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Review Article

Comprehensive Review on Phytochemistry and Ethanomedicinal uses of Malvaviscus arboreus Dill. Ex. cav. medicinal plant species

Vineeta Arya[*1], Tirath Kumar[2], Priyanka Joshi[3], Jigiyasa Jaiswal[4]

[*1,2,3,4]*Department of Pharmaceutical Sciences, Kumaun University, Bhimtal-Nainital, Uttarakhand, India,263136*

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ABSTRACT

A magnificent flowering shrub in the Malvaceae family is Malvaviscus arboreus Cav. Malvaviscus arboreus Cav. flowers are a rich source of phytochemicals, including P-coumaric acid, ferulic acid, chlorogenic acid, gallic acids, protocatechuic acid, and p-hydroxy benzoic acid. Total soluble flavonoids such as kaempferol, myricetin, quercetin, and rutin are present in the flowers. Additional phytochemicals found in this plant include quinones, phenols, tannins, alkaloids and/or nitrogenous compounds, coumarins, saponins, anthocyanins, steroids, glycosides, terpenoids, emodins, and terpenoids. The medicinal qualities of this plant are due to these phytochemicals. This herb can be used medicinally to treat a variety of conditions, such as whooping coughsore throat, pneumonia, gastritis, wounds, fever, hypertension, and liver issues, stomachaches, diarrhea, gall bladder issues, cystitis, and disorders of the kidneys. Studies in botany have been conducted on the petiole, leaf, flower, and stem. Numerous studies' worth of experiments showed that extracts from different components have a wealth of medicinal advantages, including antifungal, hepatoprotective, antibacterial, antioxidant, gastrointestinal protective, anticonvulsant and anticancer properties.

INTRODUCTION

Plants have been used as medicine for centuries and are an important part of India's health-care system. Most practitioners in Indian medicine develop and deliver their own recipes, necessitating thorough documentation and study. Approximately 40% of people in the West report using herbs to address medical ailments, and the consumption of herbal medications is steadily rising. These are not just utilized for primary health care in rural parts of underdeveloped countries, but also in industrialized countries where advanced medicines are popularHerbal medications are made exclusively from medicinal plants, while traditional medicines also contain minerals and organic materials. Because of the rising prevalence of adverse pharmaceutical reactions and the high cost of the modern medical

***Corresponding Author:** Vineeta Arya
Address: *Department of Pharmaceutical Sciences, Kumaun University, Bhimtal-Nainital, Uttarakhand, India,263136*
Email : vineetaarya986@gmail.com

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system, interest in conventional therapy is expanding exponentially at the public, academic, and level of government.[1] Since ancient times, India has had a vast ethnobotanical knowledge base. Much research is being conducted on the pharmacology, chemistry, biotechnology, botany, and pharmacognosy of botanical remedies.[2] Some ongoing research in the development of medications involves species of Malvaviscus arboreus (used for Hepatoprotective activity, Gastroprotective activity, Antimicrobial activity, and anti-convulsant activity). Malvaviscus arboreus Dill. Ex. Cav is a delightful Malvaceae blooming shrubs. The 244 genera that comprises the Malvaceae family of blossoming plants contain 4,225 species. Okra, a hibiscus, cotton fibers, and durian are some of the plants in this family that are most significant economically. can bloom all year long in both bright and somewhat shaded environments. It bears pink and red blossoms, among other colors. These species are utilized as potted plants and hedgerow plants in gardening.[3] Malvaviscus is a tiny genus in the Mallow family. In addition to bearing schizocarpic fruits with five different segments, members of the genus Malvaviscus are distinguished from Hibiscus plants by having five enormous stigmas covering the central style, as opposed to ten. It contains secondary metabolites with significant biological and economic significance. is well-known for its excellent phytoconstituents and biological potential, making it popular in folk medicine around the world.[4] The plant originated in Central and South America and has since spread to various tropical and subtropical regions, including India's Uttarakhand region. It is mostly used as a seasoning. Numerous ailments have been treated with , including as whooping cough, injuries, a high fever, elevated blood pressure, throat pain, gastroenteritis, complications of the liver, stomachache, diarrhea, problems with the liver and gallbladder, cystitis, and renal diseases.. Although malvaviscus plants are often used for their aesthetic and therapeutic qualities, their leaves, fruits, and petals are additionally utilized in dishes such as salads,jellies, and natural remedies.[5,6] plants contain several phenolic compounds, including flavonoids, alkaloids, fatty acids, sterols, triterpenes, tannins, or tannin coumarins and the saponins steroids, glycosides, terpenoids or emodins, and anthocyanins and phenolic acids, cardenolides, and/or nitrogenous compounds, quinines.[7]

