



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA):IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

A Systematic Review On Sida Acuta Burm F.: Morphological Characteristics, Phytoconstituents And Pharmacological Activities

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ARTICLE INFO

Received: 07 Feb 2024

Accepted: 11 Feb 2024

Published: 12 Feb 2024

Keywords:

Sida Acuta, Pharmacological Activities, Phytoconstituents, Neuroprotective, Malvaceae,

DOI:

10.5281/zenodo.10648892

ABSTRACT

Numerous studies have found that indigenous people in tropical countries have used various parts of *Sida acuta* to treat a variety of health issues, including rheumatic affections, azoospermia, oligospermia and spermatorrhea, leucorrhoea, wounds, sciatica, nervous and heart diseases, colds, coughs, asthma, tuberculosis and respiratory diseases, blood, bile, and liver disorders, elephantiasis, haemorrhoids, ulcers, stomach disorders and abdominal pain, headaches, fever and malaria, skin diseases, worms, diarrhoea and dysentery, venereal diseases, toothaches, and snake bites. Numerous pharmacological characteristics of *Sida acuta*, including antioxidant, antimicrobial and antibacterial, antimalarial, cardiovascular, antiulcer, analgesic and anti-inflammatory, antipyretic, hepatoprotective, hypoglycaemic, insecticidal, and anticancer, have been the subject of scientific investigation. Alkaloids, saponins, coumarins, steroids, tannins, phenolic compounds, cardiac glycosides, sesquiterpene, and flavonoids are among the numerous bioactive components that give the plant extract its various qualities and applications in conventional medicine. The goal of this review research is to provide a thorough overview of the literature regarding the phytochemical and pharmacological profiles, and ethnomedicinal applications of *Sida acuta*.

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



INTRODUCTION

Since the beginning of medical field, medicinal plants are used to treat a variety of ailments. Many shrub or plant, belongs to the family malvaceae which contain over 244 genera with 4225 known species. It has been widely used traditionally for its potent medicinal activities. It is found throughout the warmer parts of India.[1] Various other species from this family also have medicinal properties. Because of its various medicinal uses there has been an increase in the interest of studying its pharmacogenetic and pharmacological properties in recent years. Although the entire plant is utilised medicinally, requests for the leaves are the most common. Leaves are used to cure rheumatism because they are thought to have diuretic, anthelmintic, calming, and wound-healing qualities. This plant's leaf decoctions are used to cure azoospermia, oligospermia, haemorrhoids, and stomach pain. Meanwhile, its leaf juice was used to treat stomach issues and vomiting. In Indian traditional medicine, roots are mostly employed as stomachic, diaphoretic, and antipyretic. While *Sida acuta* is also used to treat illnesses of the blood, bile, liver, neurological system, and urinary tract, the whole dried plant's hot water extract is taken orally as an abortifacient and febrifuge.[2] A component of Siddha formulation, *Sida acuta* is advised in cases of rheumatism, facial paralysis, spermatorrhoea, leucorrhoea, haemorrhage, gonorrhoea, and pulmonary TB. It is believed that this plant may also have some thrombolytic action. Many components of the plant have been used extensively for the treatment of dandruff, rheumatism, liver issues, kidney stones, neurological disorders, testicular enlargement, and elephantitis by the tribal population from north-eastern and southern areas of India. Tribes in Tamil Nadu, Southern India, also utilise this plant to cure skin conditions, diarrhoea, dysentery, and

of the modern drugs are isolated from the traditionally used medicinal plants. *Sida acuta*, also known as *Sida carpinifolia* is a herbaceous bronchitis. In addition to India, this ethnomedicinal plant is used in other Asian countries (Sri Lanka, Taiwan); in Central and South America (Mexico, Venezuela, Colombia, Cuba, Nicaragua, Guatemala); and in African nations (Nigeria, Togo, Ivory Coast, Kenya) for the treatment of fever, asthma, haemorrhoids, diarrhoea, malaria, and other sexually transmitted infections.[3] The purpose of this review research is to give a broad overview of current understanding on the pharmacological characteristics and biological assessment of *Sida acuta*, including its chemical constituents, medicinal uses, and drug development potential. The primary goal of this study is to provide current information on *Sida acuta*, a plant that may be significant because of its invaluable pharmacological qualities. With the use of this data, researchers and students will be able to fully comprehend the plant's known pharmacological and phytochemical characteristics for use in their next studies.

