WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 9, Issue 12, 131-140. Review Article ISSN 2277– 7105

A REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL ACTION OF LIMONIA ACIDSSIMA L.: A MULTIPOTENT MEDICINAL PLANT USED AS NEUTRACEUTICAL, FOOD AND HERBAL COSMETICS

Pranali Band[1]*, Ashwini Chavhan[2], Gauri Dongare[3], Akshada Kale[4], A. N. Aher[5] and Sonali Gawali[6]

[1,2,3,4]P.G. Student, Mvp's College of Pharmacy, Nashik, Maharashtra, India.

[5]HOD, Assistant Professor, Pharmacognosy Department, Mvp's College of Pharmacy, Nashik, Maharashtra, India.

[6]Assistant Professor, Mvp's College of Pharmacy, Nashik, Maharashtra, India.

Article Received on
08 August 2020,

Revised on 28 August 2020,
Accepted on 18 Sept. 2020

DOI: 10.20959/wjpr202012-18651

***Corresponding Author**
Pranali Band
P.G. Student, Mvp's College of Pharmacy, Nashik, Maharashtra, India.

ABSTRACT

LIMONIA ACIDSSIM l. has been traditionally used as an Ayurvedic medicine. It is the only species of its genus, in the family Rutaceae. Different parts of *LIMONIA ACIDSSIMA* such as leaves, bark,fruit pulp, rind, roots, flowers contains variety of phyto-constituents such as alkaloids, phenols, tannins, flavonoids, saponin, esters, fat, calcium, iron, coumarin, tyramine etc., and posses multipotent pharmacological actitivities such as anti-venom, anti-malarial, anti-larvecidal, anti-diarrhoeal, anti-dysentry, cardiac tonic, liver tonic, anthelmentic, antifungal, expectorant, anti-diabetic, anti-cancer, anti-dermatophytic, etc. This plant is used in neutraceuticals, food and herbal cosmetic industry. This review majorly deals with identification, standardization, nutritional value, food value, medicinal uses, phytochemical and pharmacological action of different parts of *LIMONIA ACIDSIMMA L.*

KEYWORDS: LIMONIA ACIDSSIMA, Pharmacological, Phytochemical, Rutaceae.

INTRODUCTION

In India, Ayurveda, Siddha, Unani, and homeopathy utilises a large number of plants for treatment of human and animal diseases. Those plants used were called as medicinal plants.

The medicinal plants are referred to plants that are used for therapeutic or medicinal values. India is one of the leading countries in Asia in terms of the wealth of traditional knowledge systems related to the use of plant species. India is also known to harbor a rich diversity of higher plant species (about 17000 species) of which 7500 are known as medicinal plants.[4]

There are number of herbs which are used for their medicinal and cosmetics properties, Limonia Acidissima L. is one of them. Different parts of Limonia Acidissima L. are responsible for different medicinal, nutritional as well as cosmetics properties. Fruit of Limonia Acidissima L. is used as a substitute for bael in diarrhea and dysentery. Fruit is much used in India as a liver tonic, cardiac tonic, for effective treatment of high cough, sore throat and disease of the gums. Leaves and stem bark of wood apple have been studied for anti-tumor and antimicrobial activity and pulp has anti-inflammatory, antipyretic activity. The fruit contains flavonoids which gives anti-oxidant property, saponins which are responsible for foaming and anti-fungal property. Glycosides, tannins, some coumarins and tyramine derivatives have also been isolated from the fruits of Limonia. The fruit shells of Limonia Acidissima contain anti-fungal compounds, namely, psoralene, xanthotoxin, 2, 6-dimethoxybenzoquinone and osthenol. The shell of the fruit can be also used for skin exfoliation purpose.[7] *Limonia acidissima* Linn, syn. *Feronia limonia* (Rutaceae) is an aromatic, slow growing deciduous tree up to 9m tall grows all over India. Often polygamomonoecious tree with rough, spiny bark. The leaves are deciduous, alternate, dark-green, leathery, pinnate, with 5-7 leaflets, each leaflet 25-35mm long and 10-20 mm broad. The fruit is round to oval, globose, large, 2 to 5 inch wide, with a hard, woody rind, which is grayish-white, scurfy rind. The pulp is sticky brown, aromatic odorous, resinous, astringent, acid or sweetish, white seeds scattered through it.[12] Flowers are normally bisexual. In India, the fruits ripen from early October to March. Seedlings do not bear fruit until the plant is 15 years old.[4]

