

ETHANOBOTANY, PHYTOCHEMISTRY AND PHARMACOLOGY OF *ABELMOSCHUS MOSCHATUS* MEDIK

Anu Raj¹ and Kandasamy Palanisamy Jaiganesh*

*Associate Professor, Division of Pharmacognosy and Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India.

¹Research Scholar, Division of Pharmacognosy and Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India.

***Corresponding Author: Dr. Kandasamy Palanisamy Jaiganesh**

Associate Professor, Division of Pharmacognosy and Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India.

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ABSTRACT

Abelmoschus moschatus Medik, is an erect, hispid, herbaceous plant with aromatic and medicinal property belonging to the family Malvaceae. Syn, *Hibiscus abelmoschus* Linn. The plant is traditionally used in the treatment of various health ailments. In India, roots, leaves (rarely) and seeds are considered as valuable traditional medicines. Seeds are used as a tonic, cooling, aphrodisiac, ophthalmic, cardio tonic, digestive, stomachic, constipating, carminative, pectoral, diuretic, stimulant, antispasmodic, deodorant, and effective against, intestinal complaints, stomatitis and heart diseases. This present study reveals that wide range of novel phytochemical constituent has been isolated from this plant with diverse chemical properties and deals with enormous data that has been generated due to recent wide spread research in phytochemical, pharmacological aspect of this plant also include on its ethanobotany.

KEYWORDS: *Abelmoschusmoschatus* Medik. Ethanobotany, Phytochemistry, Pharmacology.

INTRODUCTION

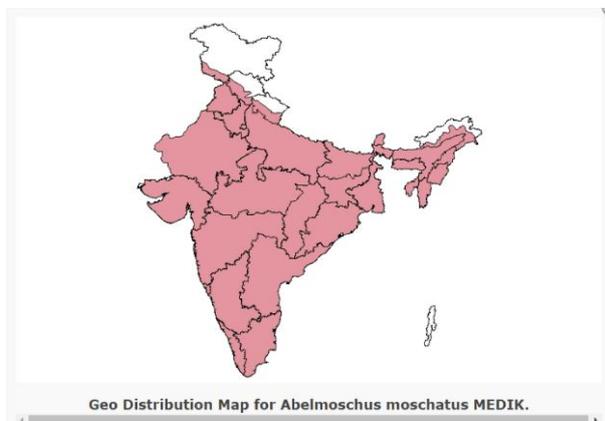
Medicinal plants have been used in healthcare since time immemorial. Studies have been carried out globally to verify their efficacy and some of the findings have led to the production of plant-based medicines. The global market value of medicinal plant products exceeds \$100 billion per annum.^[1] Every part of medicinal plant is used in one or the other way. India has a vast resource of indigenous plant and mineral which are excellent source of therapeutic claim. One of such accessibility of medicinal plant is *Abelmoschus moschatus* Medik. It is an erect, hispid, herbaceous plant with aromatic and medicinal property belonging to the family Malvaceae. Syn, *Hibiscus abelmoschus* Linn, growing to 1 - 2 m. The corolla is yellow with a purple centre, and about 7 to 12 cm in diameter. Leaves are alternate, rough, and hairy and heart shaped. The seeds have a sweet, flowery, heavy fragrance similar to that of musk. They have 3 - 5 lobes and can grow to 15cm long. Loamy soils with neutral pH and plenty of organic matter are ideal for its cultivation.^[2] It is globally distributed at Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Papua New Guinea, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam, and Australia in Asia. It is globally distributed in India were Assam, Gujarat Manipur, Meghalaya, Odisha, and Uttar Pradesh and locally distribute in Andaman & Nicobar Islands, Andhra

Pradesh, Kerala, Tamil Nadu. The system of medicine is used in Ayurveda, Folk medicine, Unani medicine; Chinese medicine. The plant is rich in a number of phenolic compounds, flavonoids, carbohydrates, proteins, sterols, tannins, fixed oil, and fats. *A. moschatus* has been extensively studied by various researchers for its biological activities and therapeutic potential.^[3]



The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species cannot be planted in other countries than those depicted. Since some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

Distribution in India



Botany

Botanical Name: *Abelmoschus moschatus* Medik.

Family: Malvaceae

Synonym(s): *Hibiscus abelmoschus* L.

