

A COMPREHENSIVE PHARMACOGNOSTICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW ON *SIDA ACUTA* BURM.F.

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ABSTRACT

Sida acuta Burm.f. (Family: Malvaceae) has been widely utilized in traditional system of medicine for the treatment of various ailments. The present project provides a comprehensive review of *Sida acuta* with emphasis on its taxonomy, morphology, microscopic characters, ethnomedicinal uses, phytochemical constitution and pharmacological activities. Morphology and microscopy studies aid in the proper identification and authentication of the medicinal plant and the phytochemical investigation reveals the presence of alkaloids such as quindoline, Crytolepinone and ephedrine, aliphatics, flavonoids, steroids, phenolics are mainly Evofolin A and B, terpenoids, tocopherols and coumarins including were significantly present in the plant extract responsible for the extensive pharmacological activities antibacterial, antimicrobial, antioxidant, analgesic and anti-inflammatory, antipyretic, hypoglycemic and wound healing properties were supported by both in vitro and in vivo experimental

models. Available toxicological evaluations suggest that the plant extracts exhibit low toxicity and are relatively safe within therapeutic dose ranges. The review highlights the medicinal significance of *Sida acuta* and supports its potential as a promising source of bioactive compounds for herbal drug development.

KEYWORD: *Sida acuta*, Malvaceae, Ethnomedicinal, Quindoline, Crytolepine, Evofolin.

INTRODUCTON

Since the beginning of human civilization, people have utilized medicinal herbs for their medicinal and nutritional benefits. Nature has been a source of therapeutic substances for thousands of years, and a large number of medications have been identified from natural resources and utilized. The applications of these agents in conventional medicine served as the foundation for many of these isolations. *Sida acuta* Burm (Malvaceae) is one of those plants currently used by indigenous people for the management of some health problems. The traditional system of medicines such Ayurvedic, Siddha, and Unani systems utilize the species of the genus *Sida* (Fam. Malvaceae). In Ayurvedic system these species are identified as Bala and nagabala. *Sida acuta* Burm.f. is called as Arvalmooku pachilai, Vattatiruppi or Arrivalm. This plant is grows upto 1.5-meter-tall, upright and it is a branching tiny perennial herb or shrub species. The leaves are lanceolate, almost glabrous, with peduncles equal to the petioles; the flowers are yellow, solitary or in pairs; fruits are 5-carpeled with slender mericarps and relatively large calyces that enclose and conceal the fruits the seeds are smooth and black; the bark is smooth and greenish; the root is thin, long, cylindrical, and extremely rough. It is found in India and Nepal basically originated from North America. The majority of these plants were sufficiently grown in roadsides, waste areas, farmed fields, and drainage regions, where they are also referred to as Sengh. The phytochemical components found in the medicinal plant *Sida acuta* are Alkaloids, flavonoids, phenolic compounds, saponins, glycosides, terpenoids, and sterols. The primary bioactive constituent present in the *S. acuta* are Vasicine and vasicinone alkaloid. *Sida acuta's* antioxidant activity is greatly enhanced by the presence of flavonoids and phenolic compounds, and its therapeutic effect is further enhanced by saponins, glycosides, and sterols. *Sida acuta's* wide range of phytochemicals supports its importance in pharmacognostic and phytochemical research and serve as a solid scientific foundation for its traditional usage in a variety of diseases or illnesses conditions. *Sida acuta's* widespread usage in traditional medicine is supported by experimental research that show a wide spectrum of pharmacological actions. According to research, the plant's extracts have hepatoprotective, antibacterial, anti-inflammatory, analgesic, antipyretic, antioxidant, antimalarial, and wound- healing qualities. Alkaloids, flavonoids, tannins, saponins and the phenols are the important phytochemical constituent which are responsible for the therapeutic benefits.



Figure: 1 *Sida acuta* Plant.

