Historical Background, Origin, Distribution & Present Status of Wood apple

ABSTRACT

Wood apple (*Feronia Limoia* L.; Rutaceae family) commonly known as poor man's fruit in India is native to South India and Sri Lanka. Almost all parts of the tree are used in preparing herbal medicine and have several nutraceutical importance. Sanskrit term, "kapittha," receives several mentions in a number of ancient texts including "Hinduism: an Alphabetical Guide". Buddhist scholar mentioned wood apple as an Indian fruit and military commander and poet *Chauvundaraya*(940-989AD) listed wood apple in numerous medicinal remedies and mentioned in *Charak Samhita* and *Sushruta Samhita*. Wood apple has been planted extensively or being allowed to grow naturally in the reserved forests throughout Southeast Asia, Northern Malaysia and on Penang Island. In India, it is more common in Deccan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Chhatishgarh, Bihar, Jharkhand, West Bengal, Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, Kerala and Odisha, however, no data is available for its area and production. Unfortunately, the lack of attention has meant that their potential value is under-exploited and they are in danger of continued genetic erosion, ultimately leading to disappearance.Therefore, it is necessary to spread the awareness of its importance among common people and researches to identify superior genotypes, production problems of wood apple for their ex-situ collection, conservation, evaluation and utilization that is being explained by this study after having various literatures available in different forms from different sources. This paper will help future researchers to conserve as well as explore the possible benefits of this crop to the common people harnessing societal value of growers.

Key words:-Underutilized fruits, Nutraceutical, Genotypes, Conserve and Ex-situ etc.

INTRODUCTION

Wood apple is a thorny tree and most common underutilized fruit crop in India. It belongs to the family Rutaceae and is botanically known as *Feronia* (*F. limonia*L.) (Thakur *et al.*, 2020). In India, wood apple fruit was traditionally known as a "poor man's food" until processing techniques were developed in the mid 1950s. The genus *Feronia* is assigned to the tree in the honor of Roman Goddess of forest (Sridhar *et al*., 2019). In addition to wood apple, it is also referred to as elephant apple or monkey fruit since elephants enjoy it, and wood apple in other regions due to the hard wooden shell (Mani, 2020). Other frequent names for wood apples include "curd apple," "golden apple," "stone apple," and so forth; these names are typically depending on language, location, and culture (Jayakumar *et al*., 2012 and Khan *et al*., 2019). The people living in rural areas think that the animal's digestive system possesses a unique ability to break down the fruit's insides without compromising the fruit's outer hard texture. As a result, the fruit appears entire when the animal excretes.

Other dialectal names in Thailand as *ma-khwit*; as *Kramsang* in Combodia; as *Ma-fi* in Loas; as *Gelingggai*or *Belinggai* in Malaysia, , as *pomme d' elept, hanpomme de bois, or citron des mois* in French (Nath *et al*., 2008) as *Tuffâhhelfîl* in Arabic, as *Kath bel* in Bangladesh, as *Thibin, Thanaka, tha nap-hka* in Burmese, as *mu ping guo, mu ping kuo* in Chinese, as

*elefantæble*inDanish, as *olifants appel* in Dutch as *kabeet, kabut* in Fiji, as *vellampelam, vakandra* in Hindu and as *Elefantenapfel* in German (Lim, 2021).

In India, it is known differently in different languages such as Kayat bael, Kavataleal, Kavita in Bengali, as kotha, Kondhu in Gujrati, as Kaitha in Hindi, as Kavatha in Marathi, as Vilamaram, Vilangai in Tamil and as Kaith in Urdu etc. (Anon., 1999).

The wood apple is a tropical tree. It is one of thehardiest fruits grown in semi-arid and arid regions, excluding high altitude and cold region of India. Fruit has an acidic nature when unripecondition but, gives pleasant flavour when ripe(Das *et al*., 2003). This deciduous tree has globose, orange-sized fruits with a stiff, woody rind, and strangely pinnate leaves. One of the common hard-shelled citrus fruits, it is a member of the orange subfamily Citratae of the Rutaceae family, which also includes the genera Feroniella, Aegle, Chaetospermum, Balsamocitrus, and Aeglopsis (Swingle, 1914).