Taxonomy

Kingdom: Plantae

Sub-kingdom: Tracheobionta

Super-division: Spermatophyta

Division: Magnoliophyta

Class: Magnoliospida

Subclass: Rosidae

Order: Sapindales

Family: Rutaceae

Genus: Limonia L.

Synonym

Feroniaele phantum Correa,

Feronia limonia (L.) Swingle,

Schinus limonia L.

Vernacular names

English: - Wood Apple, Elephant Apple, Monkey Fruit or Curd Fruit

Hindi: - Kaitha, Kath Bel or Kabeet

Oriya: - Kaitha

Sanskrit: - Kapittha or Dadhistha.

Telugu: - Vellaga Pandu

Tamil: - Vilam Palam

Malayalam: - Vilam Kai

Bengali: - Koth Bel

Gujarati: - Kothu

Malaysia: - Belingai

Ayurvedic Properties and Action of Kapitha

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)

Virya: Sita (Cooling); Unripe Pulp: Ushna (Hot)

Vipaka (transformed state after digestion): Madhura (Sweet); Unripe Pulp: Amla (Sour)

Action Vata-pitta-har; Rakta - pitta-har

Nutritional importance

100g of wood apple pulp contains 140kcal. The fruit contains carbohydrates and proteins. It is also rich in beta carotene, vitamin B, vitamin C, thiamin and riboflavin. Wood apple fruits that grow in the wild tend to have more tannin than those cultivated for commercial purposes.[4]

L. acidissima is a nutrient-rich fruit that contains a surprisingly high amount of protein (10%) and also shows good amount of phenolic content and which corresponds to a good source of antioxidants in dried powder. Additionally, the pectin content of the fruit pulp is 3–8%. The fruit contains flavonoids, phytosterols, glycosides saponins tannins, carbohydrates, triterpenoids, vitamins, and amino acids as its chemical constituents. There are reports that some coumarins and tyramine derivatives were also isolated from the fruits of Limonia.[1]

Medicinal Properties

The fruit contains fruit acids, vitamins and minerals. It is used mainly as a liver tonic to stimulate the digestive system. The fruit is also astringent, especially when unripe, and a cardiac tonic. The pulp of the fruit, especially when unripe, is used in the treatment of diarrhoea and dysentery. The fruit is also seen as an effective treatment for hiccough, sore throat and diseases of the gums. Both the fruit pulp and the powdered rind can be poulticed onto bites and stings of venomous insects. The fruit is part of a formula that is applied as a paste to the breasts in order to tone them. The leaves contain tannins and an essential oil. They are astringent and are used internally, often combined with milk and sugar, in the treatment of indigestion, flatulence, diarrhoea, dysentery (especially in children) and haemorrhoids. Oil derived from the crushed leaves is applied on itchy skins.[1] All the parts of *Limonia* are prescribed in indigenous system of medicine for the treatment of various ailments. Fruits are refrigerant, stomachic, stimulant, astringent, aphrodisiac, diuretic, cardiotonic, tonic to liver and lungs, cures cough, hiccup and good for asthma, consumption, tumours, opthalmia and leucorrhoea.[11] Unripe fruit is astringent while seeds are used in heart diseases. The fruits are used as a substitute for bael in diarrhea and dysentery. Leaves are astringent and carminative, good for vomiting, indigestions, hiccup and dysentery. The leaves have hepatoprotective activity. The gum is demulcent and constipating, and is useful in diarrhoea, dysentery, gastropathy, haemorrhoids and diabetes.

