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REVIEW ARTICLE

A Review on medicinal properties of *Hemidesmus indicus*

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ABSTRACT
All over the world, Ayurveda is attaining better significance and prevalence because of its astonishing medicinal use. Humans have used many remedial plants against several diseases since the origination of civilization due to their medicinal use. According to the WHO survey, more than eighty percent of people depend on ayurvedic medicines for several facets of their initial health care. Hemidesmus indicus R.Br. is being utilized mostly in ayurvedic medicine. Its roots smell like camphor. Medicinally valuable plants are used either singly or in a combination with others. Significant attempts have been made to confirm its effectiveness as a healing perspective through pharmacological inspections followed by a large variety of claims. Several properties like antipyretic, antioxidant, liver and kidney protection, against diarrhea, antimicrobial, anticarcinogenic, etc of Anantamula to have been identified by several in vivo and in vitro pharmacological studies. It has biologically active compounds like hemidesmin 1 and 2, alpha and beta amyrin, lupeol acetate, etc., accountable for several pharmacological properties. This review gives a recent outline of broad details of the phytochemical studies, disease curing capacity, and pharmacological studies of Hemidesmus indicus.
Keywords: Antimicrobial, Anticarcinogenic**,** *Hemidesmus indicus, Pharmacological properties, Phytochemistry*

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INTRODUCTION

Ayurveda is a conventional method of medicine having a large number of properties to generate good health [1]. It focuses on bringing back the patient's physical, mental and emotional stability, by which health can be enhanced and illness can be prevented. Nowadays the usage of herbal therapy is increasing tremendously. Because of its cost-effective production, compatibility to the human and animal body, and lower side effects, requirements have been increased. In developing countries, its demand has increased more than eighty percent. Nevertheless, between 250,000-400,000 species of plant, only six percent are biological potential and about fifteen percent have been studied phytochemically. So it appears to assess the herbs correctly.

GENERAL INFORMATION

Hemidesmus indicus(L.) R. Br. is generally named Sarsaparilla or Ananatamul in the family *Asclepiadaceae*. It is a prostrate semi-erect shrub with a woody rootstock and enormous slender wiry laticiferous branches with purplish-brown bark that is present throughout the year. In India, Sri Lanka, Pakistan, Iran, Bangladesh, and the Moluscos, it grows in a semi-arid, rural environment in the plains up to a height of 600 meters. Commonly found in open scrub jungles, hedges, and uncultivated soils [2]. All parts of it have beneficial properties but leaves, stems, and roots are mainly used therapeutically. It is the most commonly used medicinal plant in Ayurveda, Siddha, and Unani to cure illnesses like diarrhea, chronic fever, burning of the body, leprosy, sexually transmitted diseases, UTI, eczema, psoriasis, etc. Because of its cost-effective production and lower side effects, herbal drug usage was increasing day by day in contrast to other drugs. Ayurveda declares the medicinal capacity of this plant and many pharmacological studies have been done and therefore the recent review scrambles obtainable details in a complete way [3].

Medicinal Usages Stated In Ayurvedic Pharmacopoeia

It can be used in abuse, loss of appetite, diarrhea, cough, itching, asthma, pyrexia, leprosy, and blood diseases [4].

Medicinal Uses as Depicted by Ethnobotanical Studies

*H. indic*es are used as conventional drugs in blood diseases, skin diseases, asthma, eye diseases, diarrhea, fever, sexually transmitted diseases, kidney and liver diseases, leprosy, burning sensation, arthritis, UTI, etc. Its root is commonly known as Nannari in Kathalai of Tamil Nadu. Fruit of some plants, *Calophylluminophyllum, Diospyrosebenum, Terminalia chebula*etc. along with its root powder and honey can encourage semen production. It contains many biologically active compounds, coumarin, hemidesmine, emidine, rutin, etc. It can be used to treat thirty-four types of illness therefore its demand is increasing day by day, the needed amount is 1.2tonnes per annum but it is in small quantities.

