



A REVIEW ON POTENTIAL OF MEDICINAL PLANT: LIMONIA ACIDISSIMA L.

Smit Bhavsar*, Palak Sapra, Bharat Maitreya and Archana U. Mankad

Department of Botany, Bioinformatics and Climate change impact management, School of Science, Gujarat University, Ahmedabad-380009.

Email: -aumankad@gujaratuniversity.ac.in , saprapalak@gmail.com

ABSTRACT

Plant is an important source of medicine and plays a key role in achieving objectives of WHO for wellbeing of all mankind. People are getting aware about natural products, to fulfil the requirement of medicinal values, *Limonia acidissima*

L. of family Rutaceae, emerged out to be one of the most valuable plant owing multiple medicinal properties. The main objective of the present study is to recognize and identify different chemical constituents of the plant, which are important in the field of medicine. Hence in this article, the attempt has been made to study literature of different medicinal values, Pharmacological activities and the Ethnobotanical uses of *Limonia acidissima* L. The complied information of the plant can be used in various medicinal field.

Keywords: *Limonia acidissima* L., Phytochemicals, Ethnomedicinal, Pharmacological, Medicinal

INTRODUCTION

Medicinal herbs or plants have been known to be an important potential source of therapeutics or curative aid. India is known for thousands of years old knowledge of 'Ayurveda' in the entire world. Many diseases have been cured using knowledge of Ayurveda. Wood apple has got high medicinal value. Every part of the fruit possesses medicinal property. Wood apple has anti-diabetic and antioxidant potential by reducing the level of blood glucose (Patel et al., 2012). Wood apple fruit is considered to be one of the natural sources of antioxidants due to its potential radical scavenging activity of various phytochemicals (Nithya and Saraswathi, 2010) and its anti-oxidant properties using different extracts were extensively studied (Sachin and Arya, 2013, Ramdas and Seema, 2010, Suree Nanasombat et al., 2012 and Teeica Priya Darsini et al., 2013). The seed composition and fatty acid profile were reported as 28% protein and 34% oil (Ramakrishna et al., 1979).

Plant description

Limonia acidissima L. (syn. *Feronia elephantum* *Hesperethusa crenulata*, *Schinus limonia*) is the only species of its genus, of the family Rutaceae. It is native in Bangladesh, India, Pakistan, Sri Lanka, and Vietnam.

Taxonomic Position

Kingdom: Plantae

Sub-kingdom: Tracheobionta Super-division: Spermatophyta Division: Magnoliophyta Class: Magnoliopsida Subclass: Rosidae

Order: Sapindales Family: Rutaceae

Genus: *Limonia* L. Species: *L. acidissima*.

Vernacular names

Wood-apple, elephant-apple, monkey fruit, and curd fruit are the variety of common names in the languages of its native habitat regions (Nguyen Thi and Nguyen Phuoc, 2014).

Morphology of the plant

Limonia acidissima L. is a large tree growing to 9 metres (30 ft) tall, with rough, spiny bark. The spines are axillary, short, straight, 2-5 cm long on some of the zigzag twigs. The leaves are pinnate, with 5-7 leaflets, each leaflet 25-35 mm long and 10-20 mm broad, with a citrus-scent when crushed. Leaflets opposite in 2-3 pairs and a terminal one. The fruit is a berry 5-9 cm diameter, and may be sweet or sour. It has a very hard rind which can be difficult to crack open. The pulp is sticky, brown, and aromatic. It is odorous, resinous, astringent, acid or sweetish, with numerous small, white seeds scattered through it. The rind is greyish-white in colour and 6 mm thick. It has woody and extremely hard outer shell (called as rind) which is very difficult to crack open. Hammer is used to crack the hard rind of wood-apple fruit, 5-6 mm long, hairy with thick, green cotyledons; germination epigeal. (Prasanta and Debasis, 2014). Habit of *Limonia acidissima* L. is tree. It is a moderate sized tree which can grow up to 9m (30 ft) tall. It is generally deciduous type. It is an erect tree with a few upward reaching branches bending outward near the summit where they are subdivided into slender, branchlets drooping at the tips. It grows at moderate pace.

