

Wood apple-Its nutritive value and medicinal benefits

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■ **Abstract :** Wood apple also known as *Aegle marmelos* is a dry land fruit in the shape of pyriform, oval, oblong; 15-17 m in diameter; belongs to Rutaceae family with botanical name *Limonia acidissima* L. It requires a monsoon climate with a distinct dry season. It can be planted in all kinds of soil. It is highly valued for its therapeutic values in Ayurveda and is known to cure liver disorders, indigestion, piles, respiratory problems, diarrhea and dysentery. The aroma of wood apple is a complex mixture of many volatile compounds such as esters, alcohol, aldehydes, ketones, ethers and aldehyde which predominates in immature wood apple but their content decreases as the fruit matures. All the volatile components are of great importance for the complete characteristic aroma profile of the fruit. The fruit can be used in the preparation of product such as jelly, chutney, jam and beverage. Some people eat raw wood apple pulp with or without sugar; Srilankan people prepare a popular drink known as Sinhalese as dimbulkiri (wood apple milk) by mixing ripened wood apple pulp with coconut milk and palm sugar. A fruit with such diverse values and immense potentialities indicate its scope for processing commercially into valuable products. Thus wood apple brings about many nutritional and medicinal benefits which can be used in development of various value added products.

■ **Key words :** *Aegle marmelos*, Rutaceae, Nutritional properties, Medicinal properties

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Wood apple also known as *Aegle Marmelos* is underutilized, former and indigenous fruit plants. It is known by many different names such as elephant apple, kainth and monkey fruit. Its shape is pyriform, oval, oblong, 15-17m in diameter belongs to Rutaceae family with the botanical name *Limonia acidissima* L. It is one of the hard fruit crop found all over the plains of southern Maharashtra, West Bengal, Uttar Pradesh, Chhattisgarh and Madhya Pradesh.

Wood apple is small to moderate size, deciduous, glabrous tree with thorny branches reaching to a height of about 10m with a girth about 0.6m to 1.6m (Troup, 1921). The fruit is not under regular orcharding, however

along the border of fields, roads, railways lines and as a roadside tree, near villages and banks of river are the most common places where the plants are found as stray plant.

Plant seed are important unconventional sources of proteins which when incorporated in food products would improve the functional properties such as absorption of water or oil and also in the formation of stable foam. They are also good nutritional supplements.

The fruit is amazingly hard rind which can be difficult to crack, security rind about 6mm thick, greyish-white, pulp is brown, odorous, mealy, resinous, astringent, acid or sweetish with numerous small, white seeds

scattered through it. There are two forms, one with large sweet fruits and the other with small, acid fruits.

Propagation is done by seed used and vegetative method. But high rate of seeding mortality and out breeding nature of this plant account for the poor regeneration and inferior germplasm. To overcome this, in vitro propagation through axillary bud proliferation has been developed (Jebas *et al.*, 2015). It is a climacteric fruit, ripening may also takes place after fruit is harvested. It is well known for its quality and storage life, which helps avoiding the waste of raw material.

The fruit contains a number of phyto constituents, which are the key factors in the medicinal values. Almost all parts of the plant such as leaf fruit seed bark and root are used to cure a variety of disease (Sekar *et al.*, 2011).

Table 1 : Taxonomy	
Kingdom	Plantae
Order	Sapindales
Family	Rutaceae
Subfamily	Aurantioideae
Genus	Aegle
Species	A.marmelos

History and origin of wood apple :

Wood apple is native and common in dry plains. It first originated in India, Bangladesh, Pakistan, Sri Lanka and Vietnam. It grows well during monsoon and its tree grows upto 450 meter. Wood apple is resistant to drought and it grows well in light soils.

In India, it grows throughout the dry regions. Wood apple is abundantly found in Indian states such as Andhra Pradesh, Maharashtra, Tamil Nadu, Madhya Pradesh, Karnataka, Kerala and western Himalayas. Besides India, wood apple widely grows in Malaysia, Thailand, Cambodia and other parts of South east Asia.

