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Review on Medicinal Importance of *Butea monosperma* Lam. (Taub)

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ABSTRACT

Butea monosperma is a renowned therapeutic plant, a medium size deciduous tree broadly dispersed in India, Bangladesh, Cambodia, Myanmar, China South-Central, Nepal, Laos, Sri Lanka, China Southeast, Pakistan, and Vietnam. *Butea monosperma* is being used in customary medication preparation from the pre historic period. It is acknowledged as the forest's flame and is often branded as Dhak or Palash. It is described in Upanishads, Susruta Samhita, Vedas, Ashtanga Sangraha, Astanga Hridaya, and Charka Samhita. It belongs to the family of Fabaceae, which has an extensive range of vigorous principles, and it has phytoconstituents such as glycosides, flavonoids, etc. This revisional analysis is focused on the pharmacological actions, mainly shown by seeds, flowers, fruits, barks, leaves, etc., like anti-diabetic, anthelmintic, hepatoprotective, anti-stress, anti-implantation, anti-convulsant, wound healing, giardiasis, anti-oxidant, anti-dopaminergic, anti-microbial, sunscreen, anti-diarrheal, free radical scavenging, anti-filarial, anti-fungal, nephroprotective, protease inhibitor, osteogenic, hemagglutinating, anti-ulcer, giardiasis, anti-asthmatic, anti-inflammatory, anti-fertility and anti-cancer activity. GC-MS analysis of *Butea monosperma* shows the attendance of important compounds which is volatile and HPLC analysis for non-volatile, which supplies light to its medicinal properties. These therapeutic chattels may provide impending active principles with advanced usefulness and the leastafter-effects as equated to accessible artificial drugs.

Keywords: *Butea monosperma*; GC-MS; HPLC; Pharmacological activity; Phytoconstituents

1. INTRODUCTION

Nowadays, Naturals products are playing a principal role all around the world by preventing and curing human diseases. Traditional medicines are being utilised for a long and it narrates a bunch of healthcare products and practices. These medicines have always been mentioned for medicinal information evolved by ancient cultures that integrate animal, plant, and mineral-based remedies, mystical therapies, and physical modus operandi planned to support welfare or treat diseases. Traditional medicines are being utilised beyond allopathy, a famous way of medicine these days. *Butea monosperma* (here in after referred to as "BM" in some places) is recognised as an extensive structure of healthcare in many cultures for hundreds or thousands of years. Ayurvedic medicine, Unani medicine, and Chinese medicines are the best examples of traditional medicines and Dhak plant is one of them. In the world, the population of 80 % depends on Herbal medicines.[1,2]

Butea monosperma plays a significant role to increase the importance of these herbal medicines. This tree was known commonly during the Vedic era as kimsuka, which means a parrot as probably the Palash plant flower has some resemblance to a parrot.[3] The Palash plant flower is orange in color shown in (Fig. 1).

Palash is an average-height broad-leaved tree that is progenies of the 'Fabaceae'. This is also recognised as bastard teak and "forest's flame". Local communities and tribals call the tree of Palash such as Mutthuga, Khakhra, Bengal kino, Tesu, Chichra Bijas, Sneha, and Dhak. This tree also grows all around the world including the Indian subcontinent. It is also referred to in this tree that this is a descent of god 'Agnidev' when he was punished by the goddess Parvati for interrupting the privacy of goddess Parvati and Lord Shiva. The tree of Palash grows up to the height of 50 ft with attractive bunches of its flowers. The tree losses its leaves when it develops the flowers, and it generally happens from January to march.

The Palash leaves are recycled for manufacturing pattal (leaf plates) and Donnas (cups) for rural celebrations. It is also used for making biddies (Villagers' cigarettes) in some parts of India by raping the tobacco in the leaf. The foliage of Dhak plant leaves is impatiently eaten by the cattle. The color of the Palash plant fruit is light green as displayed in (Fig. 2). The Dhak plant seed is large as displayed in (Fig. 3) and flattened commonly known as 'Pit-papra' or 'Palas-papra' which is anthelmintic[4]. Oil is also prepared from the Dhak seed, which is yellow in color and called

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"kino oil". This oil is tasteless and shows remarkable antimycotic and prophylactic effects[5].The bark of the Palash plant is utilised for rough cordage when it yields a kind of brown color fibers. The Palash plant bark is deep brown in color as displayed in (Fig.4).

Figure 1. Dhak plant flower.

Figure 2. Dhak plant fruit.

Figure 3. Dhak plant seeds.

Figure 4. Dhak plant bark.

The tree gum, generally known as Bengal kino, is desiccated juice acquired from slitting the trunk of the tree which possesses a caustic effect. The tree gum is called 'Kamar-kasin' which is used in many food dishes. It is measured as worthy by the druggist due to its harsh quality and by the leather workers due to the existence of tannin. The gum is the best substitute for 'Kino gum'.[6]

The red and orange dye yielded from Dhak plant flowers is known for insect repellant properties and for making color. Minerals are also playing a significant role because it also shows therapeutic effects in human, considered by many studies and it also supplies color to herbal products. Palash flowers are rich in minerals like (a) zinc, which plays a key role in stabilizing membranes (b) copper, important for red blood cells formation (c) chromium, important for neuromuscular system transmission (d) manganese, important for the development of hemoglobin and minimum amount of (e) lead.[7] The tree of Palash is the best army for the lac beetle and thus it is convenient to produce natural lac with its help. Almost all fragments have both remedial as well as pecuniary importance.[8]

2. PHYTOCONSTITUENTS

BM has the potential to make a prominent place in the pharmacological industry because of its chemical constituents which have existed in the various parts of the plant. Seeds contain flavone glycoside, which is antiviral in nature.[9] Flowers are rich in antifungal flavone glycoside, which is effective against *Fusarium oxysporum, Aspergillus niger, Penicillium digitatum,* and *Trichoderma viride*[10] β-sitosterol reported in the seed oil of BM, which is anti-inflammatory in nature.[11] Bark contains kino tannic acid which is astringent in nature; Histidine, which plays a key role in manufacturing blood cells; lupenone, which is known for their anti-viral, anti-inflammatory, anti-diabetic chattels; lupeol, which is utilised for acne treatment and medicarpin, which has anti proliferative activity.The root has glucose, glycosides, glycine, and aromatic compound.

