



MADHUCA LONGIFOLIA (SAPOTACEAE): A REVIEW OF ITS PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE

N. DEVI AND R. SANGEETHA*

Department of Biochemistry, School of Life Sciences, VELS University, Chennai

ABSTRACT

Herbal medicine is still the mainstay of about 75 – 80% of the world's population in the developing countries for primary health care. *Madhuca longifolia* (Mahua) Syn. *Madhuca indica* (Sapotaceae) commonly known as Butter nut tree is an economic plant growing throughout the subtropical region of the Indo – Pak subcontinent. Extensive studies show the presence of secondary metabolites like sapogenins, triterpenoids, saponins, flavonoids and glycosides. Conventionally, it has been used to treat infections, wounds, rheumatism, heart disease, diabetes and many other disorders. Experimental studies have demonstrated that Mahua exhibits antimicrobial, antioxidant, antiinflammatory, antiulcer, cardioprotective, anticarcinogenic, immunomodulant and hypoglycaemic properties. The outcome of these studies have emphasized the existing pharmacological profile of Mahua and provided a convincing support to its future clinical use in modern medicine.

KEYWORDS: Herbal Medicines, Mahua, Sapotaceae, Secondary metabolites, Pharmacological profile.



R. SANGEETHA

Department of Biochemistry, School of Life Sciences, VELS University, Chennai

INTRODUCTION

Since the beginning of the human civilization, plants have been used as a folk medicine and pharmacopoeial drugs. About 80% of the world's population is totally dependent on plant extract and its derivatives for the treatment of various infections and diseases. In India, about 2000 drugs used are of plant origin and the search for phytomedicines that are safe and affordable is still on-going. *Madhuca longifolia* (Mahua) Syn. *Madhuca indica* is one such a large size deciduous tree commonly known as Butter nut tree and belongs to family Sapotaceae widely distributed in Nepal, India and Ceylon.¹

DISTRIBUTION & HABITAT

Naturally *M. longifolia* grows in the moist forests on the west side of India from Konkan southwards to

Travancore, Deccan, common in Ceylon, cultivated in the Carnatic and upper Burma.¹

BOTANICAL DESCRIPTION

M. longifolia is an ever green tree which attains height up to 70 ft. The tree matures and starts bearing at 8-15 years and fruits up to 60 years. Leaves are 10-30 cm long, lanceolate, narrowed at both ends, glabrous distinctly nerved, anthers 16, 2-seriate subsessile, lips 3-toothed, thick and leathery.² Flowers are small, fleshy and pale white in colour. Fruits are 2-6 cm long, ovoid fleshy and greenish yellow when ripe.³ Flowers are the rich source of sugars, vitamin A, ascorbic acid, thiamine, riboflavin, Ca, P, Fe, Mg, Cu, anthocyanins, betains, salts of malic and succinic acid.⁴ Bark contains 17% tannins.⁵ Bark is used for rheumatism, ulcers, itches, bleeding and spongy gums. The bark is a good remedy for inflammations, sprains and pruritus. Mahua seeds are of economic importance as they are good source of edible fats.⁶



Figure 1
Parts of *Madhuca longifolia*

TAXONOMY & NOMENCLATURE

Binomial Name : *Madhuca Longifolia*
Kingdom : Plantae
Order : Ericaleae
Family : Sapotaceae
Subfamily : Caesalpinioideae
Tribes : Caesalpinieae
Genus : *Madhuca*
Species : *longifolia*

SYNONYM(S)

Madhuca latifolia Macb., *Bassia latifolia* Roxb., *Mahua indica* J.F. Gmel. VARIETIES²: *Madhuca longifolia* (Koenig) J.F. Macb. var. *longifolia*, and *Madhuca longifolia* (Koenig) J.F. Macb. var. *latifolia* (Roxb.) Cheval.

VERNACULAR/Common Name

Honey tree, butter tree (English), mohua (India), mi, Illuppai (Sri Lanka), Illuppai (Tamil), Mahua (Hindi &

Bengali), Madhukah (Sanskrit), Errape (Kannada), Ippi (Telugu), Irippa (Malayalam), Mahuda (Gujarat).

