

Biological Properties, Phytochemistry and Traditional Uses of Mahua (*Madhuca longifolia*): A Review

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Article Info

Article history:

Received 20 July 2014

Received in revised form

30 July 2014

Accepted 20 August 2014

Available online 15 September 2014

Keywords

Ayurveda,
Phytochemistry,
Traditional use,
Madhuca longifolia,
Butter nut tree,
Sapotaceae

Abstract

Madhuca longifolia commonly known as mahua belongs to family Sapotaceae. It is also known as the butter nut tree. Mahua is a large tree, about 17m high with a large top, shady, deciduous tree. The seeds of *Madhuca longifolia* are good source of edible fats. An important economic tree growing throughout India. It contain sapogenins, triterpenoids, steroids, saponins, flavonoids and glycosides. *Madhuca longifolia* is used as stimulant, emollient, demulcent, astringent, anti-tumour, oxytocic, anti implantation, uterotonic, nutritive, anti-progestational, spasmogenic, antiestrogenic activity, anti-cancer and anti-bacterial, antiepileptic. The bark of *Madhuca longifolia* is used in the treatment of ulcers, tonsillitis, rheumatism, and bleedings. Mahua oil is used for manufacturer of laundry soaps and detergent, and also used as cooking oil in various tribal region of India. The tree is considered a boon by the tribal's who are forest dwellers and keenly conserve this tree. The tribes consider the mahua tree and the mahua drnk as paprt of their cultural heritage. The outcome of these studies will further expand the existing therapeutic potential of *Madhuca longifolia* and provide a convincing support to its future clinical use in modern medicine.

1. Introduction

Since long, the ayurvedic period, the herbal drugs were the sole source of medication for majority of population pertaining to the holistic approaches consisting of easier method of uses and better results. Despite vast continuous developments in the drug therapy, herbal sources are still of great importance and nearly 60% of the world's population continuously using such drugs. These are not only used for primary healthcare in rural areas in developing countries, but also in developed countries as well where modern medicines are predominantly available. The use of plants as a source of medicine has been inherited and is an important component of the health care system in India and abroad even in the present era. The ayurvedic treatments of several ailments have focused on the need of investigating newer but potent and safer herbal medicines for use in various afflictions of the public in general. *Madhuca longifolia* which belongs to family Sapotaceae. *M. longifolia* commonly known as Mahua, Butter nut tree. Mahua is a medium to large sized deciduous tree distributed in Nepal, India and Sri Lanka.¹ *Madhuca longifolia* is a large tree about 17 M height with a large top.² *Madhuca longifolia* is a large, shady, deciduous tree dotting much of the central Indian Landscape, both wild and cultivated. *Madhuca longifolia* seeds are of economic importance as they are good source of edible fats.³ The flowers have been traditionally used as cooling agent, tonic, aphrodisiac, astringent, demulcent and for the treatment of helminthes, acute and chronic tonsillitis, pharyngitis and bronchitis.⁴ *Madhuca longifolia* leaves are expectorant and also used for chronic bronchitis and cushing's disease.⁵ *Madhuca*

longifolia is one of those multipurpose forest tree species that provide food, fodder and fuel.⁶

2. Taxonomy

Botanical Name	:	<i>Madhuca longifolia</i>
Family	:	Sapotaceae
Subfamily	:	Caesalpinioideae
Tribes	:	Caesalpinieae
Genus	:	Madhuca
Species	:	longifolia
Order	:	Ericaleae

3. Traditional Uses

The bark of *Madhuca longifolia* is used for rheumatism, chronic bronchitis, decoction for rheumatism, bleeding and spongy gums.⁷ It is a good remedy for itch, swelling, fractures and snake bite poisoning, internally employed in diabetes mellitus,⁸ fruits are astringent and largely employed as a lotion in chronic ulcer, in acute and chronic tonsillitis and pharyngitis.⁹ The seeds cake is used as anti-inflammatory, antiulcer and in hypoglycemic activity. Bark of *Madhuca longifolia* is very useful for the treatment of diabetes, rheumatism, bleeding spongy gums, ulcer and tonsillitis.¹⁰ The leaves play a very important role for wound healing, hepatoprotective, antioxidant, antimicrobial, astringent, stimulant, emollient, demulcent, rheumatism, piles, nutritive, verminosis, gastropathy, dipsia, bronchitis, dermatopathy, cephalgia, hemorrhoids and cushing's disease. The roots of *Madhuca longifolia* have antipyretic, anti-inflammatory properties. Internally roots are used in phthisis and scrofula.¹¹ the root powder is useful in diarrhea and other chronic fluxes. The root have antioxidant activity and also given in debility.