Wood apples are an inexpensive, incredibly nutrient-dense, readily perishable, and seasonally available fruit that can be preserved all year round for human use as processed goods like jam, chutney, and jelly (Vidhya *et al.,* 2011). In Ayurveda, it is highly prized for its therapeutic properties and is said to treat respiratory issues, piles, diarrhea, dysentery, and liver ailments. Wood apple juice has exceptional thirst-quench properties and has great potential to become a major crop in the beverage production industry. In Indian households, wood apples are traditionally eaten raw due to its exceptional flavor and ideal balance of tart and sweetness. The majority of the tree's parts are utilized to make herbal remedies. The roots can be used to treat dyspepsia, diarrhea, and dysentery. Aqueous preparations of the stem and root bark are applied topically to heal eczema, urticaria, malaria, fever, and jaundice. The fruit and root demonstrated antiamoebic and hypoglycemic properties in pharmacological trials. Alkaloids abound in the plant, with Aegline, Marmesin, Marmin, and Marmelosin being the main ones. Luvangetin and pyranocoumarin, which were extracted from seeds, had noteworthy antiulcer properties. The leaf's essential oil possesses antifungal properties (Yadav *et al*., 2011). The leaves smell like anise and are fed to cattle.

Timber is used to make household items, small tools for agriculture, and house construction. From the seeds of the wood apple (*Limoniaacidissima*), protein concentrate and protein isolate were prepared, along with seed flour. Protein isolate had the highest protein content (85.93%) compared to protein concentrate (76.50%) and wood apple seed flour (27.56%). However, flour, protein concentrate, and protein isolates of wood apple seed had higher concentrations of the essential amino acids (Histisine, Threonine, Valine, Leucine, Isoleucine, and Lysine) of the protein (Banupriya *et al*., 2016). Additionally, it is stated that the protein concentrate, isolate, and flour from wood apple seeds were found to be nutritionally equivalent to other oilseed flours and may find application in the creation of additional food formulations. Activated carbon with the highest surface area and the most developed micro, meso, and macroporosity is produced from the woodapple shell using the $ZnCl_2$ carbonization process and activation at 800°C in a nitrogen atmosphere (925 m^2/g) (Karthikeyan *et al*., 2012). The fruit's rind is so thick and hard that it can be carved to resemble a bowl or ashtray. Hard wood from the tree is useful for woodworking. Timber is utilized in the building of hubs, houses, posts, mill rollers, and farm equipment. The wood is also used as fuel. For fodder, the leaves are clipped. Because of its water tolerance, the plant has also been used as citrus rootstock in Thailand. Additionally, the bark yields an edible gum. A bland, non-bitter oil rich in unsaturated fatty acids can be found in seeds (Lim, 2021). The wood is hard, heavy, durable, and yellow-grey or whitish. A white, transparent gum that is

exuded from the trunk and branches is used as an adulterant or replacement for gum arabic. In addition, artists' watercolors, ink, dyes, and varnish are made from gum. According to Janick and Robert (2008), the gum is made up of 42.7% d-galactose, 35.5% arabinose and xylose, and trace amounts of rhamnose and glucuronic acid.

For the impoverished, wood apples can be vital to their security of food and means of subsistence. These plants run the risk of becoming neglected, but they frequently contribute significantly to rural communities' cultures, means of subsistence, and ability to generate income. Sadly, because of the neglect, their potential value has not been fully realized, and they run the risk of continuing to lose genetic diversity, which could eventually cause them to become extinct.