BOTONICAL INFORMATION

Traditionally *Sida acuta* was used to manage various disease conditions. *Sida acuta* is a small, erect annual herbaceous shrub with a woody root, about 0.5-1.5 m height. It found abundantly on side of roads and cultivated fields.[4] Tiny stellate hairs interspersed with long, simple hairs cover the stem, petioles, and pedicels. Simple, alternating leaves and an axillary, single inflorescence with stalks up to 1.3 cm long that are joined approximately half way through are the features of this plant. The fruit is capsule-shaped and has five to six carpels, while the yellow blooms have five petals. Flowering and fruiting of this plant stars from September and last upto May.[5]



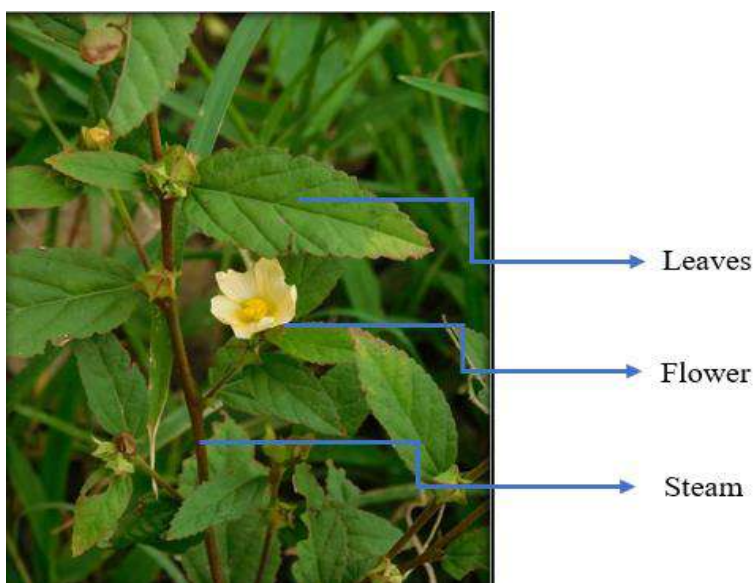


Fig. No. 1: Arrow indicating different parts of *Sida acuta* plant

Table 1: Vernacular Names of *Sida acuta* Burm. f [1&5]

Language	Vernacular Names
English	Hornbeam-Leaved Sida
Ayurvedic	Balaa
Marathi	Pata
Hindi	Kareta
Gujrati	Jangli Methi
Telugu	Visha Boddi
Tamil	Vattatiruppi
Malayalam	Cheruparuva
Bengali	Kurola

Table 2: Taxonomical Hierarchy [2&6]

Kingdom	Plantae
Phylum	Anthophyta
Class	Dicotyledonae
Order	Malvales
Family	Malvaceae
Genus	Sida
Species	Sida Acuta
Scientific Name	Sida acuta Burm f.

PHYTOCHEMICAL CONSTITUENTS

Sida acuta contains various chemical constituents such as:

- **Phytochemical:**

Tannis, Saponin, Alkaloids, Flavonoids, Terpenoids, Phenolics, Glycosides, Steroids, Terpenoids.

- **Vitamin:**

Ascorbic acid, Niacin, Thiamin, Riboflavin, β -Carotene.

- **Mineral:**

Calcium, Iron, Phosphorus, Sodium, Magnesium.[7&8]

PHYTOCHEMICAL INVESTIGATION [9]

- **Test for Alkaloids (Mayer's test):**

When few drops of Mayer's reagent is added to the solution of extract it produces white yellowish precipitate, this indicates presence of alkaloids.

