

A Review on Pharmacological Approach of the Therapeutic Property of *Madhuca longifolia* (J.Koenig ex L.) J. f. Macbr. Flower

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ABSTRACT

Liver plays an important role in maintaining the metabolic function and excretion of toxins from the body. An injury or liver dysfunction caused by consumption of toxic chemicals, excessive alcohol and microbes result in a challenging condition called hepatotoxicity. *Madhuca longifolia* belonging to Sapotaceae family is found to possess pharmacological properties in the treatment of various diseases. The present review aims at compiling the hepatoprotective effect of Mahua flower based on various experimental studies. Methanolic extract of Mahua flower exhibited hepatoprotective property when administered at different dosages in rat was found to lower the levels of SGPT, SGOT, ALP and total bilirubin simultaneously increasing serum total proteins and albumin. The ethanolic extract also showed hepatoprotective activity against paracetamol induced hepatotoxicity in albino rats when administered in dosage of 500 and 750 mg/kg body weight by stimulating the healing and regeneration of hepatocytes. Hepatoprotective activity might be due to the effect of extracts against the cellular leakage and loss of function of the cell membrane in hepatocytes. The protective effect might be due to the presence of alkaloids, flavonoids and phenolics. Future prospects include purification and characterization of phyto-compounds present in the *Madhuca longifolia* flower. Further studies on mechanism of action will lead to discovery of novel therapeutic agents for the treatment hepatic diseases.

KEY WORDS: Hepatotoxicity, Hepatoprotective, Hepatocytes, *Madhuca longifolia*, Methanolic, Phyto-compounds.

1. INTRODUCTION

Liver is the principal site for enhanced metabolism and excretion. It is involved in maintaining the homeostasis of the body followed by regulation of biochemical pathways leading to growth, nutrient supply, defense mechanism, energy production and reproduction^[1]. It is also important in the maintenance of metabolic functions and detoxification of exogenous and endogenous toxins like xenobiotics, drugs, chemicals and chronic alcoholism^[2]. Plant based foods have

been considered to be effective against the disease conditions and are popularly used by around 80% of the population^[3]. *Madhuca longifolia* commonly referred to as Mahua or Butternut plays an important source of nutrient and the chemical constituents have therapeutic property against many disease conditions. It belongs to Sapotaceae family^[4]. It is a large deciduous tree growing up to the height of 15-16 meters^[5]. Mahua flowers are used as a therapeutic agent against many

disease conditions such as ulcer, snakebite, scabies, rheumatism, etc.^[6]. It is one of the emerging alternatives with pharmaceutical properties^[7].

The main objective of this review is to compile the various experimental studies with respect to hepatoprotective property of Mahua flower to provide an opportunity for the development of novel drugs against hepatic diseases.

2. *Madhuca longifolia* (J.Koenigex L.)

J.f.Macbr.

2.1 Taxonomy

Kingdom: Plantae

Family: Sapotaceae

Subfamily: Caesalpinioideae

Tribes: Caesalpinieae

Genus: *Madhuca*^[8]

2.2 Nomenclature

Madhuca longifolia is synonymously called as *Madhuca indica*^[3]. The common name of *Madhuca longifolia* in different languages includes the following:

Hindi: Mohva; Kannada: Erappe; Telugu: Ippa;

Tamil: Illuppai; Sanskrit: Madhukah; Malayalam:

Illuppa, Iruppapu; Marathi: Moha, Mhowra;

Bengali: Mahula, Kochra; Oriya: Mohuka,

Mohulo^[3].

2.3 Flower

Mahua flowers are found in definite fascicles near the ends of branches, drooping on the pedicels. They are small (2cm long), fleshy, dull or pale white in colour. Corolla is tubular, freshly, pale yellow, aromatic and caduceus. Calyx is densely clothed with rusty tomentum. Stamens number between 20-30, usually 24-26 anthers are hispid at the back with stiff hairfollicles^[4].

Flowers are used as a sweetener in many dishes due to its high content of reducing sugar by the tribal and rural people.

People residing near the forests in states like Bihar, Madhya Pradesh, Himachal Pradesh, Orissa and Maharashtra mainly depend on this flower when the agricultural production is impracticable^[3]. It is used as a flavoring agent and also in the preparation of pickles^[9].

2.4 Nutritional importance

The aromatic compound present in mahua flower is 2-acetyl-1-pyrroline. It is a rich source of polysaccharides' which on hydrolysis produces D- galactose, D- glucose, L- arabinose, L-rhamnose, D- xylose and D- glucuronic acid. In addition to this it also contains 4.4-7% protein and essential minerals like calcium, potassium, phosphorus, magnesium, copper and iron in abundance. Amino acid content includes lysine, arginine, aspartate, glutamate, threonine, valine, tryptophan, isoleucine, leucine and proline. It is also a rich source of anthocyanins, betains, salts of malic and succinic acid^[4,10,11]. Purohit^[12] reported that air dried mahua flower contains invert sugar (52.6%), cane sugar (2.2%), albuminoids (2.2%) and other substance.

