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A COMPREHENSIVE REVIEW ON KAPITHHA (LIMONIA ACIDISSIMA LINN.) ACCORDING TO AYURVEDIC AND MODERN ASPECT

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ABSTRACT

Limonia acidissima Linn. commonly known as *Kapittha* and is the only species within the monotypic genus *Limonia*. A true multipurpose tree, both gathered from the wild and also cultivated for its edible fruit, has wide range of medicinal and other uses. It has got high medicinal value. Every part of the fruit has got its medicinal property. The fruit is much used in India as a liver and cardiac tonic and when in unripe state, as a means of halting diarrhea and dysentery and for effective treatment for hiccough, sore throat, and disease of the gums. Fruit pulp has anti-inflammatory, antipyretic, and analgesic activity. In addition to this, *L. acidissima* also has hypoglycemic, anti tumor, larvicidal, antimicrobial and hepato-protective activity. This review will be helpful to create interest toward the lesser-known facts and less documented work done on *L. acidissima.*

KEYWORDS: *Kapithha, Limonia acidissima Linn.*, active constituents, Phytochemical, Pharmacological activity.

INTRODUCTION

Ayurveda is a traditional system of Indian medicine used over thousands of years for healing and well being of body. India is blessed by varied agro-climatic conditions which have paved a way to grow variety of fruits in different seasons of the year. The latin name of *Kapithha* is *Limonia acidissima Linn*. It belongs to the family Rutaceae synonomicaly known as *Feronia*

Limonia Swinglel, *Feronia elephantum*, *Schinus Limonia* and commonly also called as wood apple and elephant apple is native and common in the wild in dry plains of India and Ceylon and cultivated along roads and edges of fields and occasionally in orchards. It is also grown throughout Asia tropical, Asia temperate, Southern America and northern Malaysia. *Limonia acidissima (L.*) of family Rutaceae (Citrus family) belongs to the monotypic genus Limonia. Wood apple is a deciduous, erect tree with a few upward-reaching branches bending outward near the summit where they are subdivided into slender branchlets drooping at the tips.[3] It can grow up to 9 metres tall. The fruit shape resembles an apple and the name wood apple is due to the fruit hard shell. It requires a pronounced dry season to give fruit. A ripe bael fruit in India. The fruit is also known as elephant-apple, monkey fruit, or crud fruit. It can grow up to 9 metres tall.*Kapithha* has *Rasa* (taste on the tongue): *Kashaya* (Astringent), *Madhura* (Sweet), *Amla* (Sour); Unripe: Pulp: *Amla* (Sour), *Kashaya* (Astringent),*Guna* (Pharmacological Action): *Laghu* (Light), Unripe Pulp: *Guru* (Heavy)and *Virya*: *Sita* (Cooling); Unripe Pulp: *Ushna* (Hot) *Vipaka* (transformed state after digestion): *Madhura* (Sweet); Unripe Pulp: *Amla* (Sour). It's Action *Vata-pitta-har; Rakta - pitta-har*.[1,2,3,4,5]

Ayurvedic classification

According to different *Samhitas* / *Nighantus*[4,6,7]

***Bhavaprakash nighantu* -** *Amradi Phal Varga*

***Dhanwantari nighantu* –** *Shatapushpadi varga*

***Raj nighantu* –** *Amradi Varga*

***Kaiyadeva nighantu* –** *Kritanna Varga, Aushadhi varga*

Types of *kapithha*[1,4,7,8]

According *Charaka, Bhavaprakash Nighantu, Dhanwantari Nighantu, Madanpal Nighantu, kaiyyadev Nighantu Kapittha* is of 2 types-*Pakkva and Apakkva Kapittha*.