Distribution

Limonia acidissima L. is widely South-Asia like India, Sri Lanka, Pakistan, Bangladesh, Myanmar, Andaman & Nicobar Islands. In India, it is found mainly in dry regions. It is reported from Punjab, Gujarat, Delhi, Rajasthan, Madhya Pradesh, West Bengal, Arunachal Pradesh, Maharashtra, Goa, Karnataka, Tamil Nadu and Andhra Pradesh. (Vishakha *et al.*, 2019)

Ecology

It can be grown easily in dry plains. It is favourable to grow in climate having monsoon climate and distinct dry season. The tree can grow up to altitude of 450m in Eastern Himalayas. It is adapted to light soil and it is apparently drought tolerant. (Pratima *et al.*, 2014)



***Limonia acidissima* L. Leaf *Limonia acidissima* L. Bark**



Limonia acidissima L. Fruit Limonia acidissima L. Whole plant Figure-1: Limonia acidissima L. plant parts

Nutritional Values

Wood apple pulp represents about one third of the whole fruit. Pectin content of fresh pulp is 3- 5%. Per 100gm edible portion, approximate contents of the pulp are: water 74g, protein 8g, fat 1.5g, carbohydrates 7.5g, ash 5g. The seeds contain per 100gm edible portion: water 4g, protein 26g, fat 27g, carbohydrates 35g and ash 5g. The dried pulp contains 15% citric acid and small quantities of potassium, calcium and iron salts.,

Phytochemicals Investigation

The primary phytochemical analysis of different plant parts of *Limonia acidissima* L. reported the presence of alkaloids, terpenoids, phenols, flavonoids, Saponins, steroids, glycosides, fats, mucilage, fixed oils and gums. (Panda *et al.*, 2013), (Jayshree *et al.*, 2014), (Vijayvergia *et al.*, 2014), (Thomas *et al.*, 2005). Stigmasterol, a potential antioxidant is found from the unripe fruit of *Limonia acidissima* L. Citric acid and other fruity acids have been reported from the fruit pulp. Pericarp contains alkaloids, coumarins, fatty acids and sterols. It also contains dictamine, umbelliferone, isopimpinelline scorparone, xanthotoxol, isoimperotonin, xanthotoxin, and marmesin. (Chakroborty *et al.*, 1959) Leaves have stigmasterol, psoralen, bergapten, orientin, vitedin, saponarin, tannins and essential oils. (Patra *et al.*, 1988). The bark of the plant contains marmesin, feronolide and feronone. (Rahman *et al.*, 2002). Carbohydrates, proteins, amino acids are fixed oils are found from the seed. Feronia lactone, geranylumbelliferone, bergapten, osthol, isopimpinellin, marmesin and marmin have been isolated from the roots of the plant. (Patel *et al.*, 2002).

Ethno-medicinal uses

Limonia acidissima L. has significant image having medicinal properties in folk as well as classical system of indigenous medicines. 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 (Orwa *et al.*, 2009). Ripe pulp is rubbed to reduce pain caused by venomous stings. (Pullaiah *et al.*, 2006; Aman *et al.*, 1969). 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 (Bakshi *et al.*, 2001; Warriar *et al.*, 1994). Unripe fruits are astringent and seeds are used in heart diseases. Seeds are used in treatment of diarrhoea and dysentery (Pratima *et al.*, 2014). The leaves are astringent, carminative, good to cure vomiting, indigestion, hiccup and dysentery, also acts as cardiotonic (Bakshi *et al.*, 2001; Warriar *et al.*, 1994; Prajapati *et al.*, 2003). Tribal people of Saurashtra, Gujarat apply the paste of leaves for the treatment of piles or haemorrhoids (Jadeja *et al.*, 2006). In Maharashtra leaf powder is taken with water to treat acidity and ulcers (Kamble *et al.*, 2010). The bark possess aromatic and cooling effect. It is useful in the vitiated conditions of Pitta (fire and water-bile) (Warriar *et al.*, 1994). The Santhal tribe use the bark in the treatment of asthma, bronchitis, etc. The bark is also useful for the