Figure 1:*Hemidesmus indicus R. Br.* parts

PLANT PROFILE

- *Hemidesmus indicus R. Br.*
- Another name: *Periplocaindica L.*
- Family: *Asclepiadaceae*
- English : Hemidesmus, Indian sarsaparilla, East Indian sarsaparilla.
- India:Anantamul, Kapuri,
- Hindi- salsa, Magrabu.
- Telugu- Sugandhi- pala, Gadis Gandhi, Muttavapulagamu.
- Tamil- Nannari. Kannada- Karibandha, Sogade.
- Malayalam- Naruninti.

Plant description

- It's a slender, laticiferous, twining, wiry perennial shrub.
- Stem -There are a lot of thin stems with crisped ends.
- Leaves – Five to ten cm long, simple, contrary, differ from elliptic-oblong to linear-lanceolate. It has reticulate veins and is bright green.
- Flowers – Subsessile cymes with opposing axles are greenish-purple.
- Fruits – slender and cylindrical, approximately ten cm tall seeds.
- Seeds are black, six to eight cm tall.
- Roots – cylindrical, irregularly bent, slightly twisted, and aromatic. 1.5-2 cm in diameter, externally dark brown and internally yellowish-brown in color.

Morphological characteristics:

Root

Roots are aromatic, woody, or slender. Used for medicinal purposes.

Stem
Branches and stems twine anticlockwise, elongate, thin, veined, and gangly, with a dark purple or purplish-brown color and a heavily curved appearance at the edges [6].
Leaves
Basal parts of the shoots' leaves are linear to lanceolate.
Flowers
The outer surface, greenish-yellow to greenish-purple, inner surface dull yellow to light purplish, deeply five-lobed calyx, gamopetalous, about twice the calyx, five stamens, inserted near the base of corolla with a thick coronal scale [7].
Fruit
Two straight slender narrowly cylindrical widely divergent follicles, Seeds many, flat, oblong, with a long tuft of white silky hairs [8].
Phytochemistry
Phytochemical components reported from different parts.
Roots
The root also contains hemindicusin, coumarin solenoids, hemidesmin 1 and 2, beta and alpha amyrin, lupeol acetate, beta-sitosterol, hexadecanoic acid, and lupeoloctasonate. Glucose, hemidesmol, hemidesterol, vanillin isomer, resin acid, glucoside, -amyrin triterpene, and benzaldehyde are among the crystalline constituents found in the oil [9].
Stem
Indicine and hemidine are present, as well as pregnane glycoside, hemidescine, and emidine. Demicunine and heminine are pregnaneoligoglycosides. Desinine, Indicusin, Medidesmine, Hemisine, and Demicine are all forms of desinine. Steroid compounds and triterpenoids are also present [10].
Leaves
Contains coumarins, hemidesminine, hemidesmin one and two. Flavonoids, hyperoside, rutin and tannins [11].
Flowers
Contains Flavonoids, Hyperoside, Isoquercetin and Rutin.

ETHNOPHARMACOLOGY
It can be used as tonic, alterative, demulcent, diaphoretic, diuretic, and blood purifier. Also used in nutritional diseases, sexually transmitted diseases, UTI, skin infections, etc. It is used in powdered form or syrup. It can be also used for the preparation of some medicines. It also can be used instead of Sarsaparilla from Smilax spp, as a KI vehicle[12]. The syrup can be used in the manufacturing of sharbat as a flavor.
It has a specific place in Indian medicines. Its root can be used against snake bites or scorpion sting. It encourages our health, chubbiness, fairness and kidney and skin problems, STDs, etc. [13].
In Ayurveda, root (cooling) and stem are used against fever, sweating, increased urine production, and in the treatment of syphilis, skin color loss, liver, brain, and kidney problems, UTI, asthma, etc. [16].
In Unani medicine, root and stem are used to stimulate bowel movement, reducing sweating and diuresis. Used in the treatment of syphilis and skin problems. Roots can reduce joint pain. The stem is best for brain, kidney, and liver problems. Also used in paralysis, asthma, UTI, etc. [16].
From its and Semal, *Bombaxceiba* roots in central India, "Herbal Mala" is made, a good remedy for Marasmus. For blood purification, herbal tea is prepared from its bark. ‘ Conventionally, its root was used as a remedy for hair graying, hepatitis, and eye problems. Intake of fried (in ghee) root powder up to one month can reduce body burning. The mixture of root powder with cows' milk intake can be used as a remedy for renal calculi [17].
Roots are best for the reduction of uric acid deposition and pain in joints, fever, cold, eye and skin problems, and also ringworms. It can be used to encourage our health and also in blood purification. Some STDs can be cured with this. Chronic diseases, stomach problems, cough, asthma, and infertility can be treated. Also, it can purify the urogenital tract. Kidney, liver, and some skin problems can be cured with its root [18].
Tribals in India used its roots as a remedy for gonorrhea, piles bleeding, hepatitis, and dysentery. Root paste is used in scorpion sting in tribals of Rajasthan. Also used as a flavoring agent in many medicines, facial creams, and some other cosmetics [19].
PHYTOCHEMISTRY
Leaves, tissue, and mature plants contain rutin and steroids. It contains essential oils and phytosterols like saponins, hemidesmol, and hemidestrol. In addition to these substances, it also contains