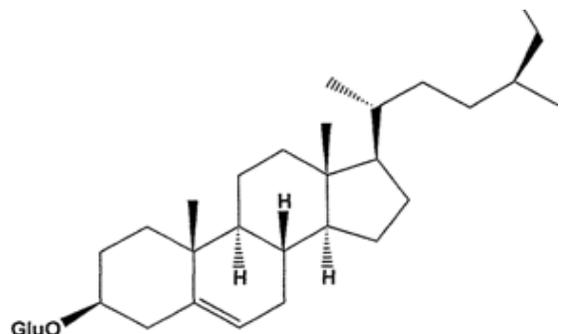
Corresponding Author,

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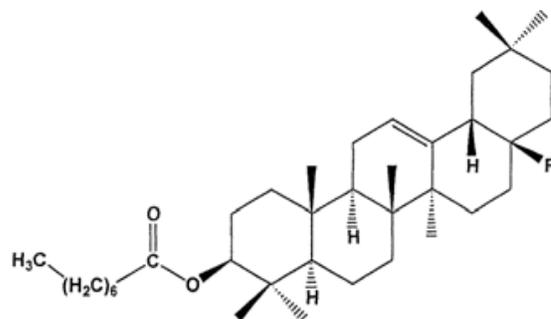
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4. Phytochemistry

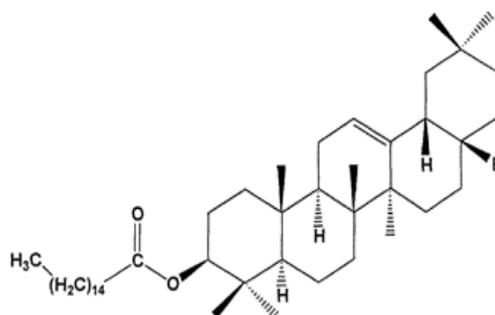
Sr. N.	Part Of Plant	Chemical Constituent	Ref. N.
1	Leaves	Dglucoside, stigmasterol, β -carotene, xanthophylls, erythrodiol, palmitic acid, myricetin, 3- O-arabinoside, 3-O-L-rhamnoside, quercetin, 3-galactoside; 3 β -caproxy and 3 β -palmitoxy- olean-12-en-28-ol, oleanolic acid, β -sitosterol, 3-O- β -Dglucoside, 3 β -caproxyolcan- 12-en-28-ol, β -carotene, n-octacosanol, sitosterol, quercetin, β -sitosterol- β -Dglucoside, n-hexacosanol.	12, 13, 14, 15, 16, 17, 18, 19,
2	Bark	Ethylcinnamate, sesquiterene alcohol, α -terpeneol, 3 β -monocaprylic ester of erythrodiol and 3 β -capryloxy oleanolic acid. α - and β -amyrin acetates.	20, 21, 22, 23
3	Seeds	Myricic, palmitic and stearic acids, α -alanine, aspartic acid, cystine, glycine, isoleucine and leucine, lysine, methionine, proline, serine, threonine, myricetin, quercetin, Mi-saponin A, saponin B, arachidic, linolelic, oleic.	24, 25, 26, 27
4	Fruits	n-hexacosanol quercetin and dihydroquercetin, β -sitosterol and its 3 β -Dglucoside, α - and β - amyrin acetates.	28, 29, 30, 31
5	Flower	Vitamins A & Vitamins C	32



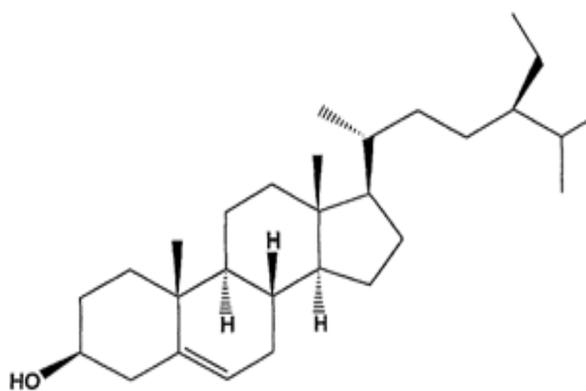
β -D-Glucoside of β -sitosterol



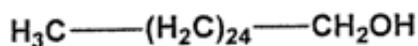
Erythrodiol 3 β -caprylate R=CH₂OH
Oleanolic acid 3 β -caprylate R=COOH