treatment of rinderpest in cattle. Tribal people of Dhasan valley use bark to get relief from itching (Bakshi *et al.*, 2001). Bark is taken in the form of powder in case of biliousness. The gum extracted from the trunk is look like gum Arabic, used in the treatment of bowel movement and relieve tenesmus. The dried powder is used to cure dysentery and diarrhoea (Panda *et al.*, 2000). 'Thanaka', paste made from the roots of *Limonia acidissima* L., is used as cosmetic. It is applied on face to remove small dark spots and lesions on the skin. (Bandara *et al.*, 1988). Tribal people from Orissa like Kondhs, Santhals, Gadabas, Koyas, Juangs use the paste of the root to relieve the body pain (Bakshi *et al.*, 2001).

Other usage

Apart from medicinal properties possess by the potential plant *Limonia acidissima* L. A complete ripe fruit can be directly consumed as any other fruit. Different types of dishes are made from the pulp of the fruit. 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 without sugar or it can be blended with coconut milk and palm sugar and frozen as ice cream. In Indonesia, wood apple is taken with honey and eaten in breakfast (Prajapati *et al.*, 2003). In Thailand, the leaves are used as salad. 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. The shell is tough like the shell of walnut. So it can be crushed into smaller and smaller granules. These granules can be used for exfoliation purpose in skin care cosmetics which help to remove the dead cells from the surface of the skin. It is believed that the paste of *Limonia acidissima* L. bark if applied regularly can help to make skin smooth, soft and well-textured. (Patra *et al.*, 1988).

Pharmacological Studies

Antioxidative activity

Different parts of the *Limonia acidissima* L. have been screened for antioxidant activity (Sherminet *et al.*, 2012). The antioxidant activities of plant parts on stable radical DPPH has showed the highest free radical scavenging activity is shown in crude methanolic extract. The pet ether soluble fraction (PE) also exhibited strong antioxidant potential. The methanolic extract of *Limonia* fruit was also screened for their free radical scavenging properties by FRAP assay and DPPH assay (Nanasombat *et al.*, 2012). Different extracts from leaves of *Limonia acidissima* L. has been reported (Atarde *et al.*, 2011; Merinal *et al.*, 2012).

Anti-Diarrhoeal activity

Number of chemical constituents extracted from plants are used to treat diarrhoea (Pokale *et al.*, 2011). The anti-diarrhoeal activity and gastrointestinal motility reducing activity of alcoholic and aqueous extract of bark of *Limonia acidissima* L. have shown anti-diarrhoeal activity in the concentration of 200mg/kg compared with the control group. Ethanolic extract have showed noteworthy anti-diarrhoeal activity and significantly decreased the propulsion of charcoal meal through the gastrointestinal tract (Senthilkumar *et al.*, 2010).

Antidiabetic activity

The methanolic extract of fruit pulp of *Limonia acidissima* L. reported that it improved the glucose tolerance in alloxan induced diabetes in rats as compared to control ($p < 0.01$). A significant reduction in blood urea and creatinine is reported from the extract of the plant. It has also increased total protein level in them (Ilango *et al.*, 2009). A substantial dose dependant antibiotic effect of methanolic fruit extract and aqueous leaf extract of *Limonia acidissima* L. in streptozotocin induced diabetic rats have been well documented (Mohan Priya *et al.*, 2012; Joshi RK *et al.*, 2009).

Antibacterial Activity

It has been reported that ethanolic extract of leaves of *Limonia acidissima* L. retain broad spectrum of activity against Gram-negative and Gram-positive bacteria which are responsible for the most of bacterial diseases (Panda *et al.*, 2013; Thomas *et al.*, 2005; Momin *et al.*, 2013).

