Madhuca longifolia (Mahua): A comprehensive ethno pharmacological review

Mohd Saif, Rachna Varma, Rishi Kant and Rakesh Kumar Gupta

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Abstract
Madhuca longifolia is cultivated as well as found in wild and considered as boon for the forest dwellers for its medicinal property. It is an economic plant grows mainly in subtropical region of India and Pakistan. It is commonly known as Mahua and known for its antimicrobial, antioxidant, antipyretic, anti-inflammatory, antilulcer, cardioprotective, antihyperglycemic, antifertility, antiulcer activities. Its chemical ingredients include terpenoids, proteins, starch, anthaquinone glycosides, phenolic compounds, mucilage, cardiac glycosides, tannins, flavonoids and saponins. This article gives a brief description of Madhuca longifolia regarding its identification, phytochemical properties, traditional uses including anti-inflammatory, antipyretic, antihyperglycemic, antifertility, antilulcer activities. The outcome of this review will further expand the existing knowledge about Mahua and provide a convincing support to its future clinical use in modern veterinary and human medicine.

Keywords: Madhuca longifolia, Mahua, pharmacology, anti-ulcer, anti-pyretic

Introduction
Madhuca longifolia is the botanical name of Mahua tree which belongs to family-Sapotaceae (Banerji et al., 1996; Devi and Sangeeta, 2016; Khare et al., 2018) [1, 8, 11]. Medium to large sized deciduous tree, spreading branches and a large rounded crown. Leaves are clustered at the end of branches, elliptic, obovate. Flowers are small, cream-coloured and produced in clusters at end of branches (Verma et al., 2014) [32]. Fruit, a green egg-shaped fleshy berry. Seeds are either double convex or flattened on one or two sides. The Honey tree (English name) has many medicinal uses. Almost all parts of this tree are medicinally very important. Tribals in Central India worship this tree for its medicinal values and also for its relevance in their rituals. Mahua is a large deciduous tree growing widely under dry tropical and sub tropical climatic conditions (Verma et al., 2014; Khare et al., 2018) [32, 11]. Madhuca longifolia is distributed in Andhra Pradesh, Gujarat, Madhya Pradesh, Odisha, Chhatisgarh, Jharkhand, Bihar, Uttar Pradesh. It is an important tree for poor, greatly valued for its flowers and its seeds known as tora. The tree has religious and aesthetic value in the tribal culture. The trees with best girth in forest are often Mahua trees as it is protected and cared by forest dwellers. Mahuatreecan be found in forests, revenue, and private land (Khare et al., 2018) [11]. The early settlers had rights to specific Mahuatreeces occurring near the village in private, revenue and forestlands. Some trees may even be located at long distance from the village but are recognized as being associated to a family. These rights are only for harvesting (lowers but not for fruits and have been practiced. These rights have passed from generation to generation. When father divides the property among his sons, he also divides Mahuatreec between them but keeps some for himself till the end, as it becomes an easy source of income. In absence of sons, harvesting rights are given to daughters when they get married. Sometimes villagers of one region, in dearth of Mahua, visit relatives who have trees in abundance (Mishra and Padhan et al., 2013) [14]. In most agricultural communities people rely on seasonal crop production. For many rural people, and especially for the poor, these cycles entail periods of food shortage. It is at these critical periods that the importance of forest foods is greatest. Of course, forests and fallow lands provide food resources in most seasons, in the form of edible leaves, fruits, wild vegetables, roots and tubers (Verma et al., 2014) [32].
leathery, most of leaves pointed at the tip and bred near end of branches, epileptic or elliptic oblong 7.5 to 23 cm into 3.8 to 11.5 cm (Khare et al., 2018) [11]. Flowers are small and fleshy, dull or pale while in color and in define fascicles near end of branches. Fruits are 2-6 cm long, fleshy and greenish. Bark dark color, cracked (Variers et al., 1995) [11]. Useful parts of plant: Every part of ally plant possess sonic medicinal properties, either in small of large proportion. Different parts of a plant often contain different active ingredients, so that one part may be toxic and another one quite harmless (Wyk et al., 2004) [13]. The plant consists of several parts, they may be classified according to the function. They are root, bark, leaves, flowers, fruits, seeds, oil.