How to store and effect of storage on wood apple :

It was observed when wood apple is stored for a prolonged period, the consistency and viscosity of its pulp was not affected, but its taste reduced. The content of ascorbic acid reduces during storage due to oxidation. The content of calcium and phosphorus also decreases with storage of wood apple. Ripe wood apples can be easily and safely stored at room temperature. If you want to store them for a little longer period, place them in the refrigerator. If you need to store it for much longer period, remove the pulp and mix it with lemon juice. This can

then be stored in the freezer.

Different ways to eat wood apple :

- You can eat its flesh raw
- Make your own refreshing wood apple juice
- Replace your old-style chutneys with wood apple chutney
- Prepare some delicious wood apple jelly-children would love it
- You can also replace jams with wood apple jam
- Wood apple ice cream
- You can also enjoy a delicious glass of wood apple smoothie
- Wood apple milkshake is another great beverage
- Combine wood apple with other fruits and make a delicious fruit salad.

Composition :

Indian wood apple seed (*Feronia elephantum* Correa) constituting 6% (dry weight basis) of the fruit, contains 34% oil and 28% protein. The kernel comprises 62% of the seed. The oil is yellow with an iodine value 131, saponification value 192, unsaponifiable matter 1%. Fatty acid profile of oil by GLC is: palmitic 19.3, stearic 7.3, oleic 27.2, linoleic 19.8 and linolenic 26.4% (Ramakrishna *et al.*, 1979).

Distribution :

A. marmelos is a subtropical plant and grows upto an altitude of 1,200 m altitude from sea level. It grows well in the dry forests on hilly and plain areas. *A. marmelos* is a widely distributed plant and found in India, Ceylon, China, Nepal, Sri Lanka, Myanmar, Pakistan, Bangladesh, Nepal, Vietnam, Laos, Cambodia, Thailand, Indonesia, Malaysia, Tibet, Sri Lanka, Java, Philippines and Fiji. In India it found in Sub-Himalayan tracts from Jhelum eastwards to West Bengal, in central and south India. It found almost in all the states of India. *A. marmelos* is known by different names in different parts of world, some of them are mentioned in Table 2.

Name Language *Aegle marmelos* : Latin Wood/ Stone apple, Bengal Quince, Indian Quince : English Mbau Nau, Trai Mam : Vietnamese Bel, Gudu : Nepali Toun : Lao (Sino-Tibetan) Bnau : Khmer Modjo : Javanese Oranger du Malabar : French Ohshit, opesheet : Burmese Mojo tree : Indonesian Pokok Maja Batu : Malay Mapin, Matum, Tum : Thai Shreepal, Bilva, Bilwa

Table 2 : Different names *A. marmelos*

Name	Language
Aegle marmelos	Latin
Wood/Stone apple, Bengal Quince, Indian Quince	English
Bel, Gudu	Nepali
Toum	Lao (Sino-Tibetan)
Bnau	Khmer
Modjo	Javanese
Oranger du Malabar	French
Ohshit, opesheet	Burmese
Mojo tree	Indonesian
Pokok Maja Batu	Malay
Mapin, Matum, Tum	Thai
Shreephal, Bilva, Bilwa	Sanskrit
Sir Phal	Old Hindi
Kaveeth	Marathi
Bel, Shreefal	Bengali
Vilva Maram, Vilva Pazham	Tamil
Bel	Urdu

: Sanskrit Sir Phal : Old Hindi Bel, Shreefal : Bengali Kaveeth : Marathi Vilva Maram, Vilva Pazham : Tamil Maredu : Telugu, Bel : Urdu.