HISTORY

Because wood apple is sometimes referred to as "bael," which may also refer to a fruit that is similar (*Aegle marmelos*), its history is a little hazy. Nonetheless, the Sanskrit word for wood apple, "kapittha," appears multiple times in various ancient writings. The wood apple seed was compared to a great cosmic egg that held the origin of creation in the Puranas, Sanskrit texts written between 1 BC and 1,000 AD, according to the book "Hinduism: an Alphabetical Guide." The wood apple was identified as an Indian fruit by Buddhist scholar Xuanzang (602 and 664 AD), and military leader and poet Chauvundaraya (940–9889 AD) included wood apple in a long list of medicinal uses (Banupriya *et al.,* 2016). Wood apple has been used as medicine since ancient times and is mentioned in two early Sanskrit medical tractises, the Sushruta Samhita (6th century BC) and the Charak Samhita (written by Maharshi Charak) (Mani, 2020). Fruits are used as the only or a contributing ingredient in ayurvedic medicines (Bhatt *et al.,* 2015), adding significant nutritional and commercial value (Dowarah*et al.,* 2021). Hindus regard it as sacred. Though not grown for commercial purposes, it is revered in Southern India, particularly around the Ganesh Chaturthi celebration (Mani, 2020). Due to its common name, "elephant apple," which implies that it is an elephant's favorite, wood apples have been widely planted or allowed to grow naturally in protected forests and elephant sanctuaries . Its fruits are also used to pray the Hindu Elephant- headed God, Lord Vinayaka, and therefore, it is extensively grown near the Lord Ganesh temple all over the country (Nath *et al.,* 2008). Wood apple finds a mention in the Yajurveda. It has been mentioned in writings dating back to 800 B.C. In Dharma sutras and Saiva Upanishads Shriphala/Sriphala in Sanskrit means the fruit of plenty. As the tree is affiliated with Laksmi it is also called Sri-vrksa -the tree of prosperity and good fortune. Since the Ancient time it has a great cultural, socio-economic and religious significance in India.

The wood-apple was first given a binomial name by Linnaeus in 1753 as *SchinusLimonia*, with citation to a rather full description drawn up by Linnaeus himself and published, in 1747, in his account of Hermann's herbarium of Ceylonese plants (Swingle 1914). Four citations are given under *Limoniaacidissima*. The first is to Burman's Thesaurus Zeylanicus, p. 143, which includes two or more species, one of them being very probably the common lime *Citrus aurantifolia* (Christm.) Swing. The second citation is to his own Flora Zeylanica and certainly applies to the wood-apple. The third citation is to Rumphius Herbarium Amboinense, which is also the wood-apple or a closely allied species. The fourth citation is to Rheede, Hortus Malabaricus, and is *Hesperethusacrenulata* (Roxb.) Roem. *Limonia* then being invalid, the next oldest generic name must be taken up. This is *Feronia,* published by Corrêa in 1800, the name now commonly used.

Since the wood-apple was first published as *SchinusLimonia* by Linnaeus in 1753, the oldest valid name of the wood-apple is *Feronia Limonia* (L.) n. comb. (Swingle, 1914). Wood apple (*Limoniaacidissima* L.) is one of the lesser known fruit like Roktogota (*Haematocarpusvalidus*) in Bangladesh (Rahim, 2015 and Dowarah*et al*., 2021).

ORIGIN AND DISTRIBUTION

South India and Sri Lanka are the original home of the wood apple (Bakshi *et al.,* 2001; Lande et al., 2010). The wood apple is native to and widely grown in the arid plains of Bangladesh and Pakistan (Bakshi *et al*., 2001; Kirtikar and Basu, 1993); it is also grown in Ceylon and India (Banupriya *et al*., 2016).

The wood apple is range from Indo-China and the Philippine Islands to West Africa (Swingle, 1914). It is also grown throughout Southeast Asia, Northern Malaysia and on Penang Island (Jayakumar *et al.,* 2012). It is grown beside roads, on the edges of fields, and sometimes in orchards in Sri Lanka and India. It is grown in parks and villages in Malaysia and Indonesia (Verheij and Coronel, 1992).