**Table 1: Parts of Madhuca and its medicinal properties**

<table>
<thead>
<tr>
<th>Parts of Madhuca</th>
<th>Medicinal Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf</td>
<td>Fracture Emollient, Skin Disease, Rheumatism, Headache, laxative, Piles, Hemorrhoids, Emetics, Anti Earthworm.</td>
</tr>
<tr>
<td>Oil</td>
<td>Sweet, Refrigerant, Aphrodisic, Tonic, Dipsica, Bronchitis, Astringent, Antulcer, Acute and Chronic Tonsillitis, Pharyngitis</td>
</tr>
<tr>
<td>Fruit</td>
<td>Rheumatism, Ulcer, Inflammation, Bleeding, Spongy Gums, Tonsillitis, Diabetic, Stomach Ache, Anti Snake Poisoning, Astringent, Emollient, Fracture, Itching</td>
</tr>
<tr>
<td>Bark</td>
<td>Hepatoprotective, Refrigerant, Gastrophy Liquor, Jelly, Sweet Syrup, Expectorant, Increase the production of milk in woman, Stimulant, Diuretics, Anthelmentic, Verminosis</td>
</tr>
</tbody>
</table>

**Phytochemical Property**

The therapeutic value of the plant depends on the active constituents present inside the different part of the plant, which may be present in the small or large quantity (Sardana et al., 1995; Devi and Sangeeta, 2016; Khare et al., 2018) [19, 8, 11]. The secondary metabolites are the important substance responsible for the main medicinal properties in the crude drugs (Sengar et al., 2009) [22]. The leaves of Mahua tree contain saponin, an alkaloid, and glucoside. Sapogenin and other basic acid are found in the seeds. Various Photochemical studies on Mahua include characterization of Sapogenin, triterpenoids, steroids, saponin, flavonoids and glycosides. In view of the aides and attributed medicinal properties new components including mahuducic acid (pentacycl triterpenoids), madhushazone, triterpene glycosides and madhucosides A and B20. The fresh flower of Mahua contains 2 acetyl pyrrolone, the aroma molecule. They also contain polysaccharide which on hydrolysis give D-galactose, D-glucose, L-arabinose, L-rhamose, D-xyllose and D-glucuronic acid (Miller et al., 2005; Khare et al., 2018) [13, 11]. The chemical composition of mahua flower reveals its high nutritional value. Apart from being a rich source of sugar and protein, the flowers also contain essential minerals like Ca, P, Fe, and K. Calcium is a major component of the hone and assists in teeth development (Brody et al., 1994; Patel et al., 2010) [4, 16]. Phosphorus is next in importance to calcium as utilization of Ca is closely related to it. Most of the Calcium in the body is deposited as the calcium Phosphate (Gopalan et al., 2004) [19].

**Table 2: Parts of Madhuca and its chemical composition**

<table>
<thead>
<tr>
<th>Part</th>
<th>Phytoconstituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bark</td>
<td>Flavonoids, Triterpene, Sterol</td>
</tr>
<tr>
<td>Latex</td>
<td>Soluble Resin, Insoluble Resin</td>
</tr>
<tr>
<td>Flower</td>
<td>Carotene, Ascobic Acid, Thiamine, Riboflavine, Nicanine, Folic Acid, Biotine, Inositole.</td>
</tr>
<tr>
<td>Fruit</td>
<td>Moisture, Protein, Fat, Carbohydrates, Minerals, Calcium, Phosphorus, Iron, Carotene, Ascorbic acid, Tannins</td>
</tr>
</tbody>
</table>

