

Review Article

ETHANOBOTANY OF MAHUA (*Madhuca Indica*)

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Abstract: Mahua botanically referred to as *Madhuca longifolia* (Koenig) J.F. Macbride and/or *Madhuca indica* J.F. Gmel. syn. *Madhuca latifolia* Macbr belongs to *Sapotaceae* family and is found in the forest belts of Asian countries mainly India, Nepal, Myanmar, Sri Lanka and others. It is one of the legendary tree which has its roots from our ancestors and is protected by our tribal and forest community people. Mahua as a tree has attained a long journey from the reign of the kings and emperors through the colonial and British rulers through the present day under accessioned NTFP tree. The legacy of the Mahua tree can be traced back from the poems and stories of our writers and poets and to the controversial discussions in various reports and government compilations. Mahua is known for its typical mystical fragrance and sweet taste. Mahua liquor is a famous product. However, amongst the local tribes and forest residents it is also considered sacred and auspicious and hence is an essential part of their rituals as well as food. The present review is an attempt to revive the legacy of Mahua tree which has once lost its identity but now many attempts are being made to restore it for its social and economical importance. The review covers the legacy of the tree, its social, nutritional, health and medicinal uses.

Keywords: Mahua, nutritional benefits, health benefits, food and non-food uses, economic importance.

Introduction

The Legacy of Mahua

Mahua a tree with legacy of old times and an answer to developing economy of present times indicates a perfect blend of rich traditional Indian culture and modernization. It is amongst a few heritage assets of our tribes having rich cultural significance as well as a source of food, feed, fuel and medicine. Mahua finds its place in scripts of our poets through prayers, songs, stories as well as it is an important ingredient of many rituals. Mahua has found its special place in *Charak Samhita*- the age old Ayurveda script, where it is appreciated for its curative properties, especially the flowers of Mahua. *Atharva veda* calls Mahua as ‘*Madhuka*’ in Sanskrit and relates it to a plant of ‘love spell’ where it is used as a drink which is intoxicating and sweet [1]. Literature of James Merry MacPhail (an author of *Colonial times*) named *The Story of the Santals* (1922)[2], dedicated to the lives of the then *Adivasi* clan, refers Mahua as ‘*Santhals*’ which resembles a carpet of Mahua flowers spread on the floor of

the forest and wrote it as ‘wilderness that fell like bread from heaven’. In another chapter entitled ‘The Cycle of the Seasons’ in the same script, the writer mentions Mahua flowers so ‘precious’ that the community people suspend merry making and festivals just to devote their full time in collecting mahua flowers. These flowers being so energetic that a little consumption will delay hunger pangs for long. In the 16th century documents also, Mahua is mentioned by Mughal emperor Babur in his stories [3].

In the history Mahua has been reported to act as a savior during famine and periods of starvation. Vinita Damodaran, a historian from the past in its script ‘*Famine in Bengal: A Comparison of the 1770 Famine in Bengal and the 1897 Famine in Chotanagpur*’ [4] reported the use of fruits and its fleshy corolla as food for several starving months of famine, droughts and epidemics. Similar reports of Mahua being the savior from starvation of thousands of poor people was dictated by Sir Charles Watt (Scottish botanist) in his *A Dictionary of the Economic Products of India*, during 1873-74 scarcity in Bihar [5].

However, with the onset of colonial and modern era the forests got denuded of this precious wealth. The Adivasis and other natives of the land who once protected and depended on these trees for their living, abandoned them for the riches. Also, the lands were declared private and reserved thus restricting the approach of the locals. But it was more a trick of trading Mahua by the colonists to earn money from Mahua spirit. The conditions worsened with the passing of ‘Mhowra Act, 1892’ by the Bombay Government. The act defined Mahua as intoxicant and dangerous and its collection and possession (especially by the indigenous/ local people) was declared a ‘criminal act’. This finally curbed the Indian market of the local Mahua liquor, made indigenously, and opened a way for the imported spirits and liquor. Europeans used Mahua for the preparation of distilled spirits and for feeding their animals especially the pigs. As per a report of *The Calcutta Review* (1917) [6], the Mahua flowers that were shipped from Calcutta to England stayed well even after two long years of storage or harvesting. The meat of pigs which were fed Mahua flowers became famous as ‘Mahua pork’[3].