Common Name(s): musk mallow [English].^[4]

Taxonomic Hierarchy

Kingdom	Plantae
Sub kingdom	Viridiplantae
Infra kingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Sub division	Spermatophytina
Class	Magnoliopsida
Super order	Rosanae
Order	Malvales
Family	Malvaceae
Genus	<i>Abelmoschus</i> Medik.
Species	<i>Abelmoschus moschatus</i> Medik.

Common Name

English: Muskmallow, Ambrette

Sanskrit: Latakasturika, Gandapura

Hindi: Mushkdana, kasturi bendi, Kasturidana

Marathi: Kasthuri bhendi

Tamil: Varttilaikasturi

Telugu: Kasturi benda

Kannada: Kasturi bende

Assamese: Gorukhiakorai

Gujarati: Mushkdana

Malayalam: Kasthurivenda

French: Ambretta semi

German: Musk Okra

Description

It is an annual or perennial herb or undershrub, about 1-3 m tall. Stem and branches hirsute with simple prickly or stellate yellow hairs. Roots- somewhat tuber like, but not swollen; leaves- alternate, extremely variable both in size and shape, palmately lobed or palmilobed, transversely orbicular to elliptic, about 3-19 x 2.8-18 cm across, base cordate, 3-7 nerved, usually sagittate to hastate with to-parted segments, about 5-9, lanceolate-obovate, margins dentate-serrate, rarely entire, apex acute to acuminate, sparsely hirsute with simple hairs both above and beneath, becoming glabrescent later, coriaceous; petiole- usually longer than the leaf lamina, hirsute, about 2-20 cm long, stipules filiform, linear, about 5-12 mm long. Inflorescence axillary or terminal, solitary; flowers-bisexual, pedicel slender, inarticulate, about 1.5-6 cm long, epicalyx 6-10, free, base rarely connate, segments about 2-3 x 1-2 mm across, calyx 5 lobed, base connate, valvate, membranous, sericeous inside, stellate tomentose outside, about 1.5-3 cm long, corolla large, 5, yellow with dark purple near the centre, obovate, apex rounded, glabrous, about 10 cm across^[5]; Stamens-indefinite, monodelphous, about 2.5 cm long, forming an epipetalous staminal tube united with corolla, filament short, introrse, anthers basifixed, throughout; ovary-superior, 5 locular, ovules many; fruit- capsule, ovoid-globose, about 4-8 x 2.5 cm across, apex beaked or acuminate, dehiscent with longitudinal slits towards the base, densely hispid with simple hairs; seed- many, reniform or globose, about 3-4 mm across, concentrically ribbed minutely stellate hairy or glabrous, musk scented, and black.^[6]

Cultivation

Abelmoschus moschatus is propagated by seed and requires a humid tropical or subtropical climate, although heavy and continuous rain affects crop growth negatively. In the tropics it occurs up to 1650 m altitude in Indonesia, while in India it is cultivated up to 1000 m. The optimum temperature for vegetative growth is about 20°-28°C, but it can tolerate temperatures up to 45°C. Frost is not tolerated. It is day length sensitive, short days promoting early flowering. Flowering is also stimulated by low night temperatures. During flowering and fruiting dry weather is preferred. *Abelmoschus moschatus* thrives in fertile loamy soils with neutral pH

and plenty of organic matter is ideal for its cultivation.^[2] Growth is often poor on clay and sandy soils and on saline or strongly alkaline soils. Water logging is not tolerated. The optimum time of sowing is June-July with pre-monsoon showers. Seeds are soaked in water before sowing for 24 hours. It takes 5-7 days for proper germination.