- **Test for Flavonoids (Shinoda's test):**

When 1 ml of 10% ammonium hydroxide solution is added to the aqueous solution of extract it produces yellow fluorescence, indicates the presence of flavonoids.

- **Test for Saponins (Frothing test):**

Mix 5 ml of distilled water in 10ml of the aqueous extract and shake vigorously for 5 min and allow to stand, forming honeycomb froth indicates the presence of saponins.

- **Test for Phenols (Ferric chloride test):**

Add few drops of 5% ferric chloride solution to about 5 ml solution of extract, if dark green colour observed it indicates the presence of phenols.

- **Test for Tannins (Ferric Chloride test):**

In 1 ml of aqueous extract solution add 1-2 drops of 0.1% ferric chloride solution, blue and green black colour observed indicates the presence of gallic tannins and catecholic tannins respectively.

- **Test for Steroids (Sulphuric acid test):**

In 5 ml aqueous extract add 2 ml of acetic anhydride with 2 ml H₂SO₄. Change of colour

from violet to green or blue indicates the presence of steroids.

- **Test for Terpenoids (Salkowski test):**

Add 2 ml of chloroform to the leaf extract, and add 3 ml of concentrated H₂SO₄ carefully to form a layer. At the interface a reddish-brown coloration observed which shows the presence of terpenoids.

- **Test for Cardiac glycosides (Keller-Killani test):**

Add 2 ml of glacial acetic acid and one drop of ferric chloride solution to about 5 ml of aqueous extract. To this mixture add 1 ml of concentrated sulphuric acid. At the interface formation of a brown ring indicates a deoxy-sugar characteristic of cardenolides. A brown ring appears above the violet ring, a greenish ring may form gradually throughout the thin layer in the acetic acid layer.

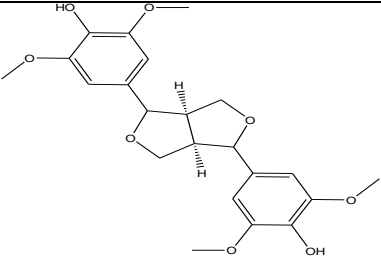
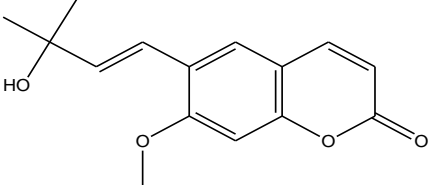
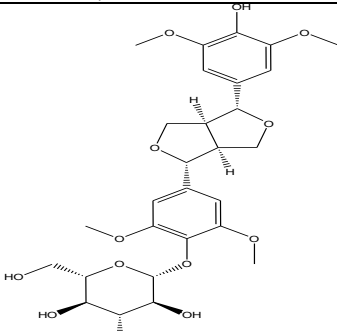
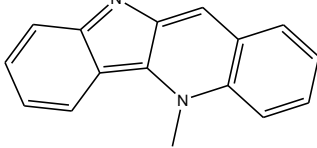
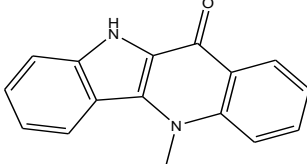
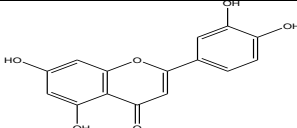
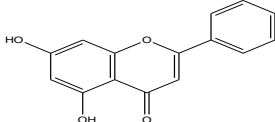
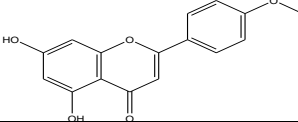
Table 3: Phytochemical investigation [10&11]

