Plants are one of the most important sources of medicines. They have been used since ancient times to heal and cure diseases and to improve health and well being. India has rich heritage of use of medicinal plants in clinical practices. According to WHO, 80% of world’s population rely on traditional plant based medicines for their health care. It is believed that current drugs such as NSAIDS and opiates which are analgesia inducing drugs are not useful in all cases, because of gastrointestinal irritation, liver dysfunction and many other side effects [1]. Therefore, there is still a need existing for the discovery of new drugs from medicinal plants. The crude extracts of plant parts and phytochemicals are known to contain some biological properties and can be of great significance in the therapeutic treatments [2]. Sida is considered to be one of the most important genuses of plants. There are nearly 1096 species of Sida out of which 100 species are medicinally important. Over 2000 years, in India the plants from genus Sida are widely used [3].

Sida cordifolia L commonly known as Country Mallow and Bala (Sanskrit) is a herb belongs to Malvaceae family is widely distributed throughout the tropical and subtropical regions of India. The plant is shrubby, branched and grows well in damp climates. The leaves are cordate or ovate oblong 2.5-5 cm long and 2.5-5 cm broad. The shrub grows to a height of about 0.75 – 1.5 m. The flowers are small, yellow or white in color with calyx 6-8 mm long and corolla slightly exceeding the calyx. The fruits are 6-8 mm in diameter with carpels 7-8, strongly reticulated, with a pair of awns on each carpel [4]. The leaves contain both ephedrine and pseudoephedrine, whereas alkaloid, ephedrine, vasicinol, vasicinone and N-methyl tryptophan were present in roots and seeds of Sida cordifolia plant and hence it can be used as medicinal herb [5]. Hence the present study, review the following pharmacological activities which have been recently explored.

**Antimicrobial activity**

Chilakapathi Damodar Reddy et al, 2012 [6] evaluated antimicrobial activity using different extracts of Sida cordifolia against bacteria and fungi by disc diffusion method. Solvent control dimethyl sulfoxide (DMSO) showed no effect against the tested bacteria and fungi. Aqueous extract showed highest inhibitory activity compared to other extracts [7].

Kalaarasan A et al, 2010 [8] showed that ethanolic leaf extract have significant activity than methanolic extract with zone of inhibition 9.5 mm for Klebsiella pneumonia, 11 mm* for Pseudomonas aeruginosa at 75 ml/disc concentration. Mahesh B et al, 2008 [9] performed antimicrobial activity for five medicinal plants from which Sida cordifolia showed the highest antibacterial activity for Bacillus subtilis and Staphylococcus aureus, highest antifungal activity for Fusarium verticillioides. Mohammad Abdul Motaleb Momin et al, 2014 [10] investigated phytochemical screening of ethanolic extract of Sida cordifolia roots and reported antioxidant, antimicrobial and analgesic activity. [11] Rajesh Singh Pawa et al, 2011 studied radical scavenging activity using DPPH radical and ascorbic acid was measured in terms of hydrogen donating radical. The IC50 value of ethanolic and aqueous extracts of Sida cordifolia was found to be higher than ascorbic acid. For antioxidant activity the presence of phytoconstituents such as alkaloids, flavonoids and phenolic compounds in the plant which makes ethanolic extract more significant [12]. Maurice Ouedraogo et al, 2012 [13] performed free radical scavenging activity and found a decrease in the DPPH absorbance which was induced by antioxidant.

**Antioxidant activity**

Frazoniti EM et al, 2000 [14] investigated aqueous extracts of Sida cordifolia against anti-inflammatory, analgesic and acute toxicity effects in rats. The aqueous extract also increased the latency period of mice in the hot plate method and inhibited a number of writhes produced by acetic acid at the oral dose of 400 mg/kg.