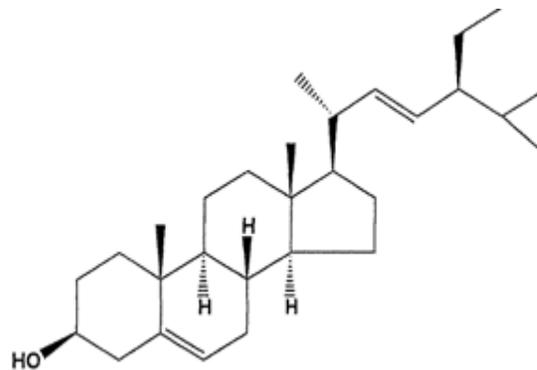
3 β -Palmitoxy-olea-12-en-28-ol R=CH₂OH
Oleanolic acid palmitate R=COOH



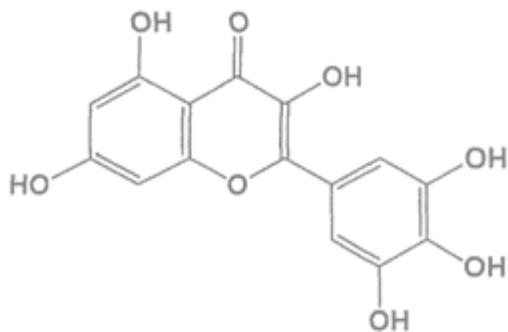
β -Sitosterol



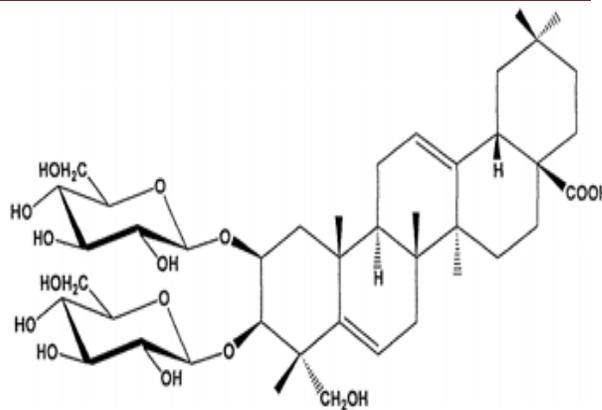
n-Hexacosanol



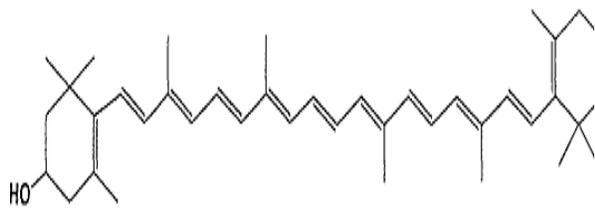
Stigmasterol



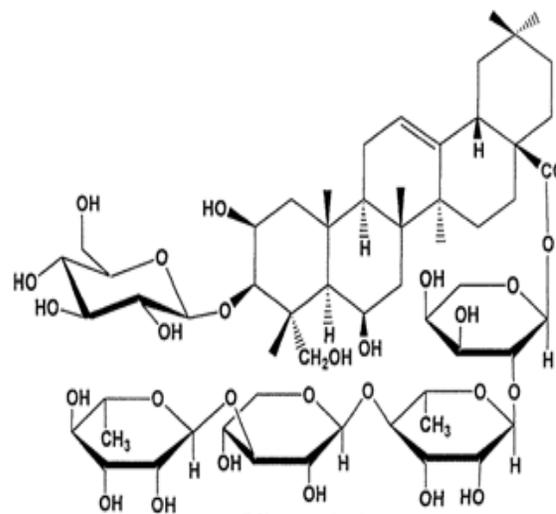
3,3',4',5,5',7-Hexahydroxyflavone
(Myricetin)