Nowadays with a concept of reviving the traditional trees vis-à-vis forests, rejuvenating depleting forests, planting trees which are resistant to climate change and which are familiar to the particular land Mahua trees have again gained attention of the new era researchers and community workers. Planting new Mahua, sal and tamarind forests, reviving the medicinal claims of the Mahua flowers and fruits and also the food products from Mahua are attracting attention of many people. But let’s hope it is no more an exploitation of the nature but is a

step to revive a legendary tree 'Mahua' which still finds its place in many local songs, poems and poetries and still is a part of many rituals and festivals.

The tree

Mahua, botanically referred to as *Madhuca longifolia* (Koenig) J.F. Macbride and/or *Madhuca indica* J.F. Gmel. syn. *Madhuca latifolia* Macbr [7] belongs to *Sapotaceae* family and is botanically named as *Madhuca longifolia* is native to the wild of India, Nepal, Myanmar, Sri Lanka and other South Asian countries. It is a multipurpose tree which is available for very short time in the tropical regions. It is very popular amongst the tribal or forest people and is utilized by them as food, feed, fodder, fuel and medicine. In addition to liquor, it is also popular amongst tribes for its sweet taste so that it is easily utilized in the preparation of various kinds of food products especially in festivals and rituals. Its decoction, paste, flower are a source of curing many diseases like headache, bronchitis, skin diseases and other diseases related to *pitta*. [8-10]. It is a deciduous tree of economic importance. The tree is short/ medium sized and grows up to the length of 16-20 meters. The trunk is usually stout with small bole and round branched crown. Roots are large spreading and may be slightly superficial. It has grey coloured, vertically cracked, exfoliating and wrinkled bark with alternately clustered leaves. The tree is classed under the 'forest trees' which is 'Non-timber Forests Produce' (NTFP) and thus is life line of tribal people. In India, it is available in the belts of the states of Madhya Pradesh, Rajasthan, Chattisgarh, Bihar, Jharkhand, Uttar Pradesh, Maharashtra, Gujarat, Orissa, Andhra Pradesh, West Bengal and Karnataka [11-13]. The tree bears pale white, succulent and petite flowers. Flowers on Mahua tree bloom only for one night. These are seen on green or pink coloured furry bunches with 10-12 cream coloured flowers with typical sweet fragrance. After completing their blooming cycle of one night these flowers fall off the tree which are usually collected by local people for further use. Also, some of the flowers which get pollinated grow into fruits that are ovoid, fleshy and green-yellow in colour. These fleshy fruits have brown, shiny, elliptical, flat, oily seeds usually four in number [12-14]. Each Mahua tree produces approximately 80-320kg of flowers annually. In India, state of Madhya Pradesh approves Mahua trading on large scales and as per an estimate it is approximately Rs 8.4 million for an estimated production around 5730 metric tonnes [15]. Mahua is a Non-Timber Forest tree which grows well in sandy soil of deciduous forests viz., dry teak, dry mixed type of forests [16]. It is very sturdy plant and can be found in the areas with sodic and saline soils, rocky and gravely lands and can even find a place to grow inbetween the crevices of barren walls or rocks with a little source of soil

in it [17]. It is not adaptive to waterlogged soils but can withstand drought conditions appreciably. These plants are usually native to forest conditions but can be cultivated in deep loam soils which are well drained [18]. The forest with Mahua trees can be seen in full bloom during the month of March-April and the fragrance of ripe fruits is everywhere in the forest during May-June [19].

Sacred grove

Mahua is a tree of socio-economic importance for the tribals or the people who live in and around forests. Various tribes belonging to Indian sub-continent including *Kol*, *Bhil*, *Gondetic*, *Gong*, *Andh*, *Baiga*, *Bharia*, *Bhatra*, *Mawasi*, *Bhujia* from Madhya Pradesh, *Santhal* tribe from the parts of West Bengal and Jharkhand consider it auspicious and an important part of their daily well being. Mahua tree as a whole is of aesthetic value and religiously important to them. They use seeds, bark, leaves and flowers (both fresh and dry) as food and feed, that too for humans and animals both. Mahua decoction is helpful in improving lactation in humans and enhancing milk production in ruminants [20]. Decoction of tree bark, leaves, seeds, flowers and dried fruits aids in treating stomach worms [21]. These are used in the treatment of swelled gums and snake bites [22]. Oil from the seeds of Mahua is used for treating Pneumonia. Mature flowers of Mahua are converted into liquor and are used in the treatment of Diabetes Mellitus by the local tribes [23].