Shailender et al., 2011 [15] conducted a study to screen the ethanolic extract of Sida cordifolia for acute and sub-acute anti-inflammatory effects. Sida cordifolia L showed acute inflammatory activity and it was found to be 48.83% with a concentration of 100mg/kg of extract and for 200 mg/kg of extract 53.48% was observed. The ability to inhibit the increase number of fibroblast and synthesis of collagen and mucopolysaccharides during granuloma tissue formation indicates the efficiency of anti-inflammatory agents in sub-acute inflammatory states. Sida cordifolia Linn showed significant (p<0.05) anti-inflammatory activity by reducing granulomatous tissue in cotton pellet granuloma method and thus found to be effective in sub-acute inflammatory conditions [16]. Ternikar et al., 2010 [17] investigated anti-inflammatory activity from the seed oil of Sida cordifolia and it showed a significant activity at a dose of 400 mg/kg body weight. Swathy SS et al, 2010 [18] studied the effect of ethanolic extract of Sida cordifolia roots on quinolinic acid induced neurotoxicity and its effects were compared with standard drug deprenyl in rat brain. Cyclooxygenase and lipoxygenase are the markers of inflammatory responses which were increased in the quinolinic acid treated rats and this was decreased upon administration of plant extract and deprenyl.

**Anti-ulcer activity**

lilation, aspirin and ethanol treatment in 36h fasted albino rats and found that the extract possessed significant antiinflammatory activity against different ucer causing agents in all the three experimental models. Binu K. Philip et al, 2008 [20] investigated the anti-pyretic and anti-ulcerogenic properties of the methanolic extracts of Sida cordifolia (MESC) in rats.

**Anti-diabetic activity**
Kanth and diwan et al., 1999 [21] studied hypoglycemic, analgesic and anti-inflammatory activities with aerial and roots of Sida cordifolia. Mahrukh Ahmad et al., 2013 [22] evaluated hypoglycemic, anti-hyperlipidemic and antioxidant potential of alcoholic extract of Sida cordifolia at a dose of (200 and 400 mg/kg) in streptozotocin- induced diabetes rats at the dose of 55 mg/kg. At a dose of 400 mg/kg Sida cordifolia extracts showed significant reduction of the blood glucose level in diabetic rats and there was a decrease in total cholesterol, triglycerides, low density lipoprotein, plasma- creatine, plasma-urea nitrogen. There was a significant increase in antioxidant enzymes such as catalase and superoxide-dismutase activity was observed.

**Nephroprotective activity**
Bhatia et al., 2012 [23] observed that treatment with both ethanolic and aqueous extracts of Sida cordifolia Linn. Showed nephroprotective activity when compared to gentamicin. The extract possessed antioxidant activity. Sida cordifolia might have exhibited nephroprotective activity. Mehul V et al., 2012 [24] exhibited Sida cordifolia as nephroprotective using aqueous extract at a dose level of 200 mg/kg and 400 mg/kg concentrations against gentamycine 100 mg/kg and cisplatin (7mg/kg). The flavonoids and phenols present in Sida cordifolia contribute for antioxidant potentiality that exhibits nephroprotective activity.

**Cytotoxicity**
Joseph et al., 2011 [25] conducted a study to identify the bioactive compounds from the Sida cordifolia plant and observed the cytotoxic effect on hela cell lines. The results from GCMS analysis showed mainly four different compounds such as Vasicinol, Ephedrine, Vascinone and Hypaphorine based on retention time and peak observation. The results of cytotoxic activity on hela cells treated with Sida cordifolia extracts showed cells with uncontrolled growth has been arrested and there is decline level of cancerous cells.

**Anti-Hypercholesterolemic activity**
Gangadeep Kaur et al., 2011 [26] reported that the methanol and ethanol extracts of Sida cordifolia at a dose level of 500, 750 and 1000mg/kg was administered orally to normal rats. There was a decrease in the serum glucose level in streptozocin induced diabetic rats. The rats which were treated with extract (1000 mg/kg) showed a significant reduction in cholesterol, triglyceride, LDL and VDL. HDL was increased by treatment with the extract of Sida cordifolia. It may be due to the presence of alkaloids and flavonoids in the extract that inhibits the pathway of cholesterol synthesis and activates LDL receptors of hepatocyte which is responsible for the uptake of LDL into the liver.