UL.N. = *Limonia acidissima linn.*

Taxonomical classification of limonia acidissima linn[12]

Kingdom: Plantae Division: Magnoliophyta

Class: Magnoliopsida Order: Sapindales Family:Rutaceae Genus: Limonia L. Species: L. acidissima

Nirukti[4,6,13]

1. कपित्थः -कपयः तिष्ठन्ति अत्र । (भा.दी.) Monkeys will stay in plenty on this trees.
2. कपिप्रिय - (भा) - कपीनां प्रियः । (त्त) कपिषु तिष्ठति कपिप्रियत्वात् । (क्षी.स्वा.) –– Its fruits are liked by monkeys.
3. ग्राही- (१)गृह्णाति इति । ग्रह उपादाने' । (भा.दी.) ग्राही पुरीषसंग्रहणीयं फलमस्य । (कै) (त्त) विष्टम्भकारित्वात् । (क्षी.स्वा.) It causes constipation OR it acts as antidiareal.
4. कठिनफलः (शनि)- कठिनं फलमस्य ।The fruit is hard.
5. कषायाम्लफलः (कैनि)- K.A रस –Astringent Taste.
6. गन्धफल: (धान)- गन्धवान्त फलान्यस्य । Aromatic fruit.
7. ग्रन्थिफल (रा.)- ग्रन्थिलः फलमज्जाऽस्य ।its fruit pulp containing Lumps.
8. चिरपाकी (कै)-चिरेण पच्यते ।It takes long duration for ripening.
9. दन्तशठ:- (त) दन्तानां शठ इव, अपकारित्वात् । (भा.दी.) अम्लत्वात् दन्तानां शठ: अपकारकः इति । (क्षी.स्वा.) Its sourness spoils the teeth.
10. दधित्थ:- (त) दधिवर्णो द्रवः तिष्ठति अस्मिन् । (भा.दी.) (त्त) दध्नि तिष्ठति इति दधित्थः । (नि.आ.) The fruit pulp (unripen) resembles the colour and appearance of curd.
11. दधिफल:- दधि फले [illegible]
12. पुष्पफलः- पुष्पयुक्तं फलमस्य । । (नि.आ.) (भा.दी.) पुष्पवत् सुरभिः फलमज्जाऽस्य । Its fruit is present with the flower attached to it at the tip.
13. मन्मथः - मननम् । 'मन ज्ञाने' । मथति । 'मथ विलोडने' । (भा.दी) & (नि.आ.) मनो मश्नाति, वाजीकरत्वात् । It helps in improving digestion.
14. कपीतनक :- (KAPEETANA- KA) Albizzia procera. (स्व.) कपीतनो अश्वत्थ वृक्षः । तस्य कः कपीतनकः । It is similar to Pipal tree in properties.

Paryay of *kapittha*[4,6,7,8,9]

Paryaya	*Dhanwantari Nighantu*	*Madanpal Nighantu*	*Kaiyadeva Nighantu*	*Bhavprakash Nighantu*	*Raj Nighantu*
Dadittha	+	-	+	+	-
Grahi	+	-	+	-	+
Gandhaphal	+	-	-	-	+
Dadhiphal	+	+	+	+	+
Akshakasya	+	-	+	-	-
Chirapaki	+	-	+	-	+
Kapipriya	+	-	+	+	-
Surbhicchada	-	+	+	-	-
Takracchida	-	-	+	-	-
Dadhi	+	-	+	-	+
Hrudya	-	-	+	-	-
Kashayamlaphala	+	-	+	-	-
Malura	+	+	+	-	+

Mangalya	-	-	-	-	+
Neelmallika	-	-	-	-	+
Kuchaphala	-	-	-	-	+
Vruttaphala	-	-	-	-	+
Karavallabha	-	-	-	-	+
Danthashatha	-	-	-	+	+
Kathinaphala	-	-	-	-	+

Vernacular names[4,6,7]

Language	**Name**
English	Wood apple, elephant apple, Kaith
Hindi	*Label, kaith*
Kannada	*Kadu nimbe, belada hannu*
Marathi	*Kavath*
Bengali	*Katbhel*
Gujrati	*Kotha*
Tamil	*Villa*
Malyalam	*Cheru*
Telugu	*Kapitthamu*

Raspanchak[1,2,3,4,6,7,9,10]