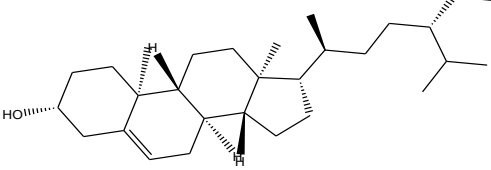
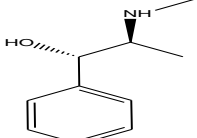
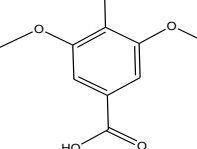
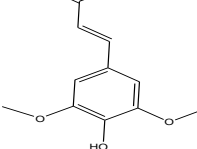
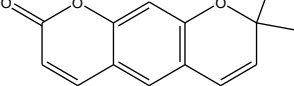
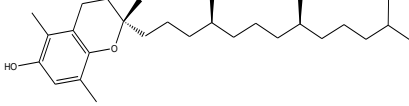
Phytochemical Constituents	Solvents			
	Alcohol	Water	Chloroform	Petroleum ether
Alkaloids	+	-	-	-
Flavonoids	+	+	+	+
Terpenoids	-	-	-	+
Saponins	-	-	+	+
Phenols	+	-	+	+
Glycosides	+	+	+	+
Tannis	+	-	+	+
Steroids	+	-	+	+

Table 4: TLC data of various extracts [11]

Extract	Developers	RF Value
Alcoholic extract	5 % concentrated sulphuric acid in methanol	0.44, 0.36
Aqueous extract	5 % concentrated sulphuric acid in methanol	0.06, 0.07, 0.30, 0.55, 0.67, 0.80
Chloroform extract	5 % concentrated sulphuric acid in methanol	0.62, 0.64
Petroleum ether extract	5 % concentrated sulphuric acid in methanol	0.07, 0.4, 0.3, 0.55, 0.74
Extract	Developers	RF Value

Table 5: Information about phytochemical present in *Sida acuta* [12&13]

Sr No	Phyto-constituents	Chemical Name	Chemical Formula	Structure	Ref.
1	(+)-Syringaresinol	4-[(1S,3aR,4S,6aR)-4-(4-hydroxy-3,5-dimethoxyphenyl)-hexahydrofuro[3,4-c]furan-1-yl]-2,6-dimethoxyphenol	C ₂₂ H ₂₆ O ₈		12
2	(E)-Suberenol	6-[(E)-3-hydroxy-3-methylbut-1-enyl]-7-methoxychromen-2-one	C ₁₅ H ₁₆ O ₄		12
3	Acanthoside-B	(2S,3R,4S,5S,6R)-2-(hydroxy(methoxy)methyl)-3-((3aR,6aR)-4-(4-hydroxy-3,5-dimethoxyphenyl)tetrahydro-1H,3H-furo[3,4-c]furan-1-yl)-5-methoxy-6-phenoxytetrahydro-2H-pyran-3,4,5-triol	C ₂₈ H ₃₆ O ₁₃		12
4	Cryptolepine	5-methyl-5H-indolo[3,2-b]quinoline	C ₁₆ H ₁₂ N ₂		12
5	Cryptolepinone	5,10-dihydro-5-methyl-11h-quindolin-11-one	C ₁₆ H ₁₃ N ₂ O		12
6	Luteolin	2-(3,4-Dihydroxyphenyl)-5,7-dihydroxy-4H-1-benzopyran-4-one	C ₁₅ H ₁₀ O ₆		13
7	Chrysin	5,7-Dihydroxy-2-phenyl-4H-chromen-4-one	C ₁₅ H ₁₀ O ₄		13
8	Acacetin	5,7-Dihydroxy-2-(4-methoxyphenyl)-4H-1-benzopyran-4-one	C ₁₆ H ₁₂ O ₅		13

9	β -Sitosterol	17-(5-ethyl-6-methylheptan-2-yl)-10,13-dimethyl-2,3,4,7,8,9,10,11,12,13,14,15,16,17-tetradecahydro-1H-cyclopenta[α]phenanthrene-3-ol	C ₂₉ H ₅₀ O		12
10	Ephedrine	(1R,2S)-2-(methylamino)-1-phenylpropan-1-ol	C ₁₀ H ₁₅ NO		12
11	Syringic acid	4-Hydroxy-3,5-dimethoxybenzoic acid	C ₉ H ₁₀ O ₅		12
12	Sinapic acid	3-(4-hydroxy-3,5-dimethoxyphenyl)prop-2-enoic acid	C ₁₁ H ₁₂ O ₅		12
13	Xanthyletin	2,2-dimethylpyrano[3,2-g]chromen-8-one	C ₁₄ H ₁₂ O ₃		13
14	β -tocopherol	(2R)-2,5,8-trimethyl-2-[(4R,8R)-4,8,12-trimethyltridecyl]-3,4-dihydrochromen-6-ol	C ₂₈ H ₄₈ O ₂		12

TRADITIONAL USES

Sida acuta plant traditionally used for treating various disease conditions. Different parts of Sida acuta have different traditional uses.

