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Review

# Medicinal value of Bael, *Aegle marmelos*

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## ABSTRACT

*Aegle marmelos* is a species of tree native to India. It is present throughout southeast Asia as a naturalized species. The tree is considered to be sacred by Hindus. Its fruits are used in traditional medicine and as a food throughout its range. All parts of the herb (leaves, fruits, roots) are used for medicinal purposes. Bael is the only member of the monotypic genus *Aegle*. It is a mid-sized, slender, aromatic, armed, gum-bearing tree growing up to 18 meters tall. It has a leaf with three leaflets. It has a reputation in India for being able to grow in places that other trees cannot. It copes with a wide range of soil conditions (pH range 5-10), is tolerant of water logging and has an unusually wide temperature tolerance (from -7 to 48°C). It requires a pronounced dry season to give fruit. The Bael fruit has a smooth, woody shell with a green, gray or yellow peel. It takes about 11 months to ripen on the tree and can reach the size of a large grapefruit or pomelo and some are even larger. The shell is so hard that it must be cracked with a hammer or machete. The fibrous yellow pulp is very aromatic. It has been described as tasting of marmalade and smelling of roses. The fruit is eaten fresh or dried. If fresh, the juice is strained and sweetened to make a drink similar to lemonade. In the system of Ayurveda this drug finds several and frequent therapeutic uses in different forms and recipes. They are prescribed in a number of diseases such as gastro-intestinal diseases, piles, oedema, jaundice, vomiting, obesity, pediatric disorders, gynecological disorders, urinary complaints and as a rejuvenative. Besides the wide medicinal utility the plant and its certain parts (leaves and fruits) are of religious importance since the tree is regarded as one of the sacred trees of Indian heritage. The fruit is also used in religious rituals. Research has found the essential oil of the Bael tree to be effective against 21 types of bacteria.

**Keywords:** *Aegle marmelos*; medicinal uses; sacred tree; diseases; processing

## INTRODUCTION

Quince, Golden apple in English; Bael, Bel, Belgiri, Belli in Hindi; Shivadruma, Shivaphala, Vilva in Sanskrit; Bel Kham in Urdu, Bel in Assamese and Marathi; Bilivaphal in Gujarati, Marredy in Malayalam, Belo in Orrisa; Vilvama, Vilva marum in Tamil and Bilva, Bilvapandu in Telegu belongs to family Rutaceae. Due to curative properties it is one of the most important medicinal trees in India. All the

plant parts like leaves, roots, bark, seeds and fruits of Bael are important ingredients of several traditional formulations against various diseases and many bioactive compounds have also been isolated of it (Badam et al 2002, Gupta and Tondon 2004). Fresh leaves are used in West Bengal as a remedy for beri-beri (a deficiency disease caused by lack of vitamins especially B1). The fruit is said to act as a tonic for heart and brain. It is best given in sub-acute or chronic cases of diarrhoea and dysentery and in irritation of the alimentary canal. A yellow dye is obtained from the rind of the unripe fruits. The dried fruits after their pulp separated from the rind are used as pill boxes for keeping valuable medicines, sacred ashes and tobacco (Sharma et al 2011). The mucilage of the seed is a cementing material. Root is one of the ingredients of Dashmula, a common Ayurvedic formulation particularly useful in loss of appetite and puerperal diseases (Sampathkumar et al 2012). The wood takes a fine polish and is used in building houses, constructing carts and agricultural implements. All the products obtained from Bael are highly nutritive and therapeutic hence it is getting popularized in India as well as abroad. Value added products are also prepared from Bael which include squash, Murabba, fruit nectare, jam, jellies, Bael powder etc. The fruit is rich in pectin but poor in acid and hence does not give a good jelly unless extra acid is added. Due to the presence of seeds and mucilage in the pulp, the ripe fruit cannot be eaten comfortably. Also due to the presence of oxidative enzymes the pulp readily turns brown on exposure (Sampathkumar et al 2012).Its history of cultivation dates back to 800 BC. The fruit has also been mentioned in Yajurveda. Bael is said to do best on rich, well drained soil. It also grows well in swampy, alkaline or stony soils having pH range from 5 to 8. It grows up to an altitude of 1200 m where the temperature rises to 48.9°C in the shade in summer where prolonged droughts occurs and descends to -6 to 7°C in winter.