Ethno Pharmacology

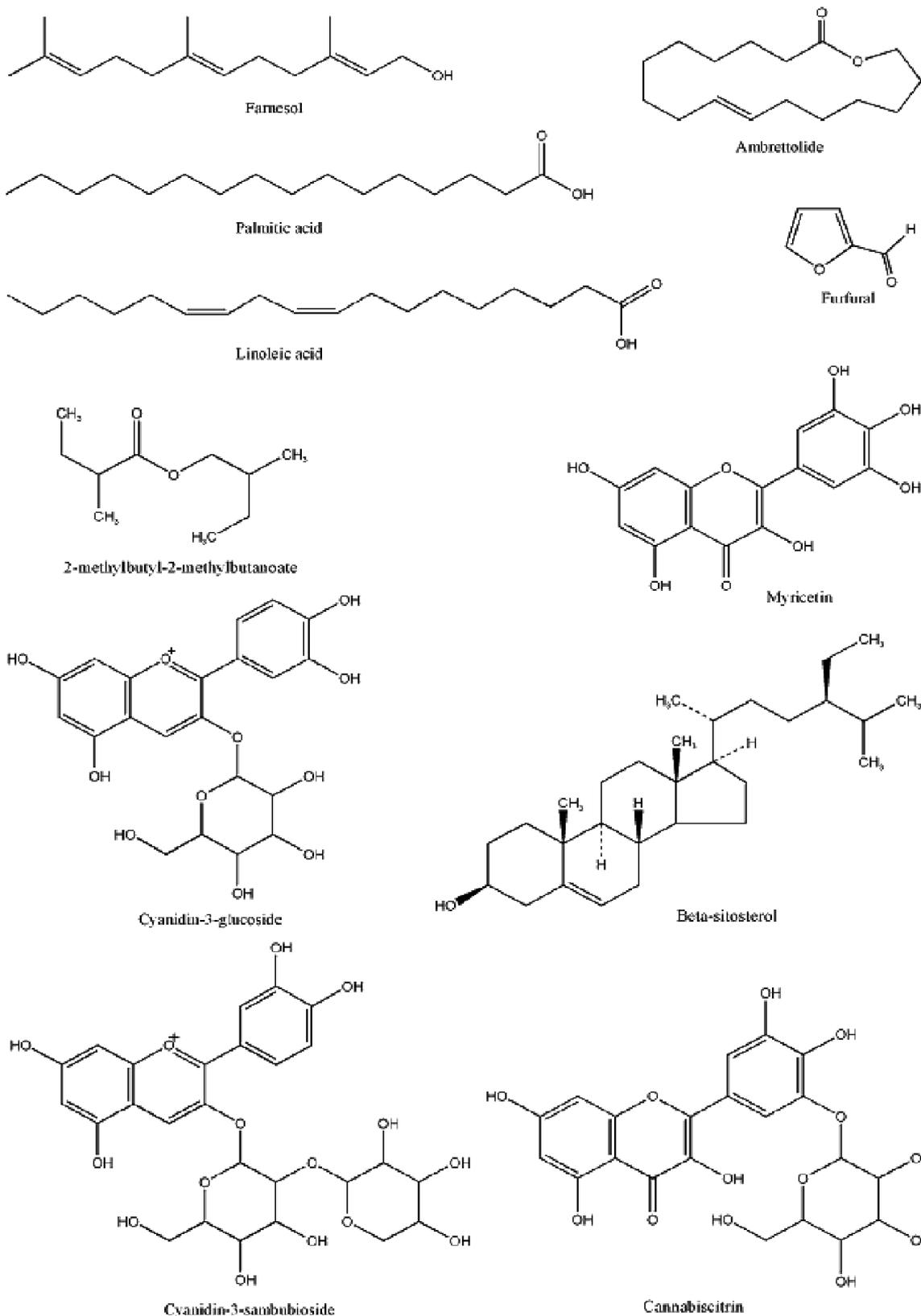
Decoction of pounded seed used as a diuretic, tonic and Carminative Seeds used as anti hysteric. Mucilaginous decoction of root and leaves used for gonorrhoea. In Malaya, leaves and roots used as poultice, is used for headaches, rheumatism, varicose veins, cystitis and fever. In Bombay, paste of seeds applied for itches. In Java, powder or infusion of roots used to stimulate the kidneys and intestines.^[7] In the West Indies, seeds are used as antispasmodic. Infusion, decoction or tincture of seeds used for nervous debility, hysteria and other nervous disorders. Seed are used for fevers and gonorrhoea; as inhalant to relieve dryness of the throat and hoarseness. Powdered seeds steeped in alcohol applied to snake bites. In the Caribbean, is used for female reproductive problems and for childbirth. In Egypt, seeds are chewed to relieve stomach problems, to soothe nerves and "sweeten" the breath; also considered as an aphrodisiac. Seeds made into an emulsion with milk, for skin itches. In Ayurveda, plant considered to pacify aggravated *pitta*, *kapha*, bronchitis, asthma, dyspepsia, coli, calculi, diarrhea, flatulence, vomiting, and nervous system disorders. In Aromatherapy, oil is used for relieving stress, fatigue, anxiety. Also, used for cramps, muscle aching, depression and nervous complaints.^[8]