- **Roots:**

Antipyretic, Aphrodisiac, Diaphoretic, Antirheumatic, Diuretic, Stomachic and Wound Healing. Smooth paste of the root is made by adding sparrow dung and water, this paste is used in bursting of boils.

- **Leaves:**

Anthelmintic, Demulcent, Diuretic, Rheumatic affections and Wound Healing. Gingelly oil moist leaves are applied on abscesses.

- **Whole Plant:**

Anti-Inflammatory, antirheumatic, anti-ulcer, diaphoretic, febrifuge, malaria, anthelmintic, sedative, fever, rheumatism, and to eradicate intestinal worms. [1,2&5]

PHARMACOLOGICAL ACTIVITIES

Table 6: Pharmacological Activities

Sr. No	Activity	Part of Plant	Extract	Animal	Dose	Induction	Standard	Ref
1	Analgesic activity	Whole Plant	Aqueous Acetone	Swiss mice	200, 400 & 600 mg/kg	Acetic acid, Formalin	Paracetamol	15
2	Anticonvulsant activity	Whole plant	Methanol	Swiss albino mice	100, 200 & 400 mg/kg	Maximum electroshock (MES) &	Phenytoin & Diazepam	16

						Pentylentetra zole (PTZ)		
3	CNS depressant activity	Whole plant	Methanol	Swiss albino mice	100, 200 & 400 mg/kg	-	Diazepam	16
4	Anti hyperglycemic & Antilipidemic activity	Leaf	Ethanol	Albino wistar rats	50, 250 & 500 mg/kg	Streptozotocin	Glibenclamide	17
5	Anti-inflammatory activity	Leaf	Ethanol	Albino wistar rats	100, 200 & 400 mg/kg	Egg albumin	Phenylbutazone	18
6	Antioxidant activity	Leaf	Ethanol	Albino wistar rats	20, 40 and 60 mg/kg	10% ethanol	-	19
7	Antispasmodic activity	Leaf	Ethanol, n-hexane, methanol	Albino mice	300 & 600 mg/kg	Plasmodium berghei	Chloroquine	20
8	Antipyretic activity	Leaf	Petroleum ether, acetone, ethanol, water	Albino wistar rats	500 mg/kg	12% Brewer's yeast suspension	Paracetamol	21
9	Epididymal effect	Leaf	Ethanol	Albino wistar rats	500, 1000, 1500 mg/kg	Olive oil	-	22
10	Hepatoprotective activity	Root	Methanol	Male albino wistar rats	50, 100 and 200 mg/kg	Paracetamol	Silymarin	23
11	Histo-hormonal activity	Leaf	Ethanol	Albino wistar rats	500, 1000, 1500 mg/kg	Olive oil	-	24
12	Kidney Function Indices and electrolytes	Root and Leave	Ethanol	Albino wistar rats	50 & 100 mg/kg	10% ethanol	-	25
13	Neuroprotective and memory impairment activity	Root	Hydro-alcoholic	Albino wistar rats	50, 100 and 200 mg/kg	Scopolamine	Piracetam	26
14	Neuroprotective activity	Leaf	Ethanol	Male albino wistar rats	200 mg/kg	Mercuric chloride	-	27
15	Prostatic activity	Leaf	Ethanol	Male albino wistar rats	500, 1000, 1500 mg/kg	Oliv oil	-	28
16	Sexual behavior activity	Leaf	Chloroform, petroleum	Sprague-dawley albino rats	200 mg/kg	-	Sildenafil citrate	29

			ether, methanol					
17	Antiulcer activity	Leaf	Ethanol	Swiss albino mice	100, 200 & 400 mg/kg	Helicobacter pylori	Clarithromycin	30
18	Wound healing	Leaf	Methanol	Guinea pig	3000, 4000, 5000 mg/kg	Excision wound created	Penicillin skin ointment	31

