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# Medicinal & traditional uses of *Shahtoot (Morus indica* Linn.): A review

**Dr. Subodh Kumar and Dr. Bachchu Singh**

**Abstract**
A morus is moderate-sized monoecious tree, 3 to 6 meters high, with reddish or yellowish brown, smooth bark, marked with long horizontal lenticels. Leaves are ovate, 5 to 20 centimeters long, 2.5 to 8 centimeters wide, with tapering pointed tips, and 3-nerved, heart-shaped base, sharply-toothed margins, sometimes deeply 3-lobed, of hairy texture when young, rough when mature. It is a Fruit of famous tree about 3-4 inches long, it has two types 1) *Toot Safed* & 2) *Toot Siyah*. It is also called *Shahtoot*. Native to China; cultivated in Punjab, Uttar Pradesh, Kashmir and North- Western Himalayas.
The Properties of *Shahtoot such as*- Analgesic, Anthelmintic, Antibacterial, Anti rheumatic, Diuretic, Hypotensive, Hypoglycemic, Purgative, Sedative Tonic. Good Nervine tonic etc. Constituents**:** Tannins; phytosterols; sulfur; essential oils; saponins; Mulberroside F, fat, 30%; urease; sugar, pectin, citrates, malates, sterols, flavones, flavanone, stilbene. *Shahtoot* having so medicinal properties for the diseases.

**Keywords:** *Shahtoot*, unani medicine, temperament (*mizaj*), important formulations (*Aham Murrakabat*), studies

## Introduction
A morus is moderate-sized monoecious tree, 3 to 6 meters high, with reddish or yellowish brown, smooth bark, marked with long horizontal lenticels. Leaves are ovate, 5 to 20 centimeters long, 2.5 to 8 centimeters wide, with tapering pointed tips, and 3-nerved, heart-shaped base, sharply-toothed margins, sometimes deeply 3-lobed, of hairy texture when young, rough when mature. Flowers are unisexual; the female flowers numerous and crowded in short spikes. Fruiting spikes are axillary, peduncled, dark purple or nearly black when ripe, fleshy, and 1.5 to 3 centimeters long.

**Distribution:** It is native to Asia and also found in all warm countries. Now it is cultivated in Batan Island & Province.

**Vernacular Name** [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
**Hindi:** *Shahtoot, Toot*
**Arabic:** *Al-toot, Toot*
**Persian:** *Al-toot*
**Latin:** *Morus indica Linn.*
**English:** *Indian Mulberry*

**Constituents** [6, 36, 69]
Tannins; phytosterols; sulfur; essential oils; saponins; Mulberroside F, fat, 30%; urease; sugar, pectin, citrates, malates, sterols, flavones, flavanone, stilbene, benzophenone and coumarin derivatives, tannin, succinic acid, calcium malate, calcium carbonate, invert sugar, pentosane, tannin, carotin, ash, vitamin C and choline. Prenylflavonoids, glycoside, isoquercitrin, astragalin, scopolin, skimmin, roseoside II, benzyl D-glucopyranoside, coumarins, Flavonoids, triterpenes.

**Properties** [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 38]
Analgesic, Anthelmintic, Antibacterial, Anti rheumatic, Diuretic, Hypotensive, Hypoglycemic, Purgative, Sedative Tonic. Good Nervine tonic, Refrigerant, Antipyretic, Liver-Kidney tonic, Blood-stimulating. Antitussive, Antiedema, Anticonvulsant.

**Parts utilized** [1, 2, 3, 6, 8, 11]
Leaves, Fruits, Twigs, Stems, Roots, Wood cut in cubes.

**Unani Description of *Morus indica* Linn:** It is a Fruit of famous tree about 3-4 inches long, it has two types 1) *Toot Safed* & 2) *Toot Siyah*. It is also called *Shahtoot*. Native to China; cultivated in Punjab, Uttar Predesh, Kashmir and North- Western Himalayas.

