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Review Article

ETHNO MEDICINAL AND THERAPEUTIC POTENTIAL OF *SIDA ACUTA* BURM.F.

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ABSTRACT
Sida is one of ethnomedicinally important genus of plants. The plants from genus *Sida* are used in India over 2000 years. The most medicinally important species of *Sida* like, *Sida acuta, Sida cordifolia, S. rhombifolia, S. spinosa, S. carpenifolia, S. humilis, S. veronicaefolia* are used in *Ayurvedic* system. *Sida acuta* is one of such ethnomedicinally important shrubs or herbs from genus *Sida* belonging to Malvaceae family. In the present review we listed the plant usages in folk medicine in some regions where the plant grows and discussed on the confirmed activities after laboratory screenings.
Key Words: Ethnomedicinal, Sida, subshrubs, herbs, folk medicine, activity.

INTRODUCTION

Since the beginning of human civilization, medicinal plants have been used by mankind for its therapeutic value. Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been isolated from natural sources. Many of these isolations were based on the uses of the agents in traditional medicine[1].The plant-based, traditional medicine systems continue to play an essential role in health care, with about 80% of the world's inhabitants relying mainly on traditional medicines for their primary health care[2]. India has several traditional medical systems, such as *Ayurveda* and *Unani*, which has survived through more than 3000 years, mainly using plant-based drugs. The *Material Medica* of these systems contain a rich heritage of indigenous herbal practices that have helped to sustain the health of most rural people of India. The ancient texts like Rig Veda (4500-1600 BC) and Atharva Veda mentioned the use of several plants as medicine. The books on *Ayurvedic* medicine such as *Charaka Samhita* and *Susruta Samhita* referred to the use of more than 700 herbs[3, 4].

Various plant parts like roots, stems, barks, leaves, flowers, fruits, seeds & whole plant are used in various forms of medicines. They may be used alone or in combination with other plant parts. There are very clear ancient references for utilization of these plants in clinical treatments.This information of using plants & their parts for clinical treatment is very well known to common people living in rural areas. These people are using, plants traditionally for treatment of diseases. This knowledge of common, rural & ethnic people is known as ethnopharmacology, ethnobotany and ethnomedicine. These clearly show the importance of plants, however, there are not sufficient studies describing the mechanisms correlated to activities of plants. These studies may lead to the development of new & cheaper kinds of treatment of many diseases. By using modern anatomical, phytochemical, biochemical, biotechnological, bioinformatics tools, the traditionally important molecules may be assessed for their activities[5].

In India, the *Ayurvedic* system has described a large number of such medicines based on plants or plant products and the determination of their morphological and pharmacological or pharmacognostical characters can provide a better understanding of their active principles and mode of action.

Sida is one of such ethnomedicinally important genus of plants. *Sida* is a large genus with about 200 species distributed throughout the world and 17 are reported to occur in India[6].The plants from genus *Sida* are used in India over 2000 years. Most of the *Sida* species found in India are known by general name "Bala" and referred under "*Bala Chatustaya*" in *Ayurvedic* System of Medicine. The drug Bala has been mentioned in Charak Samhita under Brihaniya Kasaya, by the name of Vatyayani, under Prajasthapan Mahakasaya by the name of Vatyapushpi, it is also found mentioned under Balya Mahakashaya and Madhurskandha and in Sushrut Samhita under Vatasanshaman Vergunder the name of Bala. The most medicinally important species of *Sida* like, *S. acuta, S. cordifolia, S. rhombifolia , S. spinosa, S. carpenifolia ,S. humilis, S. veronicaefolia* are used in *Ayurvedic* system[7]. It is used for various purposes like neurological disorders, headache, leucorrhoea, tuberculosis, diabetics, fever, uterine disorders and as an antirheumatics and antipyretic agent as described in *Ayurveda*. The plants are also quiet prone for adulteration due to availability of number of species & also due to lack of sufficient information[5].All the species of this genus are annual herbs except *Sida rhombifolia* which is a perennial herb. *Sida acuta* is one of such ethnomedicinally important sub shrubs from genus *Sida*.

***Sida acuta* Burm. f.**
Syn: *S. carpinifolia, S. lanceolate, S. herbaceae*

DESCRIPTION

Sida acuta Burm. f., a small, erect, much branched, annual shrub or herb; ranging from 30 to 100 cm in height, with a strong taproot,stem and branches flattened at the extremities, fibrous, almost woody at times. The weed is frequently found in pastures, wastelands, cultivated lands, roadsides, lawns, and in planted forests[8]. Once the plant becomes established, it is very competitive, holding and denying sites to other plants. The plant can be propagated both by seed and stem cuttings.

