



PHARMACOLOGICAL ACTIVITIES OF *SIDA CORDIFOLIA*: A REVIEW

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ABSTRACT

The application of plants as medicines date back to prehistoric period. Herbal drugs constitute a major share of all the officially recognized systems of health in India viz. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy. *Sida cordifolia* L. is a perennial shrub belonging to family Malvaceae widely distributed throughout the tropical and sub-tropical plains all over India. It has wide variety of therapeutic and pharmacological uses like analgesic, anti-inflammatory, anti-stress, anti-diabetic along with anticancer activity. Apart from these it also has many uses like emollient action, demulcent, bronchodilator, vaso-relaxant properties etc. Due to all of these properties this plant is one of the cornerstones in ethnopharmacology and ethanobotanical sciences. Pharmacological screening of botanicals is necessary for viewing new chemical entities which is designed to search for novel drug actions at an early stage of drug development and this review highlights about all the pharmacological activities of *Sida cordifolia* L.

Key words: Ayurveda, *Sida cordifolia*, Ethnopharmacology, Homeopathy.

INTRODUCTION

Plants are one of the most important sources of medicines. The medicinal plants are extensively utilized throughout the world in traditional system of medicines "Ayurveda" (Cordell GA, 2000). India is rich source of medicinal plants and is called "Botanical Garden of the World" with enormous wealth of biodiversity. There are almost 45,000 plant species recorded in India so far (MOEF, 1994) of which 7,500 species have been used for medicinal purposes (Kala CP, 2005). According to WHO, 80% or three quarters of world's population rely on traditional/plant base medicines for their primary health care. Tribal communities in India still collect and preserve locally available plants used in treating various disorders (Mahishi P et al., 2005). The present study was focused on the pharmacological review of *Sida cordifolia* L.

Vernacular names

Hindi : Kungyi

English	:	Country mallow
Sanskrit	:	Bala
Tamil	:	Mayir-manikham
Bengali	:	Brela
Guajarati	:	Junglimethi
Malayalam	:	Velluram
Punjab	:	Simak
Maharastra	:	Chikana

Regional Names

Bariar, Batyalaka, Beejband, Bijband, Chiribenda, Chitimutti, Hettuti-gida, Janglimethi, Kharenti, Khareti, Kisangi, Mayir-manikham, Muttuva, Paniyar-tutti, Simak, Tupkaria, Tutturabenda and Velluram.

Scientific Classification

Kingdom	:	Plantae
Division	:	Angiospermae
Class	:	Eudicots
Order	:	Malvales
Family	:	Malvaceae
Genus	:	<i>Sida</i>
Species	:	<i>Sida cordifolia</i> L.

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Occurrence & Distribution

Sida is a large genus with 200 species distributed throughout the world of which 17 species are reported to be in India (Sivarajan VV and Pradeep KA, 1996). *Sida cordifolia* L. which is commonly called as country mallow or Bala in Ayurveda belongs to Malvaceae family is widely distributed along with other species throughout the tropical and sub-tropical plains all over India and Srilanka up to an altitude of 1050 m (Ankit Jain et al., 2011; Kanth and Diwan, 1999).

Botanical description (Pramod V et al., 2012; Gamble JS, 1935; Rangari VD et al., 1995; kalaiarasan A & Ahmed John S, 2010):

It is small, erect perennial shrub grows upto 0.75-1.5 m height with the following characteristics	
Leaves	- Yellowish green, Chordate-oblong or ovate-oblong, obtuse or sub-acute at the apex with heart shape, 2.5-7cm and 2.5-5cm broad with 7-9 veins.
Flowers	- White to dark yellow with hairy 5 lobed calyx and 5 lobed corolla
Roots	- Stout with 5-15 cm having greyish yellow outer surface
Fruits	- Sub-discoïd or moon sized with 6-8 mm in diameter
Seeds	- Trigonous, glabrous and tufted pubescent near hilum

Chemical Constituents (Ghosal S et al., 1975; Ranajitkumar S et al., 2008; Amritpalsingh, 2006)

Earlier phytochemical screening revealed the presence of Ephedrine, Pseudoephedrine, Quinazolines (Vasicine, Vasicinol), Cryptoleptins, Phytosterols (Stearic and hexacosanoic acids, Sterculic, malvalic and fumaric acid), Flavonoids, Saponins, Asparagine, N- methyl Tryptophan.