Sanhita/Nighantu	***Ras***	***Vipak***	***Veerya***	***Guna***
Charak[1]	*Madhur, amla, kashay*	-	-	*Guru*
Sushrut[2]	*Madhur, amla,*	--	-	*Guru*
Ashtang Hridya[3]	*Katu*	*Katu*	*Ushna*	*Laghu*
Dhanwantari Nighantu[6]	*Madhur, amla*	-	-	-
Bhavaprakash Nighantu[4]	*Katu*	-	-	-
Rajnighantu[7]	*Madhur, amla*	-	-	_
Madanpal Nighantu[9]	*Madhur, amla, kashay*	-	-	-
Kaiyadeva Nighantu[8]	*Kashay, Amla, Madhur*	-	-	*Guru*

Panchabhautik sanghatan[4]

Sr. No.	***Raspanchaka***		***Prithvi***	***Jal***	***Tej***	***Vayu***	***Akash***
1	*Rasa*	*Madhur,*	+	+	-	-	-
		Amla	+	-	+	-	-
2	*Veerya*	*Sheeta*	+	+	-	-	-
3	*Vipaka*	*Madhur*	+	+	-	-	-
4	*Guna*	*Guru*	+	+	-	-	-
		Snigdha	+	+	-	-	-
			6	5	1	0	0

CONCLUSION

Prithvi and Jal *mahabhutadhikya* is there in Kapithha. In *panchbhautik sanghatan*,

-Due to *Madhura rasa (Prithvi + Jal) Kapittha* is *VataPittahara.*

-Due to *Madhura vipaka (Prithvi + Jal) Kapithha* is *vatahara, Hrudya, Vishaghna.*

***Karmas* of *kapittha*[1,2,5,6,7,9,10]**

Karma	*Ch.S.*	*Su.S.*	*DN*	*KN*	*RN*	*BPN*	*M.N*
Vatakaphahar	-	-	+	+	-	+	-
Kasa	-	+	+	+	-	-	-
Shwasa	-	+	+	+	-	-	-
Rochana	+	+	+	+	-	-	-
Trushnaghna	-	+	+	+	-	+	+
Grahi	+	+	+	+	+	-	+
Vrananashana	-	-	-	-	+	-	-
Kanthaghna	+	+	-	+	-	+	+
Vishagna	+	-	-	-	-	+	-
Vrushya	-	-	-	-	+	-	-
Vatpittahar	-	-	-	-	+	+	-

***Rogaghnata*[1,2,3,5,6,7,9,10]**

Charaka – *Kanthaghna, vishagna, grahi, vatalam.*

Sushruta – *Kasa, shwasa, Aruchi, Trishnaghna.*

Ashtang hridya – *Vani jayet.*

Dhanwantari Nighantu – *Trishnahara.*

Kaiyadev Nighantu -Tridoshahar, Hridya, Mutravikara.

Rajnighantu-Vrananashana.

Bhavprakash Nighantu – *Hikkashaman,vatpittajit.*

Madanpal Nighantu – *Shwasa roga* (Asthma), *Trishna, Hikka.*

***Swaroop*[4,5,6]**

Erect Tree

Patra – *Andakar-Abiandakar*, 7-10cm inches length

Pushpa –Faint red

Phala –5-7.5cm Round or hard shell, Sweet in taste. Seed-small

Morphology[4] External morphology

The slow-growing tree is erect, with a few upward-reaching branches bending outward near the summit where they are subdivided into slender branchlets drooping at the tips. The bark is ridged, fissured and scaly and there are sharp spines:3/4 to 2 inches (2-5 cm) long on some of the zigzag twigs. The deciduous, alternate leaves, 3 to 5 inches (7.5- 12.5 cm) long, dark-green, leatherv often minutely toothed, blunt orthe zigzag twigs. The deciduous, alternate leaves, 3 to 5 inches (7.5- 12.5 cm) long, dark-green, leathery, often minutely toothed, blunt or notched at the apex, are dotted with oil glands and slightly lemon-scented when crushed.

Dull-red or greenish flowers to ½ inch (1.25 cm) wide are borne in small, loose, terminal or lateral panicles. They are usually bisexual. The fruit is round to oval, 2 to 5 inch (5-12.5 cm) wide, with a hard, woody, grayish-white, scurfy rind about 1/4 inch (6 mm) thick. The pulp is brown, mealy, odorous, resinous, astringent, acid or sweetish, with numerous small, white seeds scattered through it.