Nutritive value

Ancient scripts reveal that Mahua was an important source of food and medicine during the times of scarcity and famine in India. Various parts of the tree viz., bark, leaves, buds, flowers are used as food for humans and feed for animals. Its nutritional composition was able to keep up the nutrition level in the body in the times of scarcity. Table 1 and 2 gives the biochemical composition of the Mahua flowers and properties of Mahua seed oil respectively.

Flowers: Flowers of Mahua are sweet in taste and thus are a good source of sugars. Various sugars including sucrose, glucose and fructose and others contribute to its sweetness [24]. In addition, they contain carotene, the Vitamin A precursor and ascorbic acid which exhibit anti-oxidant properties. Minerals like Calcium and Phosphorous are abundantly present in Mahua flowers. Mahua flowers contain appreciable amounts of essential amino acids [25-26]

Seeds: Mahua tree is also called as '**Indian butter tree**' [27]. The seeds of Mahua are rich in yellow coloured solid fat called as 'Mahua butter' where the oil content varies between 33-43 per cent of the weight of the kernel [28]. Fat from seeds of Mahua contains major fatty acids

including Stearic acid, palmitic acid, linoleic acid and oleic acid. The butter is one of the richest sources of naturally available carotenoids [29].

Table 1 Biochemical composition of flowers of Mahua (*Madhuca longifolia*)

S.No.	Compound	Quantity (%)
1	Moisture (%)	19.8
2	Protein (%)	6.37
3	Fat (%)	0.50
4	Total Sugar (%)	54.06
5	Total invert sugar (%)	54.24
6	Reducing sugars (g/100g)	36.3
7	Calcium (%)	8.00
8	Phosphorus (%)	2.00
9	Ash (%)	4.36
10	pH	4.6
11	Starch (g/100g)	0.94
12	Fibre	10.8
13	Calcium(mg/100g)	45
14	Phosphorous(mg/ 100g)	22
15	Carotene(mg/100g)	307
16	Ascorbic acid (mg/100g)	40

Source: [16,36]

Economic importance

Mahua is categorized as Non-Timber Forest Produce and its various parts are utilized for both food and non-food purposes and thus helps to add to the income of local/ tribal people. However, it is a season based source of income, but the products developed from it could fetch the money for a longer duration. Mahua liquor is the most popular product from the Mahua flowers which are fermented to produce liquor by the local or the tribal people. Mahua liquor is popular since ancient times and has earned a lot of bucks for the then producers and makers. This was one of the reasons that it was banned (collection of flower and preparation of liquor) by the Britishers. With the enforcement of 'Mhowra Act, 1892' by

the Bombay Government, collection, preparation and consumption of Mahua based liquor was banned. The act defined Mahua as intoxicant and dangerous and its collection and possession (especially by the indigenous/ local people) was declared a 'criminal act'. However with the passage of time and end of the colonial era, Mahua once again gained popularity and today it has again become the mainstay of the tribal population. Local people, especially the tribals, around the Mahua grooves usually collect the flowers and fruits and use to barter them on daily basis to fulfill their needs [30]. Also, being a rich source of oil Mahua is now being reported to have been used as an option of 'biodiesel' production. According to an estimate annual production of Mahua oil is approximately 60 million tones [31]. Thus in addition to its seeds and flowers, a Mahua tree imparts various substantial and insubstantial benefits hence providing an approximate income of Rs1500/- per tree [32].

Non-food uses: Mahua seed oil is used in the preparation of soaps, candles and cosmetics. The traditionally produced seed oil from Mahua is usually low grade but is popularly used as a substitute of ghee as well as an adulterant for commercial ghee [33]. The oil layering or coating over other seeds is used to control infestation of pests in the seeds during storage. The oil cake (the waste of oil extraction) is rich in saponins and thus is beneficial against various fungal infections and root-knot disease caused by nematodes.

Table 2: Properties of oil present in Mahua seed

S.No.	Compound	Quantity (%)
1	Protein	16.9
2	Fibre	3.2
3	Carbohydrates	22
4	Ash	3.4
5	Saponins	2.5
6	Tannins	0.5
7	Refractive index	1.452-1.462
8	Saponification value	187-197
9	Iodine value	55-70
10	Unsaponifiable matter (%)	1-3
11	Palmitic C 16:0 (%)	24.5
12	Stearic Acid C 18:0 (%)	22.7
13	Oleic Acid C 18:0 (%)	37.0
14	Linolic Acid C18:2 (%)	14.3

Source: [16,36]

Food uses

Mahua tree has full potential for feeding the population. The sweet tasting flowers, fruits and even the leaves of the tree are edible. These are consumed fresh or dried, cooked or

uncooked, fermented and non-fermented. It is eaten alone or in combination with other local food materials including regular flours [33]. Various categories of food products are prepared from Mahua products.