Myricetin as the active principle of *Abelmoschus moschatus* to lower plasma glucose in streptozotocin-induced diabetic rats.^[9] Mediation of β -endorphin by myricetin to lower plasma glucose in streptozotocin-induced diabetic rats.^[10] *Hibiscus abelmoschus* seed extract as a protective active ingredient to favour FGF-2 activity in skin.^[11] *Abelmoschus moschatus* (Malvaceae), an aromatic plant, suitable for medical or food uses to improve insulin sensitivity.^[12]

PHYTOCHEMISTRY

The characteristic musk-like odour of the seed oil is mainly due to the presence of a ketone, ambrettelide, a lactone of ambrettolic acid.^[13,14] The seeds are valued for the fiber, 14.5 % lipids, 13.4 % starch, 2.3% protein, 5% resins and 0.2 to 0.6% volatile oil. Analysis of volatile oil report myricetin-3glucoside, glycoside cynadin, beta-sitosterol and betaD-glucoside.^[15] The other principle components identified are farnesyl acetate (70%), 7(Z)hexadecan-16-olide, 9(Z)-octadecen-18-olide (14%), ambretolide, farnesol, dodecyl acetate and decyl acetate.^[13] Detailed investigation of the basic fraction of a CO₂ extract of seeds revealed a total of 58 nitrogen containing volatile constituents. Among these are 27 pyrazine derivatives, 12 pyridines and 7 thiazoles

including four natural compounds i.e., 1-(6-ethyl-3-hydroxypyridin-2-yl) ethanone, 1-(3-hydroxy-5,6-methylpyridin-2-yl) ethanone, 1-(3-hydroxy-6methylpyridin-2-yl) ethanone and 1-(3-hydroxy-5methylpyridin-2-yl) ethanone.^[16] The fatty oil of seeds contains the phospholipids: 2- cephalin, phosphatidyl lserine and its plasmalogen and phosphatidyl choline plasmalogen. It contains farnesol and ambrettolic acid lactone. β - sitosterol and its β - d – glucosides are isolated from leaves. Petals contain β -sitosterol, flavonoid myricetin and its glucoside. Anthocyanins like cyanidin-3-ambubioside and cyanidin-3- glucoside are present in the flowers oil from the seeds is rich in linoleic acid and contains α -cephalin, phosphatidyl serine, its plasmalogen and phosphatidyl choline.^[17]



PHARMACOLOGY

Seed Oil/ Safety study/ Edibility

Y. R. Rao *et al.*, 2005, were studied after extraction of fragrance from the seed coat, seeds are flaked and extracted with hexane to yield fatty oil.^[17] The FA composition possesses saturated, monosaturated, and

polyunsaturated FA in ratios close to UN WHO recommendations. Acute oral toxicity study and safety evaluation tested on albino rats show it to be comparable to groundnut oil and suitable for edible use.^[18] Studied the presence of volatile components in okra seed coat.^[19]

Myricetin/ Anti-diabetic activity

Myricetin was purified from the aerial part of *Abelmoschus moschatus* was studied in streptozotocin-induced diabetic rats.^[9] It is concluded that hypoglycemic effect of myricetin is due to the enhancement of glucose utilization by activation of opioid μ -receptors of peripheral tissues in response to increased β -endorphin secretion.^[10] Results showed that intravenous injection of myricetin to cause a dose dependent decrease in plasma glucose concentration. Myricetin, a naturally occurring flavonol, ameliorates insulin resistance induced by a high-fructose diet in rats.^[20]