**Temperament (*Mizaj*):** Cold & Moist in 2nd

**Action (*A'afal*):** *Mulattif, Munaffis wa Mohallil,.*

**Action (*Istemal*):** *Khusunat-e-Halaq, Avram Halaq wa Hanzara, Warm-e-Lozeteen.*

**Side effect (*Muzir Asrat*):** *Vaatnaadee*.

**Antidote (*Musleh*):** Honey and *Anaar (Punica granetum)* Juice.
**Substitute (*Badal*):** Gird-e-Samaaq**.**

**Important Formulations (*Aham Murrakabat*):** *Sharbat-e-Toot Siyah* [1, 2, 3, 4, 5, 6, 7, 8, 9, 10].

**Folkloric** [1, 2, 3, 5, 6, 8, 11]

- **For headaches, cough, and fever associated with influenza:** Mix 6 to 12gms of *Toot* leaf preparation with Chrysanthemum and Mentha in 5:3:1 proportions. Boil to a concentrated decoction and drink.
- **Constipation in the elderly:** 6 to 15gms dried fruit preparation, boil to a concentrated decoction and drink. Backache: 9-15gms twig preparation, boil to a concentrated decoction and drink.
- **Eyestrain causing reddening and pain in the eyes:** get leaf preparation, steam in water, and expose eyes to the smoke which emanates from the preparation.
- **Fever arising from lung complications, cough, and hemoptysis;** also skin edema: use 9-15gms of bark in decoction.
- **Rheumatic arthritis, lumbago, leg pains:** use 9-15 gm *Toot* twig material.
- **Fever, cold and coughing:** use 6 to 9gms leafy drug in decoction.
- In Brazil, used for fever, lowering of cholesterol and blood pressure, and liver protection.
- Juice of fresh bark used for epilepsy in children and in dribbling of the saliva.
- Milky sap of the tree is used for aphthous stomatitis in infants, and in incised wounds caused by snake, centipede, and spider bites.
- Decoction of leaves used for sweating feet, dropsy, and intestinal disorders.
- Bruised leaves used for wounds and insect bites, and also to promote hair growth.
- Twigs considered prophylactic for all forms of cold; also, diuretic and pectoral.
- Lye made of ashes of mulberry wood used as stimulant and escharotic in scaly skin diseases and unhealthy granulations.
- Fruits have been used for diabetes.

**Others**

- **Paper Making:** Bark used in early China for making paper.
- **Silkworm Food:** Leaves used as food for silkworms.
- **Protein Source/Leaves/Pig Diet:** Study showed the possible use of mulberry leaves as main protein source.
- **Cosmetics:** Extract of roots for skin whitening (Japan); used in the manufacture of hair care and hair-growth/tonic products.

**Studies**

- **Anti-dopaminergic**: Anti-dopaminergic effect of the methanolic extract of *Morus alba* L. leaves: Extracts of MA showed significant dose-dependent potentiation of haloperidol and metoclopramide induced catalepsy. Study showed MAME possesses antidopaminergic activity and suggests the plant's antipsychotic potential [12].
- **Diabetes:** Evaluation of hypoglycemic effect of *Morus alba* in an animal model: Mulberry leaf extract showed positive effects in diabetes-induced Wistar rats, restoring the diminished beta cell numbers [13].
- **Anti-allergic:** Inhibitory Effects of Morus alba on Compound 48/80-Induced Anaphylactic Reactions and Anti-Chicken Gamma Globulin IgE-Mediated Mast Cell Activation: Study showed mast cell effects and suggests a potential for HEMA as a therapeutic tool for allergic diseases [14].
- **Mulberroside F/Skin whitening:** Mulberroside F Isolated from the Leaves of *Morus alba* Inhibits Melanin Biosynthesis: Study isolated Mulberroside which showed inhibitory effects on tyrosinase activity and melanin formation suggests a potential for use as a skin whitening agent [15].
- **Anti-melanoma/Antioxidant:** Quantitative Analysis of Rutin, a Flavonoid Compound in the Leaves of m *Morus alba*: Rutin showed to be an inhibitory of melanoma growth, anti-tyrosinase and antioxidant

suggesting a potential for dietary supplements or cosmetic applications [16].