In the western Himalayas, the tree may grow to a height of 450 meters above mean sea level (MSL). According to Vaidayaratnam*et al.* (1995), it grows best in light soils and appears to be drought tolerant.

It is a rare phenomenon to find a well planted wood apple orchard in India. The information regarding area and production under this fruit crop in India are not available. Generally scattered trees are found in forests, community land on field bunds and road sides or in a homestead garden. The tree is commonly grown as a border plant in addition to being found in jungles (Sharma, 1983). According to Veeraraghavathatham*et al*. (1996), this tree is perfect for cultivation along roads, field borders, and occasionally orchards. Wastelands common in wild, dry plains are good places for it to grow. It is distributed in the theAlavallis of south east Rajasthan in India (Vyas *et al*., 2005; Sharma, 1983). It is more common in Deccan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Chhatishgarh, Bihar, Jharkhand, West Bengal, Rajasthan, Gujrat, Tamilnadu, Andhra Pradesh, Kerala and Odisha (Ghosh *et al.,* 2012).

The trees are also found in the western Ghats spread with rich biodiversity heritage in Eastern Parts (Kirtikar and Basu, 1993).

It grows in the western Himalayas in both wild and cultivated forms up to an elevation of 1500 feet; in Maharashtra, it is most prevalent in the Deccan, Thane, and Chandrapur districts. Additionally, it is said to exist in some areas of Jharkhand's Hazaribagh, Palamau, and Chota Nagpur as well as in the Vidhyan hills of Uttar Pradesh and Chattisgarh's forests.

In Uttar Pradesh it is scattered in many districts such as Hardoi, Sitapur , Ayodhya, Bahraich, Gonda, Barabanki, Lucknow, Kushinagar, Etwah and Kanpur (Pandey *et al*., 2013). Wood apple of Gazipur and Rajshahi area are fairly large (Nath *et. al.,* 2008). Although less used, the Bundelkhand region of India has a high biodiversity for wood apples. Bundelkhand's agroclimatic conditions hold great promise for its commercial cultivation. (Kumar *et al*.2021). Fruits from wood apple trees were harvested in Milkipur Tehsil, Faizabad, specifically from Ratapur village (Kumar and Deen, 2017). The Hardoi districts of Utter Pradesh (U.P., India) local market provided fresh harvested wood apple fruit (Khan *et al*., 2019).

The genotype diversity of wood apple is highest in the semi-arid lateritic belt of West Bengal. By Dowarah*et al.* (2021), the diversity-rich wood apple district has been studied and fruits of twelve

distinct genotypes have been collected from diverse villages in different blocks, including Makarampur, Raipur, Surul, Ruppur, Bahadurpur, Ballavpur, and Sahebdanga. In the Nadia district of West Bengal, a preliminary survey was conducted to identify and choose twenty trees from various locations. In Shantipur, Gede, Kalyani, Krishnanagar, Karimpur, Haringhata, Ranaghat, Nabadwip, Chakdah, and Palashi, final studies on the top ten accessions were conducted (Mani *et al.,* 2020).

In Tamil Nadu, wood apples are traditionally grown as a commercial crop under dry land horticulture and as a holistic fruit tree. In Chennai, wood apple trees are widely distributed and can be found growing naturally in the grounds of some residential bungalows and institutions, or they can be planted at the homestead level (Rao, 2004; Banupriya, 2016). More than thousands of wood apple trees were observed during a study of the sustainable production of wood apples in line with current research findings. These trees were found along roads, the edges of fields, and occasionally in orchards in the districts of Salem and Krishnagiri. Since it is a fruit of wild trees, numerous trees have been seen in the districts of Salem, Dharmapuri, Namakkal, Krishnagiri, and Coimbatore colleges and universities.