The plant grows well in many soils, including some heavy clay and can tolerate dry as well as high rainfall conditions.

ETHNOMEDICINAL USES OF *SIDA ACUTA*

(a) **Whole plant**

The plant has a variety of traditional uses. In traditional medicine, the plant is often assumed to treat diseases such as fever, headache, skin diseases, diarrhoea and dysentery[9].It is used as anti-inflammatory and hepatoprotective, astringent, cooling, tonic and febrifuge, stomachic. The hot water extract of the dried entire plant is administered orally as a febrifuge and a diuretic. The drug is used as diuretic in rheumatic infections and as a demulcent in gonorrhoea and chronic dysentery[10]. *Sida acuta* is an ingredient in Siddha formulation indicates in rheumatism, facial paralysis, pulmonary tuberculosis, sciatica, haemorrhage, spermatorrhoea, leucorrhoea and gonorrhea[11]. Plant is credited with abortifacient, anthelmintic and antiemetic properties[4]. In Nicaragua, the decoction of the entire plant is taken orally for asthma, fever, aches and pains, ulcers, anthelmintic medication as well as for venereal diseases[12,13].

(b) Leaf

Leaves of *S. acuta* are used in demulcent and diuretic[14]. Leaves are considered to possess demulcent, diuretic, anthelmintic and wound healing properties and also used in rheumatic infections[15]. The leaf juice is used for vomiting and gastric disorders[16]. In Nigeria, the infusion of the leaves is given to women in labour and the decoction of the leaves is used in malaria fever[17]. The juice of the leaves are boiled in oil and applied to testicular swellings and in elephantiasis and also leaf juice is used as a poultice for dandruff[18]. In the Philiphines, leaves are employed for making poultices for sores. Decoction of the leaves is credited with emollient and tonic properties and leaf juice is given for relief in chest pain and as anthelmintic [19]. In South-western Nigeria a decoction of the leaves of *S. acuta* is used to clean wound[20]. The paste of leaves is mixed with coconut oil and applied on head regularly for killing dandruffs and also for strengthening hair[21].

(c) Root

Roots are sour and sweet, removes **tridosha,** useful in fever, burning of the body and urinary discharges (Ayurveda). The root is regarded as cooling, astringent, tonic, useful in treating nervous and urinary diseases and also used in disorders of the blood, bile and liver[7,22]. The plant in combination with other drugs is recommended for the treatment of snake bite and scorpion sting[23]. Root of this plant is made into a smooth paste with sparrow's dung and water and applied for bursting of boils and abscesses. The roots of the *Sida* species are considered excellent adaptogenic and immunomodulator, general nutritive tonic and prolonged life, useful in tuberculosis and in wasting diseases associated with injury, heart diseases, cough and respiratory diseases[10]. Root is said to possess aphrodisiac, antirheumatic, stomachic, diaphoretic, diuretic, antipyretic and wound healing properties[24]. The root extract is given in leucorrhoea[11]. Root decoction is used for rheumatism, breathing problems and cough[18]. In Papua New Guinea, the fresh root is chewed for the treatment of dysentery[25].

REPORTED ACTIVITIES OF *SIDA ACUTA*

(a)Antimicrobial/antibacterial Properties

Hoffman *et al.* (2004)[26] screened *S. acuta* with some other African medicinal plants, utilized in traditional herbal remedies in Ghana, West Africa for their antibacterial and antifungal activities. Extracts of *S. acuta* had activity against the Gram positive microorganism *Staphylococcus aureus* including methicillin resistant *Staphylococcus aureus*. Another study was carried out by **Dicko, *et al,* (2005)**[27] for their antioxidant and antimicrobial activities against pathogenic bacteria of four medicinal plants including *S. acuta.* The whole plant of *S. acuta* had the lowest polyphenol and antioxidant activity in comparison to other tested plants. The antimicrobial study was conducted on the *Shigella dysenteriae, Shigella boydii, Shigella flexneri, Salmonella thyphi, Salmonella parathyphi* B, *Salmonella parathyphi* C, *Klebsiella pneumoniae, Klebsiella oxytoca, Klebsiella ozenae, Escherichia coli* and *Staphylococcus aureus.* Whole plant of *S. acuta* had been found to have microbicide activity against *S. dysenteriae, S. parathyphi B*, and *S. aureus* and microbiostatic against *K. ozenae*.