Therapeutic and Traditional uses of *Sida cordifolia* L.

Whole plant	- Astringent, Emollient, Aphrodisiac. It tones the blood pressure and improves the cardiac irregularity. Useful in fever, fits, Ophthalmic, rheumatism, colic and nervous disorders. Aerial parts of plant has the bronchodilator value of the vasicinone, vasicine and vasicinol that are used to prepare formulations to treat bronchial affections, especially in what refers to the cough, asthma, bronchitis, nasal congestion,
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	-	flu, pain in the chest, etc. Juice of the whole plant, pounded with a little water is used in treating spermatorrohea, rheumatism, and gonorrhoea (Nadkarni KM, 1954; C.P Khare, 2007)
Bark	-	Considered as cooling. It is useful in blood, throat, urinary system related troubles, piles, phthisis, insanity
Seeds	-	Aphrodisiac, rheumatism treatment
Roots	-	Diuretic, Decoction of the root of bala and ginger is given in intermittent fever attended with cold shivering fits. Root juice is also used to promote healing of wounds. Powder of the root and bark together, is given with milk and sugar for frequent micturition. Oil prepared from the decoction of root bark mixed with milk and sesame oil, finds application in diseases of the nervous system, and is very efficacious in curing facial paralysis and sciatica (Koman, 1921; Amrit Paul singh, 2006).
Leaves	-	Oils are used topically to the sore muscles and sore joints in rheumatism and arthritis with the crushed leaves can be used to alleviate local pains because of its astringent value in curing external wounds or skin imperfections.
Stems	-	Demulcent, emollient, febrifuge and diuretic.

PHARMACOLOGICAL ACTIVITIES

Gastric anti-ulcer activity

Akilandeswari S et al., (2013) screened for gastric anti-ulcer activity with the ethanol extract of leaf of *Sida cordifolia* L. The ulcers were induced in 36hours fasted albino rats by pylorus ligation model, ethanol (1ml/kg) and aspirin (300 mg/kg) induced gastric lesions and comparison made with reference drug famotidine at dose level (20 mg/kg). The plant extract of *Sida cordifolia*

L. (100 and 200 mg/kg, b.wt) exhibited potent anti-secretory volume, acidity and ulceration, thus, establishing significant antiulcer activity against different ulcer induced models.

Philip BK *et al.*, (2008) evaluated for anti ulcerogenic activity of methanolic extract of *Sida cordifolia* L. at a dose level 500mg/kg against ethanol and aspirin induced gastric ulcers.

Toxicity assessment and analgesic activity

Konate K *et al.*, (2012) tested aqueous, acetone extracts of *sidaacuta* and *Sida cordifolia* L. for toxicity assessment and analgesic activity. They observed the toxicity of both extracts administered intraperitoneally up to a dose level of 200 mg/kg and 6gm/kg body weight for 14 and 28 days showing altered biochemical, physical parameters and showed LD₅₀ values as 3.2gm/kg and 3.4gm/kg.

The extracts also showed a significant inhibition of acetic acid induced (0.6% at 10ml/kg) writhing in a dose- dependent manner and the significant inhibition of inflammation was observed in formalin (20µl, sub plantar route) induced inflammation at dose levels 200, 400 and 600 mg/kg body weights. Among both *Sida cordifolia* L. exhibited potent analgesic activity.