lupeoloctacosanoate, alpha and beta amyrin, lupeol acetate, amyrin acetate, hexatriacontane, coumarins, triterpenoid saponins, starch, and tannic acid. By distillation with water, smilasperic acid is acquired.
Leaves: It possesses 2.5% tannins.
Stem: Demicunine and heminine, 2 novel pregnaneoligoglycosides from CHCl3: EtOH (3:2) soluble extract of dried stems of H. indicus. *Hemidesmus indicus* has been found to contain Desinine, Indicine, Hemidine, Indicusin, Hemidescine, Emidine, Medidesmine, Hemisine, and Demicine.
Flowers: Contains flavonoids, hyperoside, isoquercetin, and rutin but leaves contain only hyperoside and rutin.
Root: Root contains some essential oils and triterpenoids. Alkaloids, tannins, phenols, coumarins, glycosides, and saponins have been contained in root extract (ethanolic). Aqueous extract of its roots has also been found to contain para-methoxy salicylic acid. Sitosterol can also be present in roots. Roots contain 0.6 percent saponins and 3.0 percent tannins, according to quantitative analysis. The bio-active theory of H. indicus has been established as 2-hydroxy 4-methoxy benzoic acid (HMBA), a small molecular weight aromatic compound. The establishment of 2-hydroxy-4-methoxy benzaldehyde and HMBA in its roots was accomplished using reverse-phase HPLC [21].