The antimicrobial activities of ethanol extract of the aerial parts of *S. acuta* were tested against standard *Staphylococcus aureus* and clinical isolated *Staphylococcus aureus, Bacillus subtilis, Streptococcus faecalis, Esherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Candida albicans.* The extract showed significant inhibitory activity against standard strain and clinical isolates of *Staphylococcus aureus, Bacillus subtilis* and *Streptococcus faecalis.* Neither the concentrated extract nor its dilutions inhibited *Esherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa* and *Candida albicans*[28].

Ekpo and Etim, (2009)[29] studied the antimicrobial effect on isolates microbes from human skin infections, *Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Escherichia coli, Scopulariopsis candida, Aspergillus niger* and *Aspergillus fumigates* by using ethanolic and aqueous extracts of *S. cuta*. Ethanolic extract revealed a higher significant inhibition against *S. aureus* and *B. subtilis*. The aqueous extract had no significant effect on the test organisms. The extracts had no inhibitory effect on the fungi isolates.

Iroha *et al.*, (2009)[30] studied antimicrobial activity of aqueous and ethanol leaves extracts of *S. acuta* against 45 clinical isolates of *Staphylococccus aureus* isolated from nasal cavity of Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) affected patients from University of Nigeria teaching hospital. The overall results indicated that *S. acuta* extracts have appreciable antimicrobial activity against *S. aureus* isolated from HIV/AIDS patients. Antimicrobial activity of chloroform and ethanol leaf extract of *Sida acuta* was carried out with two Gram +ve (S*taphylococcus aureus*, *Bacillus subtilis)* and two Gram –ve (*E.coli, Pseudomonas aeruginos*) bacteria and fungi (*Candida albicans*, *Aspergillus niger*) as test microorganisms. All the three microorganisms were markedly affected by both the extracts and the maximum activity was found against gram positive *Staphylococcus aureus* and gram negative *Escherichia coli* respectively[31].

Karou *et al*., (2006)[32] investigated the antimicrobial activity of alkaloids from *S. acuta* against Gram positive and Gram negative bacteria. The antibacterial assays were performed by the agar well diffusion and the broth micro dilution for the evaluation of inhibition zone diameters, minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) values. The highest inhibition zone diameters were recorded with gram positive bacteria. The two major alkaloids in the extract, identified as cryptolepine and quindoline, exhibited good antimicrobial activity against several test microorganisms.

(b)Anti-inflammatory/Analgesic activity

Mridha *et al.*, (2009)[33] investigated analgesic activity of leaf extra of *S. acuta* using petroleum ether, acetone and distilled water. The acetone extract of the leaf showed maximum analgesic activity amongst other extracts.

Oboh and Onwukame, (2005)[34] also investigated the analgesic and anti-inflammatory properties of the crude extract of S. *acuta* in mice by using tail immersion and mouse ear oedema model. The crude extracts exhibited significant analgesic and anti-inflammatory activities in mice and was dose dependent. The powdered aerial part of *S. acuta* showed significant oedema suppressant activity [35].

The analgesic activity of *S. acuta* whole plant was evaluated by hot plate and tail immersion methods at three dose levels in mice. Its extract showed significant protection at the highest dose of 500 mg/ml [21].

(c) Antimalaria activity

Karou *et al.*, (2003)[36] investigated antimalarial activity of four plants of the traditional medicine of Burkina Faso, including *S. acuta* and were tested *in vitro* on fresh clinical isolates of *Plasmodium falciparum*. The screening showed among four plants *S. acuta* has a significant activity and *Pterocarpus erinaceus* has a moderate activity. Chemical screening showed that the activity of *S. acuta*, was related to its alkaloid contents.

Marimuthu,(2010)[37] studied the larvicidal and repellent activities of crude leaf extract of *S. acuta* against three important mosquitoes. The crude extract had strong repellant action against three species mosquitoes as it provided 100% protection against *Anopheles stephensi* for 180 min followed by *Aedesa egypti* 150 min and *Culex quinquefasiatus* 120 min.

The in vitro antiplasmodial activities of the ethanolic and decoction with water extracts of the aerial part of *S. acuta* of Ivory Coast were tested on two strains of *Plasmodium falciparum,* Cameroon (chloroquine-resistant strain) and a Nigerian chloroquine-sensitive strain. The ethanolic extract exhibited a better antiplasmodial activity than the decoction[38].

