

A Comprehensive Review of Sida Acuta: Potential Plant of Medical Interest

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Abstract

For thousands of years, plants and herbs have provided a plethora of food and medicinal benefits to humans. Numerous studies have found that indigenous people from tropical countries use various parts of the Sida acuta plant to treat a variety of health problems, including rheumatic affections, azoospermia, oligospermia, and spermatorrhea, leucorrhoea, wounds, sciatica, nervous and heart diseases, colds, cough, asthma, tuberculosis, and respiratory diseases, diseases of the blood, bil It has been scientifically studied for its numerous pharmacological profiles, which include antioxidant, antimicrobial and antibacterial activity, antimalarial activity, cardioprotection (anti-cholesterol), analgesic and anti-inflammatory activity, antipyretic activity, hepatoprotection, hypoglycemic activity (low blood sugar), insecticidal activity, and anticancer activity. Its diverse properties and applications in traditional medicine are attributed to the presence of bioactive constituents such as alkaloids, saponins, saponin derivatives, coumarins, steroids, tannins, phenolic compounds, cardiac glycosides, sesquiterpene, and flavonoids, which are all present in significant amounts in the plant extract. It is the goal of this review research to provide a comprehensive evaluation of the literature on the ethnomedicinal uses, phytochemical and pharmacological profiles, and toxicity of Sida acuta, as well as its ethnomedicinal applications.

Introduction

Medicinal plants have been used by people for their nutritional and therapeutic properties since the dawn of human civilisation. Medicinal substances have been derived from natural sources for thousands of years, and an astounding number of modern medications have been identified from natural sources. Many of these isolations were made as a result of the traditional medical use of these drugs. Indigenous people are actively employing the herb Sida acuta Bunn.f (Malvaceae) to treat a variety of ailments, including diabetes and high blood pressure. This plant is a tiny perennial herb or small shrub with upright, branching stems that grows to around 1.5m in height [1]. This tree's bark is smooth and greenish, and its root is thin, long, cylindrical, and extremely rough. Its leaves are lanceolate and nearly glabrous, and its peduncles are equal in length to its petioles. Its flowers are yellow and solitary or in pairs; its seeds are smooth and black [2, 3]. Known locally as "sengh" in the Western portion of the nation, it may be found in abundance in cultivated fields, waste areas, and roadside verges across Cameroon. Sida is the name given to it by most people. Once the plant has established itself, it becomes extremely competitive, taking

over and restricting space to other plants. Seeds and stem cuttings are both effective methods of propagation for this plant. The leaves, bark, root, seeds, and blossom of this tree, as well as its other components, are used in folklore medicine to treat various ailments.

Traditional uses

All parts of the plant are utilised for medicinal reasons, but the leaves are the ones that are requested the most commonly by patients. Plantain leaves are believed to have demulcent, diuretic, anthelmintic, and wound healing effects, and they are used to treat rheumatic conditions [4,5]. The decoction of the leaves is used to treat stomach discomfort, haemorrhoids, azoospermia, and oligospermia [6,] and other conditions. In India, the juice of the leaf is also used to treat vomiting and stomach diseases [7, 8]. The roots of the *Sida* species are considered excellent adaptogenic and immunomodulators, as well as a general nutritive tonic and life-prolonging agent; they are useful in the treatment of tuberculosis and other diseases associated with injury, such as heart disease, cough, and respiratory diseases, among other things. Root has also been stated to have aphrodisiac, antirheumatic, stomachic, diaphoretic, diuretic, antipyretic, and wound healing effects [8], among other attributes. Root extract is used to treat leucorrhoea [9], breathing issues, and cough [10], among other conditions. In Papua New Guinea, the fresh root is chewed for the treatment of dysentery [11], and it is also used for other purposes. It is widely used in Indian traditional medicine for stomachic, diaphoretic, and antipyretic properties. Traditionally, it has been used to treat mental and urinary problems as well as abnormalities of the blood, bile, and liver [12], and its hot water extract has been used as a febrifuge, diuretic, and abortifacient [13]. Besides that, it is used to cure gonorrhoea, elephantiasis, ulcers, and it is said to have aphrodisiac effects. The juice of the root is given topically on wounds and burns. The entire plant extract is frequently considered to be effective in the treatment of ailments such as fever, headache, skin disorders, diarrhoea, and dysentery [14], although this has not been proven. It is used as a diuretic in the treatment of rheumatic illnesses, as well as a demulcent in the treatment of gonorrhoea and chronic diarrhoea. It is a component in Siddha formulation that is indicated for the treatment of rheumatism, facial paralysis, tuberculosis, sciatica, haemorrhage, spennatorrhoea, leucorrhoea, gonorrhoea, and gonorrhoea in women. The herb has been shown to have abortifacient, antehntic, and antiemetic qualities [15], among other things.