3. PHARMACOLOGICAL ACTIVITY

3.1 Anti-diabetic Activity

Diabetes was one of the foremost causes of death in the year 2019 means a prediction of 1.5 million deaths unswervingly triggered by diabetes, which placed it in the ninth position in the ranking of deaths that happened in that year[13]. Major worries of cirrhosis lead to diabetes, mome inositol, which is displayed in (Fig. 5), is well known anti-cirrhotic compound and gamma. Sitosterol, which is displayed in (Fig. 6), is anti-diabetic in nature help in lowering blood sugar existed in the bark of BM.[14,15] Dhak flower's methanol excerpt in contradiction of extraordinary alimentary nutrition and streptozotocin-tempted diabetic rats has shown anti-diabetic activity and lipid-lowering.[16]

Figure 5. Gamma-Sitosterol (414 g/mol).

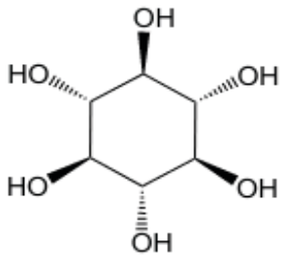

Figure 6. Mome Inositol (194 g/mol).

An investigation was conducted on the ethanolic excerpts of Dhak leaves. It was noticed in Type 2 diabetic rats that there was an increase in the level of blood insulin. The interesting fact of the investigation is the formation of hepatic glycogen and secretion of insulin in isolated rats.[17]

The powder of Dhak fruits was administered orally at various dosages in usual and diabetic subjects and it not only shows a noteworthy decrease in blood glucose, LDL cholesterol, urine sugar, and total lipids but also showed an upsurge in HDL cholesterol.[18]

In a study, methanolic excerpts of Dhak fruits at the dose of 3 gm/30 ml of water for 30 days have shown a reduction in blood urine sugar, glucose levels, and plasma glycoprotein. It has also shown a decrease in lipid profile and the rebuilding of liver enzymes activities, which suggests probable anti-diabetic effects.[19]

Diabetic rats which have alloxan show decreased levels of blood-sugar, when treated with 200 mg/kg ethanolic excerpt of Dhak single dose. When this dose is continued for two weeks shows a lessening in serum cholesterol, blood glucose, and triglyceride and an augmented level of total protein, albumin, and HDL-cholesterol when equated to the diabetic controller assembly.[20]

3.2 Anti-Diarrheal Activity

The different enormousness management of ethanol excerpt of BM stems bark at the bouts of 400 mg/kg and 800 mg/kg inhibited gastrointestinal motility and PGE2-induced enteropooling and caused castor oil-induced diarrhea. This solution is used in traditional treatment as an representative of nonspecific antidiarrhea. In this treatment loperamide was the standard antidiarrheal drug.[21]

3.3 Anthelmintic Activity

A total of 24 % of the universal biosphere's populace is septic with soil-transmitted helminth contaminations resulting in infection in more than 1.5 million.[22]

The GC-MS scrutiny of the Dhak seed shows the seed is rich in anthelmintic compound[23] i.e., Benzothiazole, 2-(2-hydroxyethylthio) as displayed in (Fig. 7) and Milbemycin B as displayed in (Fig. 8).

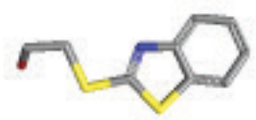

Figure 7. Benzothiazole, 2-(2-hydroxyethylthio) (211.3 g/mol).

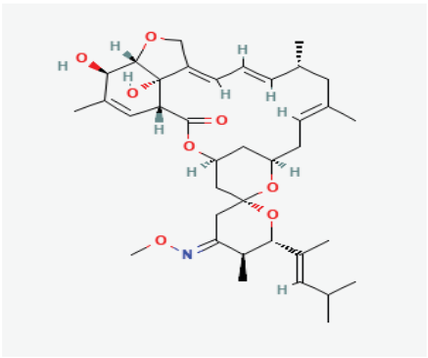

Figure 8. Milbemycin B (639.8 g/mol).

The anthelmintic effect was seen when methanol excerpts of Dhak seeds were treated against Caenorhabditis elegans.[24]

Shade-dried seed crude excerpt of BM at the doses of 1, 2, and 3 g/kg given to the sheep are effective against parasitic worms which are available in the Gastrointestinal tract. The reduction of eggs in feces increased in bout reliant manner. Levamisole is used as a standard anthelmintic agent.[25]

3.4 Hepatoprotective Activity

The aqueous excerpt of Dhak flowers is screened for hepatoprotective activity in CCl4 (1.5 ml/kg, i.p) prompted hepatotoxicity at dissimilar doses i.e., 200, 400, 800 mg/kg p.o. The CCl4 can cause live cirrhosis and necrosis. Consequently, the administration of CCl4 has altered the number of biochemical boundaries such as protein, albumin, hepatic sterol peroxidation, abridged glutathione, and overall protein levels. It was seen that Dhak has reestablished the entire transformed biochemical limits including histo-pathological changes in the dose-dependent method.[26]

The methanol excerpt of BM stem bark at the doses of 200 mg/kg and 400 mg/kg were significant to decrease

the level of SGPT, SGOT, ALP, and TB and increase the level of TP in the CCl4 tempted hepatotoxicity in male albino rats, which shows the hepatoprotective effect of BM. Liv-52 is used as a standard drug.[27]

BM hydroalcoholic excerpt of the stem bark at the doses of 100 mg/kg and 200 mg/kg decrease the level of hepatotoxicity in comparison to the CCl4-induced group. This hepatotoxic effect of BM is due to the attendance of phytochemical constituents which have gallic acid, pyro catechin, and kino-tannic acid.[28]

3.5 Anti-stress Activity

The ethanolic excerpt of part of *Butea monosperma* i.e., water-soluble was found to be beneficial in dropping the water obsession stress induced extraordinary deliberation of serotonin and plasma cortico-steroidal hormone.[29]