Adebayo *et al.*, (2011)[39] reviewed on medicinal plants used to treat malaria in Nigeria. *S. acuta* and some other plants showed intense activity against malaria parasites *in vitro* and in experimentally infected mice.

(d)Antiulcer activity

Ethanolic extract of leaves of *S. acuta* showed a considerable degree of antiulcer activity in comparison to positive controlled treated group[40]**.** The antiulcer activity of ethanolic extract of whole plant of *S. acuta* also supported by **Malairajan *et al.*, (2006)**[41]. They studied for its antiulcer against aspirin plus pylorous ligation gastric ulcer, HCl-ethanol induced ulcer and water immersion stress induced ulcer in rats. They found that ethanolic extract markedly decrease the incidence of the ulcer in the first two models.

(e) Hypoglycemic activity

The effect of the aqueous and methanol extracts of *S. acuta* on blood glucose levels in both normal and diabetic rabbits had been studied. The leaf extracts were screened for their effects on blood glucose levels in glucose overloaded rabbits and anti-diabetic activity in alloxan induced diabetic rabbits Both extracts were effectively decreased the blood glucose in alloxan induced diabetic rabbits and increased the tolerance for glucose in glucose fed normal rabbits. This reduction was not superior to that of glibenclamide, a sulphonylurea anti-hyperglycemic agent. This indicates that the aqueous and methanol crude leaf extracts of *S. acuta* possess hypoglycemic activity in diabetic and normal glucose fed rabbits[42].

The methanolic and ethanolic leaf extracts of *S. acuta* were capable of lowering elevated blood glucose level associated with alloxan induced diabetic in rats at the lower dose. The antioxidant effects demonstrated by these extracts may contribute to this protective effect, although ethanolic extract demonstrated better antioxidant activity than methanol extract. These extracts also attenuated the dyslipidemia associated with alloxan toxicity thus providing additional beneficial effect in the diabetic rats. The ethanol and methanol extracts produced hypoglycaemic and hypolipidaemic effect and showed some potential in attenuating alloxan induced anaemic state. The methanol extract showed better potential in reversing the decrease in haematocrit as well as Total White Blood Cell (TWBC) associated with alloxan toxicity[43]**.**

(f) Antipyretic activity

The petroleum ether, acetone, ethanol and aqueous extracts of the leaf of *S. acuta* were evaluated for their antipyretic activity. It was observed that all the extracts lowered the temperature with passage of time but the acetone extract showed better antipyretic activity amongst other extracts. The antipyretic activity of the ethanol extract was observed to be more as compared to other extracts and its effect was seen within 1.5 hours as compare to others extracts[44].

(g) Hepatoprotective Effect

Hepatoprotective effects of methanolic extract of *S. acuta* were obtained against liver damage induced by paracetamol overdose as evident from decreased serum levels of glutamate pyruvate transaminase, glutamate oxaloacetate transaminase, alkaline phosphatase and bilirubin in the *S. acuta* treated groups compared to the intoxicated controls. The hepatoprotective effect was further verified by histopathology of the liver. Pretreatment with *Sida acuta* extract significantly shortened the duration of hexobarbitone induced narcosis in mice indicating its hepatoprotective potential. Presence of the phenolic compound, ferulic acid in the root of *S. acuta*, confirmed the significant hepatoprotective effects [45].

(h)Wound Healing activity

Akilandeswari *et al.*, (2010)[46] investigated the effects of topical administration of methanolic extract of *S. acuta* ointment on two types of wound models in rats, (i) the excision and (ii) the incision. In the excision model the extract treated wounds were found to epithelialise faster and the rate of wound contraction of the *S. acuta* ointment was found to be greater than that of the control. In the incision wound studies, there was a significant increase in tensile strength of the 10-day old wound due to treatment with *S. acuta* ointment and the reference standard Nitrofurazone ointment when compared with the respective control. It is concluded that the wounds contracting ability of the methanol extract of *S. acuta* ointment produced significantly greater response in both of the wound types tested than the control.

Adetutua *et al.*, (2011)[20] recorded thirty-six plant species with their local names and parts used in the traditional wound healing preparations. Most of the plant extracts including *S. acuta* reported to have both antioxidant and antibacterial activities, thereby suggesting all have some potential for wound healing. A decoction of the leaves of *S. acuta* is used to clean wound.