PLANT DESCRIPTION

BOTANICAL CLASSIFICATION

- Kingdom : Plantae
- Subkingdom : Tracheophytes (Vascular plants)
- Phylum : Magnoliophytes (Angiosperms)
- Class : Magnoliopsida (Dicotyledonae)
- Order : Malvales
- Family : Malvaceae
- Genus : *Sida*
- Species : *Sida acuta*
- Scientific name : *Sida acuta* Burman f.
- Common name : Common wireweed, Morning mallow, Broomweed

VERNACULAR NAME

- Sanskrit : Bala
- Hindi : Bariyar
- Tamil : Malaidangi , Arivaal mooku pachilai
- Telugu : Nelabenda
- Kannada : Vishakaddi
- Malayalam: Malatanni
- Marathi : Chikana
- Gujarati : Bala
- Odia : Siobala
- Bengali : Kureta

MORPHOLOGICAL CHARACTERS

External features of *S. acuta* stem, leaf, flower, fruit, seed are given below

- **HABIT:** Erect, much branched, perennial or sometimes annual shrubs, usually 30-150cm tall.
- **STEM:** It is spherical, woody, and thin. It contains hairy stem at young and pubescent with simple stellate hair, internodes short; branches arise from lower nodes, green when it is young and turning brown and woody on maturity.
- **LEAF:** It has simple, lanceolate to linear, alternative 3-7 mm long and it is a yellowish green colour are longer in shape with margins and point tip and star shape hairsstage, 2-7cm long and 0.5-2cm wide, reticulated venation, slightly hairy surface, petioles 2 - 6 mm long.
- **FLOWER:** The flower is small, bright yellow in colour, solitary, actinomorphic, bisexual, 5 calyx and 5 corolla, buttercup like in shape was alternate, slender, lanceolate, acute margin 0.5-4 cm wide, lower surface smooth.
- **FRUIT:** Schizocarp, breaking into mericarp segments.
- 1- **SEEDS:** One seed per mericarp and are kidney shaped (oblong) or oblong, 2mm long, dark brown to black in colour.
- **ROOTS:** The taproot is tough and broken up like fibres. It is one long, hard cylinder with many small roots coming off it. The outside of the taproot is brown, has ridges, and is bumpy; when it breaks open, it will smell like dirt. The inside has a thin layer of cork covering it, then a layer of parenchyma (a soft, spongy tissue that makes up most of the plant), next there is a distinct ring of xylem and phloem, then almost no pith in the middle.

MICROSCOPICAL CHARACTERS

TRANSVERSE SECTION OF LEAF

TS of petiole

The petiole's TS has a wavy, round shape. Numerous stellate trichomes cover the entire petiole's surface in the epidermis. Three to four layers of collenchyma cells and five to six layers of thin-walled parenchyma cells make up the cortex. Rosette crystals is visible throughout the cortex. The inner cortical region is made up of a thick pericyclic layer covering cortex a sizable conjoint collateral vascular bundle. Phloem contains rosette crystals and is composed of a collection of thin-walled cells. Xylem is composed of xylem vessels

and parenchyma along with xylem fibres. A few numbers of parenchyma cells make up the elementary pith that occupies the section's centre.

TS of lamina through midrib

Dorsi-ventral amphistomatic leaves with wavy upper and lower epidermis are seen in TS. Double-layered palisade cells follow the upper epidermis, whereas spongy parenchyma cells follow the lower epidermis. The lower epidermis has more coverage and glandular trichomes, while the upper epidermis produces stellate and glandular trichomes. Two to three layers of collenchyma cells and three to four layers of thin-walled parenchyma cells make up the midrib area. The ground tissue of the midrib contains a small number of rosette crystals. A conjoint collateral vascular bundle with xylem encircled by phloem occupies the midrib's center. Rosette crystals are found in phloem. The vascular bundle is covered in an uneven layer of pericyclic sheath.

TRANSVERSE SECTION OF STEM

The stem's transverse part has an oval shape. The epidermis is composed of a single layer of cells with thin, rectangular walls. The cortex is made up of two layers of chlorenchyma on the outside, three to four layers of collenchyma cells in the middle, and three to four layers of deep rotund to oval parenchyma cells on the inside. Druses of calcium oxalate crystals are present in some of the parenchyma cells, and pericyclic fibers are arranged in rings outside the phloem. A continuous ring is formed by closely spaced vascular bundles. Mucilage cells are found in both the cortex and the pith, which is composed of thin-walled parenchyma cells. The majority of the cells contain starch granules.