Throughout Nicaragua, a decoction of the complete plant is used orally for the treatment of asthma, fever, aches and pains, ulcers, and as an anti-worm drug [16, 17]. In contrast, a decoction of the dried entire plant is taken orally for the treatment of sexual diseases. Central Americans utilise the plant to cure a variety of ailments including asthma and kidney inflammation as well as colds, fever, headaches, ulcers, and worms. Throughout Colombia, the whole plant has been used to treat snake bites, and it has been shown to decrease the hemorrhagic effects of *Bothrops atrox* venom [19, 20]. Cameroonians believe that the whole plant possesses anti-inflammatory, anti-rheumatic, diaphoretic and febrifuge, sedative, anti-ulcer, and anthelmintic characteristics, among other things. Fever and rheumatism are treated with a decoction of the whole plant, while intestinal worms are eradicated with an infusion of the whole plant. [21] The same decoction is also used to treat malaria, which is a parasitic disease. When applied to the head as a poultice, the leaves can help to relieve headaches. A toothache might be relieved by chewing on the root. Wounds can be cleaned with a decoction made from the plant's leaves. The plant extract is also known as an abortifacient because of its ability to induce abortions.

Reported phytoconstituents and nutrients

To determine the chemical makeup of *Sida acuta*, a large number of scientific studies have been carried out. Almost all sections of the plant are being investigated in these studies, although the leaves and roots are the most extensively investigated. Phytochemical screening of the *Sida acuta* species revealed the presence of alkaloids such as vasicine, ephedrine, and cryptolepine (the primary alkaloid in the plant) [22,23], saponosides, coumarins, steroids (ecdysterone, -sistosterol, stig1naterol, ampesterol), tannins, phenolic compounds (evofolin-A and B, The phytochemical and micronutrient content of *Sida acuta* was investigated in another research by Nwankpa et al [25], who used conventional analytical procedures to analyse the plant.

A few of the general characteristics of flavonoids include their ability to act as powerful water-soluble super antioxidants and free radical scavengers; their ability to prevent oxidative cell drainage; their strong anticancer activity; and their ability to protect against all stages of carcinogens [26]. Flavonoids found in the intestinal tract have been shown to lower the risk of heart disease and inflammation [27]. Additionally, flavonoids have been shown to have significant antiulcer activity in a variety of experimental models of gastric and duodenal ulceration [28]. Alkaloids, both in their isolated pure form and their synthetic derivatives, are used as basic medicinal agents for their analgesic and bacterial effects [29], as well as their antihypertensive, antiarrhythmic, antimalarial, and anticancer activities [30]. Tannin-rich medicinal herbs are used to treat a wide range of ailments, including leucorrhoea, rhinorrhea, and diarrhoea, among others. More recently, tannins have piqued medical attention because to the increased frequency of severe conditions such as AIDS and a variety of malignancies [31], as well as the fact that they are inexpensive. Tannins are valuable in the dyestuff business because they may be used as caustics in the manufacturing of dyes and inks. In addition, tannins have demonstrated their use in the food business, where they have been used to purify wine, beer, and fruit juices, as well as coagulants in the manufacturing of rubber [32]. In addition to their antimicrobial and antifungal properties, saponins also have anti-inflammatory, anti-yeast, and antidote properties. Saponins have a variety of functions in plants, the most important of which is to act as an anti-feedant and to defend the plant from microbes and fungus [33]. Phenols have been intensively studied for their potential as disease preventives [34]. Steroids are antioxidants in vitro and have a relationship to human reproduction [35], as well as other properties. The findings of the phytochemical and micronutrient screening of *Sida acuta* provide weight to the medical advantages that this plant has been employed for in the past and support its traditional applications for the treatment of a variety of health conditions, such as diabetes and hypertension.