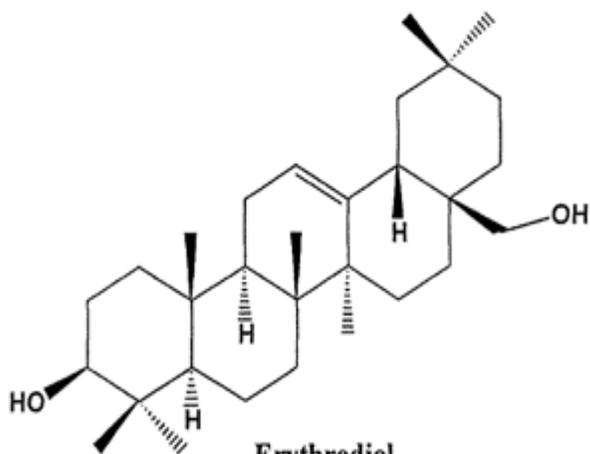
2,3-Di-O-glucopyranoside of bassic acid
(Saponin A)



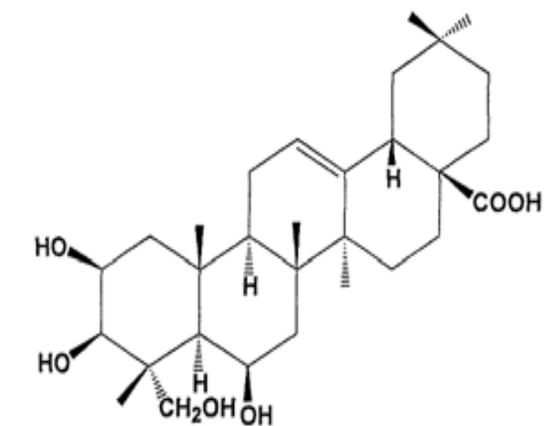
Xanthophyll



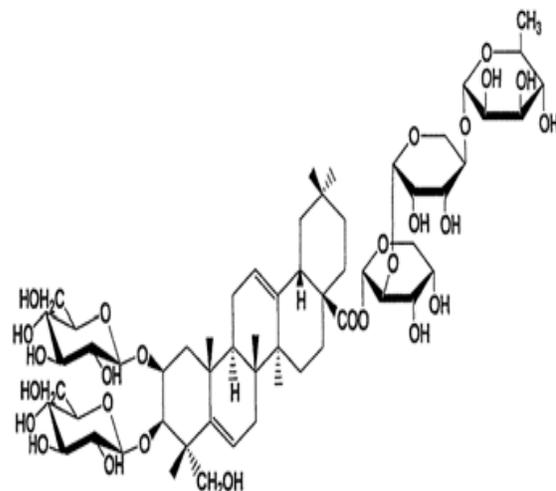
Mi-saponin A



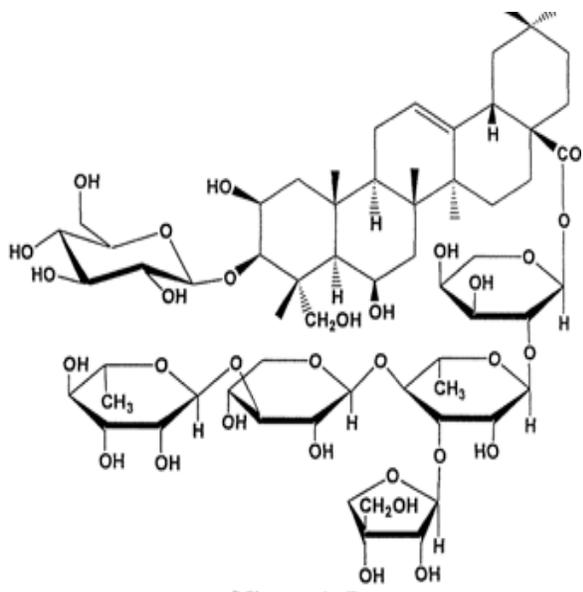
Erythrodiol



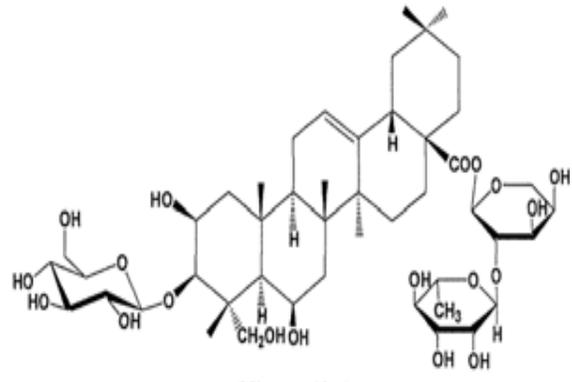
2β, 3β, 6β, 23-Tetrahydroxy-12-oleanen-28-oic acid
(Protobassic acid)