- **Hypoglycemic:** Flavonoid rich fraction of an alcohol root bark extract of Egyptian *Morus alba* was studied for hypoglycemic activity in stretozotocin-diabetic rats. Study revealed the extract may protect pancreatic beta cells from degeneration and diminish lipid peroxidation [17].
- **Skeletal Muscle AMPK Activity Stimulation:** Study showed *Morus alba* leaf water extract stimulates skeletal muscle AMPK activity acutely without changing the intracellular energy status [18].
- **Antidepressant:** Study of aqueous extract of *Morus alba* leaves green tea on mouse behavior showed the extract possesses an antidepressant without an anxiolytic effect. At high doses, a sedative effect was noted with alterations of other functions, ie, muscle strength, maze activity and pain response [19].
- **Anti-Ulcerogenic:** Study of MA ethanol extracts on ethanol-induced gastric mucosal injury in animals indicates that MA exhibits significant antiulcerogenic activity in rats with marked reduction of gastric mucosal damage, reduction of edema and submucosal leucocyte infiltration [20].
- **Anti-Dyskinesia:** Study results suggest a protective effect of *Morus alba* extract against haloperidol-induced orofacial dyskinesia and oxidative stress [21].
- **Anti-Hypertensive:** In a study of 50 medicinal plant extracts, *Morus alba* was one of four that showed strong ACE inhibitor activity, with decrease in both systolic and diastolic blood pressure [22].
- **Hypotriglyceridemia:** Results showed the aqueous extract of leaves of *M. alba* decreased the plasma level of triglycerides [23].
- **Post-Traumatic Nerve Recovery:** Results showed the potential of *M. alba* extract to enhance functional recovery after crush injury with significant improvement of both sensory and motor functions. Study suggests *M. alba* may serve as functional food for post-traumatic nerve recovery and suggests further studies to identify the active ingredient/s and mechanisms [24].
- **Ob-X/Obesity-Regulating/Hypolipidemic:** Ob-X, a mixture of three herbs-*Morus alba*, Melissa officinalis, Artemisia iwayomogi was studied and shown to regulate body weight, adipose tissue mass, lipid metabolism, in part, through changes in the expression of hepatic PPAR alpha target genes [25].
- **Hepatoprotective/CCl4 Hepatotoxicity:** Study showed the hydroalcoholic extract at a dose of 800 mg/k exhibited a significant liver protective ability by lowering the levels of AST and ALT, decreasing sleeping time, with less pronounced destruction of liver architecture, absence of fibrosis and inflammation as compared with the carbon tetrachloride group [26].
- Study showed the *Morus alba* and Calendula officinalis extracts possess highly promising hepatoprotective effects against CCl4-induced hepatotoxicity [27].
- **Anti-Stress:** Study showed attenuation of chronic restraint stress (RS)-induced perturbations (cognitive dysfunction, altered behavioral parameters, etc.) were attenuated by an ethyl acetate soluble fraction of *Morus alba*. Study results suggest that in addition to classically established pharmacologic activities, the plant has immense potential as anti-stress agent [28].
- **Immunomodulatory:** Study showed *Morus alba* increased the levels of serum immunoglobulins and prevented mortality induced by bovine Pasteurella multocida in mice. It showed an increase in phagocytic index, a protection against cyclophosphamide-induced neutropenia and increased neutrophil adhesion. Results conclude MA increases both humoral and cell mediated immunity [29].
- **Antidepressant:** Study showed the aqueous extract of *Morus alba* leaves green tea possesses an antidepressant effect without an anxiolytic-like effect. At higher doses, the extract might show a sedative effect and alteration of other functions [30].
- **Leaves as Protein Source:** Study of effect of mulberry leaves in diet for pigs on digestibility indices and N balance showed that in rice-based diets, it is possible to use mulberry leaves as the main protein source [31].
- **Flavonoids/Antiasthmatic Effect:** Study showed *Morus alba* flavonoids antagonize acetylcholine on the contraction of bronchial lung, extending the latent period of asthma, reducing eosinophilic invasion [32].
- Anti-Cataract **Activity/Antioxidative/Antidiabetic/Antihypercholesterolemic:** Study showed an ameliorating effect of mulberry leaves on retinal neurotransmitters, retinal neuronal cells and anti-cataract activity which may be attributed to the flavonoid content with potential anti-oxidative activity, hypoglycemic, and anti-hypercholesterolemic effects [33].
- **Antioxidant:** Study showed *Morus alba* leaves have more antioxidant activity than *Rosmarinus officinalis.* The methanol extract of leaves showed inhibition of lipid peroxidation of lipid in egg-yolk. Results indicate the leaves are a good source of natural antioxidants [34].
- **Suppressive Response of Confections Containing Leaf Extracts on Blood Sugar and Insulin:** Study showed the effective ration of ELM to sucrose, which suppressed postprandial blood glucose and insulin, was 1 to 10. The digestion of sucrose and starch was inhibited by the ELM, with an additional benefit of a prebiotic effect. Results suggest a potential contribution to diet therapy management for type-2 diabetes mellitus [35].
- **Histopathologic Effect on Diabetic Pancreas of Rats:** According to histological and biochemical results, animals treated with mulberry leaf extract showed reduction of blood glucose levels by regeneration of ß cells [36].
- **Radioprotective:** Study showed mulberry fruit powder given to gamma-irradiated rats offered protection against gamma irradiation-induced oxidative stress. Study suggests a potential as a radio-protective agent [37].
- **Antischistosomal/Hepatoprotective:** Study investigated the antischistosomal and hepatoprotective activity of *Morus alba* leaf extract. Results concluded mulberry could ameliorate preexisting liver damage and oxidative stress conditions due to schistosomiasis [38].
- **Nephroprotective/Hepatoprotective:** Study evaluated the renal protective effects of *M. alba* related to its free radical scavenging properties. Results showed the