3.6 Anti-implantation Activity

A weak estrogen namely Butin, which can be recognised at 1/20th part of the contraceptive dose, was sequestered from the influence of Dhak seed and was given to female rats at several doses (5, 10, and 20 mg/ rat/ day) for first five days of pregnancy and it shows contraceptive activity in the treated rats and presented anti-implantation activity at the rate of 40 %, 70 %, and 90 %. Alcoholic excerpt of *Butea monosperma* has also shown anti-fertile activity.[30]

3.7 Anticonvulsant Activity

Epilepsy is identified as the most collective neurological disease as around 50 million publics worldwide have epilepsy.[31]

An investigation was conducted on the ethanolic excerpts of *Albizzia lebbeck* leaves and Hibiscus rosa sinensis flowers and on the petroleum ether excerpt of Dhak flowers. The petroleum ether excerpt of Dhak has revealed anticonvulsant commotion. The acetone decipherable part of the petroleum ether extract of the Dhak flower was used in the investigation. The largest electroshock electrical sparking penty lenetetrazole and lithium-pilocarpine were tempted to the fractions dwindling animals. It was found that it was botched to shield animals from strychnine-induced paroxysms. The substances of Gamma-Amino Butyric Acid (GABA) and serotonin have increased brain content.[32]

A study was held on the ethanolic excerpt of Dhak bark and leaf. It shows anticonvulsant consequences in pentylene tetrazole and the largest electroshock seizure models[33].

3.8 Wound Healing Activity

The investigational impost of wound healing activity of ethanolic excerpt and acetone segment of Dhak stem (bark) exhibited notable wound healing commotion. It was manifested by the enhanced speed of wound shrinkage, the decline in the phase of epithelialisation, and growth in albuminoid installation[34].

A treatment was conducted on the rats for the evolution of cutaneous wound healing movement of the alcoholic excerpt of Dhak bark for the investigation a full chunkiness expurgation bound wound was made on the posterior (back) side of the rat. The granulation tissues which were molded post-wound on the 4th, 8th, 12th, and 16th days were used to calculate the DNA, entire collagen hexosamine protein, and uronic acid. It was found that this treatment has augmented cellular propagation and collagen combination on and around the wound. It was shown by the enlargement in DNA, total collagen, and total protein content of granulation tissues. The excerpt inhibited the wound healing activity in the rats much better and speedier than in other animals. Antioxidant properties were the reason behind the wound-healing activity of BM[35].

After 18 days of treatment wound area of Albino rats shows epithelialisation by a methanolic excerpt of Dhak flowers. 10 %w/w excerpt is more effective as compared to 5 %w/w. Soframycin is used as a standard drug[36].

3.9 Giardiasis

Dibutyl phthalate, as displayed in (Fig.9), isan anti-parasitic compound available in the Dhak bark.[14]

Figure 9. Dibutyl phthalate (278.34 g/mol).

A protozoal parasite, *Pippalli rasavana* (PR), and *Girudia lambia* cause a common gastrointestinal infection namely Giardiasis. The ash of roots, stems, leaves, and Dhak flowers was assorted with *Piper longum* (Pippali) for preparing herbal ayurvedic medicine. It was seen that the medicine has caused 98% recovery from the infection by showing significant activity against Giardiasis. The PR had no hostile consequence on the organism in vitro. It persuaded remarkable actuation of macrophages as proven by augmented Macrophage Migration Index (MMI) and phagocytic commotion with higher doses of PR reclamation enhanced up to 98 % at 900 mg/KG.[37]

3.10 Anti-dopaminergic Activity

In rats, induced foot shock aggression was reduced by Dhak methanolic excerpt due to the presence of iso flavone which exhibited antidopaminergic activity. In presence of vehicle-treated mice, the haloperidol-induced cataleptic response was produced at 60 min, and in ME, EAS, and FEAS haloperidol-induced catalepsy was maintained up to 180 min in which the number of 3 min fights in mic reduced by ME, EAS, and FAS at

treatment level of 50 and 100 mg/kg i.p. in comparison with the vehicle-treated group[38].

3.11 Anti-microbial Activity

The Dhak leaf excerpt with different solvents showed significant antimicrobial activity in the Kirby-Bauer agar-well diffusion method. The largest MIC seen in *K. pneumoniae* is 13.30 µg/ml in the petroleum ether excerpt and the minimum is seen in *P. aeruginosa* in the petroleum ether excerpt, *Citrobacter* species in the acetonic excerpt, *S. typhi* in the methanolic excerpt, and *Enterococcus* in water that is 0.52 µg/ml[39].

Investigation on flowers of BM resulted in the isolation of 12 flavonoids such as dihydrochalcone, and dihydromono-spermoside together with 3 chalcones, 1 flavone, 4 flavanones, and 3 isoflavones has shown antimicrobial activity. The chalcone butein demonstrated uppermost antimicrobial activity through MIC of 12.5 µg/ml and the MIC value of other flavonoids ranges between 25 to 100 µg/ml. kanamycin sulfate, isoniazid, and rifampicin are used as standard drugs[40].

The ethanolic and aqueous excerpt of the bark of BM shows antibacterial commotion contrary to gram-positive bacteria i.e., *Bacillus subtilis*, and gram-negative bacteria, i.e., *Pseudomonas aerogenosa* and *E. coli.* The largest zone of inhibition is shown at 1000 mg/ml in the ethanolic and aqueous excerpt.[41]

Ethanolic excerpt of flowers of BM (10 mg/disc) shows antimicrobial action against *E. aerogenes*, *Pr. vulgaris*, *S. aureus, K. pneumoniae*, Ps. aeruginosa, *S. typhimurium, S. paratyphi, S. typhi, and Sh. flexneri*. The largest zone of inhibition shows in contradiction of *E. aerogenes*, *Ps. aeruginosa*, *S. typhi* and *S. paratyphi*[42].

Petroleum ether and methanol excerpt of Dhak gum show antimicrobial activity in contradiction of *Bacillus cereus, Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Saccharomyces cerevisiae*, and *candida albicans*. No zone of inhibition was reported against *Salmonella typhimurium* and *Escherichia coli.* ciprofloxacin and amphotericin B are used as standard drugs[43].