**Origin and distribution**

Bael is native to India (Zeven and de Wet 1982) and found throughout southeast Asia. In India this fruit is grown in Indo-Gangetic plains and sub-Himalayan tracts up to a height of 500 m, in northeast India and dry and deciduous forests of central and southern India. Besides occurring as natural wild, Bael is commonly grown in the homestead gardens, backyards, religious places and in the farmers' fields. It is found growing along the foothills of Himalayas, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Rajasthan, Madhya Pradesh, Chhattisgarh, Uttaranchal, Orissa Deccan plateau and along the east coast (Singh 2000, Purohit and Vyas 2004). It is also found occurring in Andaman Island (Anon 1985). It is cultivated all over India near temples since it is a sacred tree. The Chinese Buddhist pilgrim Hiuen Tsiang when came to India

(1629 AD) noticed the presence of this tree in India (Sambamurthy and Subrahmanyam 1989). It is also found in Pakistan and northern Malaysia, the drier areas of Java and to a limited extent on Northern Luzon in the Philippine Islands where it first fruited in 1914. It is grown in some Egyptian gardens and in Surinam and Trinidad. Specimens of Bael have been maintained in citrus collections in Florida and in agriculture research stations but the tree has never been grown for its fruit in this state. Bael fruit was resorted to by the Portuguese in the East Indies in the 1500's and by the British colonials in later times as a means of halting diarrhoea and dysentery (Sampathkumar et al 2012).

**Mythological values of Bael**

The tree is held sacred by the Hindus and has great mythological significance and abounds in the vicinity of temples. This tree is the symbolic representation of Shiva, Parvati, Surya and Lakshmi- the Goddess of Wealth. It is believed that Lord Shiva is believed to live under the tree hence Bael leaves are used for offering Lord Shiva. According to the Shiva Purana (7 AD) the Bilva tree is the manifest form of Lord Shiva himself while all the great Tirthas (pilgrimage places) are said to reside at its base. It is said that no worship of Shiva is complete without offering Bel Patra or Bilva leaf. Thus Shiva is called Vilvadanda or staff of the Bel-wood. These leaves on the lingam cool and refresh the heated deity. Its trifoliate leaf or Tripatra symbolises the three functions- creation, preservation and destruction of the Lord as well as His three eyes. The lighting of the Deepak (lamp) before this tree bestows knowledge and enables the devotee to merge in Lord Shiva. The leaves of the tree have a very pleasant aroma. It is also found in Devi temples where it is worshipped. In Bengal during the Durga Pooja on the Ashtami (eighth day) the Goddess Durga is invoked on a twig of Bael tree.

**Taxonomy and morphology**

*Aegle* belongs to one of the three monotypic genera of orange subfamily Aurantioideae, tribe Clauseneae and subtribe Balsamocitrinae. The scientific classification is given as under:

| Kingdom | Plantae |
|---|---|
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Order | Sapindales |
| Family | Rutaceae |
| Subfamily | Aurantioideae |
| Tribe | Clauseneae |
| Genus | *Aegle* Corrêa |
| Species | *A marmelos* |
| Binomial name | *Aegle marmelos* (L) Corr Serr |

**Botanical characteristics (description of plant)**

It is slow growing medium size deciduous tree of height 8-10 m and 90-120 cm girth. The branches sometimes bear 2-5 cm long straight, sharp and axiallary thorns. It has short trunk. The bark is thick, soft, flaking, shallowly furrowed and corky

with drooping lower branches. A clear gummy sap resembling gum arabic exudes from wounded branches and hangs down in long strands becoming gradually solid. Taste of this gum is sweet at first but later irritating to the throat. The leaves are deciduous, alternate, trifoliate and rarely pentafoliate. Mature leaves emit a disagreeable odour when bruised. Leaflets are ovate to lanceolate, acuminate with pointed, shallowly toothed leaflets, 4-10 cm long, 2-5 cm wide and the terminal one with a long petiole. New foliage is glossy and pinkish maroon. The bisexual flowers are nearly 2 cm wide, borne in clusters, sweet scented and greenish white. The shallow calyx has 5 short sepals and is pubescent on the outside. The 5 petals are oblong ovoid, blunt, thick, pale greenish white and dotted with oil glands. Stamens are numerous, sometimes coherent in bundles. Ovary is oblong ovoid, slightly tapering, axis wide, cells numerous (8-20), small, arranged in circles with numerous ovules in each cell. Fruits may have hard, woody rind, grey-green until the fruit is fully ripe, when it turns yellow. The pulp is sweet with faint aromatic odour, thick yellow and orange to brown in colour. Seeds are numerous and arranged in the cells surrounded by a slimy transparent mucilage. Seeds have woolly hairs. Fruits come in June.