Free radical scavenging capacity and Anticandidaleffect

Ouedraogo M *et al.*, (2012) investigated for antifungal activity, antioxidant and immunostimulant activity using total alkaloidal compounds from *Sida cordifolia* L. The alkaloidal compounds in combination with reference Nystatin and Clotrimazole exhibited antimicrobial effects against candida strains. They also observed immunostimulatory effects of *Sida cordifolia* L. alkaloids at the doses of 50,100 and 200mg/kg p.o. against cyclosporine A which is a immunosuppressive at a dose level 25 mg/kg and compared with reference concanavalin A (25mg/kg p.o). The synergistic effect between alkaloidal compounds with reference showed significant potent antifungal effect and polyphenols present in *Sida cordifolia* L. may be responsible for antioxidant activity against immunosuppressant due to oxidative stress.

Nephroprotective activity

Mehul V *et al.*, (2012) demonstrated *Sida cordifolia* L. as nephroprotective against gentamycin (100mg/kg) and cisplatin (7mg/kg) induced nephrotoxicity. Administration of aqueous extract of *Sida cordifolia* L. (200 and 400 mg/kg) significantly (p<0.001) reduced the levels of serum urea, creatinine and BUN in nephrotoxicity induced rats. The presence of flavonoids and phenols contribute for antioxidant potentiality of *Sida cordifolia* L. showing nephroprotective activity.

Bhatia Lovkesh *et al.*, (2012) reported both ethanolic and aqueous extract of *Sida cordifolia* L. at dose levels 200 and 400 mg/kg, showed nephroprotective activity in gentamycin induced (100mg/kg) nephrotoxicity. The polyphenols present in *Sida cordifolia* L. may have shown antioxidant potentiality in regaining antioxidants defense system that may exhibits nephroprotective activity.

Anti-Nociceptive and Antioxidant property

Hemayet H *et al.*, (2012) evaluated for the anti-nociceptive and antioxidant properties of the ethanolic extract of *sida cordifolia* root against acetic acid induced writhing model in mice. Acetic acid-induced writhing model represents pain sensation by triggering localized inflammatory response. The ethanolic extract of roots of *Sida cordifolia* L. exhibited significant (p>0.001) writhing inhibition in acetic acid induced writhing model.

The antioxidant property of ethanolic extract of *Sida cordifolia* L. was assessed by DPPH (1, 1-diphenyl-2-picryl hydrazyl) free radical scavenging activity. It was shown that the percentage (%) scavenging of DPPH radical was increased significantly with increasing dose (P< 0.001). IC₅₀ value of the extract was found to be significant when compared to the IC₅₀ value of the reference compounds ascorbic acid and BHA respectively. The potentiality of the extract of *S. cordifolia* as anti-nociceptive and antioxidant may be due to the presence of tannins, phenolics might be responsible for its activity. Dekkers JC, 1996 also evaluated the antioxidant effect of ethanolic extract of the roots of *Sida cordifolia* L.

Anti-diabetic and Anti-hypercholesterolemic effect

Gagandeep Kaur *et al.*, (2011) demonstrated methanol and aqueous extract of *Sida cordifolia* L. (500mg/kg, 750mg/kg & 1000mg/kg) significantly (p<0.05) reduced fasting serum glucose levels in streptozotocin induced diabetic rats at a dose of 45mg/kg, i.v dissolved in 0.05M citrate buffer at pH 4.5. They observed a reduction in cholesterol, TGL, LDL and VLDL levels and increase in HDL levels in diabetic induced rats after pretreatment with methanol and aqueous extract of *Sida cordifolia* L. this may be due to the presence of alkaloids and flavonoids in the extract, compared with metformin (500 mg/kg).

Kanth and Diwan (1999) reported that the aerial and root extracts of *Sida cordifolia* L. showed good analgesic, anti-inflammatory and hypoglycemic activities. The ethyl acetate extracts of the roots at a dose of 600 mg/kg showed comparable anti-inflammatory activity with Indomethacin (20mg/kg) and possessed significantly higher activity. The ethyl acetate extract of the root and aerial parts has potent central and peripheral analgesic activities when compared to methanol extract. The

methanol extracts of roots showed significant hypoglycemic activity.