Origin and Distribution

It is a member of the mallow family and can be a shrub or perennials. Native to South and Central America, Mexico, and the Southeast United States. Several tropical and subtropical areas were also exposed to it in Asia: Bangladesh, China, India (throughout India specially in North East India), Nepal, Pakistan; North America: Carribean Islands, Mexico, Guatemala, Honduras, United States of America; South America: Brazil, Columbia, Ecuador, Peru and throughout Assam.[8]

Common Names

Manzanilla, Manzanita, Lady teardrop, Sleeping Hibiscus, and Wax mallow are some of its popular names.[8]

Taxonomy

- Botanical name : Malvaviscus arboreus Dill ex. Cav.
- Kingdom: Plantae
- Subkingdom: Viridaeplantae (green plants)
- Division: Magnoliophyta
- Subdivision: Spermatophytina
- Phylum: Tracheophyta
- Class: Magnoliopsida
- Superorder: Rosanae
- Order: Malvales
- Family: Malvaceae
- Subfamily: Malvoidea

- Tribe: Hibiscea
- Genus: Malvaviscus
- Species: arboreus [4]

Morphology

- Erect shrubs or undershrubs that reach a height of 1-4 meters.
- Stems are woody, with branches covered in simple and stellate hairs that eventually become glabrate.
- Petiole is puberulent and about 2–5 cm long; stipules are straight, spathulate, and caducous, about 3-5 mm long; leaves are alternate, unlobed or shallowly 3-5 lobed, broadly ovate-elliptic to lanceolate, about 4–22 x 3–13 cm across, with a rounded base, 5–9 veins, coarsely crenate–serrate margins, acute to acuminate apex, and sparse pubescence with simple and stellate hairs both above and below.
- Typically, the inflorescence are loose, solitary, axillary cymes.
- Flowers are bisexual, ascending, with a pedicel that is slender and puberulent, measuring approximately 5-15 mm in length. The involucellar bractlets are linear and spathulate, and the calyx is 5 lobed, clearly nerved, with campanulate lobes lanceolate, base connate, apex acute to acuminate, persistent, and a showy, scarlet red, whitish, orange, campanulate or cylindric, measuring approximately 2.5-3 cm in length.
- About 5-7 centimeters long, the staminal column is longer than the corolla tube with basifixed anthers in the upper half. 10 locular, axile placentation, superior ovary, 10 branching style.
- Fruit capsule, round and globose, 1.5 cm in diameter, juicy, and edible (tasty). Brownish seeds that are reniform or subglobose.[9]

Malvaviscus arboreus Uses

Medicinal uses

- It helps to promote the general health of the cardiovascular system. The immune system in its entirety also benefits by the use of it.
- Wax mallow flowers are used as a blood sugar regulator in many traditional cultures.
- Rarely, plant material may even help stimulate hair growth by delaying the appearance of baldness.
- The plant's leaves are used to make emollients that are used for soothing skin, reduce inflammation, and ease itching.
- The plant's floral portions were utilized by Mexicans as a menstrual cure and to ease gastrointestinal pain.
- Many ailments, such as bronchitis, cystitis, diarrhea, dysentery, fever, cough, common cold, flu, gastritis, hypertension, kidney diseases, problems with the liver and gallbladder, gallstones, diabetes, stomach aches, sore throats, tonsillitis, and wounds have all been treated with the plant.[10, 11]