Internal morphology[11]

Fruit Pulp - shows irregular, thin-walled, parenchymatous cells; numerous idioblast cells filled with reddish-brown content; stone cells, slightly triangular and oval, with concentric striations and narrow lumen, found in groups; a few fibro-vascular bundles distributed in the pulp; xylem vessels having spiral thickenings.

Powder - Reddish-brown; shows fragments of fibro-vascular bundles, stone cells, triangular to oval with concentric striations and narrow lumen, vessels and idioblast filled with cell.

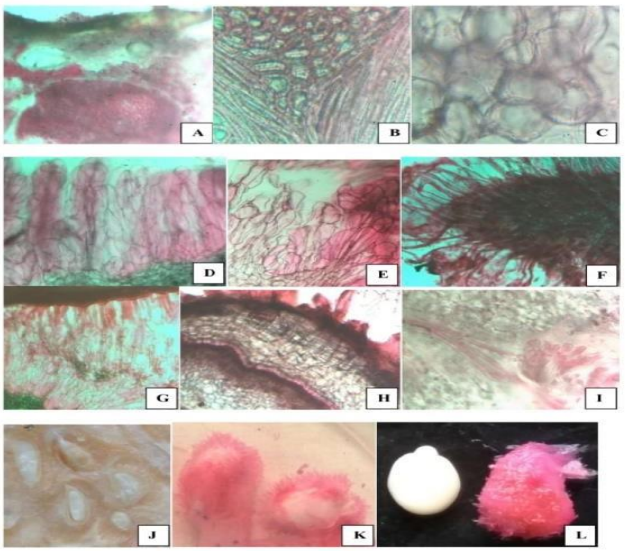

Fig.1. Pharmacognostic characters of *Limonia*, A. Epicarp with oil cavities and part of Mesocarp, B. Groups brachysclereids separated by groups of parallelly arranged macrosclereids, C. Ground parenchyma of Endocarp, D. Array of mucilage glands, E.Mucilage gland enlarged, F. Sclerotic fibres of seed testa, G.Glands and seed fibres entangling, H. T.S of testa and tegmen, I. Vascularbundles, J. Seeds in chamber, J. Surface fibres of seed stained red with safranin, K. Embryo (left) and seed (right).

Powder study

The powder of pulp shows sclereids (Fig 2A), tracheids (Fig 2B), glandular cells (Fig 2C), testafibres (Fig 2D), undground parenchyma (Fig 2E).

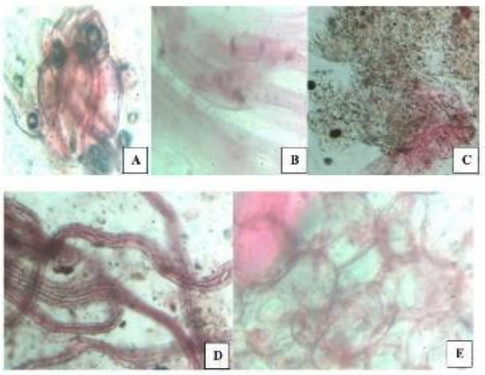

Fig.2. Powder characteristics of *Limonia* fruit. A. Group ofbrachysclereids, B.Vascular tracheids, C. mucilage, gland cells, D. Testafibres, E. Ground parenchyma.

Phytochemicals[12,13,14,15]

The preliminary phytochemical analysis of *Limonia acidissima* plant parts showed the presence of alkaloids, flavonoids, phenols, terpenoids, tannins, fats steroids, saponins, glycosides, gum, mucilage and fixed oils15-18.[12] The unripe fruits contain stigmasterol (0.015%). Fruit pulp contains large quantity of citric acid and protein (8%), pectin (16%), other fruit acids, mucilage (20%) and minerals. Alkaloids, coumarins, fatty acids and sterols have been detected in the pericarp. It also contains umbelliferone, dictamnine, xanthotoxol, scoparone, xanthotoxin, isopimpinellin, isoimperatorin and marmin.[13] Leaves contain stigmasterol, psoralen, bergapten, orientin, vitedin, saponarin, tannins and an essential oil.[14] Marmesin, feronolide and feronone have been isolated from the bark.[15] Seeds contain fixed oil, carbohydrates, proteins and amino acids. Roots contain feronia lactone, geranylum belliferone, bargapten, osthol, isopimpinellin, marmesin and marmin.