PHYTOCHEMICAL CONSTITUENTS

Plants naturally contain substances called phytochemicals, which serve a number of purposes, such as provide protection from disease and environmental stressors. Certain phytochemicals are being researched for their ability to prevent or treat a variety of diseases, and they can also improve human health. The phytocompounds found in the medicinal plant SA are diverse these includes alkaloids, flavonoids, steroids, tannins, terpenoids, Ascorbic acid, niacin, thiamine, riboflavin, β -carotene, calcium, iron, phosphorus, sodium and magnesium are among the vitamins and minerals found in SA leaves.

ALKALOIDS

Alkaloids are the special group of natural compounds found mostly in most of the medicinal plants. An alkaloid is a nitrogenous organic molecule containing one or more nitrogen atom within a ring shaped heterocyclic structures. Many pharmaceutical properties of *S. acuta* is due the presence of alkaloids. Cryptolepine and its derivatives include quindoline, quindolinone, cryptolepinone, and 11-methoxy-quindoline are the major alkaloids present in the extract of *Sida acuta*. Among these alkaloids Cryptolepine is the widely utilized for studies. In human gastric adenocarcinoma (AGS) cells, cryptolepine, which was isolated from *S. acuta*, shown anticancer potential. It also contribute to the antibacterial and antimalarial properties of *Sida acuta*. Additionally, it was demonstrated that cryptolepine vasorelaxed rat mesenteric artery rings. Using a mouse mammary organ culture method, Jang et al. demonstrated the cytotoxic effect of quinodolinone, cryptolepinone, and 11-methoxyquindoline from *S. acuta*. Quinazoline alkaloids such as vasicine and vasicinone are also reported in *Sida acuta*, and it is responsible for the antimicrobial, anti-inflammatory and bronchodilator activities.

ALIPHATICS

Organic molecules with carbon and hydrogen linked in non-aromatic rings, straight chains, or branching chains are known as aliphatics. Although aliphatics can be cyclic, only aromatic compounds have an exceptionally stable atomic ring. Hentriacontane, Nonacosane, Pristane, Phytane, Sterculic acid, Malvalic acid, Myristic acid, Palmitic acid, Stearic acid, Oleic acid and linoleic acid were identified in *Sida acuta* hence the presence of these aliphatic hydrocarbons and fatty acids contribute to the therapeutic properties such as antimicrobial, anti-inflammatory and membrane stabilizing properties.

FLAVONOIDS

Flavonoids are an important group of plant-derived phenolic compounds. They are further classified into several subclasses, including anthocyanins, flavonols, flavanols, flavanones, flavones, and isoflavones. Flavonoids present in *Sida acuta* are kaempferol-3-o- α -L-rhamnopyranosyl- β -D-glucopyranoside and kaempferol-3-O- β -D-glucopyranoside and these belongs to kaempferol glycosides. These kaempferol glycosides exhibit antioxidant, anti-inflammatory, antitumour, antimicrobial, antiviral, neuroprotective, cardioprotective and antidiabetic benefits.

PHENOLICS

One or more hydroxyl groups joined to an aromatic ring can define as phenols, it is a significant family of secondary metabolites generated from *Sida* species. Phenols are hydroxy derivatives of aromatic hydrocarbons in which a carbon atom of benzene or another aromatic ring is directly linked to a hydroxyl (-OH) group. The important groups of phenolics are the Phenolic acids, polyphenols and flavonoids. Chlorogenic acid, vanillic acid, hydroxybenzoic acid, and hydroxycinnamic acid are examples of the various group of phenolic acids. In the extract of the whole plants of *S. acuta* the phenolics identified are evofolin A, evofolin B, N-trans-ferulolytyramine, scopoletin vomifoliol, loliolid, 4-ketopinoresinol, ferulic acid, sinapic acid, syringic acid and vanillic acid. These flavonoids contribute to wide range of pharmacological activities include antioxidant and anti-inflammatory, antimicrobial, antidiabetic cardioprotective and hepatoprotective effects.

STEROIDS

Plant steroids are called as phytosterol characterized by a common tetracyclic carbon skeleton Structure therefore all steroids possess a basic cyclopentanoperhydrophenanthrene nucleus Cholesterol, Campesterol, β -Sitosterol, Stigmasterol, Stigmast-7-enol(22- dihydrospinasterol) are the steroids present in *Sida acuta*. Ecdysteroids are polyhydroxylated ketosteroids found in SA is 2D-Hydroxyecdysone.