Antioxidant/ Antiproliferative activity

Detailed study of seeds and leaf extracts of AM using total antioxidant, DPPH, and ferrous reducing antioxidant property methods. The hydro alcoholic extract of leaf showed significant antioxidant activity with highest activity of 21.52 mg AAE/dw. Hydro alcoholic seed extracts exhibited higher DPPH radical scavenging activity with IC₅₀ value of 38.1 μ g GAE/ml. Both leaf and seed extracts showed DPPH radical scavenging activity. Leaf extract of the plant showed considerably higher ferrous reducing power (6.28 mg AAE/gdw by hydro alcoholic extract) than the seed extract. Both extract also show significant lipid peroxidation and inhibiting effect as well as hydrogen peroxide, hydroxyl radical, and superoxide radicals scavenging activity.^[21]

The antiproliferative activity of leaf and seed extract of AM was performed using colorectal adenocarcinoma (COLO-205) and retinoblastoma human cancer (Y79) cell lines. Result indicate The result indicated that hydro alcoholic seed extract showed 73.33 and 74.40% inhibitory activities, at the concentration of 200 μ g/ml, against COLO-205 and Y79 cell lines, respectively. The hydroalcoholic leaf extract showed 78.25 and 78.8% inhibitory activities, at the concentration of 200 μ g/ml, against cell lines COLO-205 and Y79, respectively. Hydroalcoholic extracts exhibited antiproliferative activity against two human cancer lines.^[21]

Silver nanoparticles/ Antimicrobial activity

Study reports on the biosynthesis of stable silver nanoparticles using an aqueous extract of *A. moschatus*. The antimicrobial activity of the nanoparticles was demonstrated against some Gram positive and Gram negative bacteria.^[22]

Memory strengthening/ Seeds-property

Study investigated the memory strengthening effect of ethanolic extract of seeds of AM. Treatment significantly improved learning and memory in mice and reversed the amnesia induced by diazepam. AM also decreased whole brain AchE and malondialdehyde content and increased the brain-reduced glutathione. Results suggest a potential candidate for improving memory, anticholinesterase and

antioxidant activity, with applications in the management of dementia and Alzheimer's disease.^[7]

Hepatoprotective/ Paracetamol-induced toxicity

The hepatoprotective activity of ethanolic and aqueous extracts of seeds of *A. moschatus* was studied at the dose of 300 mg/kg against paracetamol and ethanol-induced hepatotoxicity in rats. Results showed hepatoprotective activity of all studied extracts against paracetamol induced toxicity, with the ethanol extract showing more significant effects than the aqueous extract. Both of extract prevented paracetamol-induced lipid peroxidation of liver tissue and restored altered serum marker enzymes such as serum glutamic oxalo acetic transaminase, serum glutamate pyruvate transaminase, and alkaline phosphatase and total bilirubin levels toward normal.^[23]

Anti-diabetic activity

Study showed a high level of polyphenolic flavonoids. It also exhibited characteristics of rosiglitazone. Study concludes *A. moschatus* is a potential useful adjuvant therapy for patients with insulin resistance and/or subjects wishing to increase insulin sensitivity.^[20]

Antimicrobial activity

Study on anti-microbial activity showed clear zones of inhibition against *S.aureus*, *B.megaterium*, *S.flexneri*, *P.mirabilis*, *P.vulgaris* and *Corynebacterium diphtheria*.^[24] The fraction with major antibacterial activity against C diphtheria contained terpenoid oil. Ethanolic extracts of different parts of *A. moschatus* showed a broad spectrum and strong anti-bacterial as well as antifungal activity against multi resistant pathogen.^[25]

Anti-lithiatic activity

Christina and Muthumani, 2013,^[26] were reported phytochemical investigation and antilithiatic activity of *Abelmoschus moschatus*. Study investigated the protective effect of a hydro alcoholic extract at the dose of 200 and 400 mg/kg of whole plant. *A. moschatus* against ethylene glycol induced urolithiasis in male Wistar albino rats. Results showed reduction and prevention of growth of urinary stones. The mechanism was unknown, but may be related to an increased diuresis and lowering of urinary stone forming constituents.