ethanol extract prevented alterations in serum creatinine, BUN, and serum uric acid levels. There was a decrease in creatinine clearance and urinary volume. Histopathological exam and urinary enzymes excretion suggest a protective effect. Co-administration of *M. alba* with gentamicin prevented renal functioning alterations reported with gentamicin use alone [39].

- **Antiproliferative/Hepatocarcinoma Cell Line:** Study showed water, 50% aqueous MeOH, and 100% MeOH extracts of mulberry leaves exhibited a highly significant inhibitory effect on human hepatocellular carcinoma HepG2 cell proliferation via suppression of activity of NF-κB gene expression and modulation of biochemical markers [40].
- **Comparative Antioxidant Activity:** Study evaluated antioxidant activities and phenolic contents of methanolic extractives. Mulberry Stem bark showed the highest antioxidant activity, followed by root bark, fruits, and leaves. Results indicated a high correlation and regression ($P$<0.001) between phenolic contents and antioxidant potentials of the extracts [41].
- **Herb-Drug Interaction/Cyclosporine:** Study showed mulberry significantly reduced the bioavailability of CSP (cyclosporine) through activation of functions of P-gp and CYP3A. Cyclosporine is a potent immunosuppressant widely used in transplant patients [42].
- **Leaves as Protein Source:** Study evaluated the effect of inclusion of mulberry leaves in diets for pigs on digestibility indices and N balance. Results suggest that in rice based diets, mulberry leaves could be a main protein source. Dry leaves were associated with slightly lower digestibility compared to fresh leaves [43].
- Study evaluated *Morus alba* leaf meal (MLM) for nutritive value as feed ingredient for chicken diet. Results showed the MLM contained a high content of crude protein (29.8%), along with Ca (2.73%) and neutral detergent fiber (35.77%). Results suggest the incorporation of MLM into chickens' diet could provide a good source of protein despite its high fiber content [44].
- **Pancreatic Effect/Leaf Extract:** Study examined the histopathological effects of *M. alba* leaf extracts on the pancreas of diabetic rats. According to histological and biochemical results, study concludes the extract may reduce blood glucose levels by regeneration of ß cells [45].
- **Phytoremediation/Cadmium and Nickel:** Study investigated heavy metal uptake (Cd, Cr, and Ni) from soil by different organs of *Populus alba* and *Morus alba*. Results showed P. alba and M. alb were suitable for phytoextraction of Cd and Ni from contaminated soil [46].
- **Cytoprotective against Hyperglycemia:** Study investigated the protective effects of alcoholic extract of *Morus alba* leaves on fetus fibroblast cells under hyperglycemic conditions. Results showed MA leaves has cytoprotective effects against hyperglycemia [47].
- **Anthelmintic/Leaves:** Study evaluated the anthelmintic potential of methanolic extract of leaves of *Morus alba* against adult earthworms and albendazole as standard. Results showed anthelmintic activity inversely proportional to the time of paralysis and death of worms. All test doses showed dose dependent activity [48].