The Dhak plant leaf excerpt shows antibacterial activity against gram-negative bacteria, i.e., *Pseudomonas aeruginosa, Salmonella typhi, Enterobacter aerogens, Escherichi coli,* and *Protease staphylococcus aureus.* This excerpt was also antifungal against *Aspergillus niger* and *Rhizopus stolonifera*. The largest zone of inhibition was reported against the bacteria *Pseudomonas aeruginosa* and the minimum against Fungus *Aspergillus niger*[44].

The ethyl acetate and petroleum excerpt of BM stem bark have shown anti-fungal activity towards *Cladosporium cladosporioide* as compared to the standard drug Benlate. The medicarpin was the responsible chemical constituent for the occurred anti-fungal activity.[45]

Methanolic excerpt of Dhak leaves are effective against both bacterial strain such as *Salmonella typhi, Pseudomonas aeruginosa, Salmonella typhi B, Salmonella typhi A*, *Enterobacter aerogens, Protease vulgaris, Escherichia coli, Bacillus megaterium, Bacillus subtilis, Bacillus cereus,* and *Staphylococcus aureus* and fungal strain such as *Aspergillus niger* and *Rhizopus stolonifera*[46].

3.12 Sunscreen Activity

A concentrated cream, which has contents of BM leaves excerpts, can defend against UVA and UVB rays showing the presence of sunscreen activity. The concentration generated from the incorporation of several formulations of excerpts can be applied as per contrasting skin types according to sun protection factor value. The maximum protection shows against UVA and UVB with 1.5 % and minimum at 0.5 % formulation of cream[47].

3.13 Free Radical Scavenging Activity

Querecetin is available in the root, which has free radical scavenging activity reported in HPLC analysis.[48]

The Dhak seed rich in anti-oxidant compounds i.e., Diphenylamin, 3,3',4,4'-tetrahydro-1,1'2,2'tetra hydro1,psi.,.psi.-Carotene, 1'' and Benzenamine, 4-(1-methylethyl)-N-phenyl-amine[23]. The Diphenylamine (169.22g/mol) is shown in (Fig. 10)

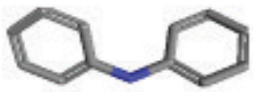

Figure 10. Diphenylamine (169.22g/mol).

The methanolic excerpt of BM flower significantly shows a free radical scavenging effect, when it was assessed by following superoxide dismutase (SOD) assay, 2,2 diphenyl-1-picrylhydrazyl (DPPH) radical. Additionally, hindrance of erythrocytes by 2,2´azo-bis (amid inopropane) dihydrochloride (APPH) antioxidant assay. It might be presumed that the existence of higher phenolic contents in the excerpt may be the reason behind these effects.[49]

Butein is an active constituent of the excerpt of Dhak flowers which is essential for apoptotic cell death, free radical scavenging activity, and hepatic cell protection. In hepatoma cells, butanolic and aqueous excerpts are more significant as compared to methanolic, acetonic, and ethanolic excerpts to show free radical scavenging activity. Both excerpts such as butein and butrin show a remarkable capability to reverse lipid peroxidation, glutathione-S-transferase activity, and level of cellular glutathione. Catalase activity was shown by only butein[50].

3.14 Anti-filarial Activity

The 120 million individuals in around 72 countries throughout the tropics and sub-tropics of Asia, Africa, parts of the Caribbean and South America, and the Western Pacific are septic with lymphatic filariasis[51].

The hexane ethanolic and methanolic excerpt of BM leaves have shown remarkable anti-filarial activity about motility embarrassment evaluation and MTT reduction evaluation. It was also seen that maximum inhibition was reported at 5 mgml-1 concentration with 5 h incubation period[52].

The aqueous excerpt of leaves and roots of BM have significantly shown inhibition in independent movement of *Brugia malayi* microfilariae, in contrast, to control, which suggests anti-filarial effects. Maximum inhibition reported at 100 mg/ml concentration[53].

3.15 Nephroprotective Activity

The flowers of BM, n-butanolic fraction i.e., 24.9 % w/w, remarkably decreased proteinuria, dyslipidemia, hypoalbuminemia, and re-established renal antioxidant enzyme activities in doxorubicin (DOX) induced nephrotic syndrome.[54]

Urine creatinine, serum urea, and blood urea level augmented when they were canned with gentamicin-induced rats, but this effect is reversed when the rat is treated with ethanolic excerpt of the leaves of BM at the amount of 400 mg/kg[55].

3.16 Protease Inhibitor Activity

An investigation was conducted by isolating the protease inhibitor with the pits of *Butea monosperma*. The protease inhibitor secluded from the Dhak seeds retains quantifiable inhibitory commotion on total gut proteolytic enzymes of *Helicoverpa armigera* and bovine trypsin. This disadvantageous paraphernalia on *Helicoverpa armigera* advocates the expediency of *Butea monosperma* in insect pest administration of food crops[56].

3.17 Osteogenic Activity

The promising in-vitro osteogenic commotion was seen in medicarpin, cajanin, formononetin, cladrin, and isoformonentin when these were isolated with the Dhak stem (bark)[57].

3.18 Hemagglutinating Activity

The investigation was conducted on several parts of Dhak plant. It has been seen that leaves, flowers, stems, and roots have not shown hemagglutinating activity, however, the Dhak seeds have shown hemagglutinating activity. The lectins were examined with human blood group A specifically and it was originated that agglutinins were proved in some of them. This test has also revealed that N-acetyl galactosamine is a powerful agglutination inhibitor[58].

3.19 Anti-ulcer and Anti-oxidant Activity

The death due to Peptic Ulcer Disease reached at the level of 55,560 or 0.63 % of total deaths in India according to the report circulated by World Health Organisation in the year 2018[59].