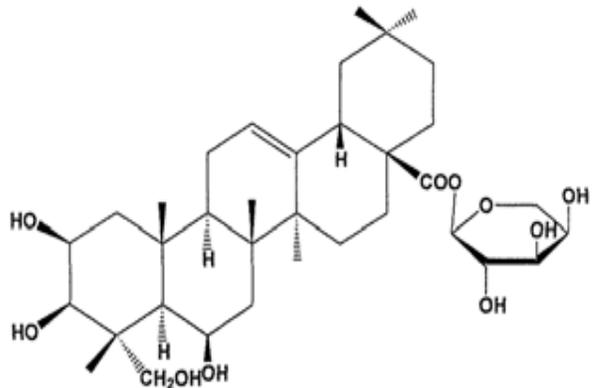
Rhamnopyranosyl 1 → 4 xylopyranosyl 1 → 2 arabopyranosyl 1 → OOC (28)
of saponin A
(Saponin B)



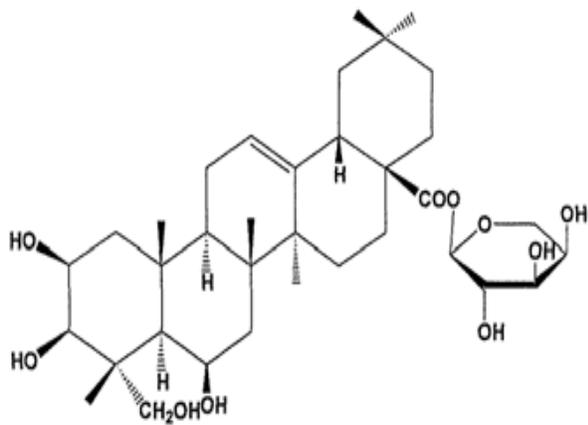
Mi-saponin B



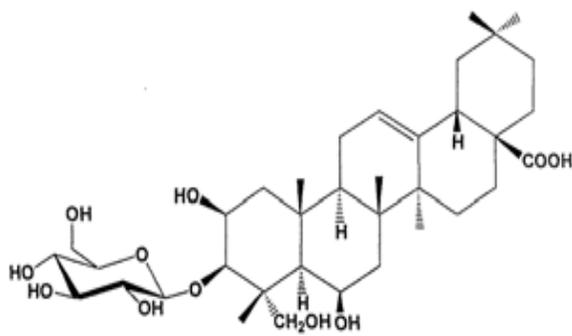
Mimusopside A



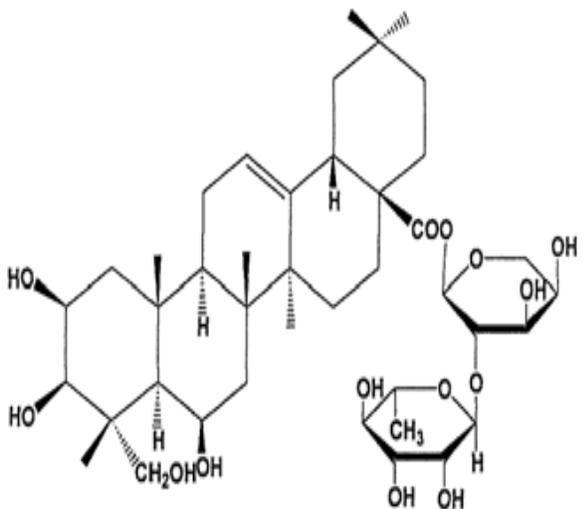
Madlongiside C



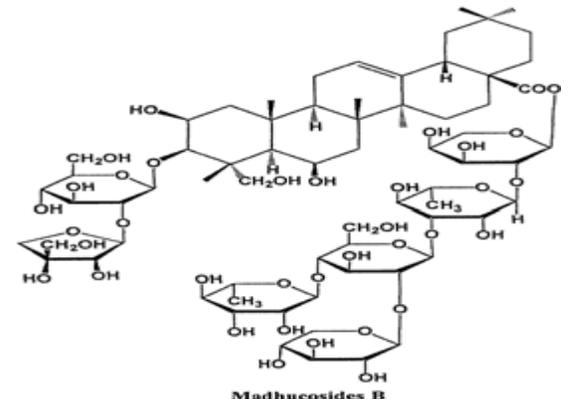
Madlongiside C



3-O-β-D-Glucopyranosyl protobassic acid



Madlongiside D



Madhucosides B

5. Biological Properties

5.1 ANTI-INFLAMMATORY ACTIVITY

The reason of the generation of the swelling or inflammation is release of the various chemical mediators from the damaged cell like histamine and serotonin.³³ Inflammation is a defensive mechanism of the body.³⁴ The most important mechanism of anti-inflammatory drugs is considered to be inhibition of PG synthesis at the site of injury. The anti inflammatory potency of drugs is corresponds with their potency with to inhibit the COX.³⁵ As more inhibition of COX means the anti inflammatory activity of that particular plant is more. The *Madhuca longifolia* is found to be a good remedy for treatment of the inflammation, its aerial parts is utilized for the treatment of inflammation. The plant material (50 g) was extracted with 100 ml of methanol for 24 hrs using soxhlet apparatus. Thus, extract were filtered and concentrated under vacuum sounding apparatus for 30 min. when this solution was given to the male vistar rat which was already having inflammation showed a satisfactory result.³⁶ Anti inflammatory effect can be measured as the percent inhibition of inflammation and calculated with reference to negative control.³⁷

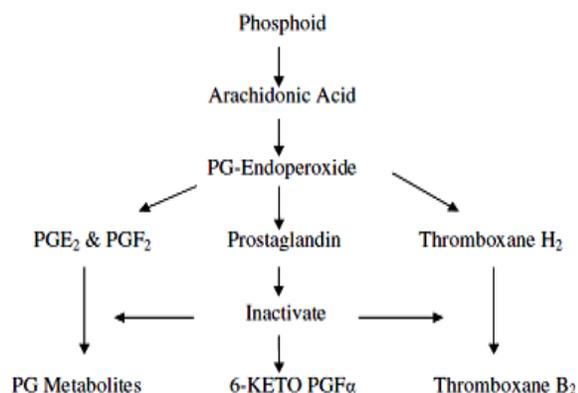


Fig. 1. Biosynthesis and Metabolism of Prostaglandin

5.2 ANALGESIC ACTIVITY