Antifungal Activity

The different extracts (petroleum ether, chloroform, methanol and aqueous) of *Limonia acidissima*



L. fruit pulp have been reported antifungal activity against pathogenic fungi (Jayshree *et al.*, 2014). The essential oil produced by the leaves of the plant exhibited antifungal activity against eight tested fungi (Gupta *et al.*, 1982).

Anticancer Activity

Limonia acidissima L. fruit extract have reported anticancer activity (Dhanamani *et al.*, 2011). Ethanolic extracts of fruit were used to determine the ED50 value (50% inhibition of cancer cell growth) in two separate breast cancer cell lines, SKBR3 and MDAMB-435 (Pradhan *et al.*, 2011).

Wound Healing properties

Methanol extract of fruit pulp of *Limonia acidissima* L. were experimented on rates. In the excision model, the wound contracted progressively when treated with the extracts and required a mean period of 16.0 ± 0.8 days for optimum healing. Incision wound model has reported increasing wound breaking strength and decreased epithelization period when treated with MELA (Ilango *et al.*, 2010).

Hepatoprotective

Ethanol extract of fruit pulp of *Limonia acidissima* L. (MELA) was investigated against carbon tetrachloride induced hepatic injury in rats. 200 and 400 gm/kg p.o doses of MELA were experimented over group of animals for 10 days. MELA showed significant dose dependant protective effect against CCl₄ induced liver damage which was mainly attributed to the antioxidant property of the extract (Ilango *et al.*, 2012).

Bio-absorbent

The shell of *Limonia acidissima* L. is used as bio-absorbent. The powdered raw material of specific size were used for the removal of the methylene blue from aqueous solution. The results showed that the removal of dye by chemically treated material is effective than raw material. The percentage removal of dye is maximum at 35°C (Torane *et al.*, 2010).
C for treated material and at 25°C for raw material

CONCLUSION

From the present study of *Limonia acidissima* L., it can be concluded that, this plant is a valuable medicinal plant. Qualitative phytochemical screening of the plants has inferred the presence of numerous potential phytochemicals which are the key factor in having medicinal values of the plant. Each and every part of the plant has its own medicinal properties and important chemical constituents. Thus, whether it is leaf, bark, pulp, seed or root all are known to cure one or other diseases. Numerous ailments such as Indigestion, piles, diarrhoea, hiccup, pharyngodynia, pruritus, gastropathy, anorexia, vomiting, haemorrhoids, bronchitis, biliousness as well as heart diseases can be treated. In addition, it can be used as a food ingredient to make processed products like jams, jellies, sweets and chutney. A presence of large number of pharmacological activities such as Antimicrobial, Anti-inflammatory, Anti-diabetic, Anti-oxidative, Anti-diarrhoeal, Antibacterial, Hepatoprotective, anticancer and bio-absorbent activities indicate that we can further explore the potential of plant and we can look forward to make potent drugs from the plant.

Thorough screening of literature available on *Limonia acidissima* L. depicted the fact that it is popular remedy among the various ethnic groups, vaidyas, hakims and Ayurvedic practitioners for cure of variety of ailments and from the current literature review, it can be concluded that plant has high medicinal values and properties.

ACKNOWLEDGEMENT

It is indeed our great pleasure to express my gratitude to the Head of the Department, Dr. Archana