A test was done with the methanol excerpt of the Dhak bark while working on the apparatus of the pharmacological action of the excerpt. The test was conducted for examining scavenging lipid peroxidation and reducing hydroxyl radicals and superoxide anion radicals. A prompt connection was subsisted connecting the percentage of free radicals scavenging effect and concentration of the excerpt. The excerpt hindered 72.47 %, 75.86 %, 68.11 %, and 77.46 % lipid peroxidation and decrease power, superoxide anion, and hydroxyl radical scavenging commotion at the concentration of 50 µg/ml, respectively. The existence of flavonoids and polyphenols in the extract may be held responsible for the antioxidant property.[60]

3.20 Anti-asthmatic Activity

According to an estimate, 262 million people were infected by Asthma in 2019 and it caused 455000 deaths.[61]

The enhancement of total protein, total cell count nitrate-nitrite, and albumin levels in bronchoalveolar solutions in rats was persuaded when an n-butanoic fraction of Dhak, hindered the lipopolysaccharide.[62]

3.21 Anti-inflammatory Activity

Lupeol, which is shown in (Fig. 11), is well known anti-inflammatory compound reported in GC-MS analysis of bark of BM.[14]

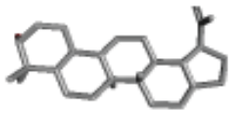

Figure 11. Lupeol (426.7g/mol).

Buterin and ISO-buterinare reported in the flower and Gallic acid in the root, which is anti-inflammatory in nature showed by HP-LC analysis.[48]

The methanolic excerpt of *Butea monosperma* unveiled anti-inflammatory activity. The excerpt was appraised by carrageenan-induced paw edema at 600 and 800 mg/kg. The granuloma tissue was formed by inhibition at 22 and 28 % and paw edema was formed by inhibition at 26 and 35 % in the cotton pellet.[63]

3.22 Anti-fertility Activity

The hot alcoholic excerpt of Dhak seeds has been given to rats and rabbits. It shows significant anti-ovulatory and anti-implantation commotion. Butin was the active constituent[64].

Methanol excerpt of Dhak stem (bark)is effective to kill sperms within 6.29 min at the concentration of 100 mg/ml, but the immobilizing activity is slow when compared to the spermicidal agent which shows complete immobilisation within 20 sec at 2 % concentration.[65]

Three-minute exposure of petroleum ether and chloroform excerpt of Dhak root showed complete immobilisation of

sperm at the doses of 15mg mL-1 without any changes as compared to the control group show curling in the hypo-osmatic swelling test. Sperm activity declines in a dose-dependent manner[66].

3.23 Anti-cancer Activity

According to an estimate, Cancer caused 9.6 million deaths, or 1/6 death, in 2018 and it is the second most important reason for death globally.[67]

Lycopene, as displayed in Figure 12 and Lycoxanthin, as displayed in (Fig.13) are the compound contained in the methanolic seed excerpt of Palash making it anti-cancerous in nature.[22]

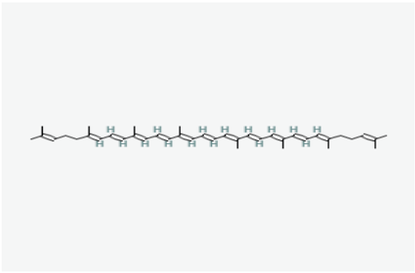

Figure 12. Lycopene (536.9g/mol).

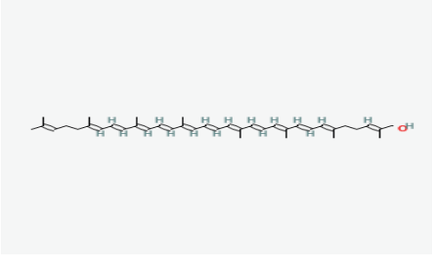

Figure 13. Lycoxanthin(552.9g/mol).

The aqueous excerpt of Palash flowers has introverted cell proliferation and gathering of three hepatoma cell lines such as HepG2, Huh7, and AML2 at the doses of 0.1, 0,3, and 1mg/ml in the Gap phase-1, showinga reduction in cell viability and inhibition in Huh7 and HepG2. There are no/ minor changes that were pragmatic in AML2 cells. This investigation shows the chemopreventive commotion of BM to develop novel Ayurvedic medicines against cancer[68].

3.24 Anti-nociceptive Activity

Petroleum ether leaf excerpt of Dhak at oral doses of 200 and 400mg/kg is effective against paw edema when compared to vehicle-treated mice such as histamine and serotonin-induced paw edema.[69]

4. CONCLUSION

The objective of this philosophy is to supply scientific evidence which is complex in curative values of *Butea monosperma*. The preparation of natural products and herbal medicine from this ethnomedicinal plant is the forthcoming prospect for further researchers.