- **Antimicrobial/Antioxidant/Leaves:** Study evaluated the *in vitro* antioxidant and antimicrobial activity of *M. alba* leaves. Ethanol and distilled water extracts showed antioxidant activity, while ethanol extracts showed antimicrobial activity against test organisms Escherichia coli, Staphylococcus aureus, Enterococcus faecalis, Pseudomonas aeruginosa, Candida albicans [49].
- **Morusin/Anticonvulsant/Modulation of GABA Receptor:** Study evaluated the anticonvulsant activity of Morusin, a flavonoid glycoside isolated from *M alba*. Results suggest anticonvulsant activity of Morusin with a mechanism probably related to the restoration of GABA level [50].
- **Protective Testicular Effects against MSG Cytotoxicity:** Study evaluated the possible protective effects of herbal antioxidants (*Morus alba*) on tissue damages related to MSG (monosodium glutamate) cytotoxicity in adult Wistar rats. Decreased spermatogenic indices together with histomorphological changes in the seminiferous tubules were noted in the MSG treated group. Results suggest MA extract can have positive effects in reduction of testicular tissue alterations related to MSG tissue toxicity [51].
- **Effect on Enzymatic Activities in STZ Induced Diabetes:** Study evaluated the effect of *M. alba* on lipid peroxidation and hepatic glucose regulating enzymes in STZ induced diabetic rats. Results showed significant increase in activities of hexokinase, G6PD and lactate dehydrogenase in Morus alba treated rats, along with reduction glutathione s transferase and glucose 6 phosphatase activities. Results suggest MA reduce hyperglycemia by controlling oxidative stress, increasing glycogen levels and preventing anaerobic glycolysis and improving hepatic carbohydrate metabolism [52].
- **Flavonoids/Cisplatin-Induced Nephrotoxicity:** Study evaluated the protective effect of hydroalcoholic extract and flavonoid fraction of *M. alba* leaves on cisplatin-induced nephrotoxicity in rats. Results showed the flavonoid fraction could prevent CP-induced pathological damage of the kidneys. Concurrent used of the flavonoid fraction of MA with CP can protect the kidneys from CP-nephrotoxicity [53].
- **Antibacterial/Antifungal/Pesticidal:** Study evaluated the antibacterial, antifungal, and pesticidal activity of *M. alba* seed oil extract. E. coli, P. aeruginosa, B. subtilis and S. aureus were the most susceptible bacterial species to the crude extract, and Aspergillus niger and S. cerevisiae were the most susceptible of the tested fungal species. Crude and seed oil extract also showed significant pesticidal activities against Sitophilus granaries [54].
- **Anti-Amnesic Activity/Learning and Memory Benefits/Serotonergic Pathway:** Study evaluated the anti-amnesic potential of EA soluble fraction of methanolic extract of *M. alba*. The effect on learning and memory was evaluated using ORT (object recognition test), EPM (elevated plus maze test) and WMT (water maze test). The result of the in-vitro study showed the extract significant improved learning and

memory through its anti-serotonergic mechanism and presents a potential treatment for dementia and other cognitive disorders [55].