TERPENOIDS

Terpenoids are the naturally occurring hydrocarbon having the general molecular formula $(C_5H_8)_n$. There are many different classification of terpenoids based on the number of isoprene units it contain. On chemical modification of terpenes by oxidation or rearrangement of carbon skeleton resulting compound is the terpenoids. In *Sida acuta*, the terpenes present are Vomifoliol, ioliolide, taraxast-1.20(30)-dien-3-one, taraxasterone and α -amyrine. In a mouse mammary organ culture model it was demonstrated that of these vomifoliol, loliolide promoted quinone reductase and inhibited 7,12-dimethylbenz-[a]anthracene-induced preneoplastic lesions.

TOCOPHEROLS

Tocopherols consist of a chromanol ring and a 16-carbon saturated side chain. Tocopherols are essential for photoprotection, scavenging reactive oxygen species in chloroplasts, and serving as signaling molecules in response to environmental stressors including heat and salinity. The main chemical role is that of a chain-breaking, lipid-soluble antioxidant. In order

to neutralize free radicals and to prevent the lipid peroxidation of cell membranes, the hydroxyl group on the chromanol ring donates a hydrogen atom. α -Tocopherol, 7-Methoxymethyl- α -tocopherol, β -Tocopherol and Tocospire from the *S. acuta*, were reported to have an antioxidant activity.

COUMARINS

Coumarin are the aromatic compounds consists of benzene ring attached to pyrone ring. *Sida acuta* has been found to contain simple coumarins, including escoporone, Heraclenol, and scopoletin, according to phytochemical studies of leaves and aerial part.

ETHNOMEDICINAL USES

Sida acuta has many traditional medicinal properties. The *S. acuta* extract can be used alone or in combination with other plants to treat various ailments. In India, *S. acuta* has a role in treatment of fever, ulcer, bronchitis, abortifacient, diarrhoea and skin infections. Although all parts of the plant are utilised medicinally, requests for the leaves are the most common.

LEAVES

Leaves are used to treat rheumatic ailments and are said to have demulcent, diuretic, anthelmintic, and wound-healing qualities. Abdominal pain, hemorrhoids, azoospermia and oligozoospermia are can be treated by using leaves decoction and it is also used for cleaning wound. The leaf juice is also used in India for vomiting, gastric disorders and utilized as anti-helminthic. Urinary tract infections can be treated by using dried leaves hot water extract.

ROOTS

The *Sida* species roots have been found to be a great adaptogenic and immunomodulator, a general nutritional tonic, and a lifelong supplement; they are beneficial for tuberculosis as well as conditions related to injuries, heart disease, cough, and respiratory disorders. The root is chewed to relieve a toothache. Additionally, root is said to have aphrodisiac, antirheumatic, stomachic, diaphoretic, diuretic, antipyretic, and wound-healing characteristics. The root extract is used for the relief of coughing, problems with breathing, and Leucorrhoea. The juice of the root is applied to wounds.

ENTIRE PLANT

It is frequently believed that the entire plant extract can cure conditions including fever, headaches, skin conditions, diarrhoea, and dysentery. While a decoction of the dried whole

plant is taken orally for venereal illnesses, malaria, the decoction of the entire plant is taken orally for asthma, fever, aches and pains, ulcers, and as an anti-worm drug. The entire plant has been used in Colombia to cure snake bites and to decrease the haemorrhagic effects of *Bothrops atrox* venom.