REFERENCES

1. Ambastha, S.; Kumari, A.; Oraon, V.; Patnaik, A.; Sharan, L. Pharmacological review on *Sesbania grandiflora* (Linn). Int. J. Botany Studies. 2022, **7**(2), 259-268.
2. Kumari, S.; Kumari, A.; Ambastha, S.; Perween, Z.; Patnaik, A.; Sharan, L. Pharmacological attributes of *Bombax ceiba* L., Paripex-Indian J. Res., 2022, **11**(3), 69-71
3. Ravindran, P.N. Sacred & ritual plants of India: Lore, Symbolism, traditions A NARRATIVE. 2022, ISBN 978-1-63606-983-8
4. Lohot, V.D.; Thamilarasi, K.; Ghosh, J.; Mohansundaram, A. & Sharma, K.K. Monograph on Palas, *Butea monosperma* (Lam.) Taubert. 2018.
5. Sacred & Ritual Planta if India: Lore, Symbolism, traditions a narrative, P.N. Ravindran, 2020, ISBN 978-1-63606-983-8
6. Roshan, S.; Sharma, P.; Gupta, R.; Sharma, S. *Butea monosperma* a traditional medicinal plant: An overview, Pharma tutor.
7. Tiwari, P.; Jena, S.; Kumar Sahu, P., 2019. *Butea monosperma*: Phytochemistry and Pharmacology. Acta Scientific Pharmaceutical Sciences (ISSN: 2581-5423), **3**, 19–26.
8. Parashar, B & Dhamija, H.K. Botanical, Phytochemical, and Biological Investigation of *Butea monosperma* (Lam.) Kuntze. *Pharmacologyonline*. 2011,**3**,192-208.
9. Yadava, R.N and Tiwari, L. A potential antiviral flavone glycoside from the seeds of *Butea monosperma* O. Kuntze. *J. Asian Nat. Prod. Res.,* 2005, **7**(2), 185-8.
   doi: 10.1080/1028602042000204054.
10. Yadava, R.N and Tiwari L. New antifungal flavone glycoside from *Butea monosperma* O. Kuntze. J. Enzyme Inhibition and Medicinal Chemistry, 2008, **22**(4), 497-500.
    doi: 10.1080/14756360701211257.
11. Gunakunru, A; Padmanaban, K.; Thirumal, P.; Vengatesan, N.; Gnanasekar, N.; Raja, S.; Rajarjan, A.T; Kumar, S.G.V and Perianayagam, B. Chemical Investigations and Anti-inflammatory Activity of fixed oil of *Butea monosperma* Seeds. *Natural Product Sci.*, 2004, **10**(2), 55-58.
12. Sutariya, B.K., Saraf, M.N., 2015. A comprehensive review on pharmacological profile of *Butea monosperma* (Lam.) Taub. *J. Applied Pharmaceutical Sci.,* **5**, 159–166.
    doi: 10.7324/JAPS.2015.50929.
13. Overview, Health topics on diabetes by WHO, Retrieved March 02, 2022, From https://www.who.int/health-topics/diabetes#tab=tab_1.
14. Bishnu Prasad and Agatha Sylvia Khalkho. GC-MS Analysis of Bioactive Compound in Bark Excerpt of *Butea monosperma* (Lam) Taub. in Jharkhand. *Int. J. Life Sci.*, 2022, **10**(1), 43-53.
15. Kumari, A.; Sharan, L.; Patnaik, A.; Oraon, V. Profiling of Phytochemicals in Annona Reticulata L.

Leaf Using GC-MS Analysis. *J. Advanced Scientific Res.* 2022, **13**(3),198-205.
doi: JASR.202213331.

16. Parween, K; Siddiqui, W.A. Protective Effect of *Butea monosperma* on High-Fat Diet and Streptozotocin-Induced Non-Genetic Rat Model of Type 2 Diabetes: Biochemical and Histological Evidence. *Int. J. Pharmacy and Pharmaceutical Sci.*, 2011, **3**(3), 74-81.
17. Samad, M.B; Kabir ,A.U; D'costa N.M; Akhter , F.;Ahmed, A; Jahan, M.R and. Hannan, J.M.A. Ethanolic Excerpt of *Butea monosperma* Leaves Elevate Blood Insulin Level in Type 2 Diabetic Rats, Stimulate Insulin Secretion in Isolated Rat Islets, and Enhance Heptic Glycogen Formation. *Hindawi Publishing Corporation*, 2014,1-13.
doi: 10.1155/2014/356290.
18. Akhtar, M.S; Naeem, F; Muhammad, F and Bhatty, N. Effect of *Butea monosperma* (Lamk.) Taub. (PalasPapra) fruit on blood glucose and lipid profiles of normal and diabetic human volunteers. *African J. Pharmacy and Pharmacology.*, 2010, **4**(8),539-543.
doi: 10.5897/AJPP.9000107.
19. Naeem, F and Khan, S.H. Evaluation of the hypoglycemia and hypolipidemic activity of *Butea monosperma* fruit in diabetic human subjects. *Turkish J. Biol*., 2010, **34**(2),189-197.
doi: 10.3906/biy-0812-21.
20. Somani, R; Kasture, S.; Singhai, A.K. Antidiabetic potential of *Butea monosperma* in rats. *Fitoterapia*. ,2016, **77**, 86-90.
21. Gunakkunru, A; Padmanaban, K.; Thirumal, P.; Pritila, J.; Parimala, G.; vengatesan, N.; Gnanasekar,N.; Perianayagam, J.B.; Sharma, S.K.; Pillai, K.K. The anti-diarrhoeal activity of *Butea monosperma* in experimental animals. *J. Ethnopharmacology*, 2005, **98**, 241-244.
doi:10.1016/j.jep.2004.12.021.
22. Overview, Health topics on helmintic disease by WHO, Retrieved March 08, 2022, From https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections.
23. Thooyavan, G.; Karthikeyan. J.; Phytochemical profiling and GC-MS analysis of *Butea monosperma* seed methanol excerpt. *J. Pharmacognosy and Phytochemistry,* 2016, **5**(5),152-157.
24. Prasanth, D.; Asha, M.K; Agarwal, A., Rani, P. Anthelmintic activity of *Butea monosperma*. *Fitoterapia*. 2001, **72**(4), 421-422
doi: 10.1016/S0367-326X(00)00333-6.
25. Iqbal, Z.; Lateef, M.; Jabbar ,A.; Ghayur, M.N.; Gilani, A.H. In vivo anthelmintic activity of *Butea monosperma* against *Trichostrongylid* nematodes in sheep. 2006, **77**(2), 137-140.
doi: 10.1016/j.fitote.2005.11.013.
26. Sharma, N. and Shukla, S. Hepatoprotective potential of aqueous excerpt of *Butea monosperma* against CCl4 induced damage in rats. *Experimental and toxicologic pathology*., 2011, **63**(7-8), 671-676.
doi: 10.1016/j.etp.2010.05.009.
27. Sathish, R.; Kumar, P.S.; Natarajan, K.; Sridhar, N. Hepatoprotective Activities of Methanolic Excerpt of *Butea monosperma* Lam Stem Bark in Wister Rats. *Asian J. Pharmaceutical Res.,* 2011, **1**(4), 130-133.
28. Tiwari, P.; Kumar, K.; Panik, R.; Pandey, A. Pandey A. and Sahu, P.K. Hepatoprotective potential of *Butea monosperma* stem bark excerpt against carbon tetrachloride-induced hepatotoxicity in albino rats. *Int. J. Medicine and Medical Sci.*, 2011, **3**(8), 252-255.
doi: 10.5897/IJMMS.9000122.
29. Bhatwadekar, A.D; Chintawar ,S.D.; Lpgade, N.A.; Somani, R.S.; Kasture, V.S.; Kasture, S.B; Antistress Activity of *Butea monosperma* Flowers. *Int. J. Pharmacology*., 1999, **31**, 153-155.
30. Sharma, S.K; Rai, G and Vasudeva, N. Anti-fertility Investigation of *Butea monosperma* (Lam.) Kuntze Root in Albino Mice. *Res. J. Medicinal Plant*., 2012, **6**(3), 260-266. URL: https://scialert.net/abstract/?doi=rjmp.2012.260.266
31. Overview, Health topics on epilepsy by WHO, Retrieved March 10, 2022, From https://www.who.int/news-room/fact-sheets/detail/epilepsy
32. Kasture, V.S.; Chopde, C.T.; Deshmukh, V.K. Anticonvulsive activity of *Albizzia lebbeck*, *Hibiscus rosasinesis* and *Butea monosperma* in experimental animals. *J. Ethnopharmacology*., 2000, **71**(1-2),65-75.
doi:10.1016/S0378-8741(99)00192-0.
33. Sangale, P.T.; Deshmukh, D.B.; Bhambere, R. Anticonvulsant effect of leaf and bark of *Erythrina Variegata* linn and *Butea monosperma* (LAM) Taub in different experimental convulsion model in rats. *Pharma Tutor*., 2015, **3**(5), 19-21.
34. Muralidhar ,A.; Babu, K.S.; Sankar, T.R.; Reddanna, P.; Latha, J. Evaluation of wound healing properties of bioactive fraction from the excerpt of *Butea monosperma* (lam) stem Bark. *Int. J. Phytomedicine*., 2011, **3**, 41-49.
35. Sumitra, M.; Manikandan, P.; Sunguna, L. Efficacy of *Butea monosperma* on dermal wound healing in rats. *Int. J. Biochemistry & Cell Biol.*, 2005, **37**, 566-573.
doi: 10.1016/j.biocel.2004.08.003.
36. Sharma R, Chakraborthy G, Mazumder A. Evaluation of Wound Healing Potential of Methanol Excerptof Flowers of *Butea monosperma* (LAM). *International Journal of Current Pharmaceutical Research*. 2012, 4(4), 29-32.
37. Agarwal, A.K.; Singh, M.; Gupta, N.; Saxena, R.; Puri, A.; Verma, A.K.; Saxena, R.P.; Dubey, C.B.; Saxena, K.C. Management of giardiasis by an immune-modulatory herbal drug Pippalirasayana. *J. Ethnopharmacol*. 1994, **44**(3), 143-146.
doi: 10.1016/0378-8741(94)01181-8.
38. Velis, H.; Kasture, A.; Maxia, A.; Sanna, C.; Mohan, M.; Kasture, S. Antidopaminergic Activity OfOsoflavone Isolated From *Butea monosperma*