A laboratory analysis performed by Verma (14) reported the presence of major eight bioactive compounds present in the mahua flower using aqueous, ether, acetone and methanolic extracts. It was found that carbohydrates, proteins, flavonoids and tannins were positive for all the extracts whereas sterols and lipids were positive in aqueous, ether and methanolic extracts only. The other two compounds alkaloids and saponins were positive in aqueous and methanolic extract respectively. The preliminary phytochemical screening with the various qualitative chemical tests revealed the presence of various phytoconstituents like alkaloids, carbohydrate, phenolic compounds, flavonoids, protein and amino acids, tannins, sterols and saponins^[17].

Table 2. Phytochemical analysis of *Madhuca longifolia* flower extracts^[8]

Phytoconstituents	Tests	Ethanollic extract	Methanolic extract
Alkaloids	Tannic acid test	+ve	+ve
Tannins	Lactic acid test	+ve	+ve
Proteins	Biuret test	+ve	-ve
Flavonoids	Alkaline reagent test	-ve	-ve
Carbohydrates	Molisch's test	+ve	+ve
Amino acids	Ninhydrin reagent test	-ve	-ve
Volatile oils	Sudan red III test	-ve	-ve
(+ve): present; (-ve): absent			

2.6 Pharmacological activity

2.6.1 Therapeutic property

Mahua flowers are used as cooling agent, aphrodisiac, astringent and demulcent, galactagogue, analgesic and diuretic. They are found to be beneficial in tonsillitis, bronchitis, helminthes, pharyngitis, impotency, inflammation, eczema, skin diseases and eye diseases^[7,9,19,20,21]. Flower extract is used for oleation for skin diseases. It also helps in boosting the quantity of seminal fluids^[21]. Fresh juice obtained from the flower benefits to arrest bleeding^[1]. Its paste aids in prevention of abscess as a spre^[4]. They are also found to be beneficial in treating burning sensation, heart diseases and ear complaints. The flowers fried in ghee (clarified butter) are eaten by people suffering from piles. The decoction of flowers quenches the thirst effectively. Due to its astringent property Mahua used in diarrhoea and colitis^[8].

2.6.2 Preparation and effectiveness of various solvent extracts of mahua flower

Scientists have studied and analyzed the impact of different types of solvents, such as methanol, hexane, and ethyl alcohol for the purpose of antioxidant extraction from various plants parts. In order to extract different phenolic compounds from plants with a high

degree of accuracy, various solvents of differing polarities were used^[22]. Moreover, scientists have discovered that highly polar solvents, such as methanol, have a high effectiveness as antioxidants^[23].

Therefore, Mahua flowers were dried at 37^o C and the solvent plant extract was prepared by mixing the finely powdered dry mahua flower (at room temperature) with 95% solvent under reduced pressure. This was filtered and stored. To prepare stock solution, stored extract was dissolved in Dimethylsulphoxide (DMSO), which was filtered before testing on cell lines^(120,24). Umadevi⁽²⁵⁾ reported that the methanolic extract of flowers of *Madhuca longifolia* shows the hepatoprotective activity against paracetamol induced hepatotoxicity.

2.6.3 Analgesic property

Aqueous and alcoholic extract of *Madhuca longifolia* flower possess analgesic effect. The analgesic effect were screened through tail flick test, hot plate test and administration of aqueous and alcoholic extract dose of 4.0 to 64.0 mg/kg body weight, intramuscularly for 3 days of *Madhuca longifolia* on rats or mice^[26]. The methanolic extract at dose of 50–200mg/kg given intraparenterally markedly reduced acetic acid

induced pain in a dose dependent manner showing that the extract possessed peripheral analgesic activity^[27].

2.6.4 Antiulcer property

The ethanolic extract of *M. longifolia* flowers were investigated for antiulcer activity in pylorusligated ulceration in the albino rats. The ethanolic extract of *M. longifolia* flowers at doses of 100,200,300 mg/kg body weight produced significant ($p < 0.01$) inhibition of the gastric fluid volume, free acidity, total acidity resulting in antiulcer properties of the extract which may be due to the presence of phytochemicals^[28].

2.6.5 Antioxidant property

One of the main reasons behind the hepatotoxicity is the oxidation of hepatic cells and damage of hepatic cell structure. In most cases it's because of oxidation of cellular component and generation of free radicals and other toxic metabolites. In order to prevent this damage, antioxidants play a vital role. The high phenolic compounds of the mahua flower may be a contributing factor towards antioxidant property due to the presence of hydroxyl groups which can function as hydrogen donor⁽²⁰⁾.Indu and Annika⁽²⁹⁾ reported that the flower extract increases ascorbic acid content followed by reduction of the ferric oxide, thus demonstrating the antioxidant activity.

2.6.6 Anti-inflammatory property

Liver damage takes place due to the inflammation in the liver cell and accumulation of fluids. Inflammation takes place mainly due to the release of chemical mediators like histamine and serotonin from the damaged cells. It is one of the defensive mechanisms of the body against the infection. Anti-inflammatory property embraces the inhibition of prostaglandin (PG) synthesis at the site of injury. Mahua flower was found to possess this

anti-inflammatory activity which might be due to phytoconstituents present in it^(27, 30).