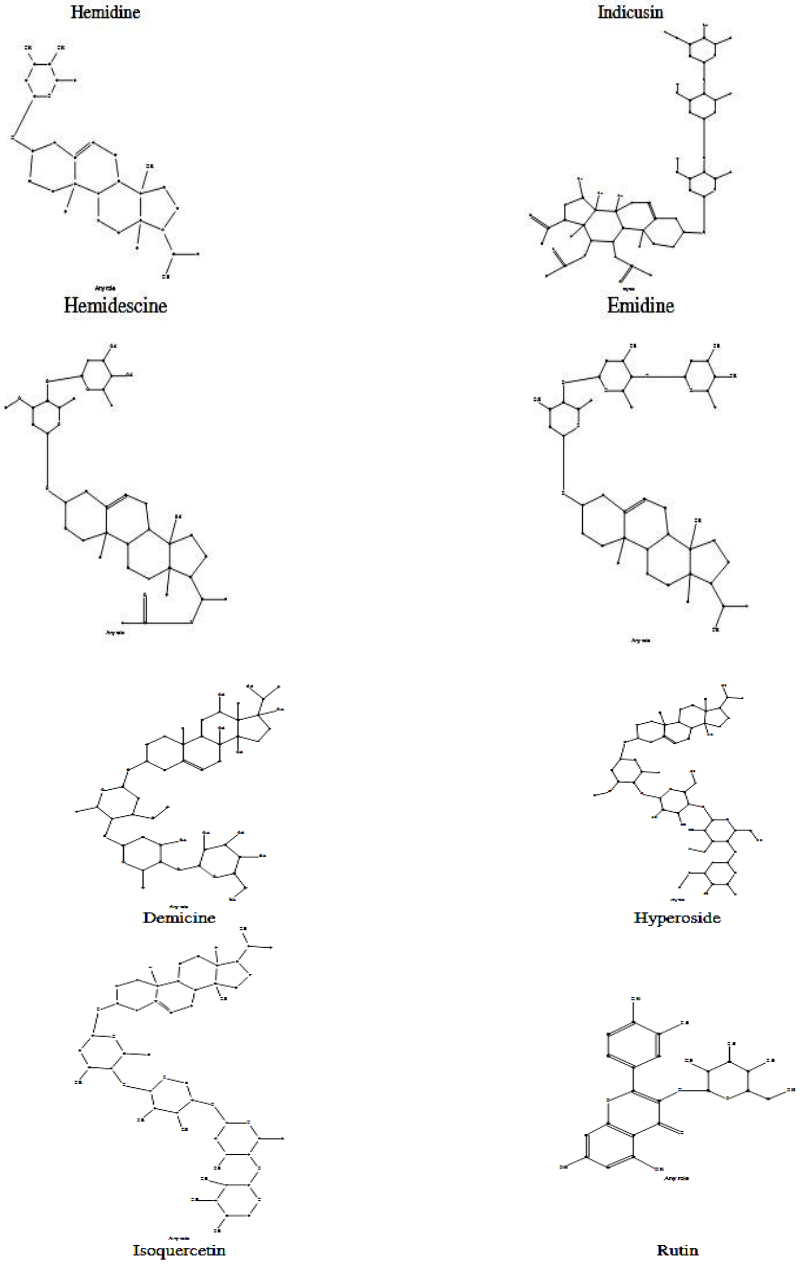

Figure 2: Chemical structures of phytochemicals derived from *H.indicus*

PHARMACOLOGICAL PROPERTY

Antimicrobial property

According to Gayathri and Kannabiran, aqueous root extracts of *Hemidesmus indicus*, as well as barks of F. *bengalensis* and *P. marspium*, have antimicrobial activity against *S. aureus*, *P. aeruginosa*, and K. pneumoniae. For testing the antimicrobial activity, methanolic and ethanolic extract of its root and *Vetiveriazizanioides* (Rath Et al., 2012) were trailed in opposition to five human pathogenic microbes by a well diffusion method. Ethanolic extract possessed a large zone of inhibition in opposition to *E. coli* and *V. cholerae*. Consequently shows notable antibacterial ability [22].

Analgesic activity

Various doses (hundred, two hundred and three hundred mg/kg) of hydroalcoholic extract of *H. indicus* in Swiss albino mice remarkably hinders thrashing action, reducing the defeating action in acetic acid aiding thrashing effect and Eddy's hot plate technique. The highest result was 10 mg of piroxicam per kilogram of body weight (b.w.), i.p., at 300 mg/kg. Hydroalcoholic extracts of 100, 200, and 300 mg/kg b.w significantly reduce the thrashing effect in adult Wistar rats when used in Eddy's hot plate process at 55-56oC. The analgesic effect may be due to the inhibition of algogenic material synthesis or the inhibition of painful message transmission at the central level [23].

Anti Enterobacterial activity

It can hinder the growth of enterobacteria, especially *S. flexneri*. The root of *H. indicus* possesses anti-enterobacterial potential [24].

Anti-acne activity

It was performed out on the terpenoid fraction of *H. indicus* roots. It was assessed against *Propionibacterium acnes* and *Staphylococcus aureus*, and reported to be successful against acne vulgaris. MIC and MBC assessments showed that the extract had an impressive acne effect against the microbes tested [25].

Antioxidant activity

H. indicus root bark has antioxidant activity and has been used for radical scavenging experiments. The extract has the possible antioxidant function, according to tests on models. It has a high scavenging potential for DPPH and superoxide radicals, but just a moderate trapping capability for NO radicals. In an erythrocyte allocation analysis, lipid peroxidation of liver homogenate and red blood cell rupture was also blocked [26].