Chopra *et al.*, (1999) showed *Sida cordifolia* L. plays a vital role in reducing blood sugar levels that helps to reduce the storage of fat. The plant can be used as a weight loss product through its blood- sugar lowering activity.

Anti-inflammatory activity

Shailender Singh *et al.*, (2011) evaluated for anti-inflammatory activity of ethanolic extract of *Sida cordifolia* L. against carrageenan (0.1 ml of 1%, subplantar of hind paw) induced paw edema and cotton pellet granuloma method. The ethanolic extract of *Sida cordifolia* L. showed (100mg/kg and 200 mg/kg) significant reduction in percentage inhibition of paw edema and granuloma formation and compared with Indomethacin at a dose of 20mg/kg p.o. They found that *Sida cordifolia* L. is effective in acute and sub-acute anti-inflammatory activities.

The oil obtained from *Sida cordifolia* L. seeds was also found to possess anti-inflammatory activity against carrageenan induced paw edema in albino rats reported by Ternikar *et al.*, (2010) at dose of 400 mg/kg body weight.

Franzotti *et al.*, (2000) reported that the aqueous extract of *Sida cordifolia* L. leaves showed a significant inhibition of carrageenan-induced rat paw edema at a dose level 400mg/kg p.o. It also increased the latency period for mice in the hot-plate test and inhibited the number of writhing produced by acetic acid at a dose of 400mg/kg p.o.

Hepato protective activity

Silva *et al.*, (2006) investigated for liver regeneration analysis of *Sida cordifolia* L. after partial hepatectomy in male wistar albino rats. The aqueous extract of *Sida cordifolia* L. in the doses of 100mg/kg and 200mg/kg, the hepatocyte regeneration index was significantly increased at low dose when compared to control group ($p < 0.001$) and the high dose also showed a significant increase in regeneration rate in comparison to control group ($p < 0.05$). It can be concluded that *Sida cordifolia* L. can exhibit a key role in the hepatocellular synthesis of DNA and in liver regeneration process.

Kotoky and Das (2000-2001) studied the anti-hepatotoxic activities of various extracts of the roots of *Sida cordifolia* L. against carbon tetrachloride intoxicated rats. The methanolic extract exhibited marked protection evidenced by serum biochemical parameters and histological examination.

Rao and Mishra (1998) carried out hepatoprotective activity of the powder with different extracts of the whole plant of *Sida cordifolia* L. against CCl_4 induced model. The methanolic, aqueous and total

aqueous extracts showed significant hepatotoxic activity comparable to that of Silymarin in galactosamine and thioacetamide induced toxicities in rat isolated hepatocytes.

Kumar and Mishra (1997) reported that the hepatoprotective activity of fumaric acid isolated from *Sida cordifolia* L. against galactosamine and thioacetamide induced hepatic cytotoxicities in isolated rat hepatocyte and *in vivo* against carbon tetrachloride, paracetamol and rifampicin induced hepatotoxicities in albino rats. The hepatoprotective activity was similar to that of Silymarin, a known hepatoprotective agent.

Anti-parkinsonism

Tamilselvi H and Chitra M (2011) carried out Neuroprotective effect of *Sida cordifolia* L. root powder in Parkinson mice model by MPTP method. They reported that neurochemical levels, antioxidant status and behavior patterns were significantly improved. Dev Seri *et al.*, (2008) reported *ashwagandha* and *Sida cordifolia* L. are prime herbs used in Parkinson's disease in ayurvedic treatment.

CNS depressant activity

Mediroset IA *et al.*, (2005) reported that *Sida* does not stimulate CNS observed with the report of Franco *et al.*, (2005) with hydroalcoholic extract of *Sida cordifolia* L. at dose level (1000mg/kg i.p and p.o) produced sedation and significant reduction in ($p < 0.001$) spontaneous locomotion.