Phytoconstituents of different parts of plant

Table 01: Phytoconstituents of different parts.[7, 9, 10, 11]

Sr. no.	Parts	Phytoconstituents
01.	Bark	**Coumarins** - Marmesin, bergapten, psoralen, luvangetin, xanthotoxin, scopoletin, iso-imperatorin, osthol and 6,7-dimethoxycoumarin " feronolide and feronone **Alkaloids** **Steroids** - Sitosterol and sitosterol-o-beta-d-glucoside**.** **Terpenoids** - Lupeol and limonin **Flavones** - 5, 7-dihydroxy-3', 4'-dimethoxy-6,8-di (3-methylbut-2-enyl) stigmasterol, sitosterol-3-O-β-D-glucopyranoside Carbohydrate, amino acid, protein, lipid tannins Phenols[7]
02.	Leaves	**Alkaloids** - Psoralen, bergapten. **Flavones** - Orientin, vitexin **Saponins** **Essential oils** Carbohydrate, amino acid, protein, lipid, tannins, alkaloids, steroids[7]
03.	Fruit	Flavonoids, glycosides, saponins and tannins and some coumarins, tyramine derivatives Acidissimin, Acidissiminol[7]
04.	Unripe Fruit	**Stigmasterol[7]**
05.	Roots	**Lactones** - Feronia lactone, geranylumbelliferone, frenolin. **Coumarin** - Aurapten, marmesin, bergapten, xanthotoxin, osthol, xanthyletin, 6-methoxy-7-geranyloxycoumarin, osthenol. **Quinolone alkaloid** - 1-methyl-4-methoxy-2-quinolone[7]
06.	Seeds	Fixed oil, carbohydrates, proteins and amino acids.[7]
07.	Pulp	**Flavone glycoside** - 5,4-dihydroxy-3-(3-methyl-but-2-enyl) 3,5,6-trimethoxyflavone-7-O-b-D-glucopyranoside. Citric acid and other fruit acids, mucilage and minerals, alkaloids, coumarins, fatty acids, sterols, umbelliferone, dictamnine, xanthotoxol, scoparone, xanthotoxin, isopimpinellin, isoimperatorin and marmin. Rich source of Beta carotene, a precursor of vitamin-A which also contains significant amount of vitamin B such as riboflavin and thiamine and it had small quantities of ascorbic acid content. Carbohydrate, amino acid, protein, lipid, tannins Resins.[7]
08.	Shell	Psoralene, xanthotoxin, 2, 6-dimethoxybenzoquinone, osthenol (anti-fungal)Amino acids[7]

Pharmacological activity

Antibacterial activity

The methanolic extract of pulp was found to possess highest antibacterial activity against *Staphylococcus epidermidis* followed by *Staphylococcus aureus* and *Bacillus subtilis.* The rind of kaitha also revealed antibacterial activity against *Staphylococcus aureus* and

Staphylococcus epidermidis. The antibacterial activity can be attributed to the phenolic content of the sample extracts. The samples having higher phenolic content were found to be better in inhibiting the growth of bacteria hence were giving zone of clearance of greater diameter.[10] It was found that ethanolic extract of *Limonia acidissima* L. leaves possess abroad spectrum of activity against Gram-positive and Gram-negative bacterial strains responsible for the most common bacterial diseases.[4] The protein hydrolyzate of L. acidissima seed shows antimicrobial activity against Salmonella typhi, Pseudomonas aeruginosa, Escherichia coli,, and Klebsiella pneumonia.[1]

Anti-diarrhoeal activity

Plants have various useful chemical constituents which are used in the treatment of diarrhoea. The antidiarrheal activity and gastrointestinal motility reducing activity of alcoholic and aqueous extract of bark of *Limonia acidissima L*. was reported.[5] Ethanolic and aqueous extracts of bark of *Limonia acidissima*, *Linn* showed Antidiarrhoeal activity.[4, 6]