PHARMACOLOGICAL ACTIVITY

ANTIBACTERIAL ACTIVITY AND ANTI MICROBIAL ACTIVITY

The aerial portion of SA is used to make the alkaloid-rich powder. Promising antibacterial effects against gram-positive bacteria are shown by agar-well diffusion experiments. The broth microdilution assay's results showed that the MIC and MBC ranges were 16 to 400 g/ml and 80 to 400 g/ml, respectively. The main active ingredients are quindoline and cryptolepine, which may be the reason of its antimicrobial activity. According to a different study, SA's ethanolic and aqueous extracts have strong antibacterial qualities, especially when it comes to microbial skin infections. A greater percentage of alkaloids, saponins, anthraquinones, cardiac glycosides, and flavonoids are found in moderate amounts, according to the phytochemical screening of these two extracts. Compared to the aqueous extract, the ethanolic extract demonstrated superior inhibition against *S. aureus* and *B. subtilis* (zone of inhibition ranging from 6 to 43 mm). It has been discovered that the amount of the dose given has a significant impact on the effectiveness of antibacterial activity. Alkaloid and flavonoid extracts have demonstrated antimicrobial action in *S. acuta*. The flavonoid fraction of the majority of *S. acuta* showed strong antifungal activity against *Candida albicans*. SA leaf aqueous and acetone extracts are effective against urinary tract infections caused by ESBL (Extended-Spectrum Beta-Lactamase) producing *Escherichia coli* (*E. coli*). According to one study, leaf extracts had higher levels of alkaloids than stem and root extracts. It was discovered that a leaf extract was more effective at preventing *P. aeruginosa*, *M. varians*, and *C. albicans* from growing. On the other hand, it was found that a root extract worked better against *A. flavus*, *S. typhi*, and *E. coli*. It has been demonstrated that copper nanoparticles (Cu-NPs) from SA have antibacterial action against *S. aureus*, *P. vulgaris*, and *E. coli*. Cerium oxide nanoparticles (CeO₂ NPs) are created using the green synthesis approach by reducing and capping the particles with phytochemicals obtained from SA leaf extracts. The resulting CeO₂ NPs are spherical in form and have a cubic fluorite structure. Significant morphological alterations and cell membrane damage are visible in a field emission scanning electron microscopy image of *E. coli* treated with the CeO₂ nanoparticles.

ANTIFUNGAL ACTIVITY

The inhibition zone and activity index were used to measure the antifungal activity of the flavonoid extracts of *S. acuta*. Seven of the eight extracts from various plant sections demonstrated exceptional effectiveness against test fungus when evaluated for bioactivity against *Candida albicans*.

Sida acuta exhibits sufficient effectiveness against one of the fungus, *A. fumigatus*, with extremely impressive partially cleared zones, according to B.R. Hoffman et al. The presence of some dispersed growth was also noted, despite the fact that fungal growth was clearly impeded.

ANTI MALARIAL

Malaria and other feverish ailments were traditionally treated with SA (Adebayo and Krettli, 2011; Banzouzi et al., 2004). Of the four distinct plants, the ethanolic extract of the SA entire plant showed a potent antimalarial activity against *Plasmodium falciparum*. of the four distinct plants, the ethanolic extract of the SA entire plant showed a potent antimalarial activity against *Plasmodium falciparum*. While the IC₅₀ values for chloroquine phosphate were found to be less than 0.042 µg/ml on average, with a median of 0.0097 µg/ml, the IC₅₀ values of SA against *Plasmodium falciparum* (3D7 chloroquine-sensitive strains) varied from 0.05 to 57.04 µg/ml. The antimalarial effects of SA may be due to its high alkaloid content in the ethanolic extract. According to a different study, two distinct resistant strains of *Plasmodium falciparum* are susceptible to the antimalarial effects of cryptolepine, an alkaloid obtained from the active fraction of the SA aerial section (Banzouzi et al., 2004). A phenolic-rich extract derived from SA leaves has been shown in vivo to efficiently reduce the plasmodium parasites.

ANTI PYRETIC ACTIVITY

Rats treated with petroleum ether, ethanolic, acetone, and aqueous extracts of *S. acuta* leaves showed antipyretic effects. They noticed that whereas acetone has a marginally lower value, all extracts showed a reduction in temperature over time. Compared to other extracts, ethanol extract had rapid antipyretic effect, which became apparent within 1.5 hours. Petroleum ether, acetone, ethanol, and distilled water were used in succession to test the antipyretic efficacy of *S. acuta* leaves. The antipyretic properties of these extracts are next tested. Acetone extract shown notable antipyretic properties out of all the extracts.