- Antimutagenic/Leaves: Study of leaf extracts of *Morus alba* and *Morus nigra* showed decreased mutability level induced with chemical mutagens, gamma rays and ageing in plants (Vicia faba, Arabidopsis thaliana) and animal (rat) cells. The demonstrated gene protection properties increases its potential for use in the food industry, providing antimutagenic protection to increase nutritional value of food products [56].
- **Comparative Amino Acid Composition/Leaves:** Study evaluated the amino acid composition of black mulberry leaves (*M. nigra* L.), white mulberry (*M. alba*) and red mulberry (*M. rubra*). All three yielded 15 amino acids which were dominated by glutamic acid, glycine, methionine and tyrosine. The highest content was found in white mulberry leaves extract [57].
- **Acetylcholine Esterase Inhibitors/Leaves:** Study evaluated *M. alba* leaf extract for acetylcholine esterase inhibitory activity using modified Ellmann's method. Results showed concentration dependent acetylcholine esterase inhibitory activity. The extract yielded major compounds viz., vanillic acid, myricetin, luteolin and kaempferol. Of the four compounds, myricetin, luteolin and kaempferol showed AE inhibitory activity. The acetylcholine inhibitory activity of these compounds present potential use in the treatment of Alzheimer's disease [58].
- **Phytoremediation:** Study concludes mulberry tree can be successfully used for phytoremediation of highly contaminated soils. Rapid growth, ease of breeding, great foliage and a deep root system make it suitable for phytoremediation [59].
- **Whitening and Antierythemic Effect:** Study evaluated a formulated w/o emulsion of ethanolic extract of mulberry fruits with its vehicle as control on skin melanin, skin erythema and skin moisture content. Results showed the cream containing 4% concentrated extract of mulberry can be used for skin whitening by decreasing skin melanin content. The decrease in erythema further suggests non-irritating quality and safety [60].
- **Moralbosteroid/Anxiolytic:** Study evaluated the anxiolytic activity of Moralbosteroid, a steroidal glycoside isolated from *Morus alba*. The study was carried out on elevated plus maze, light and dark model, and open field test. Results concluded that Moralbosteroid has therapeutic potential for managing anxiety [61].
- **Alpha-Glucosidase Inhibitory Activity**: Alpha-glucosidase inhibitors are used in the treatment of type 2 diabetes mellitus. Study of water extract of *Morus alba* leaves showed potent *in vitro* alpha-glucosidase inhibitory activity with an IC50 value of 28.11 µg/ml [62].
- **Anthocyanins/Anti-Diabetic:** Mulberry plant contains abundant anthocyanins (ANCs), which are natural antioxidants. Study evaluated the ANC composition of fruits and the effect of an ANC extract on blood glucose and insulin levels in male leptin receptor-deficient Zucker diabetic fatty (ZDF) rats. Results demonstrated ANCs extracted from MA were well tolerated and exhibited effective anti-diabetic properties in ZDF rats [63].
- **Leaf Tea Effect in Type 2 Diabetes/Hypolipidemic:** Study investigated the anti-diabetic effects of low and high doses of white mulberry leaf in a rat model of type 2 diabetes. Study results showed brewed white mulberry tea leaf has hypolipidemic rather than antidiabetic effects [64].
- **Confections with Leaf Extractives/Effect on Blood Glucose:** ELM (extractives from leaves of *Morus alba*)-containing confections at ratio of sucrose to ELM of 1:10 effectively suppress the postprandial blood glucose and insulin by inhibiting the intestinal sucrase, creating a probiotic effect [65].
- **Mulberrofuran G/Anti-Hepatitis B Virus Activity:** Study isolated mulberrofuran G and isomulberrofuran G, a pair of isomeric Diels-Alder type adducts, from the root bark of *MA*. Mulberrofurran G showed moderate activity inhibiting hepatitis B virus DNA replication with IC50 of 3.99 µM[66].
- **Pharmacological Effects/Root Bark/Comparison with "Sohakuhi":** Study evaluated n-butanol and water soluble fractions of root bark of mulberry tree for pharmacological effects and compared the clinical effects with Chinese medicine "Sohakuh". In animal models, both fractions showed cathartic, analgesic, diuretic, antitussive, antiedema, sedative, anticonvulsant, and hypotensive propertives. There appeared to be a correlation with clinical applications of mulberry root in Chinese medicine literature [67].
- **Oxyresveratrol/Anti-Inflammatory/Inhibition of Leukocyte Migration:** Study evaluated evaluated the anti-inflammatory effect of M. alba via leukocyte migration. Oxyresveratrol was isolated as an active component. Mechanistic study indicated that oxyresveratrol diminished CXCR4-mediated T-cell migration via inhibition of the MEK-ERK signaling cascade [68].
- **Antimicrobial/Toxicity Study/Leaves:** Study evaluated an ethanolic extract of Morus alba leaves for toxicity to Artemia salina, oral toxicity to mice, and antimicrobial activity. The extract showed not toxicity in mice since no animal death was detected at 2000 mg/kbw dose. However, the extract promoted biochemical, hematological, and histopathological alterations at the same dose. At 300 mg/kg, while there was no toxicity or irreversible cellular damage, there was alteration in proportion of leukocyte types. The extract showed moderate antimicrobial activity against test pathogens [69].

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