Culinary uses

- Young, delicate leaves can be cooked to enhance their texture, just like spinach.
- One may cook these leaves well in a steamer, sauté, boil, or stir-fry.
- The blossoms can be utilized for tea, whether they are either wet or dried. In Thailand, the flowers are eaten raw in salads or cooked in mild curries.
- One may use flowers to make a drink which feels like pink lemonade.
- One can also dry the berries and use them to make jelly, jam, or wine. There is also a little, edible red berry on Turk's Cap that looks like an apple and gives origin to the

alternate name "Mexican apple," for the plant.

- The leaves, flowers, and fruits of can also be used to make herbal drinks, jellies, salad dressings, and herbal dyes.[5,10]

Other uses

- In addition to being used as a landscape and garden plant, the plant is also used indoors in pots, especially in shaded locations.
- Bark from both the inside and outside can be used to create strong cordage.
- The stems' fiber can be woven into burlap-like textiles or utilized for creating rope.

Phytochemical Profile

Using qualitative assays as previously defined by the researchers, the existence of steroids, terpenoids, emodins, anthocyanins, flavonoids, saponins, tannins, glycosides, phenols, and alkaloid was examined in ethanolic extract of Malvaviscus arboreus red flower (ERF).[12] leaves contain a variety of chemicals, including protocatechuic acid, chlorogenic acid, gallic acid, p-coumaric acid, ferulic acid, and hydroxybenzoic acid.[13] The gastroprotective qualities of M. arboreous are attributed to the presence of glycosylated flavonoids (kaempferol 3-O-D-sophoroside and kaempferol 3-O-D-sambubioside) in the aqueous extract and its organic fraction of Malvaviscus arboreus.[14]

The entire ethanolic extract of aerial parts contained cardenolides, carbohydrates, glycosides, and/or nitrogenous compounds.[15] Total soluble flavonoids such as kaempferol, myricetin, quercetin, and rutin are present in the flowers. The flowers of the variety Drummondii contained 53 different flavonoid aglycone pigments in total.[16]

Pharmacological Activity

Antioxidant activity

Malvaviscus arboreus Red Flower (ERF) ethanol extract has antioxidant properties. The assays for radicle scavenging activity of DPPH and ABTS antioxidant potential test and ferric reducing antioxidant potential assay, CUPRAC and Chelating power methods were used to study anti-oxidant activity of ethanolic extract of red and white flower. Another research investigation claims that Malvaviscus arboreus's ethanolic extract has radical scavenging activity. Antioxidant activity was calculated using the DPPH technique with the IC50 value as a parameter. Plants, flowers, fruits, and dietary supplements are often evaluated for their primary antioxidant activity using the stable free radical DPPH (2, 2-diphenyl-1-picryl hydroxyl). The results of the investigation showed that flowers have free radical scavenging or inhibitory action; the red bloom had the highest level of activity. Compared to the pink-flowered variety, the red-colored flower of possesses the highest ABTS radicle scavenging activity. The red blossom has the best potential for antioxidants out of the two colors (Red and White). These flowers can be employed as principal antioxidants even if their antioxidant capacity is lower than that of ascorbic acid.[16]