TRIBAL MEDICINE

In the folk medicinal system of India and Bangladesh, various parts of the tree are used, namely whole young plants, leaves, stems, barks, roots, fruits, flowers, and seeds. The different ailments treated with these parts include tuberculosis, rheumatoid arthritis, cholera, paralysis, snake-bite, debility, tonsillitis, influenza, piles, arthritic pain, helminthiasis, low semen count, headache, flatulency, and infections, besides being used as a blood purifier and as an antidote to poison.⁷

Table 1
Parts wise use of *Madhuca longifolia*

| Parts of plant | Medicinal Properties |
|----------------------|---|
| Leaves ⁸ | Wound healing, hepatoprotective, antioxidant, antimicrobial, astringent, stimulant, emollient, demulcent, rheumatism, piles, nutritive, verminosis, gastropathy, dipsia, bronchitis, dermatopathy, cephalgia, hemorrhoids and Cushing's disease |
| Root ⁹ | Antipyretic, anti-inflammatory, antioxidant, phthisis and scrofula, diarrhea and chronic fluxes |
| Flower ¹⁰ | Tonic, analgesic, diuretic, cooling agent, aphrodisiac, astringent, demulcent, helminthes, acute and chronic tonsillitis, pharyngitis as well as bronchitis |
| Fruit ¹¹ | Astringent, lotion in chronic ulcer, acute and chronic tonsillitis and pharyngitis. |
| Seeds ⁹ | Emulscent, skin disease, rheumatism, head ache, laxative, piles and galactagogue. |
| Bark ¹² | Itch, swelling, fractures, rheumatism, bleeding spongy gums, ulcer and tonsillitis, skin diseases, epilepsy, pneumonia and piles. |

PHYTOCHEMISTRY OF MADHUCA LONGIFOLIA

The therapeutic value of the plant depends on the active component present in the parts of the plant, which may be present in small or large quantities.¹³

Table 2
Phytoconstituents of *Madhuca longifolia*

| S. No. | Parts of Plant | Chemical Constituents | Reference No. |
|--------|----------------|--|---------------|
| 1. | Leaves | B-carotene, xanthophylls, erthrodiol, palmitic acid, myricetin and its 3-O-arabionoside and 3-O-L-rhamnoside, quercetin, 3-galactoside, 3 β -palmitoxy-olean-12-en-28-ol, oleanolic acid, β -sitosterol and its 3-O- β -D-glucoside, stigmasterol, β -sitosterol- β -D-glucoside, n-hecacosanol, 3- β -caproyolcan-12-en-28-ol, n-octacosanol, sitosterol. | 14-20 |
| 2. | Bark | Ethylcinnamate, sesquiterene alcohol, α -tocopherol, 3 β -monocaprylic ester of eythrodiol and 3 β -capryloxy oleanolic acid, α and β -amyrin acetates. | 21-28 |
| 3. | Seeds | Arachidic, linoleic, oleic, myristic, palmitic and stearic acids, α -alanine, aspartic acid, cystine, glycine, isoleucine and leucine, lysine, methionine, proline, serine, threonine, myricetin, quercetin, Mi-saponin A and B. | 29-32. |
| 4. | Fruits | n-hexacosanol, quercetin and dihydroquercetin, β -sitosterol and its 3 β -D-glucoside, α and β - amyrin acetates. | 33-35 |
| 5. | Flower | Vitamin A and Vitamin C | 36 |

PHARMACOLOGICAL ACTIVITIES

To ascertain the folk and traditional claims for the medicinal uses of the plant, the potential of plant should be validated scientifically to heal a variety of ailments. Hence this review paper focuses on pharmacological activities of *M. longifolia* which are demonstrated below.