Anti-diabetic activity

Plants have various useful chemical constituents such Phenols, flavonoids which are used in the treatment of diabetes.[5] The anti-diabetic activity was performed on the alloxan induced wistar rats by using methanolic extract of fruit pulp of *Limonia acidissima*. Extract showed dose dependent effect, 200 and 400 mg/kg dose shows reduction in glucose level. More over *Limonia acidissima* extract showed significant reduction in blood urea and creatinine in treated rats but significantly increased total protein level. A significant dose dependent antidiabetic effect of methanolic fruit extract25and aqueous leaf extract of *Limonia* in streptozotocin induced diabetic rats have been reported.[4]

Anti-cancer activity

The fruit extract of *L. acidissima* Linn Shows anticancer effect. Fruit extracts from fractions 1 to 4 and also 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-assay of extracts *L. acidissima* L. shows that a fraction from an ethanolic extract had an anticancer effect on SKBR3 and MDA-MB-435 human breast cancer cells.[5]

Hepato- protective activity

Hepato-protective activity of ethanolic extract of fruit pulp of *L. acidissima* against carbon tetra chloride (CCl4) induced hepatic injury in rats is reported. It exhibited significant dose dependant protective effect against CCl_4 induced liver damage which can be mainly attributed to the antioxidant property of the extract.[5]

Wound healing activity

Wood apple is traditionally used as wound healing medicine. Different extracts of *L. acidissima* possesses significant dose-dependent wound healing activity; this supports traditional claims for the plant as a wound healer.[4]

Anti-fungal activity

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.[4]

Anti-larvicidal activity

Acetone extract of the dried leaves found to be effective against larvae of *Culexquinque fasciatus*, *Anopheles stephensi* and *Aedesaegypti.*

Diuretic activity

Diuretic activity of methanolic extracts obtained through the Microwave assisted extraction (MAE) and Bath Sonicator extraction (BSE) of *Limonia acidissima* was investigated. These findings support the traditional uses of *Limonia acidissima* leaves as diuretic agents.

Limonia acidsima as a food product

Jam is more or less a concentrated fruit processing which has fairly thick consistency and body. It is also rich in flavour, because ripe fruits which have developed full flavour are used in its preparation. A great advantage in its preparation is that it can be prepared in a single operation. Fruit bar is a nutritious product, has a chewy texture, similar to dried raisins and is a good source of dietary fibre and natural sugar. Hence it was decided to prepare the two products. For the preparation of good quality jam, jelly and fruit bar, the fruit should contain adequate amounts of pectin.[2] Fruit Bar is a nutritional product, has a chewy texture similar to dried raisins and is a good source of dietary fiber and natural sugars.[2] L. acidissima burfi

is prepared using cow milk khoa.[1] L. acidissima squash is prepared by utilizing xanthan gum, sugar, citric acid, and red chili powder.

Patel and Pandey.[13] carried out the fortification of bakery products and studied the antioxidant properties of L. acidissima. In this study, an attempt was made to utilize L. acidissimaLinn fruit powder for the fortification of wheat flour, which is used for the development of phenolic-enriched herbal biscuit to supplement scarce phytochemicals having greater antioxidant activity.[1,13] There are substantial anecdotal reports indicating that the consumption of L. acidissima could ameliorate a wide range of illnesses. In addition, it can be used as a food ingredient to make processed products like jams, jellies, sweets, and savory chutneys and juice. Rind of L. acidissima can also be used as animal feed as it does not contain any toxic compound. These results also support beneficial health claims.[1]

Limonia acidssima as a herbal cosmetic

Different parts of wood apple are responsible for different activities and can be used in cosmetics. Essential oil extract from leaves of wood apple gives anti-bacterial activity and can be used in cosmetics. Mainly the shell can be used for the exfoliation purpose in skin care cosmetics.[7] It can be used as preservative in herbal preparation. The waste fruit shell of Limonia acidissima L. is used as adsorbent.[7] The fruit contains flavonoids which gives anti-oxidant property, saponins which are responsible for foaming and anti-fungal property. Glycosides, tannins, some coumarins and tyramine derivatives have also been isolated from the fruits of Limonia. The fruit shells of Limonia Acidissima contain anti-fungal compounds, namely, psoralene, xanthotoxin, 2, 6-dimethoxybenzoquinone and osthenol. The shell of the fruit can be also used for skin exfoliation purpose.[7]