Hepatoprotective activity

The entire aerial component extract of , along with its derived fractions (petroleum ether, ethyl acetate, dichloromethane, and aqueous), exhibit hepatoprotective properties. It was investigated whether had any hepatoprotective properties against the hepatotoxic effects of carbon tetrachloride (CCl4). For six days in a succession, rats were administered the complete aerial component extract and its derived fractions orally (Petroleum Ether, Aqueous, Dichloromethane, and Ethyl Acetate). The following day, 1.5 ml/kg of CCl4 (1:1 v/v) in olive oil was intraperitoneally delivered into the rats. On day eight, cervical decapitation was used to sacrifice every rat. Following that, blood samples were taken from each group in order to measure the serum

concentrations of TB (Total Bilirubin), ALT (alanine transaminase), AST (aspartate transaminase), and ALP (alkaline phosphatase). Furthermore, liver tissues were taken for histological examination and to assess the amounts of TAC (total antioxidant capacity) and MDA (malondialdehyde). Up to the analysis, all samples were kept at -80°C in storage. For ten minutes, the drawn blood samples were centrifuged at 3000 rpm. Using commercially available kits, the obtained clear serum was used to assess the levels of ALT, AST, ALP, and TB in accordance with standard protocols. As evidenced by the reduced levels of serum ALT by 76.1% and 70.5% and AST by 71.8% and 74.3%, respectively, the results showed that the ethyl acetate and dichloromethane fractions significantly reduced the liver damage in rats. Furthermore, they reduced the increased levels of ALP by 75.1% and 62.8% and TB by 84.4% and 70.6%, respectively. The positive medicine silymarin (100 mg/kg) recovered the levels of ALT, AST, ALP, and TB by 70.9, 73.8, 71.4, and 85.0%, respectively. Their protective effects were clearly similar to those of silymarin. Furthermore, the EtOAc fraction and silymarin both improved the high levels of tuberculosis (TB) in an equivalent manner (84.4% vs. 85.0%). These results could broaden the plant's potential uses in phytotherapy down into the future. Additionally, because is reportedly edible, dietary supplementation with it may be a viable option for preventing liver damage.[11]

Gastroprotective Activity

Aqueous extract of M. arboreous flowers was used to assess the gastroprotective impact and discover potential bio-active components. This work was done in consideration of the traditional use of M. arboreous and its flavonoid and other polyphenol content. An aqueous (MaAq) and organic (MaEA) fraction were obtained from the aqueous extract (ExAq) by partitioning it using an immiscible mixture of water and ethyl acetate. In an experiment, stomach ulcers caused by ethanol were created in male rats in order to evaluate the gastroprotective effect. Tween 20 was employed as a negative control, and famotidine (10 mg/kg) and L-arginine (300 mg/kg) were used as positive controls. This investigation made it possible to show that the glycosylated flavonoids (kaempferol 3-O-D-sophoroside and kaempferol 3-O-D-sambubioside) contained in the aqueous extract and its organic component (MaEA) of M. arboreous are essentially provide the plant its gastroprotective qualities. At high levels of 97.8%, 79.5%, and 91.1%, respectively, the gastroprotective effect of the integrate extract (ExAq) at 250, 500, and 750 mg/kg was demonstrated. When the organic component (MaEA) was assessed at 125, 250, and 500 mg/kg, respectively, it showed protection values of 91.2%, 96.0%, and 99.4%. When compared to famotidine at 10 mg/kg (83% of gastroprotection), the ethyl acetate fraction showed greater gastroprotection. These results will be useful in the future development of a standardized process beneficial in the therapeutic management of stomach ulcers.[14]

Antimicrobial Activity

The hydro-distillation of leaves from Malvaviscus arboreus Cav. yielded essential oils that were assessed for their potential antibacterial properties against ATCC 25923, ATCC 4028, and ATCC 11778 of Salmonella typhimurium, Bacillus cereus, and Staphylococcus aureus.

Disk diffusion, microdilution, and bioautography procedures were used to evaluate the antibacterial activity; gas chromatography coupled to a mass spectrometer detector (GC-MS) was then used to analyze the positive extracts in order to acquire the chemical profile. The disk diffusion method was used to ascertain the maximum observed zone of inhibition after incubation for 24 hours at 37° C. The results showed that the highest observed zone of inhibition against S. aureus was 10.00a ±2.00

mm, followed by 21.80c ±0.80 mm against S. typhimurium and 14.20b ±1.50 mm against B. cereus. Direct bioautography of S. aureus, S. typhimorium, and B. cereus was performed using silica gel GF254 TLC Aluminum plates.