According to Sridhar *et al.* (2019), 86 genotypes were chosen from various Karnataka locations for the survey work. chosen genotypes from TaradhalliBalekoppa, Mallavali, Kanakapur, Mallapur, Dupdhal, TaturJcpura and Maradur,Chitrahalli and Allur, Devarhipargi, Honalli cross, Ecchalgata andRamanhalli. Dwarahalli,Godachi, ElevenHanumanhalli and Bellar farm were collected. Wood apple is such an underutilized fruit, largely grown, rather seen mostly in eastern part ofthe state of Odisha (Mohapatra *et al.,* 2022).

The majority of wood apple seedlings are found growing naturally in isolated or dispersed locations throughout Gujarat, India's different agroclimatic zones. Because of the enormous genetic diversity in the surviving populations, there is a strong likelihood that better genotypes will be selected (Yadav *et al*., 2018).

South India, Sri Lanka, Nepal Bangladesh Pakistan, Indo-China, Philippine Islands to West Africa,Northern Malaysia, Indonesia and Western Himalaya regions

Fig.1- Distribution of wood apple in world.

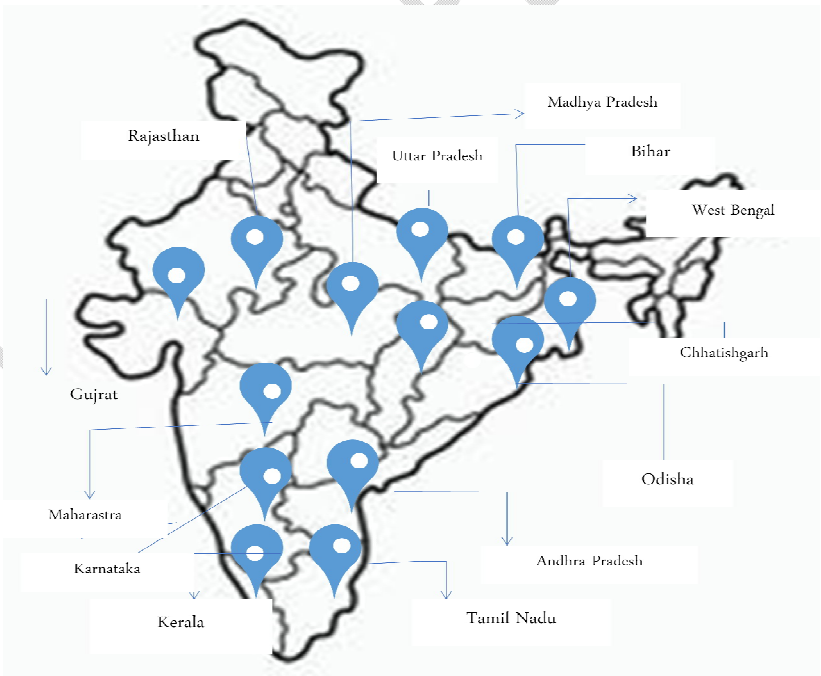

Fig.2- Distribution of wood apple in India

The wood apple (*Feronia limonia*Swingle) is the only species of the genus . The other species viz., *F. elephantumcorrea* ,*Limoniaacidissima*L., *Schinuslimonia*L., are considered as synonymous to *Feronia lemonias* Swingle, now named as *Feronia or Limonialimonia*(Dhilon, 2013).

Brief classification of wood apple

Kingdom	:	Plantae
Sub-kingdom	:	Tracheobionta
Super division	:	Spermatophyta
Division	:	Magnoliphyta
Class	:	Magnolipsida
Subclass	:	Rosidae
Order	:	Sapindales
Family	:	Rutaceae
Genus	:	*Feronia*
Species	:	*Limonia*

Source- (Bhandari, 1978)