Cardiovascular effects

Kubavat JB and Asdag SMB (2009) studied the role of *Sida cordifolia* L. (100mg/kg and 500 mg/kg) leaves on biochemical and antioxidant profile during Myocardial Infarction induced by isoproterenol (150 mg/kg s.c) and ischemia reperfusion, compared with propranolol (10mg/kg). The presence of flavonoids may be responsible for acceleration of antioxidant enzyme system during MI supporting for cardio protection.

Mediroset IA *et al.*, (2005) demonstrated Cardiovascular effects of *Sida cordifolia* L. leaf extract (5,10,20,30 and 40 mg/kg i.v) in rats induce hypotension and bradycardia either by both indirect cardiac muscarinic activation (through vagus nerve) or by direct activation of endothelial vascular muscarinic receptors and consequent release of NO by using atropine (2mg/kg i.v) and the extract abolished hypotensive responses.

Anticancer activity

Takaaki M *et al.*, (2007) reported anticancer activity for the plant alkaloid cryptolepine from *Sida cordifolia*. He observed the alkaloid induces p21 WAF1/CIP1 and cell cycle arrest in human osteo sarcoma cell lines. Sharma P.V and Nadkarni KM, 1954 reported

for anticancer activity of *Sida cordifolia* L. against human nasopharyngeal carcinoma, lymphoid leukemia and sarcoma 180 in mice.

Anti-bacterial effect

Kalaiarasan A and Ahmed John S (2010) reported for antibacterial activity of ethanol and methanol extracts of *Sida cordifolia* L. by using agar-disc diffusion method. Maximum inhibition zone was found with ethanolic extract showing significant inhibitory action against *Escherichia fecalis* and *Pseudomonas aerogenosa*.

Mahesh B and Satish S (2008) performed antimicrobial activity of five medicinal plants of which *Sida cordifolia* L. root and leaf extract of recorded a significant activity against bacteria *F. verticillioides* against fungal compare to other plant extracts.

Wound healing

Tissue healing is an important process which is the basis of various surgical manipulations it can be enhanced by several herbal medicines. Plants and their extracts have immense potential for the management of different types of wounds. Leaves and root juice are reported to possess wound healing due to its astringent properties alleviate local pains. Jaiswal *et al.*, (2004) studied that plant used in wound healing activity.

Anti-rheumatism

Sutradhar *et al.*, (2007) reported leaves of *sida cordifolia* L. in anti-rheumatism reported in rats correlated with the report of Amritpaul singh (2006) that decoction of root bark has ability to treat sciatica and

rheumatism. Traditionally oils prepared from this herb are very useful in arthritis and diseases that affect the joints. Yusuf M and Kabir M (1999) reported that aqueous extract of whole plant of *sida cordifolia* L. was used in anti-rheumatism.

Aphrodisiac activity

Agharkar *et al.*, (1991) reported that in Ayurveda, the plant is used as aphrodisiac and reported to improve sexual strength.

Adaptogenic activity

Sumanth Meera and Mustafa SS (2009) reported that roots of sida possess adaptogenic activity. Plant adaptogen are smooth prostressors which reduce the reactivity of host defense system. The mode of action of adaptogens is basically associated with stress system. Adaptogen increase the capacity of stress to respond to the external signals of activating and deactivating mediators of stress response subsequently. The stress induced increase in total WBC count is decreased by SCE, indicating adaptogenic activity.

CONCLUSION

sida cordifolia L. is widely used for its medicinal applications and therapeutic properties and it has its importance in Ayurvedic preparations due to its wide variety of pharmacological properties and thus the medicinal plants constitute very important rational resources. This plant has great potential to develop the Ayurvedic, modern medicine and athletic supplements by pharmaceutical industries.

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