ANALGESIC AND ANTI-INFLAMMATORY ACTIVITY

Sida acuta (family: Malvaceae) is traditionally used in folk medicine for the management of pain, swelling, fever, and inflammatory disorders. *Sida acuta*'s analgesic and anti-inflammatory properties have been assessed in experiments utilizing well-established animal models. The tail immersion test, which gauges a substance's capacity to raise pain threshold by postponing the reaction to a thermal stimulation, was used to evaluate the analgesic activity in mice. The mouse ear oedema model, which is frequently used to investigate acute inflammation brought on by inflammatory mediators, was used to assess the anti-inflammatory activity. In mice and rats, crude extracts of *Sida acuta* demonstrated a high pharmacological response with considerable analgesic and anti-inflammatory properties ($p < 0.001$). The analgesic properties of *Sida acuta* leaf extracts made with petroleum ether, acetone, and distilled water were examined by Mridha et al. The acetone extract showed the strongest analgesic action among these extracts, indicating that the effects were caused by moderately polar phytoconstituents.

ANTIOXIDANT ACTIVITY

Numerous *in vitro* and *in vivo* investigations have provided scientific validation of *Sida acuta*'s antioxidant activities. In common antioxidant tests like DPPH, FRAP, hydroxyl radical, and nitric oxide scavenging models, the plant extracts especially the methanolic and ethanolic leaf extracts have shown notable free radical scavenging activity. A moderate to strong antioxidant capability is indicated by the stated IC₅₀ values and reducing power. The presence of bioactive phytoconstituents that are known to neutralize reactive oxygen species and prevent lipid peroxidation, such as flavonoids, phenolic compounds, tannins, and alkaloids, is primarily responsible for this activity. These results are further corroborated by *in vivo* research that demonstrates an increase in endogenous antioxidant enzymes like superoxide dismutase, catalase, and reduced glutathione and a decrease in oxidative stress indicators such malondialdehyde.

HYPOGLYCAEMIC ACTIVITY

Diabetes mellitus is caused by either insufficient or ineffective insulin synthesis. Numerous medicinal plants have been utilized in Indian traditional medicine to treat diabetes and its consequences. These plants may provide new leads for new medications or possible sources of innovative pharmaceuticals. Ayurveda, a traditional Indian medicinal system, has identified a number of medicinal herbs that can help to decrease blood sugar levels. Indian

medicinal herbs are well-known for their ability to treat different forms of diabetes. In rabbits with alloxan-induced diabetes, the hypoglycaemic effects of aqueous and methanol leaf extracts of *Sida acuta* were investigated; both extracts showed positive effects on the animals' blood glucose levels. The results demonstrated that in glucose-fed normal rabbits, both extracts at 400 mg/kg considerably enhanced the tolerance for glucose. At 5.5 hours after the glucose load, blood glucose levels were considerably lower ($p < 0.05$). This decrease was steady and lasted for ten and a half hours. As a result, *Sida acuta* crude leaf extracts have hypoglycaemic properties.

WOUND HEALING EFFECT

Akilandeswari et al. examined the effects of topical application of *Sida acuta* ointment's prepared from methanol extract on two different kinds of rat wound models such as in excision and incision model. The extract-treated wounds in the excision model showed faster epithelialization and a higher rate of wound contraction compared to the control. When compared to the corresponding control, the use of *Sida acuta* ointment and the reference standard Nitrofurazone ointment significantly increased the tensile strength of the 10-day-old wound in the incision wound experiments. It was determined that both of the studied wound types responded considerably better to the methanol extract of *Sida acuta* ointment's ability to contract wounds than the control. Thirty-six plant species were listed by Adetutu et al. as being utilized in traditional wound healing remedies. The majority of plant extracts, including *Sida acuta*, have been shown to contain both antibacterial and antioxidant properties, indicating that they may all have some promise for wound healing. The traditional usage of the herbs to heal wounds is supported by these findings.

HEPATOPROTECTIVE PROPRERTY

Reduced serum levels of glutamate pyruvate transaminase, glutamate oxaloacetate transaminase, alkaline phosphatase, and bilirubin in the *S.acuta*-treated groups relative to the intoxicated controls when demonstrated the hepatoprotective effects of the methanol extract of *S.acuta* against liver damage caused by paracetamol overdose. The liver's histology confirmed the hepatoprotective effect even further. The hepatoprotective efficacy of *S.acuta* extract was demonstrated by the considerable reduction in the duration of hexobarbitone-induced narcosis in mice following pretreatment. The root of *S.acuta* was found to contain ferulic acid, a phenolic substance this is notable for hepatoprotective effect.