Pharmacological activities

Antimalarial activity: Karou et al evaluated the antimalarial activity of five plants used in traditional medicine in Burkina Faso to treat malaria, including *Sida acuta* [36], a plant that has been used to cure malaria for thousands of years. These plant extracts were evaluated in vitro on fresh clinical isolates of *Plasmodium falciparum*, which is a parasite that causes malaria. The results of the investigation indicated that *Sida acuta* was the most active plant in the experiment. The larvicidal and repellent effects of crude leaf extract of *Sida acuta* against three major mosquitoes were investigated in another study by Marimuthu [37], who found that the extract has larvicidal and repellent properties against three key insects. In this study, we discovered that the crude extract of the plant had a significant repellent effect against the three kinds of mosquitoes that were tested. The ethanolic extract and water decoction of the aerial part of *Sida*

acuta from Ivory Coast were tested for their in vitro antiplasmodial activities on two strains of Plasmodium falciparum: a Cameroonian (chloroquine-resistant strain) and a Nigerian (non-chloroquine-resistant strain). The results showed that both strains were resistant to chloroquine (chloroquine-sensitive strain). The ethanolic extract displayed more antiplasmodial activity than the decoction [38], indicating that it was more effective than the decoction. After doing research on medicinal plants used to cure malaria in Nigeria [39], it was discovered that Sida acuta and several other plants had high activity against malaria parasites both in vitro and when experimentally infected mice were used as test subjects. In conclusion, all of these research have demonstrated that Sida acuta possesses strong antiplasmodial action.

Anti-ulcer: According to the findings of Akilandeswari and colleagues [40], stomach ulceration was generated in experimental rats with Pylorus ligation, aspirin (300mg/kg) and ethanol (1ml/kg) injection, and the animals died as a result [41]. Then an ethanolic extract of the leaves of Sida acuta was administered to the animals, and the effects of the extract were observed. Defining and comparing the ulcer index in the test medication groups with that in the control group, as well as with that of Famotidine 20mg/kg, were used to evaluate the antiulcer activity of the various drugs (used as reference drug). A significant antiulcer activity against all three ulcer-inducing experimental models was demonstrated by reducing the ulcer index in those models, with a better result than the famotidine group, at 200mg/kg of the extract against aspirin (300mg/kg) plus pylorus ligation model, at 200mg/kg of the extract against aspirin plus pylorus ligation model. Malairajan et al [41] found evidence for the antiulcer activity of an ethanol extract of the entire plant of Sida acuta, which they concluded was effective. Using rats as test subjects, this plant extract was evaluated for its antiulcer effectiveness in the treatment of stomach ulcers caused by aspirin plus pylorus closure, HCl-ethanol generated ulcer, and water immersion stress produced ulcer. They discovered that the ethanol extract significantly reduced the incidence of ulcers in the first two models studied. It is likely that flavonoids compounds, tannins, steroids, and triterpenoids present in the plant are responsible for the antiulcer activity of Sida acuta despite the fact that the active principles responsible for this action have not been studied. Flavonoids have been shown to have significant antiulcer activity in various experimental models of gastric and duodenal ulceration [28].

Wound Healing activity: When Akilandeswari and colleagues evaluated the effects of topical administration of methanol extract of Sida cutis ointment on two types of wound models in rats, they found that they were effective in both cases [40]. They found that they were effective in both cases. In the excision model, it was discovered that the extract-treated wounds epithelialized more quickly and that the rate of wound contraction was larger than that of the control wounds. When comparing the results of the incision wound studies with the respective controls, it was found that treatment with Sida acuta ointment and with the reference standard Nitrofurazone ointment resulted in a significant increase in tensile strength of the 10-day-old wound when compared with the respective control. We came to the conclusion that the wound contracting ability of the methanol extract of S. eduleonoides ointment caused a statistically significant larger reaction in both wound types examined than the control. Adetutu and colleagues [42] identified thirty-six plant species that were employed in traditional wound healing remedies. The majority of plant extracts, including Sida acuta, have been shown to exhibit both antioxidant and antibacterial properties, implying that they all have some potential for healing wounds. The findings of this study lend credence to the traditional usage of herbs for wound healing.

Hepatoprotective activity: The hepatoprotective effects of a methanol extract of Sida acuta against liver damage caused by paracetamol overdose were demonstrated by decreased serum

levels of glutamate pyruvate transaminase, glutamate oxaloacetate transaminase, alkaline phosphatase, and bilirubin in the *Sida acuta* treated groups when compared to the intoxicated controls [43]. The histology of the liver provided additional evidence of the hepatoprotective effect of the drug. Acute hexobarbitone-induced narcosis in mice was dramatically reduced when the mice were treated with *Sida acuta* extract, showing that the plant's hepatoprotective capability was demonstrated. Because of the presence of ferulic acid, a phenolic component found in the root of *Sida acuta*, this plant has demonstrated a substantial hepatoprotective effect.