Medicinal properties :

Marmelos is extensively described in the Vedic literature for the treatment of various diseases. *A. marmelos* is traditionally used to treat jaundice, constipation, chronic diarrhea, dysentery, stomachache, stomachic, fever, asthma, inflammations, febrile delirium, acute bronchitis, snakebite, abdominal discomfort, acidity, burning sensation, epilepsy, indigestion, leprosy, myalgia, smallpox, spermatorrhoea, leucoderma, eye disorders, ulcers, mental illnesses, nausea, sores, swelling, thirst, thyroid disorders, tumors, ulcers and upper respiratory tract infections (Sekar *et al.*, 2011).

The wood apple tree is the most valuable therapeutic plant in India, which is recorded in Charka Samhita, a Sanskrit historic healthcare treatise. All parts of the plant, includes the stem, bark, root, leaves and fruit has therapeutic benefits and has been used as traditional medicine since ancient time.

It has bitter pungent, full of antioxidant and help to stimulate the pancreas to secrete insulin, which leads to lowering of blood sugar. The leaves can be used against diabetes. It support intestinal biological formulations and protects the digestive system from ulceration, reduces

the frequency of irritable Bowel Syndrome (IBS), intestinal spasm thus beneficial in treating off diarrhea, dysentery and other infections of Elementary canal. Marmelos juice contains anti-inflammatory properties that are used to reduce histamine induced contraction. This also gives positives result to relax and sooth inflamed organs.

One hundred grams of Bel fruit pulp provides 140 calories, and the nutrients found in that amount boost organ activity and metabolic speed. This all results in additional energy and reserves in the body. The high protein content also means that the body can heal faster and the muscles can grow stronger, further boosting energy reserves. In Ayurvedic treatments, all parts of the wood apple plant are used to cure snakebites. As a good source of beta-carotene, wood apples also cure liver problems. They contain thiamine and riboflavin, both of which are known as liver health boosters, this fruit also functions as an ingredient in cardiac tonics. Eating the pulp of raw marmelos with the sugar provides relief from the morning sickness during pregnancy.

Cancer is a major public health problem, being the second highest cause of death in both men and women in developed as well as developing countries (Agrawal *et al.*, 2012). In 2008, approximately 12.7 million new cancer cases (56% of which were in developing regions of the world) and 7.6 million cancer deaths (63% in less developed regions) occurred. By the year 2020, predictions report the incidence of cancer will increase 3-fold, with a disproportionate rise in cancer cases and deaths in developing countries with limited resources to tackle the problem (Baliga *et al.*, 2012).

The essential oil isolated from the leaves of *A. marmelos* tree has proved to have antifungal activity against animal and human fungi like *Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Microsporum gypseum*, *Microsporum audounii*, *Microsporum cookie*, *Epidermophyton floccosum*, *Aspergillus niger*, *Aspergillus flavus* and *Histoplasma capsulatum* (Dhankhar *et al.*, 2011).

Generally, *A. marmelos* considered safe and few studies have been carried out with respect to its toxicity. Veerappan *et al.* (2007) studied toxic effects of *A. marmelos* leaves. They found no remarkable changes in histopathological studies of heart, liver, kidney, testis, spleen and brain after 50 mg/kg body weight of the extracts of *A. marmelos* administered intraperitoneally

for 14 d successively. Pathologically, neither gross abnormalities nor histopathological changes were observed. These researchers also found that intraperitoneal administration of the extracts of the leaves of *A. marmelos* at doses of 50, 70, 90 and 100 mg/kg body weight for 14-consecutive day to male and female Wistar rats did not induce any short-term toxicity (Veerappan *et al.*, 2007). *Marmelos* leaf, seed and fruit is known to affect male fertility in reversible manner. *A. marmelos* bark extract is a rich source of marmin and fagarine known for reducing male fertility. Agrawal *et al.* (2012) found that methanolic extract of *A. marmelos* causes a dose and duration dependent infertility via reducing reproductive organ weight and serum testosterone levels. They also report reduction in sperm density, motility, viability and sperm acrosomal integrity. Exfoliation of elongated spermatids, nuclear chromatin condensation and degeneration were found in testes histopathological studies and presence of spaces within the germinal epithelium signifying testicular cytotoxicity and necrosis. Finally time dependent complete infertility was observed in that study. The authors also reported that after the withdrawal of treatment, complete restoration of the morphological as well as physiological parameters in extract treated rats (Agrawal *et al.*, 2012).