ANTIOXIDANT ACTIVITY

Oxidative stress has been recognized as a key role player in the pathogenesis and pathophysiology of several diseases. As plants generate a lot of antioxidants they can represent a source of novel compounds with promising antioxidant activity to suppress free radicals during metabolic pathways. Antioxidant activity of the crude extracts was assessed by means of DPPH free radical scavenging method where ascorbic acid was used as standard with IC50 value 45.738 μ g/ml. leaves and barks of *M. longifolia* showed considerable antioxidant activity with IC50 values 61.832 μ g/ml & 66.342 μ g/ml respectively. The phenolic content was found to be 62.43 mg and the amount of phenolic content was 61.08mg for the bark which associated with good antioxidant potentiality.³⁷ The antioxidant effects of 70% ethanolic extract of bark of *M. longifolia* (Koenig) were studied by *in-vitro* scavenging models and *in-vivo* antioxidant activity was assessed by GSH and lipid peroxidation levels. The test extract has shown dose dependant antioxidant activity in all the animal models.³⁸ *M. longifolia* exhibited higher activity in case of DPPH, ABTS, hydrogen peroxide radical scavenging, and the antioxidant property of these plants might be due to the phenolic content.³⁹ The antioxidant activity from the

ethanolic bark extract of *M. longifolia* was evaluated by free radical scavenging activity using DPPH, reducing power assay and superoxide scavenging activity. The assay result was then compared with a natural antioxidant ascorbic acid (vitamin C).⁴⁰ The methanolic extract of *M. longifolia* was evaluated by *in-vitro* methods for the free radical scavenging and antioxidant properties. ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid), DPPH (2,2-diphenyl-1-picrylhydrazyl), Nitric oxide, hydroxyl radical and hydrogen peroxide scavenging were the models used for antioxidant studies and Butylated hydroxyanisole, butylated hydroxytoluene, Ascorbic acid were used as the standard antioxidants for comparison. Derivative of Madhucic acid and the methanolic extract of *M. longifolia* (L) leaves were screened for antioxidant potential by hydroxyl radical scavenging activity; reducing power assay, super oxide radical scavenging activity, and the results were compared to standard antioxidant butylated hydroxyl anisole which shows that *M. longifolia* leaves can act as potent natural radical scavengers.⁴¹ The methanolic extract of the bark of *M. longifolia* was used to evaluate the antioxidant activity by DPPH, reducing power assay and superoxide scavenging activity and the results were compared with a natural antioxidant ascorbic acid and gallic acid. The results showed that *Madhuca* possess significant scavenging activity.⁴² The antioxidant properties of the seed of *M. longifolia* were determined by hydrogen peroxide scavenging activity and reducing power assay. Comparatively the methanol extract exhibited more antioxidant activity than water extract. From these findings it is confirmed that the seeds of *M. longifolia* possesses good antioxidant property.⁴³ The antioxidant activity of 70% ethanolic extract of *M. longifolia* (Koenig) were studied by screening GSH estimation

and lipid peroxidation and it is evident by the results obtained that the plant possesses more antioxidant property.⁴⁴ The ethanolic extract of the leaves of *M. longifolia* at two dose levels of 500 mg/kg and 750mg/kg body weight shows antioxidant activity on acetaminophen induced toxicity in rats.⁴⁵

ANALGESIC ACTIVITY

The nociceptive methods like tail flick, hot plate and chemical writhing methods were used to screen the analgesic effects in aqueous and alcoholic extract of flowers of *M. longifolia* and graded doses of both aqueous and alcoholic extract of *M. longifolia* (4.0 to 64.0 mg/kg, i.m. X 3 days) produced dose dependent analgesic effect in all the methods carried out either in rats or mice.⁴⁶ The aerial part of crude methanolic extract of *M. indica* possesses analgesic activity and it was evaluated using acetic acid-induced nociception response.⁴⁷