Cardiovascular activity: Kannan and colleagues investigated the cardioactive properties of plants from the Western Ghats of India. [44] investigated the relationship between heart beat rate (HBR) and blood flow during the stages of diastole and systole in Zebrafish embryos. When applied to Zebrafish embryos, the methanol extract of *Sida acuta* induced a drop in the HBR, which was larger than the decrease caused by Nebivolol (used as reference drug).

Antibacterial and antimicrobial activity: Leaf extracts of *Sida acuta* were tested for antibacterial and antifungal activity, and the results were positive [40]. Extracting active principles from powdered leaves using two common solvents (Chloroform and Ethanol, 95 percent each) was done in two steps, with each step taking longer than the previous. In this study, two Gram +ve (*Staphylococcus aureus* NCIM 2079 and *Bacillus subtilis* NCIM 2063) and two Gram-ve (*Escherichia coli* NCIM 2065 and *Pseudomonas aeruginosa* NCIM 2036) bacteria and fungi (*Candida albicans* NCIM 3102 and *Aspergillus niger* NCIM 1054) bacteria and two Gram-ve (*Escherichia coli* Both of the extracts under investigation had significant action against all three pathogens tested, with the highest levels of activity shown against gramme positive *Staphylococcus aureus* and gramme negative *Escherichia coli*, respectively. Under the same experimental conditions, the effects of these antibiotics were comparable to those of commercially available antibiotics.

Oboh and colleagues [45] had previously gotten a finding that was comparable to this. Agar well diffusion method was used to evaluate the antimicrobial activity of *Sida acuta* leaves extracts against 45 clinical isolates of *Staphylococcus aureus* isolated from nasal cavity of Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) patients at the University of Nigeria teaching hospital in Enugu [46]. The extracts' minimum inhibitory concentration (MIC) was determined using the agar well diffusion technique, and the death rate of each extract was determined at various time intervals ranging from 0-90 minutes. Using an agar well diffusion method, the researchers discovered that ethanol extracts had the highest antimicrobial activity (86 percent), followed by hot water extracts (61 percent) and cold water extracts (40 percent) (48 percent). While using ethanol extracts, the MIC was 0.9625-1.8125 mg/mL, when using hot water extracts, it was 7.8125-31.25 mg/mL, and when using cold water extracts it was 15.625-31.25 mg/mL. Results of death rate experiments revealed that the test organisms were killed within 0-10 minutes for ethanol and hot water extracts, and between 5-60 minutes for cold water extracts, depending on the extract. The overall findings suggested that *Sida acuta* extracts have significant antimicrobial action against *Staphylococcus aureus* isolates from HIV/AIDS patients, which is consistent with previous findings. Additionally, the findings of these research point to the potential utility of this plant in the treatment of opportunistic infections produced by *Staphylococcus aureus* that occur in HIV/AIDS patients, in addition to validating the folkloric usage of *Sida acuta* in the treatment of common ailments.

Neuropharmacological effects: In an experiment done by Dora et al., the ethanol extract from the leaves and stems of *Sida acuta* had a substantial impact on the central nervous system in experimental animals [47], indicating that the plant's historic usage as a sedative may still be

effective.

Insecticidal properties: An investigation into the insecticidal activity of the ethanol leaf extracts of the plant *Sida acuta* and three additional plants at various concentrations was conducted against the insect *Acanthscelides obtectus*. The average mortality revealed that the extracts were capable of inflicting considerable death on the target pests. It was discovered through the bioassay that the poisonous impact of the extracts was proportionate to the concentration used, and that the observed overall mean mortality increased with an increase in the time intervals between treatments [48].