Unripe bael fruit may help protect against inflammatory bowel disease (a class of conditions that includes Crohn's disease and colitis), suggests a study by Behera *et al.* (2012). For the study, a group of rats with colitis were treated with extract of unripe bael fruit. Results revealed that the extract may help to reduce intestinal inflammation, a key marker of inflammatory bowel disease. Several preliminary studies indicate that bael fruit may aid in diabetes management. In a study, for instance, tests on diabetic rats demonstrated that bael fruit may help treat diabetes by lowering blood sugar levels (Kamalakkannan *et al.*, 2013).

Scurvy disease is caused due to the deficiency of vitamin C and this effects the blood vessels. Marmelos being a rich source of vitamins is capable of curing this disease when added to the diet. The extract of bael leaf can be used to control the cholesterol level in blood which makes the bael leaves highly therapeutic too. The oil extracts from bael can be used to cure respiratory disorders like asthma or cold. This oil can also provide resistance to cold when applied on the scalp before a

head bath. Inflammation can be quickly cured when the extract of bael is applied on the inflamed region.

Nutritional benefits of bael/wood apple per 100 g :

The vast array of health benefits attributed to wood apples are mainly due to their nutrients, vitamins, and organic compounds, including tannins, calcium, phosphorous, fibre, protein, and iron. You might have heard the very popular saying that 'One apple a day keeps the doctor away', so this holds true even for wood apple. It is rich in nutrients and a great source of fibre, vitamins, calcium, phosphorous, protein, iron and beta-carotene. Due to these reasons wood apple or bael fruit is a must have fruit. Wood apple is a good source carbohydrate and dietary fibre. It is also found that the pulp contains appreciable amount of protein and low amount of fat. Furthermore, wood apple also contains various important minerals such as calcium, iron, zinc, magnesium and phosphorus. It also contains vital vitamins such as beta-carotene (a precursor of vitamin A), thiamine (vitamin B1), riboflavin (vitamin B2) and vitamin C.

The presence of protein in a food is determined by the presence of essential amino acid in it. It was found that wood apple contains appreciable amount of protein. Amino acid present in wood apple include: Presence of Amino Acids (Singh, 2015).

- Alanine
- Arginine
- Aspartic acid
- Glycine
- Histidine
- Isoleucine
- Leucine
- Phenylalanine
- Proline
- Tryptophan
- Tyrosine
- Valine

Precautions, side effects and disadvantages :

In spite of having lots of nutritional health benefits and medicinal benefits, eating bael need some precautions as it may cause some side effects and disadvantages. Some of are mentioned below:

Eating bael pulp or drinking bael juice more than the requirement may lead to the stomach pain, bloating,

Table 3 : Nutrient composition	
Nutrients	Values
Energy	137/100 kcal
Water	61.5 g
Carbohydrate	31.8 g
Fat	0.3 g
Protein	1.8 g
Fibres	2.9 g
Tartaric acid	2.11 mg
Vitamin A	55 mg
Riboflavin	1.19 mg
Iron	480 mg

flatulence, stomach upset, constipation and other digestive disorders.

Generally it should be avoided by the pregnant women and lactating mother as it may cause harmful health effects.

It should be avoided by the people suffering from the gastric troubles.

It may cause allergy to some people which should be taken care of.

It should not be eaten continuously on daily basis without any break as it may disturb the intestinal peristaltic movements.

Beal leaves contain tannins which have carcinogenic effects on longer use and may lead to abortion in pregnant women.

It may lower the blood sugar level to a great extent if eaten in high amount by the person on hypoglycemic medications.

It should be avoided by the person suffering from the thyroid disorders.

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