ANTICANCER ACTIVITY

Four different fractions like Methanol, Ethanol, Acetone, and chloroform of fruit - seeds of *M. longifolia* were used to perform *in-vitro* anticancer studies against human cancer cell line (HeLa) and MTT assay was used to analyze the cell growth inhibition. The results show that the various extracts of fruit-seeds of *M. longifolia* have a very good to moderate anticancer activity.⁴⁸ The acetone and ethanol extracts of *M. longifolia* leaves were used to perform a study against Ehrlich Ascites Carcinoma in mice and the activity of extract was compared with standard drug 5-Fluorouracil. Assessment was done by the parameters like mean survival time, tumor volume, tumor weight, tumor cell count, body weight, haematological studies and *in vitro* cytotoxicity. From the results it is concluded that oral administration of extracts increase the survival time, tumor weight, body weight and tumor volume and tumor cell count were also significantly reduced.^{49, 50}

ANTICONVULSANT ACTIVITY

The extracts of fruit-seeds of *M. longifolia* at doses of 200 mg/kg were used to study anticonvulsant activity. The studies show that the extracts protect the animals from seizures and significantly reduced the duration of tonic hind leg extension comparatively to the standard drug phenytoin which exhibits abolished tonic hind leg extension. Phenytoin, standard drug treated animals have revealed 100% protection against seizures where as the various extracts of fruits - seeds of *M. longifolia* show 95.85 % protection respectively.⁵¹

ANTHELMINTHIC ACTIVITY

Anthelmintic drugs are used to eradicate the number of helminthic parasites from intestinal tract or tissue of humans and other animals. The anthelmintic activities of different leaf extracts of *M. longifolia* were evaluated separately on adult Indian earthworm (*Pheritima posthuma*). It was found that methanolic

extract and aqueous extract of *M. longifolia* showed anthelmintic activities at a concentration of 60 mg/ml of each. The reference standard was Albendazole (60 mg/ml). The methanolic extract of *M. longifolia* showed better result compared to aqueous extract.⁵²

HEPATOPROTECTIVE ACTIVITY

In vivo hepatoprotective activity of the ethanolic extract of *M. longifolia* leaf extract was studied at various dose levels of 200 mg/kg, 400 mg/kg, 500 mg/kg and 750 mg/kg body weight on D-Galactosamine (GalN) and induced toxicity in rats. Biochemical studies shown that there is an increase in the levels of serum urea, hemoglobin (Hb), total leukocyte count, creatinine, packed cell volume, DLC, mean corpuscular volume and raised body weight along with reduced levels of neutrophils, mean corpuscular Hb content, mean corpuscular hematocrit, granulocytes, uric acid, and platelet concentrations. These values are retrieved significantly by the treatment with extracts at two different doses. Apart from these, histopathological changes also expose the protective nature of the *M. longifolia* extract against induced necrotic damage of hepato and renal tissues. In conclusion, these data suggest that the extract can prevent both renal and liver against acute injury.^{45, 53} The extract at the doses of 200 and 400 mg/kg and silymarin (standard) 100mg/kg were administered to the CCl₄ and D-galactosamine (GalN) challenged rats to study the hepatoprotective activity. The effect of extract and standard silymarin on wet liver weight, liver volume, and serum biomarkers like SGOT, SGPT, ALP, direct and total Bilirubin were measured. The results have shown that GalN and CCl₄ have enhanced the biomarker levels. From the result it can be concluded that the extract of *M. longifolia* possesses more potential towards hepatoprotectivity.^{38, 54}

IMMUNOMODULATORY ACTIVITY

Methanolic extract of bark of *M. longifolia* (MLL) was administered orally at doses of 50, 100 and 150 mg/kg/day to healthy mice and the assessment of immunomodulatory activity was carried out by testing the humoral (antibody titre) and cellular (foot pad swelling) immune responses to the antigenic challenge by sheep RBCs. Thus MLL significantly suppressed the cellular immunity by decreasing the footpad thickness response to sheep RBCs in sensitized mice. With a dose of 100 and 150 mg/ kg/day the DTH response was 7.66 ± 2.75 and 6.41 ± 1.21 respectively in comparison to corresponding value of 14.50 ± 2.38 for untreated control group. Differences in the DTH response were statistically noteworthy ($P < 0.05$) and the study confirmed that MLL shows preferential suppression of the components of cell-mediated immunity and shows no effect on the humoral immunity.⁵⁵ The ethanolic extract of *M. longifolia* at a dose of 100 and 200 mg/kg body weight was studied for its immune modulatory activity on albino mice. The antibody titre value, DTH response and effect on myelosuppression were checked against the control and cyclophosphomide, standard inducer. The significant ($p < 0.01$) increase in antibody titre value and DTH response was reported as a sign of its stimulating effect on humoral and cell mediated