Analgesics are the agents that relieve the sensation of pain without disturbing consciousness or altering other afferent inputs.³⁸ Analgesic activity was evaluated on the acetic acid induced writhing. The methanolic extract of *Madhuca Indica* 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 analgesia is expressed as the reduction of the number of abdominal constriction between control animal and mice pretreated with the extract.³⁹ In other words if the analgesic drug works the abdominal contraction will be the less in numbers. The analgesic activity of the *Madhuca Indica* can also be evaluated by the using other method of evaluation like tail flick method or hot plate method in rats.⁴⁰ Significant reduction either in the reaction time hot plate, tail flick, gradient heat, abdominal constriction compared with vehicle treated animals was consider as anti nociceptive response.⁴¹

5.3 ANTIPYRETIC ACTIVITY

Mahua 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 animal 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 <0.60c were discarded. Rectal temperature was then recorded at 20-24 hr after yeast injection. After some time interval it is found in the reduction in the rectal temperature of rat, which shows the antipyretic effect of *Mahua*.⁴²

5.4 ANTI-HYPERGLYCEMIC ACTIVITY

The significant hypo-glycemic effects of *Mahua* bark in diabetic rats indicate that this effect can be mediated by stimulation of glucose utilization by peripheral tissues. The results of the present study clearly indicated the ethanolic extract of *Mahua* bark to have a hypoglycemic effect on STZ induced diabetic rats.⁴³ In all groups except for glibencl 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.⁴⁴ Methanolic extract of *Madhuca* have significantly decreased the serum glucose level in streptozotocin and STZ-NIC induced diabetic rats.⁴⁵ The crude methanolic extract of *Mahua* leaves demonstrated dose-dependent reductions in serum glucose level following administration in glucose-loaded mice. The decreases in serum glucose levels were found to be significantly reduced at doses of 100, 250, and 500 mg extract per kg body weight. At these doses, the extract reduced serum glucose levels.⁴⁶