Natriuretic and Saliuretic activity

The roots of *H. indicus* have been shown in many reports to suppress raised urine output. As compared to furosemide and hydrochlorothiazide (25 mg/kg, p.o, each), a single dose of aqueous and ethanolic extract of *H. indicus* (200 and 400 mg/kg, p.o, each) was much more effective. These were granted to drought-stricken mice orally. The rats in the control group were given normal saline (25ml/kg, p.o.). The urine output of both rats was checked every 5 and 24 hours in metabolic cages where they were housed in pairs. Both extracts markedly elevated urine output at higher concentrations. Although the diuretic effect began progressively (within 5 hours), it persisted throughout the study (up to24 hrs). Furthermore, the diuresis induced by the aqueous extract (400 mg/kg) in 5 hours was nearly equivalent to that induced by furosemide hydrochlorothiazide. *Hemidesmus indicus* aqueous extract Urinary Na+ and K+ levels were also significantly increased by the bar. root [27].

Anti-inflammatory activity

Its roots also possess anti-inflammatory properties. It can be used against viper venom and *Propioni bacterium acne*, by decreasing reactive species of oxygen and inflammatory cytokines interleukin 8 and tumour necrosis factor α (32). Root powder paste can be used to cure swellings, inflammation and acute rheumatism. Root extract (ethanol) also possesses remarkable anti-nociceptive properties in mice and it was analyzed by giving pain through acetic acid (writing test), formalin (Paw licking test), and hot plate test in mice. In a range of 25, 50, 100 mg/kg, it was orally given. Anti-nociception was discovered in all laboratory animals in a dose-dependent manner, and it reduces both neurogenic and inflammatory pain. Root methanolic extracts may have anti-inflammatory and fever-reducing properties in a dose-dependent manner. It prevents transcription factor kappaB (NF-B) from binding to DNA due to its low molecular concentration. The electrophoretic mobility shift method [28] demonstrated this skill.

Anti-ulcerogenic activity

Root ethanolic extract was used to study the anti-ulcerogenic potential ion Wistar strain albino mice. Roots in the time of flowering and vegetation possessed anti-ulcer properties and remarkably decreased the production of gastric and duodenal wounds in mice encouraged by several ulcerogenic methods and cyto damaging negotiators. It also possesses much defensive property by a large amount of prostaglandin

secretion, giving another remedy for the curing of ulcers. It targets intensifying the protective components so that the usual balance between offensive and protective components is realized [29].

Anti hyperlipidemic property

In standard and high-cholesterol rat models, its cell culture extract was tested for several lipid profiles in serum, tissue, and feces. As per the atherogenic diet cell culture, it reduced blood, tissue, and fecal lipid material. Current in vivo studies using an ethanol-induced experimental model of hyperlipidemia reveal that 2-hydroxy 4-methoxy benzoic acid, HMBA, is a bioactive enzyme. HAMBA intake at a dose of 200gkg-1 reduced ethanol levels in mice. In rats, ethanol-induced alterations in these were effectively diminished in plasma and hepatic levels. This was caused by excessive lipoprotein lipase [30].

Hepatoprotective activity

H. indicus extract (ethanol) was discovered to suppress ethanol-induced liver toxicity in mice. It was discovered that a five hundred mg/kg dose of the extract given for thirty days decreased the elevated serum levels of ASP, ALT, ALP, and LDH projects. *H. indicus* extract (ethanol) was explored to eliminate ethanol-enhanced liver toxicity in mice. A five hundred mg/kg dose of the extract given for thirty days was noticed to lower raised serum levels of ASP, ALT, ALP, and LDH ventures. The treatment was also shown to affect globulin, albumin, and ceruloplasmin, in addition to the liver glycogen level. This shielding venture corresponded to the histochemical variation found in the liver. Increased glutathione levels, lowered oxidized glutathione, and glutathione S-transferase all confirmed that the extract improved "reduction in the reduction potential" due to ethanol-induced hepatic wound. Ingested reductones may have a "host red-ox sparing effect," according to the findings. The extract from this plant can guard against rifampicin-induced liver toxicity. The liver of mice was secured against DEN-aided expression of the GST-P, by extract made from *Nigella sativa* seeds, *H. indicus* roots, and *Smilax glabra* rhizome. In ethanol-fed mice, ethanolic root extract and HMBA inhibited liver fibrotic markers and features such as collagen level, matrix metalloproteinases, MMPs two and nine [31].