Diuretic/ Seeds- activity

Study investigated the diuretic activity of methanolic extract of *A. moschatus* seeds extracts was evaluated at the dose of 50 and 100 mg/kg in rats. The plant extract administration resulted in significant increase in urine volume in dose-dependent manner. The petroleum ether, chloroform, and alcoholic extracts of leaves of the plant were also studied for diuretic potential at the dose of 200 mg/kg in rats. The alcoholic extract exhibited significant diuretic activity as shown by increased total urine

volume and urine concentration of Na, K, and Cl. Furosemide was used as standard.^[27]

Improved insulin sensitivity

Study investigated the effect of the plant improving sensitivity in rats with insulin resistance induced by a 60% fructose diet for 6 weeks. The extract of *A. moschatus* displayed the characteristics of rosiglitazone (4mg/kg per day) in reducing the high HOMA-IR index. Treatment also increased post-receptor insulin signaling mediated by enhancements in insulin receptor substrate-1 associated phosphatidylinositol 3-kinase step and glucose transporter subtype 4 translocation in insulin-resistant soleus muscles.^[12]

Antifungal/ Trypsin Inhibitors/ Seeds- activity

Study investigated the antifungal potential of trypsin inhibitors isolated from the seeds of AM on isolated pathogenic fungal strains. ATM-I and ATM-II significantly affected the growth of *Candida albicans*, *C.tropicalis*, *C.glabrata*, *Aspergillus flavus*, *A.Niger* and *Saccharomyces cerevisiae*. Fluconazole and ketoconazole were used as positive controls. Results suggest the plant derived trypsin inhibitors have excellent potential as novel antimicrobial agents.^[28]

Anti-ageing property

A. moschatus seed extract was developed and studied its effect on skin fibroblast using vitro and in vivo method. Results showed that antiageing properties of seed extract to cause significant improvements in wrinkles, skin texture, skin elasticity, and skin density by preserving FGF-2 content of human skin, property which exhibits by heparan sulfate and dose-dependently protects FGF-2 from thermal degradation.^[11]

Hemagglutinating activity

AMTI-I and AMTI-II isolated from the seeds of *A. moschatus*, to evaluate hemagglutinating activity against both normal and trypsin-treated erythrocytes of rabbit, rat, human and sheep AMTI-I and AMTI-II was sufficient to cause the visible agglutination reaction with trypsin-treated rabbit erythrocytes and AMTI-II, agglutinated trypsin-treated rabbit and rat erythrocytes at a much lower concentration compared to those of human and sheep, as low as 12.5 µg. The inhibitors agglutinated trypsin-treated rabbit and rat erythrocytes equally but the titer value obtained with native rabbit erythrocytes was 2 times higher than that obtained with untreated rat erythrocytes. Both AMTI-I and AMTI-II also agglutinated trypsin-treated human erythrocytes irrespective of the blood groups. It is concluded that the AMTI-I and AMTI-II exhibit stable and potent hemagglutinating property against human and animal erythrocytes and may be useful in agricultural field for the development of insect-resistant transgenic crops.^[28]

Anti-bacterial/ Trypsin Inhibitors/ Seeds- activity

Study investigated the antibacterial activity associated with trypsin inhibitors (AMR-I, II, III and IV) isolated

and purified from the seeds of AM. AMTI I and II showed strong activity against *E.coli*, *P.vulgaris*, *B.subtilis*, *S.pneumoniae*, *B.cereus* and moderate activity against *K.pneumonia*, *P.aeruginosa*, *P.syringae*, and *S.pyogenes*. Results suggested trypsin inhibitors AMTI-I and II from the may serve as candidates for the development of novel antimicrobial agents.^[28-30]

CNS effects/ Seeds

Study the effect of oral administration of hydro alcoholic seed extract of AM showed CNS effects in various behavioral models, viz. forced swim, tail suspension, light-dark box, hole-board, elevated-plus maze, locomotor, ME induced seizure, PTZ and strychnine. Results indicated that the both doses of *A. moschatus* seed extract (200 and 400 mg/kg) possesses antidepressant, anxiolytic, anticonvulsant, hypnotic, and muscle relaxant activity.^[31]

CONCLUSION

Abelmoschus moschatus Medik., commonly known as musk mallow (English), kasthurivenda (Malayalam), kasturibhendi (Hindi), belongs to the family of Malvaceae and is medicinally important plant. More detail study of ethano pharmacological effect of plant should be carried out with proper scientific knowledge, detail documentations should be done in order to explore the medicinal uses and to obtain proper identification extensively studied by various researchers based on its biological activities and therapeutic potential.

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