**Propagation**

Bael is usually propagated by seeds. The seeds are recalcitrant and cannot be stored for longer periods under normal storage conditions. Budding, patch or shield on seedling rootstocks in June or July give very good success. Air layering is also successful under humid tropical conditions. In vitro propagation has also been standardized but it is not feasible commercially.

**Chemical constituents**

Various phyto-constituents have been isolated from the various parts of Bael

Nutritional Value of Bael fruit (100 g)

| Component | Value | Component | Value |
|---|---|---|---|
| Energy | 137 Kcal | Iron | 0.3% |
| Edible portion | 64% | Calcium | 0.09% |
| Moisture | 64.2% | Phosphorous | 0.05% |
| Protein | 1.8% | Potassium | 0.6% |
| Fat | 0.2% | Vitamin A (IU) | 186% |
| Mineral | 1.5% | Vitamin $B_1$ | 0.01% |
| Fibre | 2.2% | Riboflavin | 1.2% |
| Carbohaydrate | 30.6% | Vitamin C | 0.01% |

Source: Parichha 2004, Purohit and Vyas 2004

plant namely alkaloids, coumarin and steroid which may be categorized according to Maity et al (2009). The seeds yield oil (34.4% on dry weight basis). The fatty acid composition of the oil is as follows: palmitic acid 16.6 per cent, stearic acid 8.8 per cent, oleic acid 30.5 per cent; linoleic acid 36.0 per cent and linolenic acid 8.1 per cent.

**Medicinal uses**

Parts used for medicinal purpose are fruits, seeds, leaves, bark and root. It is Madhura, palatable, Kashaya, pacifies deranged Pitla, beneficial in deranged Kapha, fever, diorrhoea and appetizing and gastric stimulant. Different parts of the tree have their own medicinal importance.The medicinal value of Bael fruit is enhanced due to presence of tannin, the evaporating substance in its rind. The rind contains 20 per cent and the pulp has only 9 per cent of tannin. According to Sampathkumar et al (2012) the fruit is of considerable medicinal value when it just begins to ripen. The ripe fruit is aromatic, astringent, cooling and laxative. The unripe or half ripe fruit is astringent, stomatic (a drug that strengthens the stomach and promotes its action), anti-scorbutic (a drug which prevents or cures scurvy), and digestive. The fruit is said to act as a tonic for heart and brain.

**Anti-diabetic/hypoglycemic activity**

Diabetes mellitus is a common metabolic disease around the world today. Diabetes and its complications are directly related to oxidative stress. It is also closely related to cardiovascular and renal disorders. Bael is rich in laxatives which makes it useful in controlling the blood sugar levels. This is because it energizes the pancreas and makes it produce enough amount of insulin which is necessary to control sugar level in the blood. *A marmelos* has been used as a herbal medicine for the management of diabetes mellitus in Ayurvedic, Unani and Siddha systems of medicine in India (Kar et al 2003) and Bangladesh (Lampronti et al 2003).

Oxidative stress induced hyerglacemia or diabetes can be reduced to a great extent by extracts of Bael leaf. Extracts significantly decrease the serum glucose level, improve the ability to utilize the external glucose load and increase the plasma insulin level in artificially induced diabetic animal models (Sabu and Kuttan 2004).