IN-VITRO PHARMACOLOGICAL STUDIES

1. Antibacterial activity:

R. P. Senthilkumar et al carried-out biogenesis of Cerium oxide nanoparticles using the aqueous leaf extract of *Sida acuta*. Field emission scanning electron microscopy (FESEM) image of *E. coli* culture treated with CeO₂ NPs showed significant bactericidal activity.[32] In a study conducted by Timothy, o et al, chloroform extract of whole plant of *Sida acuta* showed significant antibacterial activity.[33]

2. Antifungal activity:

Jindal Alka et al investigated the antifungal activity of flavonoids extracted from *Sida acuta* against *Candida albicans*. In this study the flavonoid containing extract showed significant fungicidal activity against the tested fungi.[34]

3. Antioxidant activity:

In a study conducted by Akeem Yusuff et al, the ethanolic leaf extract of *sida acuta* showed good antioxidant potential.[35] Entaz Bahar et al investigated the antioxidant effect of methanolic leaf extract of *sida acuta*. In this study it is found that methanolic leaf extract of *sida acuta* has moderate antioxidant activity.[36]

4. Thrombolytic activity:

Anita Mishra et al carried out a study for the evaluation of In-Vitro blood clot dissolution activity of *sida acuta* plant. In this study it is found that the aqueous leaf extract *sida acuta* has significant thrombolytic activity.[4] Entaz Bahar et al investigated the thrombolytic activity of

methanolic extract of *sida acuta* leaves. Using in vitro model, it was found that methanolic extract of *sida acuta* has significant thrombolytic activity.[36]

5. Larvicidal & Mosquito repellent activity:

In a study conducted by Marimuthu Govindarajan et al, methanolic extract of *sida acuta* leaves showed excellent mosquito repellent and larvicidal activity *Culex quinquefasciatus*, *Aedes aegypti* and *Anopheles stephensi* mosquitoes.[37]

6. Uterine Contractile activity:

Obioma Benedeth L. Eze et al, screened uterine contractile activity of ethanolic leaf extract of *sida acuta*. In this investigation it was found that the ethanolic leaf extract of *sida acuta* possesses significant uterine contractile activity.[38]

CONCLUSION

In many countries across the world, *Sida acuta* has been utilised traditionally to treat a wide range of medical conditions. Conventional healers use the whole plant, including the leaves, bark, roots, seeds, and flowers. Significantly present in the plant extract, bioactive components such as alkaloids, saponins, coumarins, steroids, tannins, phenolic compounds, cardiac glycosides, sesquiterpene, and flavonoids are responsible traditional medicinal activities such as analgesic and anti-inflammatory, antipyretic, hepatoprotective, hypoglycemic, insecticidal, anticancer, cardiovascular, antimicrobial, antiulcer, wound healing, aphrodisiac, antibacterial, antimalarial, and antioxidant activities. Various biological tests were conducted



on the plant that produced positive results for these activities. Its high nutritional value is also supported by the extract's rich mineral and vitamin content. It is our genuine goal that the facts presented in this review on *Sida acuta* will function as a foundation for accurate assessment of this plant's extracts and for the medicinal use of its bioactive constituents.

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HOW TO CITE: Tejas D. Pimple, Sakshi N. Nagre, Bhushan R. Gandhare, Sadhana P. Gautam, Pooja P. Hulke, A Systematic Review On *Sida Acuta* Burm F.: Morphological Characteristics, Phytoconstituents And Pharmacological Activities, Int. J. of Pharm. Sci., 2024, Vol 2, Issue 2, 256-266. <https://doi.org/10.5281/zenodo.10570770>