(i) Cytotoxicity and antioxidant activity

Pieme *et al.*,(2010)[47] evaluated in vitro cytotoxicity and antioxidant activities of five medicinal plants of Malvaceae

family from Cameroon. The potential antiproliferative and antioxidant activities of extracts from five medicinal plants from Cameroon were evaluated *in vitro* on HepG-2 cells. The results showed *S. acuta* have significant antiproliferative activity, decrease of the viability of the cells in a concentration-dependent manner and exhibited weak cytotoxicity. The results of the antioxidant activity showed significant increase of SOD, CAT and GsT. Author suggested *S. acuta* may be promising alternative to synthetic substances as natural compound with high antiproliferative and antioxidant activities.

Antioxidant activity was investigated from six species of Malvaceae including *S. acuta* and found that the extract of *S. acuta* exhibited significant antioxidants properties[48]. *S. acuta* extract demonstrated a cytotoxic activity on murine and human cancer cell lines by using a MTT assay[49].

(j) Insecticidal properties

The ethanolic leaves extracts of *S. acuta* and three other plants in different concentrations were investigated for their insecticidal activity against *Acanthscelides obtectus*. Average mortality indicated that the extracts caused significant mortality on the target insects. The bioassay has indicated that the toxic effect of the extracts was proportional to the concentration and observed overall mean mortality also increased with increase in time intervals after treatment[50].

(k) Inhibitory effect on calcium oxalate crystal growth

The root of *S. acuta* is useful in nervous and urinary diseases, disorders of blood and bile and in chronic bowel complaints. Calcium oxalate is the most important constituent of urinary stone crystals. The inhibitory effects of the methanolic and aqueous extracts of the root of S. acuta on calcium oxalate crystal growth have been studied in-vitro at 20 mg/5 ml and 10 mg/5 ml doses. Calcium oxalate crystals were grown in silica gel media in Hane's tubes by single diffusion method. In both the extracts there were reductions in sizes of calcium oxalate crystal columns and also the size of the individual calcium oxalate crystals when compared to that of the controls. The results of *in-vitro* experimental models attribute an inhibitory capacity with respect to calcium oxalate crystals for the methanolic and aqueous extracts of *S. acuta*[51]**.**

(l) Cardiovascular activity

Kannan *et al*., (2012)[52] screened cardioactive herbs from Western Ghats of India. The heart beat rate (HBR) and blood flow during systole and diastole were tested in Zebrafish embryos. The methanolic extract of *S. acuta* led to decrease in the HBR in Zebrafish embryos, which was greater than that caused by nebivolol**.**

(m)Neutralizing activity against snake venom

Ethanolic extract of the whole plant of *S. acuta* has a moderate neutralizing activity against the haemorrhagic effect of *Bothrops atrox* venom[53].

(n) Corrosion inhibition

Corrosion inhibition of mild steel in 1M H_2SO_4 by leaves and stem extracts of *S. acuta* was studied using chemical (weight loss and hydrogen evolution) and spectroscopic techniques at 30-60 ^{0}C. It was found that the leaves and stem extracts of *S. acuta* inhibited the acid induced corrosion of mild steel. The inhibition efficiency increases with increase in concentration of the extracts but decrease with rise in temperature. Inhibitive effect was afforded by adsorption of the extracts. Inhibition mechanism is deduced from the temperature dependence of the inhibition efficiency and also from spectroscopic results [54] The author also studied the synergistic action caused by iodide ions on the corrosion inhibition of mild steel in 1 M H_2SO_4 by leaves and stem extracts of *S. acuta* and found that addition of iodide ions enhances the inhibition efficiency. T he inhibition efficiency increases with increase in the iodide ion concentration but decreases with rise in temperature[55].

CONCLUSION

S. acuta is a plant of wide usage in traditional medicine.In traditional medicine, the plant is often assumed to treat diseases such as fever, headache, skin diseases, diarrhoea, and dysentery. Following these traditional usages many studies have been conducted in laboratories for the efficiency of the plant, in addition the plant may have many other properties since it has not been tested for all desired pharmacological activities. Since the global scenario is now changing towards the use of nontoxic plant product having traditional medicine use, development of modern drug from *S. acuta* should be emphasized for the control of various diseases. The plant *S. acuta* holds tremendous potential for pharmaceutical products of commercial values.

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