The other main constituents of Limonia Acidissima L are saponins, flavonoids, amino acids, beta carotene, tannins, carbohydrates, vitamin B, triterpene. Constituents of this plant are responsible for some cosmetic properties hence Limonia Acidissima L. can be used in cosmetic products.[7]

CONCLUSION

It is quite evident from this review that *LIMONIA ACISSIMA L*. can be used as nutritional, cosmetics, food and medicine. Different parts of plant posses different pharmacological actions depending upon their active constituents. In addition, it can be used as a food ingredient to make processed products like jams, jellies, sweets, and chutneys and juice. Rind

of L. acidissima can also be used as animal feed as it does not contain any toxic compound. These results also support beneficial medicinal and nutritional claims. Thus, there is enormous scope for future research and further phyto-chemical and pharmacological investigation on L. acidissima.

REFERENCES

1. Shreya P. Kerkar, Sonal Patil, Arya S. S, Ashish Dabade & Sachin K. Sonawane, Limonia acidissima: Versatile and Nutritional Fruit of India, International Journal of Fruit Science, 2020; 11.
2. R. Vidhya and Anandhi Narain, Formulation and Evaluation of Preserved Products Utilizing under Exploited Fruit, Wood Apple (Limonia acidissima), American-Eurasian J. Agric. & Environ. Sci., 2011; 10(1): 112-118.
3. C. Hemalatha and S. Parameshwari, Development and Standardization of Wood Apple (limonia acidissima) Incorporated Novel Food Products, IJPSR, 2019; 10(11): 5087-5093.
4. Pratima Vijayvargia, Rekha Vijayvergia, A Review on Limonia acidissima l.: Multipotential Medicinal Plant, Int. J. Pharm. Sci. Rev. Res., 2014; 36, 28(1): 191-195.
5. Dr. Anjana Dhakar, Dr. Preeti Chorotiya, Dr. Manisha Meena, Dr. Chandan Singh, Dr. Rajendra Prasad Purvia and Dr. Manoj Kumar Adlakha, Pharmacological Properties And Phytochemical of Limonia Acidissima: A Review, World Journal of Pharmaceutical Research, 8(10): 637-645.
6. K L Senthilkumar, Bhupendra Kumar Kumawat, M Rajkumar, Senthilkumar, Antidiarrhoeal activity of bark extracts of Limonia acidissima Linn, Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2010; 1(4): 550.
7. Vishakha Bagul, Sonal Dhabekar, Disha Sansarode, Sneha Dandekar, Wood Apple (Limonia Acidissima L.): A Multipurpose Herb In Cosmetics, 2019; 4: 172-181.
8. G. Kishor Naidu, B. Sujatha, K. Chandra Sekhar NAIDU, In vitro Antibacterial Activity Analysis of Leaves of Limonia acidissima, Not Sci Biol, 2014; 6(2): 155-157.
9. P. Shivakumar Singh, G. M. Vidyasagar, Antidermatophytic activity of ethanolic leaves extract of Limonia acidissima Groff, 2015; 39: 56-62.
10. Shipra Pandey, Gouri Satpathy, Rajinder K. Gupta, Evaluation Of Nutritional, Phytochemical, Antioxidant And Antibacterial Activity Of Exotic Fruit "Limonia Acidissima", JPP, 2014; 3(2): 81-88.

11. Asha Thomas and N. R. Ponnammal, Preliminary Studies On Phytochemical And Antibacterial Activity Of Limonia Acidissima L. Plant Parts, Ancient Science of Life Vol : XXV (2) October, November, 2005; 57-61.
12. Pratima Vijayvargia, Soniya Choudhary and Rekha Vijayvergia, Preliminary Phytochemical Screening of Limonia Acidissima Linn. International Journal of Pharmacy and Pharmaceutical Sciences, 2014; 6(1).
13. Patel, A.S., and A.K. Pandey, Fortification of Limonia acidissima linn fruit powder to develop the phynolic enriched herbal biscuits. J. Bioresource Eng. Technol, 1: 74–85.