Without defining particular fractions, the essential oil of showed a single inhibitory zone on the growth of S. aureus. Using an agar dilution approach, the minimum inhibitory concentration (MIC) was found for the bioautography assay extracts that showed an inhibition zone. B. cereus was the most sensitive microbe in the microdilution test. The essential oil that was steam-distilled from leaves was reported to have a minimum inhibitory concentration (MIC) of 20 mg mL-1 against S. aureus and B. cereus. Malvaviscus arboreus red flower (ERF) ethanol extract has been shown to have antimicrobial properties against Bacillus subtillus, Salmonella typhimurium, Enterococcus, Bacillus cereus, Staphylococcus aureus, Vibrio damsela, Pseudomonas aeruginosa, Vibrio fluvialis, and Penicillium oxalicum, Aspergillus fumigatus, Aspergillus terreus, Aspergillus niger, Aspergillus flavus, and Aspergillus parasiticus. When compared to the positive control, the ERF of had an antibacterial action against the majority of the strains that were investigated, with typical inhibition zones of between 10 and 20 mm. This research enables that the potential antibacterial activity of plant species to be identified, which may be useful in the future for the preservation of perishable foods like milk and meat.[5]

Cytotoxic Activity

The objective of this research was to identify the components of the ethanol- base d extract of Malvaviscus arboreus red flower (ERF) using the 1HNMR fingerprint, GC-MS analysis, and HPLC identification of flavonoids and phenolic substances. The ERF's cytotoxic properties have been investigated. This study aims to explore the impact of the ERF on liver cancer in vitro using hepatocellular carcinoma HepG2, the most commonly used cell line for hepatotoxicity and drug metabolism research. HepG2 cells can carry out a broad range of differentiated liver functions and are non-tumorigenic, growing quickly, and shaped like epithelial cells. HPLC examination identified phenolic and flavonoid chemicals, whereas GC-MS analysis identified twenty-one components. The cells were cultivated at 37 °C in a humidified 5% (v/v) CO2 atmosphere in Dulbecco's Minimum Essential Medium supplemented with 10% heat-inactivated fetal bovine serum (FBS), 100 units/mL penicillin, and 100 mg/mL streptomycin. The cells' viability was assessed using the Sulforhodamine B (SRB) test. The hepatocellular carcinoma (HepG2) cell line was subjected to the ERF's cytotoxicity for 72 hours, during which time the SRB test was employed to evaluate its effects. With an IC50 value of 67.182 µg/µL, the results showed that ERF significantly and dose-dependently reduced the proliferation of HepG2 cells. An increase in the mortality of cancer cells indicates that ERF may have anticancer effects on HepG2 cells. Another study claims that 's ethanolic based extract has cytotoxic properties. The cytotoxic potential was ascertained using the MTT assay, and the IC50 value was shown to be 152,45 µg/mL.[17]

Antifungal Activity

The antifungal activity was assessed using diffusion discs and the minimum inhibitory concentration (MIC) method. After diluting the Malvaviscus arboreus red flower ERF ethanol extract to 25% in DMSO, various ERF concentrations (0.5–2.0 mg/mL) were added. A liquid culture medium was used to activate the strains of A. fumigatus, A. terreus, A. niger, A. flavus, A. parasiticus, and P. oxalicum for 24 hours. Spectrophotometric readings were then used to determine when the strains had reached a concentration of 0.5 McFarland. The strains included a spore suspension of 0.2 mL (106 spores