ANTIULCER ACTIVITY

S. acuta was used to screen for gastric antiulcer activity. Rats were given aspirin to cause pylorus ligation, which resulted in gastric ulcers. Rats can develop ulcers using a variety of methods, such as ligation, aspirin, and ethanol. According to the study's results, *S. acuta* ethanolic extracts have strong antiulcer action against substances that cause ulcers. When compared to the efficacy of sucralfate, this extract also successfully decreased stomach volume, free acidity, and ulcer index by 53.69. According to studies, *Helicobacter pylori* can lead to gastritis, gastrointestinal ulcers, and possibly human cancer. Mice with *H. pylori*-induced ulcers responded well to the aqueous and alcoholic extracts of SA leaf. The gastric volume, ulcer severity, and bacterial load of stomach tissue were all considerably decreased by the extract treatment.

NEUROPHARMACOLOGICAL ACTIVITY

The ethanol extract from *Sida acuta*'s leaves and stems significantly affected the central nervous system of test animals in an experiment by Dora et al., supporting the plant's traditional sedative usage. Male albino Swiss mice were used to investigate the neuropharmacological effects of *S. acuta* ethanolic extract. Sodium phenobarbital treatment has a dose-dependent impact by lengthening sleep duration and reducing sleep latency.

SIDA ACUTA ESSENTIAL MICRONUTRIENTS

Sida acuta leaves include riboflavin, niacin, thiamine, ascorbic acid, and β -carotene. *Sida acuta* contains the energy-releasing vitamins thiamine, niacin, and riboflavin. Raimi and associates used mineral analysis of *Sida acuta* to discover the following compositions, 11100.0mg/100g sodium, 24.50.0mg/100g magnesium, 65.00.0mg/100g phosphorus, 4.870.06mg/100mg iron, and 85.00.0 mg/10 mg calcium. According to Raimi et al., *Sida acuta* may be utilized medicinally since it contains essential nutrients in quantities comparable to those of green vegetables, which are frequently consumed for a healthy diet.

REPORTED TOXICITY

Although medicinal plants and their products are thought to be usually harmless, there have been a number of documented instances of negative outcomes linked to them. There is little information on the relative safety of herbal medicines compared to manufactured drugs. For most therapeutic plants and their compounds, there is a dearth of clinical and experimental data. As a result, information about the long-term harmful effects of medicinal herbs is lacking. The acute toxicity test indicates that the LD50 for SA aqueous acetone extract is 3.2

g/kg. The LD50 values' low toxicity indicates that therapeutic levels have a significant margin of safety. According to Konate et al. (2012), the extracts had no discernible effect on biochemical indicators. According to a different study, administering alcoholic extracts of SA roots and leaves changes kidney parameters and may cause tubular and glomerular dysfunction. Extracts from SA roots and leaves may be detrimental to the kidneys and cause renal failure (Nwankpa et al., 2018). Additionally, there is proof that ethanolic SA leaf extracts may harm nerve cells, especially when given in large quantities. (Okon et al., 2021; Eluwa et al., 2013).

CONCLUSION

This study highlights the taxonomy, morphology, microscopy, phytochemical constituent and traditional uses, pharmacological activities, toxicity of the medicinal plant *Sida acuta* belonging to the family Malvaceae. *Sida acuta* has been traditionally utilized in traditional medicine to treat a wide range of medical conditions. Traditional healers employ every part of this herb, including the leaves, bark, root, seeds, and flower. The phytochemical studies show that *Sida acuta* contains various bioactive compound comprised of various novel and known natural compounds such as alkaloids, flavonoids, phenolic compounds, steroids, terpenoids, fatty acids, tocopherol, cardiac glycosides. These phytochemicals were responsible for various pharmacological activities including antibacterial, antifungal, anti-inflammatory, antioxidant, antimalarial, hypoglycemic, wound healing etc., and its rich content in minerals and vitamins validate its high nutritional value. Numerous in vitro and in vivo pharmacological investigations have shown a connection between the traditional applications of the plant *Sida acuta* supports the therapeutic potential. According to the toxicity studies the plant is typically safe when taken in suitable amounts and careful dose selection are required to confirm its safety. Overall this review on *Sida acuta* emphasize the medicinal importance and suggests that further experimental, clinical, and standardization studies are required to establish its therapeutic efficacy, safety, and potential for development as a standardized herbal drug.

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