The studies have shown that administering leaf extracts of Bael reduce blood glucose levels up to 54 per cent. Kamalakkannan and Prince (2003) reported that oral administration of the water extract of Bael (125 and 250 mg/kg) twice a day for 4 weeks to streptozotocin-induced diabetic Wistar rats resulted in significant reductions in blood glucose, plasma thiobarbituric acid reactive substances, hydroperoxides, ceruloplasmin

and α-tocopherol and a significant elevation in plasma reduced glutathione and Vitamin C in diabetic rats. Similarly Kuttan and Sabu (2004) studied on *A marmelos* leaf extract on Alloxane induced diabetes and reported that used extract was enough capable to reduce oxidative stress by scavenging lipid peroxidation and enhancing certain antioxidant levels which cause lowering of elevated blood glucose level. An alkaloidal-amide, Aegeline 2 was isolated from the leaves of *A marmelos* and was found to have anti-hyperglycemic activity as evidenced by lowering the blood glucose levels in sucrose challenged streptozotocin induced diabetic rats by Narender et al (2007). The fruit extract at a dose of 250 mg/kg exhibited to be more effective than glibenclamide a well known hypoglycaemic drug (Kamalakkannan and Prince 2003). This anti- diabetic activity is due to the presence of coumarins in the fruit extract.

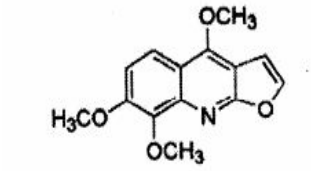
The aqueous extract of Bael seeds was also used for controlling diabetes by reducing blood glucose level in normal as well as diabetic rats as proved by various scientists. Kesari et al (2006) orally administered aqueous extract of *A marmelos* seeds at different doses (100, 250 and 500 mg/kg) to normal as well as sub-normal (fasting blood glucose (FBG), glucose tolerance abnormal) and mild (FBG 120-250 mg/dl) diabetic rats. They reported that dose of 250 mg/kg was found to be most effective and it decreased blood glucose level (BGL) by 35.1 per cent in normal healthy rats after 6 h of administration. The same dose also showed a marked reduction in BGL of 41.2 and 33.2 per cent in sub- and mild-diabetic rats respectively in glucose tolerance test (GTT) after 2 h. Treatment of severely (FBG >250 mg/dl) diabetic rats for 14 days with a dose of 250 mg/kg reduced the fasting blood glucose by 60.84 per cent and urine sugar by 75 per cent than their pre-treatment levels. However Seema et al (1996) reported that oral administration of aqueous and alcoholic extracts of Bael leaves in doses of 500 mg/kg significantly induced hypoglycaemia in normal fasted rabbits. Badam et al (2002) observed that the treatment of leaf extract on diabetic pancreas showed improved functional state of beta cells and also helped in the regeneration of parts of pancreas damaged by streptozotocin.

According to Ayurveda the leaves of the Bael plant are used to cure and control diabetes. Even in the Unani system of medicine also juice of leaves is employed as anti-diabetic drug (Akhtar et al 2005). The juice is extracted from the leaves and taken every day morning on empty stomach. It is said that it controls the blood sugar levels and brings it to normal levels in about a month (Sampathkumar et al 2012).

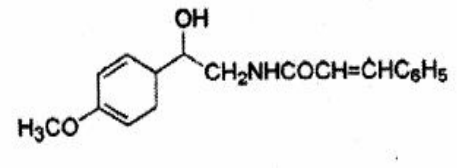
**Anticancer activity**

Most of the potent antineoplastic drugs available are expensive, mutagenic and teratogenic including drugs derived from natural sources therefore researchers are trying to develop medicines from alternate

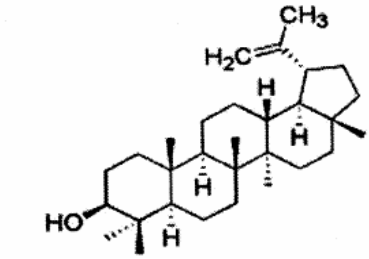
Phyto-constituents isolated from various parts of *Aegle marmelos*



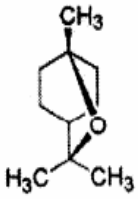
Plant part: Leaf
Phyto-constituent: Skimmianine
Biological activity: Anticancer, anti-methamphetamine, hypnotic, analgesic, anticonvulsive, antipyretic, hypothermic, anti-diuretic, anti-malarial



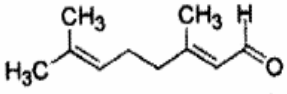
Plant part: Leaf
Phyto-constituent: Aegelin ($C_{18}H_{18}O_4$)
Biological activity: Cardioactive, anti-hyperglyc anti-dislipidemic