Antioxidant activity: Twenty-four adult wistar albino rats were split into four groups of six rats each to test the antioxidative capacity of *Sida acuta* [25]. The results revealed that *Sida acuta* had significant antioxidant activity. Aside from feed and water, group 1 got only feed and water, whereas groups 2, 3, and 4 received ethanol leaf extract of *Sida acuta* at concentrations of 20, 40, and 60 mg/kg body weight, respectively, along with feed and water. After one day of therapy, the rats were slaughtered and their plasma was collected for use in an assay for oxidative stress indicators. Results demonstrated a statistically significant drop (P0.05) in mean values of plasma malondialdehyde concentration and a statistically significant rise (P0.05) in reduced glutathione concentration when compared to the control group at 40 and 60mg/kg body weight, respectively. When compared to the control group, only the rats treated with 60 mg/kg body weight had substantially higher plasma catalase and superoxide dismutase activity (P0.05). Acute oxidative stress in rats was shown to be reduced or ameliorated by the use of an ethanol leaf extract of *Sida acuta*, which was found to have antioxidant properties in a dose-dependent way, according to the findings.

Antipyretic activity: The antipyretic effect of the leaf extracts of *Sida acuta* was investigated using petroleum ether, acetone, ethanol, and aqueous extracts of the plant. It was discovered that all of the extracts decreased the temperature with the passage of time, but the acetone extract shown superior antipyretic action when compared to the other extracts. It was discovered that the antipyretic activity of the ethanol extract was greater when compared to other extracts, and that its impact could be noticed within 1.5 hours when compared to other extracts. [49]

Neutralizing activity against snake venom: Using an ethanolic extract of the *Sida acuta* entire plant, researchers discovered that it had a mild neutralising impact on the hemorrhagic effect caused by the venom of *Bothrops atrox* [50].

Hypoglycemic activity: Using glucose overloaded rabbits, researchers investigated the impact of the aqueous and methanol extracts of *Sida acuta* on blood glucose levels in both normal and diabetic rabbits [51]. The anti-diabetic effect of the extracts was also investigated in diabetic rabbits caused by alloxan. In nonnal rabbits that were given glucose, the results revealed that both extracts at 400mg/kg considerably raised their glucose tolerance compared to the control group. Blood glucose levels were considerably lower at 5.5 hours after the glucose load (p0.05) compared to before. This decline was steady throughout the day and lasted for 10.5 hours. As a result, the crude leaf extracts of *Sida acuta* are hypoglycemic in nature (lower blood sugar).

Anticancer activity: Mallikarjuna et al [52] did a research in which they sought to determine the anticancer potential of ethanol extracts of *Sida acuta* against NDEA and CC14-induced hepatocellular carcinoma in wistar rats. They found that the extracts had anticancer activity. The administration of ethanol extracts of this plant at dose levels of 200 and 400 mg/Kg body weight for 28 days resulted in significant reductions in elevated serum levels of SGOT, SGPT, ALP, LDH, and GGT, as well as a significant increase in protein synthesis in a dose-dependent manner, according to the results. In addition, the extracts demonstrated a considerable rise in the

activities of antioxidant enzymes that diminish oxidative stress-induced damage, indicating that they possessed powerful antioxidant and anticancer potential, respectively.

Analgesic and anti-inflammatory activity: Studies on the analgesic and anti-inflammatory effects of *Sida acuta* were carried out utilising the tail immersion and mouse ear-oedema models in mice and rats [53], respectively. The analgesic and anti-inflammatory properties of the crude extracts of this plant were shown to be statistically significant ($p < 0.001$) in mice. Mridha et al. evaluated the analgesic efficacy of *Sida acuta* leaf extra using petroleum ether, acetone, and distilled water [54], as well as aqueous extracts of the plant. The acetone extract of the leaf had the most analgesic efficacy when compared to the other extracts. This validates the historic usage of *Sida acuta* for the relief of pain and inflammation [55].

Conclusion

Sida acuta has been used in traditional medicine for a long time to cure a variety of disorders affecting the human body in various nations across the world, including the United States. Traditional healers employ all components of the plant, including the leaves, bark, root, seeds, and flower, to treat their patients. Antioxidant, antimicrobial, and antibacterial properties were tested on the plant; cardiovascular effects were tested for; analgesic and antipyretic properties were tested; hepatoprotective, hypoglycemic, insecticidal, and anticancer activities were tested; and all of the results were favourable with no negative side effects. The presence of bioactive constituents such as alkaloids, saponins, coumarins, steroids, tannins, phenolic compounds, cardiac glycosides, sesquiterpenes, and flavonoids in significant amounts in the plant extract is responsible for the plant's diverse properties and traditional medical applications, while its high mineral and vitamin content confirms the plant's high nutritional value and nutritional value. In the aim that the material offered in this review on *Sida acuta* would serve as a data basis for correct evaluation of this plant extract and for medical uses of its bioactive components, the authors have written this review.

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