immunity respectively. Consequently, the *M. longifolia* with the significant immunostimulatory activity on both the specific and non-specific immune mechanisms holds great promises for being used as an immunomodulating agent.⁵⁶

ANTIMICROBIAL ACTIVITY

Disc diffusion technique was used for *in vitro* antibacterial screening of *M. longifolia* using kanamycin as standard. Zone of inhibition was observed in disc diffusion against four gram - positive and eight gram-negative pathogenic bacteria. The leaf and bark extracts showed average zone of inhibition ranged from 7-10 mm. Maximum zone of inhibition was observed at 10 mm against *Bacillus megaterium*, *Salmonella paratyphi*, *Vibrio parahemolyticus* for barks and *Vibrio mimicus* for leaves.³⁷ The antimicrobial activity of alcoholic extract of leaves and flowers of *M. longifolia* were screened against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Aspergillus oryzae* and *Aspergillus niger*., Hence the studies have confirmed that *M. longifolia* extracts revealed Significant antimicrobial activities against test microbes.⁵⁷ The antimicrobial activity of petroleum ether, chloroform, ethyl-acetate and methanol extracts of barks of *M. longifolia* were tested against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus subtilis* using agar well diffusion and micro dilution assays. In the well diffusion assay, 27 out of the 64 extracts showed good activity. Significant activity was observed in the micro dilution assay with all extracts which conclude that *Madhuca* possesses high antimicrobial potential.⁵⁸

ANTIULCER ACTIVITY

Various doses (100, 200 and 400 mg/kg, p.o) of methanolic extract of *M. indica* were studied for antiulcer activity using the pylorus ligation, ethanol-induced and naproxen-induced gastric ulcer models in rats. From experimental studies it has been concluded that methanolic extract of *M. indica* leaves possesses high antiulcer activity which can be attributed to its ability to increase the protective layer of mucin and decrease the damaging and or digestive effects of pepsin and acid.⁵⁹ The ethanolic extract of *M. longifolia* flowers were investigated for antiulcer activity in pylorus ligated ulceration in the albino rats. The ethanolic extract of *M. longifolia* flowers at doses of 100,200,300 mg/kg b.w produced significant ($p < 0.01$) inhibition of the gastric fluid volume, free acidity, total acidity and the result concludes that the antiulcer properties of the extract may be endorsed to the presence of phytochemicals.⁶⁰

ANXIOLYTIC ACTIVITY

Hydro-alcoholic extract of *M. longifolia* leaves was used to evaluate the anxiolytic activity by the closed field test which shows that after administration of hydro- alcoholic extract of *M. longifolia* leaves (100 mg/kg) or diazepam (1 mg/kg) standard, there was significant decrease in

the number of rearing, assisted rearing and number of squares traveled compared to the control group.⁶¹

CYTOTOXIC ACTIVITY

The cytotoxic activities of crude extracts of *M. longifolia* were determined by Brine shrimp lethality using Vincristine sulfate as standard with LC50 of 8.84µg/ml. correspondingly, the crude extracts of leaves and barks showed significant cytotoxicity with LC50 of 17.09µg/ml and 45.96 µg/ml.³⁷