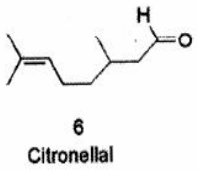
Plant part: Leaf
Phyto-constituent: Lupeol
Biological activity: Cardioactive, anti-inflammatory



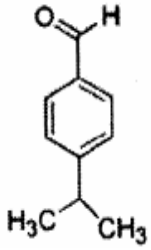
Plant part: Leaf
Phyto-constituent: Cineol
Biological activity: Antiulcer



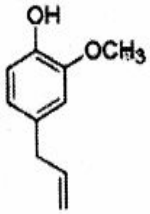
Plant part: Leaf
Phyto-constituent: Citral
Biological activity: Antiallergic, antiseptic



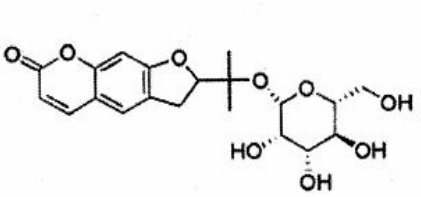

Plant part: Leaf
Phyto-constituent: Citronellal
Biological activity: Antiseptic



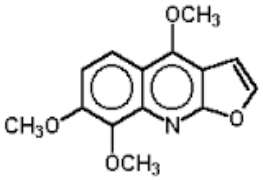
Plant part: Leaf
Phyto-constituent: Cuminaldehyde
Biological activity: Antibacterial ,



Plant part: Leaf
Phyto-constituent: Eugenol
Biological activity: Antioxidant, antibacterial

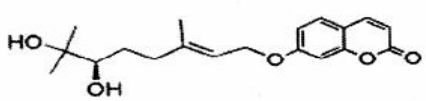


Plant part: Leaf
Phyto-constituent: Marmesinin ($C_{14}H_{11}O_4$)
Biological activity: Antioxidant, cardioprotective

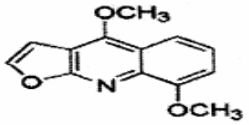


Plant part: Immature bark
Phyto-constituent: Skimmianine
Biological activity: Anticancer, anti- methamph hypnotic, analgesic, anticonvulsive, antipyretic, hypothermic, anti-diuretic, anti-malarial

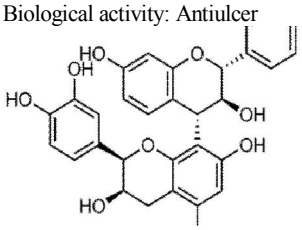
Other compounds in leaf: O-halfordinol, N-2-ethoxy-2-ethylcinnamid, N-2-methoxy-2-ethylcinnamid, a new compound 7- geranyloxycoumarin [7-(2,6-dihydroxy-7-methoxy-7- methyl-3-octaenyloxy) coumarin] named ma (Joy et al 1998)



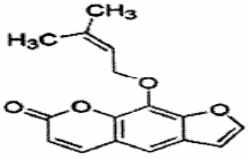
Plant part: Immature bark
Phyto-constituent: Marmin ($C_{19}H_{26}O_5$)
Biological activity: Antiulcer



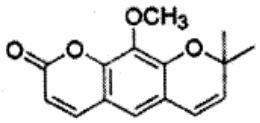
Plant part: Mature bark
Phyto-constituent: Fagarine
Biological activity: Abortifacient



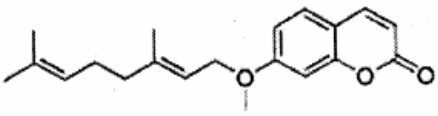
Plant part: Unripe fruit
Phyto-constituent: Tannin
Biological activity: Anti- diarrheal, astringent



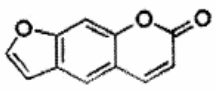
Plant part: Ripe fruit
Phyto-constituent: Marmelosin ($C_{13}H_{12}O_3$)
Biological activity: Cardioprotective, antihelm Antibacterial, antiulcer



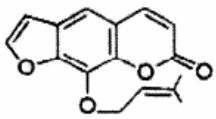
Plant part: Ripe fruit
Phyto-constituent: Luvangetin
Biological activity: Antiulcer



Plant part: Ripe fruit
Phyto-constituent: Aurapten
Biological activity: Heart beat indicator



Plant part: Ripe fruit
Phyto-constituent: Psoralen
Biological activity: Antispasmodic, artemicide, cytotoxic



Plant part: Ripe fruit
Phyto-constituent: Marmelide
Biological activity: Antiviral

Structures (Maity et al 2009)

sources that are inexpensive and non-toxic (Jagetia et al 2005). *A marmelos* leaves extract has recently been proved to control cancer. It inhibits the in vitro proliferations of human tumor cells. Induction of apoptosis may be due to the presence of skimmianine in the leaf extract which may have killed the tumor cells (Jagetia et al 2005).

