to have hypolipidemic, hypoglycaemic, antioxidative, antimicrobial, anti-inflammatory and anti-cancerous properties<sup>18</sup>. Pomelo fruits are also reportedly used in diseases like leprosy and asthma. They have been proven helpful in the management of hiccup, mental aberration and epilepsy. In addition, the rinds have been found effective as antiasthmatic, sedative, brain tonic, and in relief of headaches and eye troubles<sup>3</sup>. Rinds are also reported to be the most used parts in traditional medicine for treatment of vomiting and diarrhoea<sup>19</sup>. The seeds are

utilized against dyspepsia, coughs and lumbago and its fruit is also used in the treatment of cancer and gastrointestinal disorders<sup>20</sup>.

### PHARMACOLOGICAL ACTIONS

#### Antioxidant activity

The antioxidant property of *Citrus maxima* fruit juice was studied in rats and the results showed its protective role against Hydrogen peroxide, Streptozotocin and nitric oxide-generating system induced DNA damages. This protective activity might be due to the effect of different types of active principles acting individually or synergistically, each with a single or a diverse range of biological activities against oxidative stress. Hence suggesting that *Citrus maxima* fruit possesses antioxidant and free radical scavenging properties<sup>21</sup>.

#### Antidiabetic activity

The antidiabetic property of *Citrus maxima* was studied on Alloxan induced diabetic rats. Ethyl acetate, alcoholic and dried Juice extracts of the fruit showed highly significant antidiabetic activity. The results were comparable with reference standard Glibenclamide<sup>22</sup>.

#### Analgesic activity

The methanolic extracts of *Citrus maxima* fruit peel of different concentrations were tested for analgesic activity in mice models such as acetic acid induced writhing response and formalin induced licking and biting response. The extract at both tested doses showed better activity as compared to reference standard Diclofenac sodium at 10 mg/kg dose<sup>23</sup>.

#### Anti-inflammatory activity

Anti-inflammatory effect was tested by carrageenan induced paw edema model; The methanolic extracts of *Citrus maxima* fruit peel exerted anti-inflammatory effect. At both tested doses, the extract showed activity comparable to that of the positive control group of Ibuprofen<sup>23</sup>.

#### CNS Depressant activity

The methanolic extract of *Citrus maxima* fruit peel was studied in Open-field and Hole-cross experimental models using Swiss albino mice. The results obtained revealed that the extract had potent CNS depressant activity in a dose-dependent manner<sup>23</sup>.

#### Antimicrobial activity

The antimicrobial activity of aqueous and methanolic extracts of pulp and fruit peel of *Citrus maxima* was studied to compare its activity against *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. It was reported that the methanolic extract of the fruit peel exhibited antibacterial activity against *Escherichia coli* and *Klebsiella pneumoniae* but not against *Staphylococcus aureus*. But the methanolic and aqueous extracts of the



fruit pulp showed considerable antibacterial activity against all three bacteria<sup>24</sup>.

### Hepatoprotective activity

*Citrus maxima* fruit peel powder was used in carbon tetrachloride (CCl<sub>4</sub>) treated rat model to study the hepatoprotective activity. Dietary supplementation of *Citrus maxima* fruit peel powder exhibited significant reduction of serum AST, ALT, and ALP activities in carbon tetrachloride treated rats. It also showed a significant reduction of the oxidative stress markers and restored the catalase activity in CCl<sub>4</sub> treated rats. Furthermore, the histological examination of the liver section revealed reduced inflammatory cell infiltration, collagen, and iron deposition in CCl<sub>4</sub> treated rats. Hence, the study demonstrated that *Citrus maxima* fruit peel powder produced significant hepatoprotective action in CCl<sub>4</sub> administered rats<sup>25</sup>.

### CONCLUSION

The *Citrus maxima* is not just the world's largest *Citrus* fruit but it's also a rich source of nutrition and phytoconstituents which has a well-received role in traditional medicinal uses across the globe. In addition to this, it offers aesthetic benefits which are tapped by the cosmetics, toiletry and perfumery industries. Each part of the plant has its medicinal value, the fruit in its entirety including the juicy pulp and the vibrant peel have attributes that go beyond the dietary needs. The phytoconstituents and various extracts of the fruit have shown important pharmacological actions such as antioxidant, antidiabetic, analgesic, anti-inflammatory, anti-microbial, hepatoprotective and CNS depressant activity etc. The power-packed phytochemistry of the fruit is a good lead on its various unexplored pharmacological and medicinal potentials. Hence it can be concluded that the *Citrus maxima* fruit is a highly valuable medicinal commodity that can be evaluated in a scientific manner using scientifically approved models to understand the mechanism of actions for various medicinal uses.

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