each mL of the fungal isolate during test). Petri dishes were inoculated with the previously generated fungal strains using Czapek Dox agar. The culture medium was topped with six-millimeter sterile discs, upon which ten milliliters of the diluted extract were pipetted.. The cultures were incubated at 25 °C for 72 hours. The MIC, or minimum inhibitory concentration, of ERF was the lowest concentration at which fungal growth was effectively suppressed. DMSO was employed as a control group. A. parasiticus and P. oxalicum did not exhibit any effects from 's ERF. The minimum inhibitory concentration (MIC) values were ascertained in order to determine ERF's susceptibilities against the strains that were tested. For V. damsela, the ERF of showed the lowest MIC (1.5 ± 0.02 mg/mL). S. aureus, P. aeruginosa, V. fluvialis, E. faecalis, 2.5 ± 0.05, 10.0 ± 0.06, 10.0 ± 0.01, and 5.0 ± 0.01 mg/mL were the MIC values for each of these bacteria, in that order. A. fumigatus, A. flavus, A. niger, and A. terreus, on the other hand, had minimum inhibitory concentrations (MIC) of, respectively, 1.0 ± 0.02, 1.25 ± 0.01, 1.75 ± 0.06, and 0.75 ± 0.01 mg/mL.[17]

Anticonvulsant Activity

Several parts of Malvaviscus arboreus Dill. Ex Cav. () are traditionally utilized in the West Region of Cameroon for the treatment of various ailments, including epilepsy. This study evaluated and compared the anticonvulsant effects of the aqueous lyophilisate made from the decoction of blossoms, the leaves, stems, and roots at various concentrations using an acute epileptic seizure model induced by an injection of pentylenetetrazole (PTZ) at a dose of 70 mg/kg one hour after the various extracts were taken orally. After selecting the leaves from among these plant parts, the hydro-ethanolic extract was prepared. Its acute toxicity was compared to that of the aqueous lyophilisate of the leaves, and it demonstrated an anticonvulsant action against PTZ at dosages of 122.5, 245, and 490 mg/kg. Further testing was done on the anticonvulsant activities of the aqueous lyophilisate of leaves using models of acute epileptic seizures induced by pilocarpine (350 mg/kg), strychnine (2.5 mg/kg), and picrotoxin (7.5 mg/kg). The best extract was the aqueous lyophilisate, and leaves exhibited the strongest anticonvulsant activity. The latter proved ineffective against pilocarpine-induced seizures, but it significantly shielded the mice from convulsions brought on by PTZ (71.43%) ($p < 0.01$), PIC (57.14%) ($p < 0.05$), and STR (42%). Its primary mechanism of action was the potentiation of the brain's inhibitory systems (GABA, Glycine). An alternate method of treating epilepsy could involve .[18]

CONCLUSION

The analysis of Malvaviscus arboreus Dill. Ex. Cav. concludes by highlighting the plant's exceptional therapeutic potency and pharmacological diversity, around the world, the plant is well-known for its therapeutic qualities and mythology. It is thought to be a viable candidate for further scientific research and a helpful aid in traditional medicine. Plants are widely used in many cultures due to their presence of various bioactive chemicals, such as flavonoids, tannins, coumarins, saponins, steroids, glycosides, phenols, terpenoids, emodins, anthocyanins, cardenolides, quinones, and tannins. These compounds also contribute to the plant's wide range of pharmacological actions. Antioxidant, gastroprotective, antimicrobial, antifungal, hepatoprotective, and cytotoxic activities have all been demonstrated in Malvaviscus arboreus Dill. Ex. Cav., suggesting that it may be utilized as a treatment to treat a range of ailments. In addition, the plant has long been used to treat a variety of conditions, including coughing, wounds, fever, elevated blood pressure, bronchitis, gastritis, kidney illnesses, cystitis, and liver issues. With the growing popularity of natural therapies,

Malvaviscus arboreus Dill. Ex. Cav. becomes a keystone for sustainable healthcare solutions. Future studies should look for potential ways to complement conventional treatments, and its therapeutic benefits should be better understood at the molecular level. This review contributes to the ongoing conversation about ethno-pharmacology by providing a comprehensive understanding of the therapeutic characteristics of Malvaviscus arboreus Dill. Ex. Cav. and creating the foundation for the development of novel drugs derived from this botanical source.

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