5.5 ANTI ULCER ACTIVITY

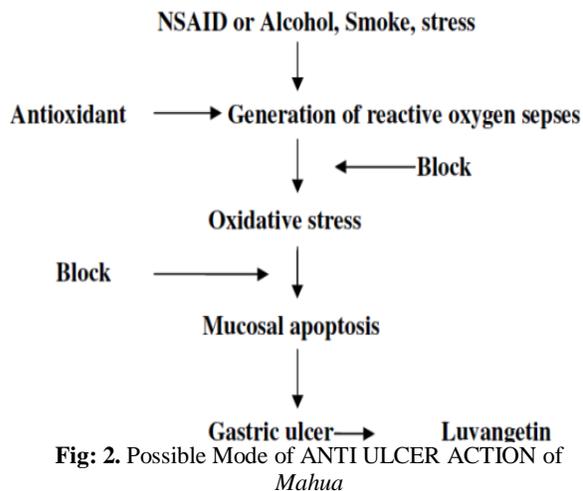


Fig. 2. Possible Mode of ANTI ULCER ACTION of *Mahua*

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.⁴⁷ 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 upper part that is called surface of an organ or the tissue.⁴⁸ Anti ulcer activity has been proved in *Madhuca Indica* plant while it is tested in the male vistar rat.⁴⁹ 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 of the tested plant materials.

5.6 ANTIOXIDANT ACTIVITY

Oxidative stress is produced during normal metabolic process in the body as well as induced by a Variety of environmental and chemical factor, which cause a generation of a various reactive free radical and subsequent change in DNA and lipids.⁵⁰ The reducing property of ethanolic bark extract of *Madhuca Indica* implies that it is capable of donating hydrogen atom in a dose dependent manner.⁵¹ The high content of phenolic compounds in the extract may be a contributing factor towards antioxidant activity because the phenol compounds are known to have direct antioxidant property due to the presence of hydroxyl groups, which can function as hydrogen donor. The reducing capacity of a compound may serve as a significant indicator of its potential antioxidant activity.⁵² The anti oxidant potency of any drug depends upon the two mechanism, first to prevent the oxidation by oxidizing itself or second by creating a layer of protection over the material.

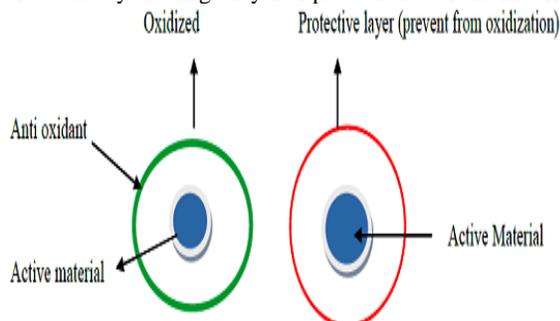


Fig: 3. Possible Mode of Action of Antioxidant

5.7 ANTI FERTILITY ACTIVITY

The percentage of fertile male mice and the number of pregnancies were significantly reduced in atropine induced mice from control mice in present case 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.⁵³

5.8 DERMATOLOGICAL USE

Due to the present atmospheric condition and pollution skin related problem are emerging day by day, and there are

few synthetic lotion and cream are available for it, but they cause several other side effect like rashes and itching too. That's why the use of medicinal or natural plant is much safer and convenient. The decoction of the bark is useful in itching and ulceration, the oil is obtained from the seed, which is useful in the several allergic disorders. It is also used as laxative.⁵⁴

5.9 HEPATOPROTECTIVE ACTIVITY

The methanol extracts of *Madhuca Indica* bark is studied for hepatoprotective activity against albino rats with liver damage induced by carbon tetrachloride (CCl₄). It was found that the methanol extract of *Madhuca Indica* bark at a dose of 300 mg/kg body weight exhibited moderate protective effect by lowering the serum levels of Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxaloacetate Transaminase (SGOT), Serum bilirubin and Serum alkaline phosphate (SALP) to a significant extent. Present finding demonstrated the methanolic bark extract of *Madhuca Indica* could afford significant dose-dependent protection against CCl₄ induced hepato cellular injury.⁵⁵

5.10 ANTIBACTERIAL ACTIVITY

The flower has an antibacterial activity against the *Escherichia coli* and resist against rice pest disease.⁵⁶

5.11 ANTIEPILEPTIC ACTIVITY

The anticonvulsant activity of the methanol extract of heart wood of *Madhuca longifolia* was assessed in pentylenetetrazole (PTZ) - induced convulsion in mice with benzodiazepine as standard drug. Mechanistic studies were conducted using flumazenil, a GABA-benzo-diazepine receptor complex site antagonist, and naloxone a non-specific opioid receptor antagonist. *Madhuca longifolia* at the dose of 400 mg/kg prolonged the onset time of seizure and decreased the duration of seizures compared to saline group.⁵⁷