Synonyms-*Feronia elephantum* Correa, *Feronia limonia* (L.) Swingle, S*chinuslimonia*L. *Cratevabalangas*K.D.Koenig, *C. vallanga*J.Koenig ex Wight & Arn., *Anisifoliumcurvispina* (Miq.) Kuntze, *A. limonia* Kuntze, *A. spectabile* (Miq.) Kuntze, *Feronia balanghas* (K.D.Koenig) Steud., *F. elephantum* Corrêa, *F. limonia* (L.) Swingle, *Hesperethusaacidissima* (L.) M.Roem., *H. ambigua*M.Roem., *Limoniaambigua* DC., *L. curvispina*Miq., *L. dulcis*J.F.Gmel., *L. elephantum* (Corrêa) Panigrahi, *L. engleriana* Perkins, *L. pinnatifolia*Houtt., *L. spectabilis*Miq., *Murraya odorata* Blanco (Anon.,2021).

Fig.3- Variability in fruits of wood apple.

PRESENT STATUS OF WOOD APPLE

Basically it is cultivated in Indian states like Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Madhya Pradesh, and the western Himalayas, it is primarily native to India but is also found in Sri Lanka, Nepal, Malaysia, Cambodia, Thailand, Africa, and other parts of southern Asia.

The wood apple variety "Thar Gaurav" was originated at the Central Horticultural Experiment Station, a regional center in Godhra, and it was released by ICAR-CIAH in 2019.

Large numbers of germplasm were established in field gene bank of the institution, after evaluation, variety Thar Prabha was developed to provide prosperity and nutritional security to resource poor farmers of dryland areas of the country. It was developed

throughselection method. This selection was collected from Bhopal district of Madhya Pradesh in 2005 and established through soft wood in-situ grafting under field condition (Yadav *et al.,* 2023). Tribal people in Madhya Pradesh's Rewa District also use fruit pulp as a treatment for amoebiosis and boils (Qureshi *et al*. 2010).

To identify the elite wood apple germplasm within its natural population from various sites within West Bengal's Nadia district, a study has been carried out. Ten high-quality germplasm samples have been selected for in-depth research on fruiting, flowering, and fruit biochemical properties after wood apple trees in 20 distinct locations were first screened for fruit quality characteristics (Mani, 2020). The National Herbarium of Cultivated Plants (NHCP) now has two new wood apple germplasm additions (Anon., 2009).

For centuries, Burmese women and girls in Myanmar have used the finely ground bark of the Thanaka tree to create a skin-protecting and beautifying cream known as Thanaka. All Myanmar markets sell the gold-colored Thanaka, which is used by both young and old. The natural components of Thanaka minimize moisture loss and assist the skin's defense mechanisms against damaging UV radiation (Thanaka, 2021).

In the city of Rembang in Central Java, BuahKawista is famously processed into a sticky, brown syrup known as Kawis syrup. BuahKawista is considered a rare fruit in the rest of Indonesia and has been processed into syrup in Rembang since 1925, sold as a favored souvenir. Wood apple rasamor VizhamPazham, it can be served as Rasam as well as a soup (Deepa, 2021).

Recently, wood apple has grown in significance as a commodity in Sri Lanka's economy. Fruit pulp is used to make wood apple cream, which is then canned and exported (Jones, 2021). In Thailand, fresh fruits, tender shoots, and young leaves are also consumed. The jelly has a purple color and resembles black currant jelly (Miami, 1987). Because of its tolerance to water, the plant has also been used as rootstock for citrus in Thailand. The wood apple variety "Thar Gaurav" originated at the Central Horticultural Experiment Station, a regional center in Godhra, and it was released by ICAR-CIAH in 2019.

REFERENCES

1. Anonymous (1999) The Ayurvedic Pharmacopoeia of India. Ministry of family Welfare, Deparment of ISM&H, New Delhi.
2. Anonymous (2009) Dare/ICAR Annual Report 2008–09. Published by DIPA ICAR New Delhi.
3. Anonymous (2021)*Limoniaacidissima* L. synonyms." *The International Plant Names Index and World Checklist of Selected Plant Families.*Plants of the World Online, Royal Botanic GardensKew,powo.science.kew.org/taxon/urn:lsid:ipni.org:names:774113-1.
4. Banupriya L(2016) Extractability and characteristics of wood apple *Limoniaacidissima* seed protein. *Ph.D Thesis* submitted to Department of Food Science and Nutrition, Periyar University, Salem.