**Nutritional and Medicinal Use**

The Mahua tree is having lots of nutritional value in it. It produces fruit which is valued for its seed which yield high quantity of fat commercially known as Mahua butter or mowrath butter, many edible and medicinal applications and it is also used as a biodiesel (Singh et al., 1991; Devi and Sangeeta, 2016; Khare et al., 2018) [23, 8, 11]. Its fat has been used as substitute for cocoa butter and ghee. It is one of the single largest sources of natural hard fat (Bringi et al., 1987) [5]. The fat which is thus obtained from Mahua fruit oil is used in cooking, frying and manufacturing chocolates. The seed fat has emulsion property so it mostly used as an emulsifying agents in few pharmaceutical industries. It is generally applied as massage oil in many part of the country, as it is very good to moisturize skin. Besides edible and medicinal uses, Mahua has industrial application as it can be utilized in the manufacture of laundry soaps and lubricants (Parrota et al., 2001; Verma et al., 2014) [15, 32]. Moreover, the seed cake is reported to have insecticidal and pesticide property and used as organic manure in crops like rice, sugarcane etc. The medicinal properties which are seen in this plant are stimulant, demulcent, emollient, healing skin diseases, rheumatism, headache, laxative, piles, and sometime as galactagogue, astringent and many more (Pinakin et al., 2018) [17].

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Traditional use
Although Mahua tree is easily found in the several part of India, it is not used as a food material. Mahua flower occupy an important position in the life of the tribal in many parts of India (Das et al., 2001) [1]. Only a small quantity of flowers is consumed in a raw, cooked or fried formed in different parts of India. Major quantity of flowers is used in the preparation of the distilled liquors. The freshly prepared liquor has a strong, smoky fetid odor, which disappear on ageing (The wealth of India et al., 2010; Verma et al., 2014) [25]. It is also seen that the pest of the Mahua tree bark is used to cure the fracture of bone. The most interested thing about the Mahua tree is that it has two fruits in different seasons; the seed oil is extracted from it and used in the several different purposes. The wood of mahua tree is also used in the house hold utility like door and window making. The tribal people use it for the development of halwa, meethi puri, barfi, mahua daru or mahuli (Pinakin et al., 2018) [17].

Sugar syrup
There are several reports on preparation of sugar syrup from dry Mahua flowers, as its sweet property is utilized in the fermentation process (Shriwastava et al., 1970; Benerji, 2010) [24-25]. The water extract of dried flower is decolorized with different decolorizing agent like slacked lime and activated charcoal before concentrating it to the desired concentration. Activated charcoal at a concentration of 3.5-5% was found to be the best agent for the preparation of the Mahua sugar syrup (Patel et al., 2010) [16]. The syrup thus obtained from the flower of Mahua is employed in the different purpose, either in the manufacturing of chocolate or as a sweetening agent (The wealth of India et al., 2010).

Pharmacological profile
Madhuca longifolia, belonging to the family Sapotaceae, is an important economic tree growing throughout India. Traditionally, Madhuca longifolia bark has been used against diabetes, rheumatism, ulcers, bleeding and tonsilitis (Khare et al., 2000; Khare et al., 2018) [10, 11]. The flowers, seeds and seed oil of Madhuca longifolia have great medicinal value. Externally, the seed oil massage is very effective to alleviate pain. In skin diseases, the juice of flowers is rubbed for oleation. It is also beneficial as a nasya (nasal drops) in diseases of the head due to pitta, like sinusitis (Dahake et al., 2010) [6]. The Mahua have several pharmacological potency and it is being used from the tradition. Few of its Pharmacological use are as follows:

Anti-inflammatory Activity
The reason of the emergence of the swelling or inflammation is release of the various chemical mediators from the damaged cell like histamine and serotonin. Inflammation is a defensive mechanism of the body (Tortoro et al., 2003) [109]. The most important mechanism of anti-inflammatory drugs is considered to be inhibition of Prostaglandins synthesis at the site of injury. The anti-inflammatory potency of drugs hampers PG synthesis.