5.12 ANTICANCER ACTIVITY

In Ayurvedic system of medicine it is stated that the bark of *Madhuca Indica* is useful in the treatment of cancer at the local application.⁵⁸

5.13 TOXICITY

Like all word views, it is not entirely without foundation- the safety risk of herbal medicine is generally lower than most of the modern drug. A mixture of saponin isolated from *Madhuca longifolia* seed did not reveal any cholinergic activity, although it produced at a higher concentration. The saponin is extremely toxic when administered parentally. L.D. 50 by IP route was one of the same orders as that by the IV route, being 50 to 70 times higher than oral route. In the root of *Madhuca Indica*, maximum amount of phenol was observed i.e. 46.0 mg/gdw. These compounds play an important role in the precursor of toxic substance and role in the growth regulation and development of plants. It is also reported to have toxic chemical aflatoxine in *Madhuca Indica* seed oil. The quality control of herbal medicine should be strictly followed to avoid any harmful effect.⁵⁹

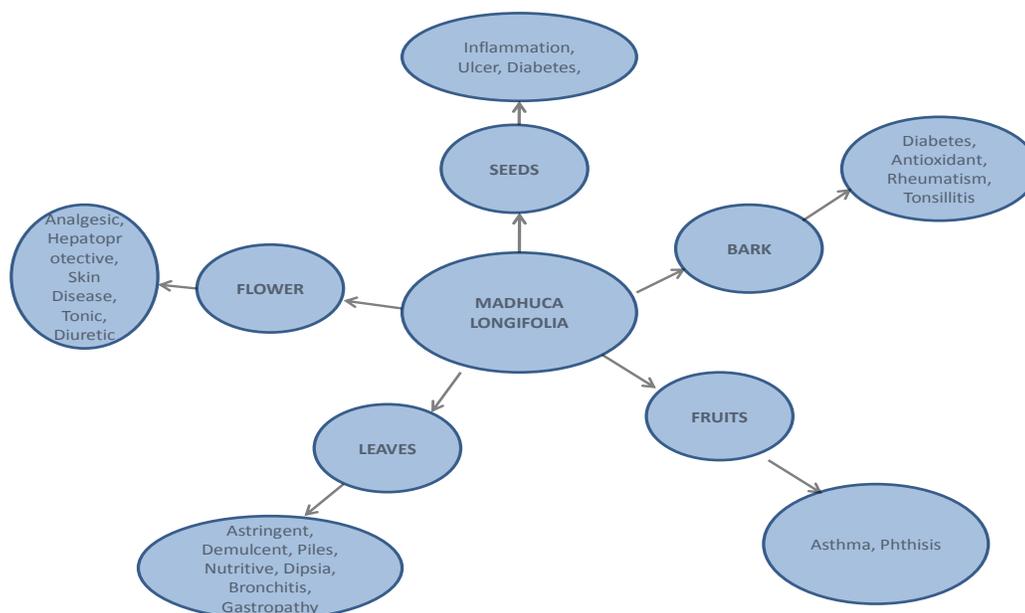


Fig. 4. Biological activity of Mahua

6. Conclusion

World is endowed with a rich wealth of medicinal plants. Medicinal plants also play an important therapeutical role in the lives of rural people, particularly in remote parts of developing countries with few health facilities as well as the urban people. Medicinal plants are the local heritage with the global importance. Presently there is an increasing interest worldwide in herbal medicines accompanied by increased laboratory investigation into the pharmacological properties of the bioactive ingredients and their ability to treat various diseases. Numerous drugs have entered the

international pharma market through exploration of ethnopharmacology and traditional medicine. Although scientific studies have been carried out on a large number of Indian botanicals, a considerably smaller number of marketable drugs or phytochemical entities have entered the evidence based therapeutics. Efforts are therefore needed to establish and validate evidence regarding safety and efficacy of Ayurvedic medicines. The outcome of these studies will further expand the existing therapeutic potential of *Madhuca longifolia* and provide a convincing support to its future pharmacotherapeutic use in clinical set up.

Acknowledgement

The authors are thankful to Hon'ble Chancellor, Teerthanker Mahaveer University, Moradabad for providing

literature survey facility to carry out the work. The work is dedicated to all my teachers.

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