Flowers. *Pharmacologyonline*. 2008, **1**, 159-168.
39. Sahu, M.C.; Pandey, R.N. In vitro antibacterial potency of *Butea monosperma* Lam. against 12 clinically isolated multidrug resistance bacteria. *Asian Pacific J. Tropical Disease*., 2013, **3**(3), 217-226. doi: 10.1016/S22221808(13)60044-4.
40. Chokchaisiri, R.; Suaisom ,C.; Sriphota, S.; Chindaduang, A; Chuprajob, T. and Suksamrarn, A. Bioactive Flavonoids of the flowers of *Butea monosperma*., 2009, **57**(4), 428-432. doi: 10.1248/cpb.57.428.
41. Lohitha, P.; Kiran, V.R.; Babu, K.R.M.; Nataraj, K.; Rani, P.A.; Madhavi, N.; Chaitanya, M.; Divya, N. Phytochemical Screening and In Vitro Antimicrobial Activity of *Butea monosperma* (L) Bark Ethanolic and Aqueous Excerpt. *Int. J. harmaceutical Sci. and Res*., 2010, **1**(10), 150-155. doi: 10.13040/IJPSR.0975-8232.1(10).150-55.
42. Tambekar, D.H.; Khante, B.S. Antibacterial properties of traditionally used medicinal plants for enteric infections by Adivasi (Bhumka) In Melghat Forest (Amravati District). *Int. J. Pharmaceutical Sci. and Res.,* 2010, **1**(9), 120-128. doi: 10.13040/IJPSR.0975-8232.1(9-S).120-28.
43. Gurav, S.S.; Gulkari, V.D; Duragkar, N.J. and Patil, A.T. Antimicrobial activity of *Butea monosperma* Lam. Gum. *Iranian J. Pharmacology & Therapeutics*., 2008, **7**(1), 21-24.
44. Daru, S.; Chauhan, P.B. Evaluation of biological activity of *Butea monosperma* and *Tectona grandis* leaf excerpt. *Int. J. Res. Scientific Innovation*., 2016, **3**(5), 49-54.
45. Marandi, R.R.; Britto, S.J.; Ignace, K. Antimicrobial and phytochemical analyses of bioactive compounds of *Butea monosperma* (Lam.) Taub. and *Butea superba* Roxb. from Jharkhand. *Am. J. Pharmtech Res.,* 2015, **5**(6), 411-424.
46. Bandara, B.M.R.; Kumar, N.S.; Swarna, K.M. An antifungal constituent from the stem bark of *Butea monosperma*. *J. Ethnopharmacology*., 1989, **25**, 73-75. doi: 10.1016/0378-8741(89)90046-9.
47. More, B.H.; Sakharwade, S.N.; Tembhurne, S.V.; Sakarkar, D.M. Evaluation of sunscreen activity of cream containing leaves excerpt of *Butea monosperma* for topical application. *Int. J. Res. Cosmetic Sci.*, 2013, **35**(1), 1-6.
48. Mehta, J.P.; Pandya, C.V.; Parmar, P.H.; Vadia, S.H.; Golakiya, B.A. Determination of flavonoids, phenolic acid and polyalcohol in *Butea monosperma* and *Hedychium coronarium* by semi-preparative HPLC Photo Diode Array (PDA) Detector. *Arabian J. Chem.,* 2014, **7,** 1110-1115. doi: 10.1016/j.arabjc.2012.11.015.
49. Hasan, S.M.R.; Hossain, M.M.; Akter, R.; Jamila, M.; Mazumder, M.E.H.; Rahman, S. DPPH free radical scavenging activity of some Bangladeshi medicinal plants. *J. Medicinal Plants Res.* 2009, **3**(11), 875-879. doi: 10.5897/JMPR.9000460.
50. Sehrawat, A.; Kumar, V. Butein imparts free radical scavenging, antioxidant and pro-apoptotic properties in the flower excerpt of *Butea monosperma*. *Biocell*., 2012, **36**(2), 63-71.
51. Overview, Health topics on filaria disease by WHO, Retrieved March 15, 2022, From https://www.who.int/health-topics/lymphatic-filariasis#tab=tab_1
52. Deshmukh, M., Sahare, K.N., Patidar, R.K., Mahajan, B.; Singh, V. Antifilarial activity of *Butea monosperma* L. leaves excerpts against *Setaria cervi*. *Trends in Vector Res. Parasitology*., 2014, 1-5. doi: 10.7243/2054-9881-1-1.
53. Sahare, K.N.; Ananddhraman, V.; Meshram, V.G.; Meshram, S.U.; Singh, V.; Reddy, M.V.R. and Goswami, K. Antifilarial Potential of *Butea monosperma* L. against microfilaria in vitro. *Int. J. PharmTech Res.*, 2012, **4**(3), 1181-1184.
54. Brijesh, S.; Lohit, B.; Sahil, S.; Madhusudan, S. Anti-Nephritic Potential Of N-Butanolic Fraction of *Butea monosperma* (Lam.) Flowers of Doxorubicin Induced Nephrotic Syndrome in Rats. *Int. J. Res. Ayurveda Pharma*., 2015, **6**(4), 478-488. doi: 10.7897/2277-4343.06492.
55. Sonkar, N.; Ganeshpurkar, A.; Yadav, P.; Dubey, S., Bansal, D.; Dubey, N. An experimental evaluation of the nephroprotective potential of *Butea monosperma* excerpts in albino rats, *Indian J. Pharmacology,* 2014, **46**(1), 109-112. doi: 10.4103/0253-7613.125190.
56. Pandey, P.K.; Singh, D.; Singh, S.; Khan, M.Y.; Jamal, F. A Nonhost Peptidase Inhibitor of ~14 kDa from *Butea monosperma* (Lam.) Taub. seeds affects ngatively the growth and development physiology of *Helicoverpa armigera*. *Biochem. Res. Int.,* 2014, 1-10. doi: 10.1155/2014/361821.
57. Maurya, R.; Yadav, D.K.; Singh, G.; Bhargavan, B.; Narayana Murthy, P.S.; Sahai, M.; Singh, M.M. Osteogenic activity of constituents from *Butea monosperma*. *Bioorg Med Chem Lett*., 2009, **19**(3), 610-3. doi: 10.1016/j.bmcl.2008.12.064.
58. Wongkham, S.; Wongkham, C.; Trisonthi, C. Boonsiri , P.; Simasathianosophon, S.; Atisook, K. Isolation and properties of lectins from the seeds of *Butea monosperma*. *Plant Sci.,* 1994, **103**(2), 121-126.
59. Overview, Health topics on ulcer by WHO, Retrieved March 18, 2022, From Peptic Ulcer Disease in India (worldlifeexpectancy.com)
60. Patil, P.; Prakash, T.; Shivakumar ,H.; Pal, S. Anti-Ulcer and anti-secretary properties of the *Butea monosperma* (Lam) bark excerpt with realation to antioxidant studies. *Iranian J. Pharmacology & Therapeutics*. 2009, 8, 1-6.
61. Overview, Health topics on Asthma by WHO, March 20, 2022, From https://www.who.int/news-room/fact-sheets/detail/asthma.