Anti-pyretic activity
Madhuca indica, is used to treat the fever in individual, as it is experimented in animals. About 5 groups of 6 rats each were injected subcutaneously with 10 ml kg⁻¹ body weight. Firstly, the animals are forced to fever by injecting the suspension of the yeast suspension, this will increase the body temperature of the experimental animal. After measuring the basal rectal temperature of each animal by a help of thermometer, about 19 Hr. after yeast injection, the rectal temperature was recorded again and animal showing a rise in temperature of <0.6°C were discarded. Rectal temperature was then recorded at 20-24 hours after yeast injection. After sometime interval it is found in the reduction in the rectal temperature of rat, which shows the antipyretic effect of Madhuca longifolia (Shekhawat et al., 2010) [23].

Anti-hyperglycemic Activity
The significant hyper-glycemic effects of Madhuca longifolia bark in diabetic rats indicate that this effect can he mediated by stimulation of glucose utilization by peripheral tissues. The results of the present study clearly indicated the ethanolic extract of Madhuca longifolia bark to have a hypoglycemic effect on STZ induced diabetic rats (Srirangam et al., 2010) [26]. In all groups except for glibenclol amide, at 30 min of initiating glucose tolerance test, blood glucose concentration was higher than at zero time but decreased significantly from 30 min to 120 min. Methanolic extracts were enhancing glucose utilization, thus the blood glucose level was significantly decreased in glucose loaded rats (Seshagiri 2007; Dahake et al., 2010) [20, 6].

Anti-fertility activity
The percentage of fertile male mice and the number of pregnancies were significantly reduced in atropine induced mice from control mice. There was complete reduction of fertility in male rat, number of pregnant females and number of litters in plant extract treated group. Among the plant based contraceptives, inhibition of male fertility after administration of natural substances has been related to decrease spermatozoa density. Also for male contraception, it is not necessary to stop spermatogenesis, but rather to eliminate the fertilizing ability of the spermatozoa by causing changes in the morphology or in the function of the sperm. The decrease in sperm count and the high number of morphologically abnormal sperms indicate interference with testicular spermatogenesis (Saif et al., 2018) [18].

Analgesic activity
Analgesics are the agents that relieve the sensation of pain without disturbing consciousness or altering other afferent inputs temperature of rat, which shows the antipyretic effect of Madhuca longifolia (Shekhawat et al., 2010) [23]. Analgesic activity was evaluated on the acetic acid induced writhing. The methanolic extract of Madhuca longifolia was given orally to the group of 6 animals. The number of writhing during the following 30 min. period was observed after acetic acid injection. Anti-analesia is expressed as the reduction of the number of abdominal contriction between control animal and mice pretreated with the extract (Shekhawat et al., 2010) [23]. In otherwords, if the analgesic drug works, the abdominal contraction will be less in numbers. The analgesic activity of the Madhuca longifolia can also be evaluated by the using other method of evaluation like tail flick method.

Anti-ulcer Activity
Gastro-intestinal ulcer is a common disorder of gastrointestinal tract. It is now considered that gastrointestinal ulcer is a disease of multi factorial origin but its detailed etiology is still not clear (Maity et al., 2009) [122]. Ulcer is a result of the imbalance between the defensive and attacking factors in the GIT. An ulcer is a local defect or
excavation of the tipper part that is called surface of an organ or the tissue (Seth et al., 1999) [21]. Anti ulcer activity has been proved in Madhuca Indica plant while it is tested in the male wistar rat (Simon et al., 2019) [29]. To evaluate the anti ulcer activity of the Mahua tree, firstly the animal is forced to produce the ulcer by any of suitable method like stress induced ulcer or carrageen induced ulcer, and then the same is treated with the extract.

Conclusion

Madhuca longifolia, commonly known as mahua, is very well known for its medicinal properties and other industrial use. Its therapeutic potential is of great importance but is not fully utilized. Mahua seeds are rich source of edible fats making it economically more important. Mahua possess a lot of ethnic values among the tribal people for the development of various fermented and non-fermented food products, and improve the livelihood of the tribal people with the increase chances of the employment.

References

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