U. Mankad and my guide Dr. Bharat Maitreya of Department of Botany, Bioinformatics and Climate change impact management, School of Sciences, Gujarat University, Ahmedabad, for



their encouragement and support to do this review

REFERENCES

- 1) Vijayvargia, P., & Vijayvergia, R. (2014). A review on *Limonia acidissima* L.: Multipotential medicinal plant. *Int J Pharm Sci Rev Res*, 28(1), 191-195.
- 2) Chitra, V. (2009). Hepatoprotective and antioxidant activities of fruit pulp of *Limonia acidissima* linn. *International Journal of Health Research*, 2(4).
- 3) Ilango, K., & Chitra, V. (2010). Wound healing and anti-oxidant activities of the fruit pulp of *Limonia acidissima* Linn (Rutaceae) in rats. *Tropical Journal of Pharmaceutical Research*, 9(3).
- 4) Patil, B. N., & Taranath, T. C. (2016). *Limonia acidissima* L. leaf mediated synthesis of zinc oxidenanoparticles: a potent tool against Mycobacterium tuberculosis. *International journal of mycobacteriology*, 5(2), 197-204.
- 5) Lindsay, S. W., Ewald, J. A., Samung, Y., Apiwathnasorn, C., & Nosten, F. (1998). Thanaka (*Limonia acidissima*) and deet (di-methyl benzamide) mixture as a mosquito repellent for use by Karen women. *Medical and veterinary entomology*, 12, 295-301.
- 6) ADIKARAM, N. B., Abhayawardhane, Y., Gunatilaka, A. L., Bandara, B. R., & Wijeratne, E. K. (1989). Antifungal activity, acid and sugar content in the wood apple (*Limonia acidissima*) and their relation to fungal development. *Plant pathology*, 38(2), 258-265.
- 7) Pandey, S., Satpathy, G., & Gupta, R. K. (2014). Evaluation of nutritional, phytochemical, antioxidant and antibacterial activity of exotic fruit" *Limonia acidissima*". *Journal of Pharmacognosy and Phytochemistry*, 3(2).
- 8) Darsini, D. T. P., Maheshu, V., Vishnupriya, M., Nishaa, S., & Sasikumar, J. M. (2013). Antioxidant potential and amino acid analysis of underutilized tropical fruit *Limonia acidissima* L. *Free Radicals and Antioxidants*, 3, S62-S69.
- 9) Pradhan, D., Tripathy, G., & Patanaik, S. (2012). Anticancer activity of *Limonia acidissima* Linn (Rutaceae) fruit extracts on human breast cancer cell lines. *Tropical Journal of Pharmaceutical Research*, 11(3), 413-419.
- 10) Neelamadhab, P., Patro, V. J., Jena, B. K., & Panda, P. K. (2013). Evaluation of phytochemical and anti-microbial activity of ethanolic extract of *Limonia acidissima* L. leaves. *International Journal of Herbal Medicine*, 1(1), 22-27.
- 11) Thomas, A., & Ponnammal, N. R. (2005). Preliminary studies on phytochemical and antibacterial activity of *Limonia acidissima* L. plant parts. *Ancient science of life*, 25(2), 57.
- 12) Banupriya, L., & Vijayakumar, P. (2016). Anti-nutrient and phytochemical screening of an underutilized fruit seed: *Limonia acidissima*. *International journal of innovative research in technology*, 2(9), 7-14.
- 13) Shermin, S., Aktar, F., Ahsan, M., & Hasan, C. M. (2012). Antioxidant and Cytotoxic Activity of *Limonia acidissima* L. *Dhaka University Journal of Pharmaceutical Sciences*, 11(1), 75-77.
- 14) Pandavadra, M., & Chanda, S. (2014). Development of quality control parameters for the standardization of *Limonia acidissima* L. leaf and stem. *Asian Pacific journal of tropical medicine*, 7, S244-S248.
- 15) Patil, S. P., & SA, K. (2012). Phytochemical screening, antibacterial and antioxidant activity of *Limonia acidissima* (l). *Bionano frontier*, 5(2), 131-133.
- 16) Ponnuraj, S. R. I. N. I. V. A. S. A. N., Jaganathan, D. I. N. E. S. H. B. A. B. U., Kanagarajan, M., & Deivamarudachalam, T. (2015). Spectroscopic analysis and antibacterial efficacy of bioactive compounds from *Limonia acidissima* L. fruit extract against clinical pathogens. *International Journal of Pharmacy and Pharmaceutical Sciences*, 7(3), 383-389.
- 17) Chitra, V. (2010). A prospective phytochemical and pharmacological screening of fruit pulp of *Limonia acidissima* Linn.
- 18) Anand, S. P., & Deborah, S. (2017). Preliminary phytochemical screening of wild edible fruits from Boda and Kolli hills. *Journal of Medicinal Herbs and Ethnomedicine*.
- 19) Aneesha, A., Rao, N. R., Tejaswini, N. S. N., Durga, A. L. S., Haseena, S., & Maneesha, B. (2018). Phytochemical studies and anti-ulcer activity of *Limonia acidissima* linn. leaf in treating ethanol induced ulcer Albino rats. *Indian Journal of Research in Pharmacy and Biotechnology*, 6(3), 104-110.
- 20) Banerjee, S. (2014). Studies on the mosquito control by a bacterium *Bacillus cereus* and phytochemicals of *Limonia acidissima*.
- 21) Singh, A. K. (2013). Probable Agricultural Biodiversity Heritage Sites in India: XVII. The