Fresh flowers of Mahua are consumed as regular cooked vegetable by the tribal and local forest people. Mahua flowers are mixed with sal seeds (*Shorea robusta*) during boiling and cooked as a substitute of staple grains. It is a popular food amongst the tribal, especially during the periods of scarcity or non-availability of food for consumption [28].

Health foods: Being a rich source of proteins, fats, carbohydrates and calcium, the Mahua flowers are preserved in the form of Jam [34]. The sweetness of Mahua flowers is exploited to be used as an organic natural sweetener in many food preparations. Also, it is used as a replacement of simple sucrose (table sugar) in trendy food products like fruit bars/ nutrition bars that will help to reduce calories by substituting sugar [35-36]. The flowers, scientifically corolla of the plant are consumed fresh, dried or cooked. The richness of sugar in Mahua flowers makes it a suitable option for the preparation of one of the most popular product from Mahua viz., fermented liquor, spirits and vinegar [15].

Mahua fruits are also sweet to taste and are utilized in the preparation of sweet food products, both as fresh or dried. Both flowers and fruits are used in the preparation of traditional sweet foods like *kheer*, *meethi poori*, *halwa*, *burfi*, *ladoo* and many more [37]. Dried Mahua flowers are an important source of sugar in fermentation industries for the preparation of various fermented products including alcohol, ethanol, lactic acid, acetone, brandy, vermouth, citric acid, vinegar and others [38-39]. The fermented country liquor from Mahua flowers is popularly called as 'Mahuli' amongst the tribals of Odisha [25, 40-41]. The wine of Mahua contains approximately 20-40 per cent alcohol in North-west regions of India. The tribal people (Santhal tribe) prepare cakes and other edible products blending Mahua flowers with grains, millets and root crops like, rice, ragi, jowar, sweet potato and others. They occasionally combine dried Mahua flowers with Sal seeds and tamarind to consume it as a substitute of regular grain based diet. It is also used during the preparation of chocolates and sweets [42-45]. Regular sweet and confectionary food products viz., jelly, jam, marmalade, toffees & candies, Mahua based bars, ladoo and beverages like squash are also some of the popular food products from Mahua [25; 46-53].

Fat in Mahua, also referred to as Mahua butter is a rich source of monounsaturated fatty acids and saturated fatty acids but limits in the availability of polyunsaturated fatty acids. This unique fatty acid composition makes it an important ingredient in food products that helps to

reduce cholesterol levels in blood and helps in maintaining heart health. It is a special ingredient in chocolate and cocoa butter manufacturing, as it promotes solidification of these products. Also, the inter-esterification of palm oil and Mahua butter yields fats (also called as plastic fats) which is free from Trans-fatty acids and is considered suitable to be used in the preparation of bakery products. However, these properties of Mahua fats are misused by some people and thus they are taken as an adulterant in other cooking fats and pure Ghee.

Medicinal benefits

Ayurved forms the backbone of Indian Traditional Medicine used by our ancestors to treat diseases, increase longieivity and maintain good health. Plants, herbs, shrubs are various sources of medicine used by our *Vaidacharyas* or *Vaidya* (traditional practitioners of medicine). The traditional book of medicinal knowledge '*Charksamhita*' and '*Sushruta samhita*' alongwith other documented illustrations, elaborates medicinal uses and health benefits of approximately 2000 plants. It clearly defines the preparation of drug, use of plant part, mode of action, way of administration of drug, precautions and many more terms of use and application.

Biochemically, various plant parts of Mahua are rich in secondary metabolites that is responsible for its medicinal properties and uses [54]. Leaves of Mahua are reported to contain saponin and glucoside, whereas seeds usually contain some basic acids alongwith aglycones of saponin viz., sapogenin. In addition to common type of secondary metabolites including steroids, triterpenoids, flavonoids, glycosides, saponins, sapogenins etc., the Mahua plant is found to be rich in specific secondary metabolites viz., penta cyclic triterpenoids (madhucic acid), madhucosides A and B, triterpene glycosides, madhushazone etc. [55]. The typical intoxicating aroma of Mahua is attributed to the presence of 2-acetyl 1-pyrroline. These are also rich in polysaccharides that yield D-compounds of glucose, galactose, xylose and glucuronic acid and L-compounds of rhamnose and arabinose [56].