ANTIHYPERGLYCEMIC ACTIVITY

The three animal groups, namely control, glucose loaded and streptozotocin induced diabetic rats were administered with the ethanolic extract of *M. longifolia* at a dose of 100 and 200 mg/kg body weight (p.o.) and the standard drug glibenclamide at a dose of 500 µg/kg to study antihyperglycemic effect in ethanolic extract of *M. longifolia*. The extract exhibited a dose dependent hypoglycemic activity in all three animal models as compared with the standard antidiabetic agent glibenclamide. Finally, the study concluded that the ethanolic extract of *M. longifolia* is a high potential antidiabetic agent.⁴⁰ The antihyperglycemic activity was assessed by methanolic extract of bark in normal, glucose loaded and streptozotocin induced diabetic rats. The methanolic extract of *M. longifolia* at a dose of 100 and 200 mg/kg body weight (p.o.) and the standard drug glibenclamide at a dose of 500µg/kg were administered and the extract exhibited a dose dependent hypoglycemic activity in all three animal models as compared with the standard antidiabetic agent glibenclamide. Hence the study concludes that the methanolic extract of *M. longifolia* is a potential antidiabetic agent, lending scientific support for its use in folk medicine.⁶² The ethanolic extract of seeds of *M. indica* was effective in reducing the plasma glucose level in normal albino rats in a dose dependent manner, producing hypoglycemic effect by stimulating the release of insulin from the β -cells and/or increasing the uptake of glucose from the plasma.⁶⁵ Alloxan induced diabetic rats were used to evaluate the hypoglycemic activity of the hydroethanolic extract of the leaves of *M. longifolia*. The study concludes that the hydro ethanolic extract significantly lowered blood glucose levels.⁶⁹

ANTIINFLAMMATORY ACTIVITY

Anti-inflammatory activity of the crude methanolic extract of *Madhuca indica* (Sapotaceae) has been evaluated using carrageenan induced oedema right hind paw volume. The results suggest a potential benefit of *M. indica* methanolic extract in treating conditions associated with inflammation, pain and fever.⁴⁷ The anti-inflammatory activity of the methanol extracts of *M. longifolia* has been studied which employs carrageenan induced rat hind paw edema model. Comparatively the extract of *Madhuca* exhibits significant, dose-dependent anti-inflammatory inhibition activity to the standard drug, indomethacin.⁵⁸ The leaf extract of *M. indica* Linn. obtained by cold extraction of mixture of equal proportions of petroleum ether, ethyl acetate and methanol was chosen for pharmacological screening.

In rat paw edema model induced by carrageenan, the acetic acid induced writhing test model and radiant heat tail-flick method, the various forms of extracts showed significant inhibition.⁶³ Acetone extract of *M. longifolia* at different doses was used to study anti-inflammatory activity against carrageenan induced rat paw oedema in albino rats. Diclofenac sodium used as standard drug. The extract exhibited dose dependent activity which lends scientific support for its use in traditional medicine.⁶⁴ The ethanolic extract (EE) and crude alkaloid extract of *M. indica* seed cake on albino rats was investigated for its anti-inflammatory effect and the study indicated that both the extracts acquire dose dependent inhibitory activity on carrageenan-induced edema, inhibiting prostaglandins or mediators involved in prostaglandin synthesis, the second phase of inflammation.⁶⁵ Acute (Carrageenan-induced inflammation), sub-acute (Formaldehyde-induced inflammation) and chronic (cotton pellet inflammation) models were used to study the anti-inflammatory activity in ethanolic extract and saponin mixture of *M. longifolia* L. (Sapotaceae). Both the extracts had a more valuable response than the reference drug diclofenac sodium and the results concluded that a high anti-inflammatory activity by *M. longifolia* was shown in chronic cotton pellet granuloma model.⁶⁶

ANTIPYREXIA ACTIVITY

Normal and the yeast induced rats have been used to study the antipyretic potential in methanolic extract of *M. longifolia* and the study indicated that the methanolic extract of *M. longifolia* mimic potential antipyretic agent, proving its scientific bases for its use in folk medicine.⁶⁷

WOUND HEALING ACTIVITY

The ethanolic extracts of leaves and bark of *M. longifolia* showed potent wound healing activity when compared with the standard drug betadine and control treatment. In excision wound model, Madhuca extract treated animals showed a significant reduction in wound area and period of epithelisation.⁶⁸