- South-Central Region of Eastern Ghats. *Asian Agri-History*, 17(3), 199-220.
- 22) Parial, S., Jain, D. C., & Joshi, S. B. (2009). Diuretic activity of the extracts of *Limonia acidissima* in rats. *Rasayan J Chem*, 2, 53-56.
 - 23) Senthilkumar, K. L., Kumawat, B. K., & Rajkumar, M. (2010). Antidiarrhoeal activity of bark extracts of *Limonia acidissima* Linn. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 1(4), 550-553.
 - 24) Poongodi Vijayakumar, T., Punitha, K., & Banupriya, L. (2013). Drying characteristics and quality evaluation of wood apple (*Limonia acidissima* L.) fruit pulp powder. *International Journal of Current Trends in Research*, 2(1), 147-150.
 - 25) Siriwardane, A. M. D. A., Kumar, N. S., Jayasinghe, L., & Fujimoto, Y. (2015). Chemical investigation of metabolites produced by an endophytic *Aspergillus* sp. isolated from *Limonia acidissima*. *Natural product research*, 29(14), 1384-1387.
 - 26) Patel, A. S., & Pandey, A. K. (2014). Fortification of *Limonia acidissima* Linn Fruit Powder to Develop the Phynolic Enriched Herbal Biscuits. *J Biores Eng Technol*, 1, 74- 85.
 - 27) Buvanaratchagan, A., & Dhandapani, R. (2016). Antifungal Activity of Ethanolic Leaf Extract of *Limonia acidissima* against Dermatophytes. *Scholars Journal of Applied Medical Sciences*, 4(41), 61-4163.
 - 28) Amin, H., Wakode, S., & Tonk, R. K. (2017). Feronia *Limonia*-A Wonder Drug. *World Journal of Pharmacy and Pharmaceutical Sciences*, 6(4), 1982-1994.
 - 29) Vidhya, R., & Narain, A. (2010). Development of preserved products (jam and fruit bar) from under exploited wood apple "*Limonia acidissima*" fruits. *African Journal of Food Science and Technology*, 1(2), 51-57.
 - 30) Vidyasagar, G. M. (2015). Antidermatophytic activity of ethanolic leaves extract of
 - 31) *Limonia acidissima* Groff. *International Letters of Natural Sciences*, 39.
 - 32) Gupta, V. C., Hussain, S. J., & Imam, S. (1997). Important folk-medicinal plants and traditional knowledge of tribals of Aurangabad and Nasik forest divisions of Maharashtra, India. *Hamdard Medicus*, 40(2), 59-61.
 - 33) Panda, N., Patro, V. J., Jena, B. K., & Panda, P. K. (2013). *International Journal of Herbal Medicine*.
 - 34) Swapnadeep, P., Jain, D. C., & Jo, S. B. (2010). Pharmacognostical studies on *Limonia acidissima* leaf. *Journal of Pharmacy Research*, 3(2), 393-396