Habitat[16]

Deciduous trees, to 20 m high,bark dark-grey or black, deeply cracked ,thorns straight, to 2.5 cm, axillary. Leaves imparipinnate, alternate, 1-3 in a cluster, estipulate; rachis 60-80 mm long, stout, glabrous, leaflets 4-7, opposite,lamina 1.3-3.8 × 1.3 cm, obovate, base cuneate, apex obtuse, margin entire, punctate, lateral nerves pinnate. Flowers polygamous, dull red, 1.3 cm across, calyx small, flat, 5-toothed, pubescent deciduous, petals 5, free. stamens 10-

12, inserted round the disc, filaments dilated below, anthers linear-oblong, disc thick, annular,5-6-celled, at length 1-celled, ovules many, stigma oblong, fusiform. Fruit a berry, 5-7.6 cm across, globose, whitish-brown, rind hard and woody with many seeds.

Ethno-medicinal uses[17]

All parts of the plant have been used by tribal people for various uses. Pulp of ripe fruits is eaten with sugar to reduce the infection of gums and throat. It also helps to cure sore throat. It helps to cure bad breath, bleeding gums. Regular usage of pulp in morning acts as medicine to tone up the sagging breast and uterus to cure sterility due to deficiency of progesterone hormones. Ripe pulp is rubbed to reduce pain caused by venomous stings. The unripe fruits are sour, aromatic, astringent, constipating and alexipharmic by nature are used in the treatment of diarrhoea, pharyngodynia, pruritus in Ayurvedic medicinal system Unripe fruits are astringent and seeds are used in heart diseases. The leaves are astringent, carminative, good to cure vomiting, indigestion, also acts as cardiotonic. Tribal people of Saurashtra, The bark possess aromatic and cooling effect. It is in the vitiated conditions of Pitta. The bark use in the treatment of asthma, bronchitis, etc.

Other usage

The fruit pulp can be mixed with variety of beverages and desserts. Fruit jams are also made from it. The sticky pulp can be eaten with or it can be blended with coconut milk and palm sugar. In India, chutney is made from the pulp. The dried pulp is often crushed into powder and add up the taste in salads. In addition of these diverse properties possessed by *Limonia acidissima L.*, it can be also used in cosmetics.

Traditional uses

Part use – Ripe and Unripe fruit.

Matra[4]

Churna – 1 to 3 gram,

Kwath – 40 to 80 ml

Doses

In powder form – 1-3 gm

In decoction form – 40 – 80 ml

Formulations[1,2,3]

Sr. No.	Reference	Formulations	Uses
1	Ch.Su. 2/13	*Rasanjan*	
2	Ch.Chi.6/35	*Kapittha flower churna*	*Kaphaj and pittaj prameha*
3	Ch.Chi.arsha/138-148	*Abhayarishta*	*Arsha, Grahani, Pandu, Hrudrog.*
4	Ch.Chi.23/48	*ksharaagad*	*Shophahar*
5	Ch.Chi.23/70-76	*Gandhhastiagad*	*Shwitra, Vicharchika, Kitibh KUshta*
6	Ch.Chi.23/96	*Hingwadi Yoga*	*Jwara,hikka ,shwas,kas.*
7	Ch.Chi.26/76	*Kharjuradi kashaya*	*Ashmari,mutrakruccha*
8	Ch.Chi.29/148	*Kapittha lepa*	*Vatarakta*
9	Ch.Chi.30/97	*Kapittha patra kalka*	*Kapha-pittaj yonivyapad*
10	Ch.Ka.7/30-32	*Kapittha Churna*	*Virechanartha*

Ch.su.-charak sutrasthan, cha. chi.-charak chikitsasthan, cha. ka.-charak kalpasthan

Pharmacological activities

Antioxidant and Antimicrobial Activity of L. acidissima[18,19]

The L. acidissima pulp is found to contain good amount of phenolic content (38.61 mg/g) 3.41 mg/g ascorbic acid, and good in antioxidant activity by ABTS and DPPH assay performed comparative assessment to understand the influence of storage condition and drying method on bioactive constituents. The protein hydrolyzate seeds shows antimicrobial activity at 300 (mg/ml) against Salmonella typhi, Pseudomonas aeruginosa, Escherichia coli.