**Hepatoprotective activity**
Kumar S. Rao and Mishra 1997 [27] studied the hepatoprotective activity with Sida cordifolia powdered roots, aerial parts and their extracts against carbon tetrachloride, paracetamol and rifampicin induced hepatotoxic rats. It was observed that the powdered aerial and root parts showed a significant hepatoprotective activity against carbon tetrachloride followed by methanolic and aqueous extracts. Silva et al., 2006 [28] demonstrated that the Sida cordifolia leaf extracts had the potential to regenerate the liver cells. Rejitha S et al., 2011 [29] studied the hepatoprotective activity of 50% ethanol extract of the roots of Sida cordifolia L. against alcohol intoxication. Alcohol induced toxicity is mediated through oxidative stress and it can be monitored by detecting lipid peroxidation products. Malondialdehyde, hydroperoxides and conjugated dienes were significantly reduced in liver and protein carbonyls in the serum which was observed in the rats that were administered with ethanolic extracts of Sida cordifolia. The mRNA level of cytochrome P450 2E1, NF-KB, TNF-α and transforming growth factor-β were found to be increased in the alcohol treated rats and their expressions were found to be decreased in the Sida cordifolia extracts treated rats.

**Antalgic activity**
Ranajith kumar suradhar et al., 2006 [30] reported analgesic and anti-inflammatory activities of a new alkaloid [5'- hydroxymethyl- 1'- (1, 2, 3, 9 -tetrahydro - pyrrolo - [2, 1- b] quinazolin -1- yl) - heptan - 1 - one (compound1) isolated from Sida cordifolia was investigated in rats. The analgesic activity of compound1 was determined by acetic acid induced writhing inhibition method and the result showed a significant reduction. The anti-inflammatory activity was studied using carrageenan induced rat paw edema and the alkaloid produced significant (p < 0.01) activity. These results indicated that compound1 possessed analgesic and anti-inflammatory activities.

**Antistress and adaptogenic activity**
Sumanth et al., 2009 [32] demonstrated about the adaptogenic activity in Sida cordifolia Linn. The extracts were prepared and administered orally in rats. Ashwagandha which was in water-soluble powder form was used as reference standard antistress drug. The result showed that Sida cordifolia extracts reduced plasma cortisol level as well as blood glucose.

**Cardiovascular activity**
Medirosset IA et al., 2005 [33] studied the cardiovascular activity of the hydroalcoholic extract of Sida cordifolia at a concentration of (5, 10, 20, 30 and 40 mg/kg) induced hypotension and bradycardia in normotensive non-anaesthetized rats. It could be due to indirect cardiac muscarinic activation and direct activation of endothelial vascular muscarinic receptors by using atropine (2mg/kgl). Asdaqad et al., 2008 [34] studied the effect of hydroalcoholic extract of Sida cordifolia (HESC) on serum lipid profile. It was concluded that administration of HESC at dose of 500 mg/kg has cardio protective potential.

**Anticancer activity**
Malikarjunna G et al., 2013 [36] evaluated the ethanolic extract of Sida cordifolia against Aflatoxin B1 (AFB1-) induced hepatocellular carcinoma (HCC) in winstar rats (250µg/ kg/ dose). The ethanolic extracts of Sida cordifolia was administered at a dose of 250 and 500 mg/kg orally. The results showed a significant restoration of abnormal serum and tissues indicating the protective effect. Takaki et al., 2007 [37] investigated anticancer activity for the plant alkaloid cryptolepine from Sida cordifolia. The results showed that cryptolepine induces growth arrest in MG63 cells through the p53-independent activation mediated through specific Sp1site in promoter region. It indicates the possibility that treatment with cryptolepine can be used as chemotherapy for osteosarcoma.
CONCLUSION

Plants are the most important source for exploring potentially useful structural compounds for developing new therapeutic drugs. *Sida cordifolia* Linn. is a versatile and widely available plant grown in the plains of India, has been used to treat various diseases for more than hundreds of years. The present review reports the various pharmacological potentials which are explored by various researchers. Yet more biological potentials are still unattested. The leaves, aerial parts and roots are used in the traditional system of medicine for various diseases related to the human race.

CONFLICT OF INTERESTS

Declared None.

REFERENCES


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