5. Banupriya L, Vijayakumar TP (2016)Centesimal composition and amino acid profiling of wood apple (*Limoniaacidissima*) seed : an underutilized protein source. *Int. J. Advanc. Res.,***4**(1): 1288- 1296.
6. Bhatt DK, Jha A (2015) A study of incorporation of therapeutic values of wood apple (*Feronia limonia* Swingle) in fruit bar. *Int. J. Pharm. Sci. Res.,* **6**(10): 4398-4405.
7. Das BC, Das SN (2003) Cultivation of minor fruits. Kalyanipublishers, New Delhi, 107-111.
8. Deepa (2021) "Vilampazham Rasam, wood apple rasam."Pâticheri,www.paticheri.com/2021/01/05/vilampazham-rasam-wood-apple-rasam/.Accessed 30 Dec. 2021.
9. Dhilon WS (2013)*Fruit Production in India.* ISBN 10: 9382471065 Published by Narendra Publishing House, Delhi, 72-73.
10. Dowarah B, Deb P, Rana G, Sushmitha K(2021) Fruit physico-chemical studies of some local wood apple *(Limoniaacidissima*L.*)* genotypes . *Int. J. Minor Fruits, Med. Aroma. Plants.***7**(1): 53-56.
11. Ghosh SN, Singh A, and Thakur A (2017) *Underutilized Fruit Crops -Importance and Cultivation: Wood apple*. Part-2. Jaya Publishing House, New Delhi. 1393-1414
12. Jayakumar A, Geetha K(2012) Wood Apple: Uses and Benefits.
13. Jones DT(2021) "*Limoniaacidissima* L." *Edible fruits and nuts*, Plant Resources of South-East Asia No 2, Edited by E. W. M. Verheij, and R. E. Coronel, PROSEA Foundation, Bogor, Indonesia, record 1514, 1991, *PROSEA*, www.prota4u.org/prosea/view.aspx?id=1514. Accessed 27 Dec. 2021.
14. Karthikeyan S, Sivakumar P (2012) The Effect of Activating Agents on the Activated Carbon Prepared from *Feronia limonia* (L.) Wood Apple Shell. *J. Environ. Nanotech.,***1**(1): 05-12.doi: 10.13074/jent.2012.10.121009
15. Kirtikar KR, Basu BD, An ICS(1993)*Indian Medicinal Plants* Vol I (Singh B and Singh M P Eds.), India, pp. 496-498.
16. Kumar A, Deen B(2017) Studies on Bio-Chemical Changes in Wood Apple (*Limoniaacidissima* L.) Fruits during Growth and Development. *Int. J. Curr. Microbiol. App. Sci.,***6**(8): 2552-2560.https://doi.org/10.20546/ijcmas.2017.608.302
17. Kumar P, Prakash O, Srivastava AK, Thakur N, Chugh, V, Singh RS (2021) Correlation Studies in Wood Apple (*Feronia limonia* L.) in Bundelkhand region of Uttar Pradesh, *Ind. J. Pure App. Biosci*., **9**(1): 316-321.DOI: http://dx.doi.org/10.18782/2582-2845.8594
18. Lande SB, Nirmal VS Kotech PM(2010) Studies on preparation of ready-to-serve beverages from wood apple pulp. *Beverag. Food World*. **37**(4): 69-70.
19. Lim TK (2021) "*Edible medicinal and non-medicinal plants, Fruits*, vol. 4." *ZLibrary*, 2012, b-ok.cc/book/5859961/fc985e. Accessed 23 Dec. 2021.
20. Mani A, Satish V, Kuchi, Mitra S, Kumar F, Bauri, Das S (2020) Identification and conservation of elite wood apple (*Feronia limonia*L.) genotypes from West Bengal. Society of Education, India. *Advan. Biores. Adv. Biores.,***11** (2): 75-80.
21. Mani S(2020). An overview on wood apple (miracle fruit) and their properties, *The Pharma Innov. J.,* **9**(11): 247-249. DOI: 10.22271/tpi.2020.v9.i11d.5345
22. Mohapatra P, Acharya G C, Mohanty P, Kar DS, Lenka J, Pattanaik K(2022) Value addition in wood apple (*Limoniaacidissima* L.). *The Pharma Innov. J.,;***11**(1): 1673-1676.