Anti-Diarrhoeal activity[20,21]

The antidiarrheal activity and gastrointestinal motility reducing activity of alcoholic and aqueous extract of bark of Limonia acidissima Linn, was evaluated.

Antidiabetic activity[22]

Plant has Phenols, flavonoids which are used in the treatment of diabetes. The anti-diabetic activity was performed by using Methanolic extract, Aqueous extract of stem bark, fruit.

Anticancer activity[23]

The fruit extract of L. acidissima Linn. shows anticancer effect. The crude extract (ethanolic extract) were used to determine the ED50 value (50% inhibition of cancer cell growth) in two different breast cancer cell lines, SKBR3 and MDAMB-435. The bio-assays of extracts showed that afraction (fraction 3) from an ethanolic extract had an anticancer effect on SKBR3 and MDAMB-435 human breast cancer cells. After 48 h of exposure, this fraction at

a concentration of 100µg/ml, significantly reduced cell proliferation in both cancer cells. In MDAMB-435 cells, cell cycle analysis showed that the fruit extract fraction 3 induced the accumulation of cells in G2/M phase, whereas no significant change in cell cycle was detected in SKBR3 cells.[22]

Antioxidative property[24.25,26,27]

The crude methanol extract of the stem bark of Limonia acidissima L. and its differentorganic soluble partitionates were screened for antioxidant activities. The antioxidant (free radical scavenging) activity of the partitionates on the stable radical 1,1-diphenyl- 2-picrylhydrazyl (DPPH) was determined.

Hepatoprotective[28]

Hepatoprotective activity of them ethanolic extract of fruit pulp of L. acidissima (MELA) was investigated against carbon tetra chloride (CCl4) induced hepatic injury in rats. MELA exhibited significant dose dependant protective effect against CCl4 induced liver damage which can be mainly attributed to the antioxidant property of the extract.

Biosorbent[29]

The waste fruit shell of Limonia acidissima is used as a biosorbent. The powdered raw material and treated material (raw material treated with acid) of specific micron size were used for the removal of the methylene blue from aqueous solution.

Antibacterial activity[30]

The ethanolic extract of Limonia acidissima. leaves possess abroad spectrum of activity against Gram-positive and Gram-negative bacterial strains responsible for the most common bacterial diseases Methanol extract showed good antibacterial activity with the high inhibition zones while chloroform extract exhibited mild to moderate activity and hexane extract was found to be less active.

Antifungal activity[31]

The different extracts (petroleum ether, chloroform, methanol and aqueous) of Feronia limonia Linn fruit pulp exhibited antifungal activity against some pathogenic fungus. The essential oil from the leaves of the plant exhibited antifungal activity against eight tested fungi.

Larvicidal activities[32,33]

Wood apple leaf is effective against larvae of Culexquinque fasciatus with 90% mortality at 3% aqueous extract.

DISCUSSION

Unripe *Kapittha* is sour in taste, hot in potency, helps in treating *kantagata rogas*, acts as *grahi* and aggravates *vata dosha*.The ripened *kapittha* alleviates all the three *doshas*, has sweet and sour taste, is heavy to digest and the flower of *kapittha* is said to treat rodent poisoning**.**

CONCLUSION

It is quite evident from this review that *Limonia acidissima L*. is an important medicinal plant. It contains a number of phytoconstituents, which are the key factors in the medicinal value of this plant. Almost all parts of this plant such as leaf, fruit, seed, bark and root are used to cure a variety of diseases. The present review summarizes some important pharmacological studies on *Limonia acidissima* and phytochemical investigations and isolated principles from them. Thorough screening of literature available on *L. acidissima* depicted the fact that it is a popular remedy among the various ethnic groups. A systemic research and development work should be undertaken for the development of products for their better economic and therapeutic utilization.The description of *kapithha (Limonia acidissima)* in *Ayurvedic* literature including various formulations show its importance in ancient as well as present times.

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