2.6.7 Antimicrobial property

The flower has an antibacterial activity against the *Escherichia coli*^[31].To analyze the antimicrobial activity of mahua flower two different extracts were prepared (aqueous and methanolic extract). From the study it was found that aqueous extract showed more antibacterial property when compared to methanolic extract against *Bacillus subtilis* and *Klebsiella pneumonia*^[8,14,30,32]. A study conducted by Kalaivani^[33] reported that when alcoholic extract of *Madhuca longifolia* flowers were screened against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Aspergillus oryzae* and *Aspergillus niger*. It revealed significant antimicrobial activity against microbes.

2.6.8 Hepatoprotective property

Hepatocytes gets damaged due to many factors such as metabolic disorders,excessive alcohol consumption, drugs and chemicals (carbon tetrachloride, galactosamine, D galactosamine / lipopolysaccharide, thioacetamide, antitubular drugs, paracetamol, arsenic, etc), resulting in hepatotoxicity¹.In a clinical study,methanolic extract of *Madhuca longifolia* flower were administered orally in two doses (100 and 200 mg/kg) to the animals with hepatotoxicity induced by paracetamol (2g/kg). The serum levels of serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), serum alkaline phosphatase (ALP) and total bilirubin, lowered with simultaneously increasing serum levels of total protein and albumin in the selected model^[13].

Some of the common conditions related to hepatotoxicity include cirrhosis, hepatitis, and hepatic encephalopathy. According to WHO (world health

organization), about 18,000 people die every year from liver diseases^[34]. Lipid peroxidation was found to be a causative factor for hepatotoxicity. It refers to the oxidative degradation of lipids resulting in the loss of structural and functional integrity of the cell membrane and biochemical function, leading to its irreversible damage or cell death and aging^[35]. An in vitro study was performed to analyze the antioxidant property of ethanolic extract (70%) of mahua flower via its reducing power and free radical scavenging tendency. The levels of GSH and lipid peroxidation levels were estimated to analyze in-vivo antioxidant activity. In the study, the CCl treated rats were given 70% of ethanolic mahua extract (200 and 400 mg/kg) and silymarin (100mg/kg). In the rats with CCl induced hepatotoxicity, the responses of 70% of ethanolic mahua extract and silymarin were measured on wet liver weight, liver volume, serum biomarkers like SGPT, SGOT, ALP, direct and total bilirubin^[34].

2.6.8.1 Stimulation of liver regeneration

Protective action of *Madhuca indica* due to its regeneration capacity for liver cell, it stimulates liver tissue regeneration by increasing the protein synthesis in injured liver cell. It may be possible by increase in the formation of ribosomal RNA synthesis, as it increases the rate of protein synthesis resulting in the regeneration of liver cell^[20].

2.6.8.2 Wound healing property

Wound healing activity of *Madhuca longifolia* directly correlate with the hepatoprotective activity. Damage caused by the hepatotoxic substances may be cured by the extract of *Madhuca longifolia*, if the rate of wound healing activity is faster than the recovery from liver toxicity may be fast^[20]. Damage caused by the hepatotoxic substances may be cured by the extract of *Madhuca longifolia*, if the rate of wound healing activity

is faster, then the recovery from liver toxicity may be fast^[20].

2.6.9 Preparation of drugs

Weerasooriya and Yatawara^[36] reported that enzyme invertase (β -D-fructofuranosidase, EC 3.2.1.26), present in the flowers of *Madhuca longifolia* plays an important role during the preparation of fermented Ayurvedic drugs known as *Arishta*. This enzyme was partially purified with a yield of 11.6%, using (NH₄)₂SO₄ fractionation, followed by gel filtration through Sepharose 4B and DEAE cellulose chromatography at pH 6.5 and 4.2.

3. DISCUSSION

The findings suggest the potential use of the ethanolic extract of *Madhuca longifolia* flowers as a novel therapeutically useful for hepatoprotective agent. The protection offered by the extract might be due to the presence of flavonoids and alkaloids^[12, 34].

World is endowed with plentiful of medicinal plants. Scientists find medicinal plants one of the best alternatives to combat the upcoming challenges associated with diseases due to its immense potential with least side effect and high safety and efficacy. Different extracts of *Madhuca longifolia* (mahua) flowers have been found possessing pharmacological activity. It is also termed as "Universal panacea in ayurvedic medicine" since all the parts of this tree is found to possess the pharmaco-therapeutic property.

3.1 Suggestions for future research

- Purification and characterization of phytochemicals from flowers of *Madhuca longifolia*.
- In vitro analysis of different phytoconstituents in relation with hepatoprotective property.
- Novel drug formulation for the prevention and treatment of hepatic diseases.

- Analyzing its positive effect against other degenerative diseases.

4. CONCLUSION

In this review, hepatoprotective property of madhuca flower based on its phyto-chemistry and pharmacological aspects has been highlighted. In addition, isolation, purification and identification of new entities from *Madhuca longifolia* flower are required as it may help further to establish the application of isolated compound in treatment of hepatic diseases.

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