23. Morton JF, Miami (1987)*Fruits of Warm Climates*.
24. Nath V, Kumar D, Pandey V (2008) Fruits for Future: Well Versed Arid And Semi Arid Fruits Vol-1.
25. Pandey AK, Pal AK, Shukla PK, Yadav MP(2013) Germplasm evaluation of wood apple (*Feronia limonia* L.).*Prog. Hort.*,**45**(1):76-79.
26. Pandey S, Satpathy G, Gupta, RK (2014) Evaluation ofnutritional, phytochemical, antioxidant and antibacterialactivity of exotic fruit *Limoniaacidissima*. *J. Pharm. Phytochem.*,**3**(2):81–88.
27. Peter KV, Shukla SK, Singh AK (2008)*Wood apple* vol-4.
28. Qureshi AA, Kumar KE, Omer S(2010)*Feronia Limonia*-A Path Less Travelled, International Journal of Research in Ayurveda & Pharmacy, 1(1): 98- 106.
29. Rajangam J, Sankar C (2022) Assessment of genetic diversity and evaluation of Woodapple (*Feronia limonia* L.) genotypes for yield andquality. *The Pharma Innov. J.*,**11**(2): 2624-2627.
30. Sharma P, Bodhankar SL, Thakurdesai PA(2012) Protective effect of aqueous extract of *Feronia elephantum* Correa leaves on thioacetamide induced liver necrosis in diabetic rats. Asian Pacific J. Trop. Biomed., **2**(9): 691–695.
31. Sridhar MY, Nataraja KH, Naik N, Satish D, Dileepkumar A, Masuthi, Karadiguddi M (2019) Identification of Elite Wood apple Genotypes for Physical Characters in Selected Districts of Karnataka, India. *Int. J. Curr. Micro. Applied Sci.,* ISSN: 2319-7706 8(9): 1999-2004.
32. Thanaka(2021) The ancient Beauty Secret." *Thanaka*, thanaka.net/. Accessed 27 Dec. 2021.
33. VeeraraghavathathamDM, Jawaharlal SJ, Rabindra K (1996)Scientific Fruit Culture. In: *Underutilized andunderexploited horticultural crops*; K V Peter (ed.), NewDelhi Publishing Agency, New Delhi : 314.
34. Vidhya R, Narain A(2011) Development of preserved products using under exploited fruit, wood apple (*Limoniaacidissima*). *American J. Food Tech.*, **6**(4): 279-288.
35. Yadav K, Singh N(2011)*In vitro* propagation and biochemical analysis of field established wood apple (*Aegle marmelos* L.). *AnaleleUniversităţii din Oradea - FasciculaBiologie Tom.*, **15**(1): 23-28.
36. Yadav T, Vishwakarma D, Saloni S, Tiwari S, Sindhu (2018)Wood apple- its nutritive value and medicinal benefits. *Int. J. Agri. Eng.*, 11:159-163.
37. Yadav V, Singh AK, Rao VVA,Singh S, Saroj PL (2018) Wood Apple Variability An Underutilized Dry Land Fruitfrom Gujarat, *Int. J. Curr. Microbiol. App. Sci.*,**7**(6): 548-555.
38. Yadav V, Singh AK, Hiwale SS, Singh S, Sharma BD(2023) Thar Prabha: A new high-yielding wood apple variety for dryland. *Ind. Horti.*,: 7-9.