**Gastroprotection properties**

Gastroduodenal ulcers are the most common form of gastric ulcers. Such ulcers develop when there is an imbalance in the acid mucosa levels or due to oxidative stress along the gastric tract. A stomach ulcer is usually caused by an infection with a bacterium (germ) called *Helicobacter pylori* and experiments gave positive results in gastric ulcer inhibition with the use of Bael. Goel et al (1997) reported that oral administration of pyranocoumarin isolated from the seeds of *A marmelos* Correa showed significant protection against aspirin-induced gastric ulcers in rats and cold restraint stress-induced gastric ulcers in rats and guinea pigs. Luvangetin, marmin and cineol isolated from Bael showed significant protection against ulcers. Similarly Dhuley (2003) reported that pretreatment of rats with unripe Bael fruit extract produced a significant inhibition of absolute ethanol induced gastric mucosal damage.

According to the Ayurveda infusion of Bael leaves is an effective remedy for stomach ulcers. 15 g of leaves should be soaked overnight in 250 ml of water and in the morning this water should be strained and taken as a drink. The pain and discomfort will be relieved when this treatment is continued for a few weeks. The phenolic compounds found in Bael extracts possessed potent antioxidants which helped in reducing gastric ulcers. Bael fruit taken in the form of beverage on account of mucilage content also has great healing properties. The mucilage forms a coating on the stomach mucosa and thus helps in the healing of ulcers.

**Anti-thyroid activity**

The hormones produced by the thyroid are circulated throughout the body in the blood stream and impact the function of many other organs. Thyroid conditions result when too many thyroid hormones are produced (hyperthyroidism) or too few hormones are produced (hypothyroidism). Hypothyroidism is much more common. There are many natural treatments to support thyroid function. These include dietary changes, vitamin/mineral supplementation, homeopathy, several herbs and trees.

Panda and Kar (2006) isolated Scopoletin (7-hydroxy-6-methoxy coumarin) from *A marmelos* leaves and evaluated for its potential to regulate hyperthyroidism. It was observed that scopoletin (at 1.00 mg/kg, po for 7 days) to levo-thyroxine treated animals decreased serum thyroid hormones level.

**Antimicrobial properties**

Bael leaf, root and fruit extracts have been studied for their antimicrobial properties. The extracts showed inhibition of many bacterial strains. The antimicrobial properties are due to the presence of bio-chemicals such as cuminaldehyde and eugenol. Maheshwari et al (2009) observed ethnolic extract of dried fruit pulp of *A marmelos* against various intestinal pathogens viz *Shigella boydii, S sonnei* and *S flexneri* and proposed that certain phytochemicals including phenols, tannins and flavonoids were effective against all. This is supported by the work of Kaur et al (2009) who treated *Escherichia coli* with Bael fruit extract.

**Antifungal properties**

Antifungal constituents, 2-isopropenyl-4-methyl-1-oxacyclopenta [b] anthracene-5, 10-dione and (+)-4-(20-hydroxy-30-methylbut-30-enyloxy)-8H-[1,3]dioxolo[4,5- h]chromen-8-one in addition to known compounds imperatorin, b-sitosterol, plumbagin, b-sitosterol glucoside, stigmasterol, vanillin and salicin were isolated during phytochemical investigation on seeds of *A marmelos* (Mishra et al 2010). A new anthraquinone, 1-methyl-2-(32 - methyl-but-22 -enyloxy)-anthraquinone (Joy et al 1998) isolated from seeds of *A marmelos* was characterized exhibited significant antifungal activity against pathogenic strains of *Aspergillus* species and *Candida albicans* (Mishra et al 2010).he antifungal activity of essential oil isolated from the leaves of *A marmelos* has exhibited variable efficacy against different fungal isolates (Rana et al 1997).