In traditional ayurveda, the tree *Madhuca longifolia* is referred to as Madhuca. Various parts of the tree, *Madhuca longifolia* as a whole is considered beneficial in treating many diseases with its external application as in skin ailments, headaches, constipation and haemorrhoids or piles. It is found to exhibit properties like hepato-protective, anti- ulcerous, anti-cancerous, anti-bacterial, anti-hyperglycemic and analgesic. It is described as a plant which has sweet tasting flowers that nourishes our body by acting as a natural coolant. The flowers of Mahua are considered *Snigdha*, which means oily and *Vikasi* which means relaxant for joints and muscles. These are not easily digested and are not considered favourable for heart.

Additionally, Mahua fruits are considered *Varnashodhak*, i.e., they are helpful in treating bruises and wounds by stopping bleeding. These are helpful in treating inflammation, unusual bleeding disorders and reduce burning sensations in affected areas. The ayurveda experts consider ripe fruits of Mahua as *vatpittashamak* which means it helps in maintaining gut health by helping secretion of bile. It aids in reducing uric acid accumulation around the joints thus helping in reduction of joint pains and other mobility related problems. Mahua in ayurveda is also considered as *veeryawardhak* i.e it aids in enhancing semen count, it is helpful in increasing lactation both in animals and humans. It is a good food to maintain general immunity and treat chronic diseases. Table 3 illustrates the use of different plant parts of Mahua tree for treatment or use in curing various diseases.

Table 3: Ethanobotanical uses of different parts of Mahua tree

S.No.	Plant part	Ailment	Preparation & use
1	Bark	Gum swelling & oral health	Decoction of bark for gargling
2	Leaves	Lack or reduced lactation	Decoction of leaves to be fed
3	Flower	Diabetes mellitus	Drink or liquor to be taken orally
		Worms of gut in ruminants	Decoction fed as water especially to calves
4	Seeds	Pneumonia	Applying seed oil on chest for warmth
5	Seed cake	Snake bite	Putting few drops of seed cake decoction in nostrils
Decoction: The concentrated extract or essence pulled out by boiling in excess water for some time and reducing its quantity to approximately half or less. Used for medicinal purposes.			

Source: [16, 27]

In addition to the scripts of ayurveda, the tribal and local people around the area of plantation of Mahua use it as a source of treating many day to day general health issues by preparing infusion or decoction of the bark. As is reported by [57], the infusion of bark is taken as a treatment for diarrhea, general fever, tonsillitis and even in treating skin ailments like scabies and leprosy. It is taken as an antidote of snake bites in Tamilnadu (India) [58]. The bark is found useful in the treatment of hydrocoel and scabies [59-60]. It is useful in the treatment of Cushing's disease and is also used as a bandage or Poultice (leaves of Mahua) to treat eczema [61] and other related skin problems.

Conclusion

Mahua, botanically referred to as *Madhuca longifolia* (Koenig) J.F. Macbride and/or *Madhuca indica* J.F. Gmel. syn. *Madhuca latifolia* Macb. belongs to *sapotaceae* family and

is botanically named as *Madhuca longifolia*. The plant is native to the wild of India, Nepal, Myanmar, Sri Lanka and other South Asian countries. It is a multipurpose tree which is available for very short time in the tropical regions. It is very popular amongst the tribal or forest people and is utilized by them as food, feed, fodder, fuel and medicine. After a long neglect due to one reason or another, the tree has again gained its valuable position in the lives of local people as well as in the economy of the country. The tree is valued for its food uses and medicinal properties. It is a rich source of many nutrients that satisfies the nutritional needs of people as well as it is a source of natural remedy for many diseases. The whole Mahua tree, i.e., roots, stems, leaves, flower buds and flowers all are beneficial in one way or other. It is used as food feed, fodder and fuel by the local and tribal people. However, due to the lack of proper scientific investigation and post harvest processing technologies, they are collected and subjected to open yard sun drying till about 80% moisture is lost, before storage [37]. The Mahua tree and its produce are short lived and thus proper post harvest management techniques and product development are the ultimate need of the hour so that its benefits can reach the population as well as growers or harvesters.

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