62. Shirole, R.L.; Kashatriya, A.A.; Sutariya, B.K.; Saraf, M. N. Mechanistic Evaluation of *Butea monosperma* using in vitro and in vivo murine models of bronchial asthma. *Int. J. Res. Ayurveda Pharm*., 2013, **4**(3), 322-331.
doi: 10.7897/2277-4343.04304.
63. Shahavi, V.M.; Desai, S.K. Anti-inflammatory activity of *Butea monosperma* flowers. *Fitoterapia*, 2007, 79, 82-85.
doi: 10.1016/j.fitote.2007.06.014.
64. Bhargava, S.K. Estrogenic and postcoital anticonceptive activity in rats of butin isolated from *Butea monosperma* Seed. *J. Ethnopharmacology*, 1986, **18**(1), 95-101.
doi: 10.1016/0378-8741(86)90046-2.
65. Udiwal, S.; Jain, N.K.; Gupta, M.K.; Goyal, S. Anti-fertility activity of *Butea monosperma* linn in lbino Rats. *Current Res. Biol. Pharmaceutical Sci.*, 2014, **3**(4), 6-11.
66. Vasudeva, N.; Rai, G.; Sharma, S.K. Anti-spermatogenic activity of *Butea monosperma* (Lam.) kuntze root. *Asian J. Biolo. Sci.,* 2011, **4**(8), 591-600.
67. Overview, Health topics on cancer by WHO, Retrieved March 25, 2022, From https://www.who.int/health-topics/cancer#tab=tab_1.
68. Choedon, T.; Shukla, S.K.; Kumar, V. Chemopreventive and anti-cancer properties of the aqueous excerpt of flowers of *Butea monosperma*. *J. Ethnopharmacology*, 2010, **129**, 208-213.
doi: 10.1016/j.jep.2010.03.011.
69. Rathod, V.D.; Bhangale, J.O.; Bhangale, P.J. Preliminary evaluation of antinociceptive and anti-inflammatory activities of petroleum ether excerpts of *Butea monosperma* (L.) leaves in laboratory animals. *World J. Pharmaceutical Sci.,* 2017, **5**(3), 246-252.

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