**Antifilarial activity**

Methanolic extract of roots and leaves of *A marmelos* were explored for possible anti-filarial effect against *Brugia malayi*microfilariae by Sahare et al (2008). It was observed that among the herbal extract, leaf extract of *A marmelos* showed complete loss of motility of microfilariae after 48 h of incubation. The presence of alkaloids, saponins and flavonoids in the roots of *V negundo* and coumarin in the leaves of *A marmelos* were responsible for anti-micro-filarial activity.

**Anti-depression activity**

*A marmelos* may be served as a potential resource for natural psychotherapeutic agent against stress related disorders such as anxiety and depression. This has been proved by Kothari et al (2010). They reported that methanol leaf extract of *A marmelos* showed significant anxiolytic and antidepressant activities possibly by increasing monoamines level at post-synaptic sites. Bael is very useful for a healthy mind and brain. Ripe Bael fruit taken with fresh cream (butter) and sugar candy powder sharpens concentration and intelligence. One can make Bael squash and keep it at home thus preserving and utilising surplus ripe Bael fruit for off season.

**Anti-inflammatory properties**

Bael extracts possess anti-inflammatory properties which help in reducing histamine induced contractions and induce positive relaxant effect in the inflamed regions or organs. Ghangale (2008) also evaluated aqueous extract of *A marmelos* for anti-inflammatory activity and proposed that Bael posseses anti-inflammatory activity. Shankarnanth (2007) demonstrated that methanolic extract of Bael leaves at a dose level of 200 and 300 mg/kg showed significant analgesic activity on acetic acid induced writhing and tail flick test in mice.

**Dysentery and diarrhoea**

The unripe or half ripe fruit is perhaps the most effective food remedy for chronic diarrhoea and dysentery where there is no fever. The anti-diarrhoeal effect of aqueous extract of *A marmelos* fruit has been reported to effect outer membrane protein of enteropathogenic *E coli* (Subramaniya et al 2009).

According to Ayurveda diarrhoea and dysentery without fever can be treated with Bael fruit. For best results use dried Bael or its powder. For dysentery and diarrhoea control, Bael fruit when still green is sliced and dried in the sun. The dried slices are reduced into powder. This powder is taken with water or fresh curd three times a day to control diarrhoea. Even unripe Bael can be baked and taken with jaggery or brown sugar (Chopra et al 1985).

**Asthma control**

Due to the presence of one or more antihistaminic constituents present in the alcoholic extract of this plant it is used in asthmatic complaints (Arul et al 2004). Asthama patients should grind 5 grams of Bael leaves, add 1 spoon of honey, take orally in morning and evening for relief (Paricha 2004). Medicated oil prepared from the Bael leaves gives relief from recurrent cold and respiratory infections. According to Paricha (2004) and Reddy et al (2006) the juice extracted from the leaves is mixed in equal quantity of sesame oil and heated thoroughly, few seeds of black pepper and half teaspoonful of black cumin are added to the hot oil. After removing from fire it is stored. Regular massage of this oil on scalp before head bath helps to build up resistance against cold and cough. To bring relief from wheezing cough and respiratory spasm Bael leaf juice is mixed in warm water with a little pepper and given as drink in south India.

**Miscellaneous uses**

Apart from having several medicinal uses of Bael it is also used for controlling pollution and can be grown in wasteland. The plant acts as a sink for chemical pollutants as the leaves absorb foul gases from the atmosphere. Raw Bael fruit produces heat and has purgative effect. It is a member of plant species group known as Cilmate Purifiers because it emits greater percentage of oxygen in sunlight as compared to other plants. This tree is also considered under the category of Fragrant

species whose flowers and essential oil volatile vapours neutralize bad smell of petrified organic matter or decaying refuge thus save humans from bacterial attack by deodorizing the bad odour of air. It is therefore an important tree of wasteland and city waste dumping areas. India shares 16 per cent of the world population while its land is only 2 per cent of the total geographical area of the world. Naturally the pressure on the land is often beyond its carrying capacity. Therefore the productive lands especially the farmlands in India are in the constant process of various degrees of degradation and are fast turning into wastelands. At present a vast area of the land is lying as wastelands in India on which there is enough scope of commercial cultivation of Bael.

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