NEUROPHARMCOLOGICAL ACTIVITY

The neuropharmacological activity has been studied from the methanolic extract and a triterpene, compound isolated from the leaves of *Madhuca longifolia* using phenobarbitone as a standard. Sleeping time was increased as well as there is a significant reduction in motor activity and marble burying activity which confirm its sedative nature.⁶⁹

TABLE 3
Traditional Uses of Madhuca Longifolia

| Ethnomedical uses | Place, Country | Part (s) used | Preparation (s) | Reference (s) |
|-----------------------------|----------------|----------------|---|---------------|
| Antioxidant activity | India | Leaves/Bark | Crude extract | 37 |
| | India | Bark | Ethanol | 38 |
| | India | Leaves | Methanol | 39 |
| | India | Bark | Ethanol | 40 |
| | India | Leaves | Methanol | 41 |
| | India | Bark | Methanol | 42 |
| | India | Seed | Methanol | 43 |
| | India | Leaves | Ethanol | 44 |
| | India | Leaves | Ethanol | 45 |
| Analgesic | India | Flowers | Aqueous/Alcoholic | 46 |
| | India | Aerial part | Crude methanol | 47 |
| Anticancer activity | India | Fruit/Seeds | Methanol/ Ethanol/Acetate/ Chloroform | 48 |
| | India | Leaves | Acetone | 49 |
| | India | Leaves | Acetone/Ethanol | 50 |
| Anticonvulsant activity | India | Fruit/Seeds | Methanol/Ethanol/Alcohol/ Chloroform | 51 |
| Anthelmintic activity | India | Leaves | Methanol/Aqueous | 52 |
| Hepatoprotective activity | India | Bark | Ethanol | 38 |
| | India | Leaves | Ethanol | 45 |
| | India | Leaves | Ethanol | 53 |
| | India | Bark | Ethanol | 54 |
| Immuno-modulatory activity | India | Bark | Methanol | 55 |
| | India | Leaves | Ethanol | 56 |
| Antimicrobial activity | India | Leaf/Bark | Crude extract | 37 |
| | India | Leaves/Flowers | Alcohol | 57 |
| | India | Bark | Petroleum ether/ Chloroform/ Ethylacetate/Methanol | 58 |
| Antiulcer Activity | India | Leaves | Methanol | 59 |
| | India | Flowers | Ethanol | 60 |
| Anxiolytic activity | India | Leaves | Hydro-alcoholic | 61 |
| Cytotoxic activity | India | Leaf/Bark | Crude extract | 37 |
| | India | Bark | Ethanol | 40 |
| Anti-hyper glycemc activity | India | Bark | Methanol | 62 |
| | India | Seed | Ethanol/Crude alkaloid | 65. |
| | India | Seed | Hydro Ethanolic | 69 |
| Anti-inflammatory activity | India | Bark | Methanol | 47 |

| | | | | |
|-------------------------------|-------|-------------|---|----|
| | India | Leaves | Methanol | 58 |
| | India | Leaves | Petroleum ether/Ethylacetate/ Methanol | 63 |
| | India | Leaves | Acetone | 64 |
| | India | Seed | Ethanol/Crude alkaloid | 65 |
| | India | Leaves | Ethanol | 66 |
| Antipyretic activity | India | Leaves | Methanol | 67 |
| Wound healing activity | India | Leaves/Bark | Ethanol | 68 |
| Neuropharmacological activity | India | Leaves | Methanol / compound triterpene | 69 |

CONCLUSION

M. longifolia is highly regarded as a universal panacea in ayurvedic medicine. Ethno medicinal description about the plant says to possess various activities like antipyretic, anti-inflammatory, analgesic, antidiabetic and wound healing. Hope the outcome of this review will further emphasize the existing phytochemical and

pharmacological profile of *M. longifolia* and provide a way in future for pharmacotherapeutic uses.

CONFLICT OF INTEREST

Conflict of interest declared none.

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