Anti-carcinogenic activity

A family of Sri Lankan traditional medicine experts recommends extracts of *Nigella sativa* seeds, *Hemidesmus indicus* root bark, and *Smilax glabra* rhizome for cancer patients. It can protect the liver from carcinogenic tumors. Long-term treatment of mice with the extract for up to sixteen months has been shown to inhibit not only diethylnitrosamine- enhanced glutathione S- transferase activity, but also the carcinogenic assisted evolution of over tumors, OT and histopathological variations causing tumor growth, HT as determined by both visual and microscopic observations of liver parts stained with H and E, Sweet's silver, and PAS staining for glycogen. A substantial reduction in blood vessel production was observed in mice treated with DEN and extract. The ability of these natural products to minimize inflammation or vascular permeability, as well as the development of harmful substances related to their anti-angiogenesis activity. Anti-inflammatory, antioxidant, and immunomodulatory effects are also present. Potential substances extracted from *N. Sativa* seeds and *H. indicus* root extract have been found to prevent tumor growth in the skin of mice in recent in-vivo studies. *H.indicus* roots were extracted using a cold extraction method with 80% ethanol: water and cytotoxicity were determined using brine shrimp lethality, sea urchin eggs, hemolysis, and the MTT technique with cancer cell lines. *H.indicus* extract has been shown in studies to have no cytotoxic effect [32]. It has immune system altering properties in human peripheral blood lymphocytes in vitro, and the potential is linked to IgG secretion, and adenosine deaminase activity, according to the researchers. The cytotoxicity of a chloroform fraction of root extract having sterols and fatty acids was increased in the Int 407 cell line, and it was effective at disseminating *Salmonella typhimurium* by inhibiting its cytotoxicity in an intestinal epithelial cell line.

Antithrombotic property

Root extract (methanolic) of *Hemidesmus indicus* inhibits platelet aggregation. The plasma recalcification period is slowed by intravenous intake. Metabolic destruction of lipids occurs by the extract of raised liberation and activation of enzymes. Platelet aggregation inhibition, slowing plasma recalcification time in rabbits, and encouraging lipoprotein lipase venture were all observed in the antiatherogenic effect of Caps HT2 with Hemidesmus indicus as as one of the additives [33].

Anti nociceptive activity

In mice, oral intake of *H. indicus* extract inhibited both neurogenic and inflammatory discomfort and had painkiller antinociceptive activity in all laboratory mice models for antinociception.

Wound curing property

Leaves extract (alcoholic, five and ten percent ointment) expanded rate of injury contraction and migration and healing time in mice. In thirty patients having a chronic injury, TA clinical study was done and they were held on observation. Based on wound migration and healing on perfect cure, it was noticed

that its root extract was put in the form of paste to wounds possessed by the healing property. In Wistar mice, five percent root methanolic extract possessed noticeable wound healing properties [34].

Renoprotective activity

Various dose levels (root ethanolic extract) of two hundred and fifty and five hundred mg/kg possessed dose-dependent minimization in the raised blood urea, serum creatinine, and raise in the glutathione and glutathione-s-transferase level in Cisplatin-induced renal injury in mice. Cisplatin-induced lipid peroxidation was also hindered by the extract. The results demonstrate that the roots' alcoholic extract has powerful kidney shielding properties. Potential of *H. indicus* root extract tested against gentamicin-induced liver toxicity in Wistar albino rats at five gm/kg single dose, p.o.for six days of treatment reduced renal impairment induced by gentamicin in rats [35].

Antivenom property

Death, bleeding, defibrinogenation, swelling, and PLA2 behavior generated by Daboiarusselii venom were effectively nullified by lupeol acetate. It also prohibited laboratory animals dying from *Najakaouthia* venom-enhanced heart, nerve, and respiratory abnormalities. For the first time, the methanol root extract was evaluated for inactivation of snake venom (*Viperarussellii*) action in albino rats and mice, and the extract greatly diminished viper venom-induced lethality and hemorrhagic property [36].

Anti-arthritic activity

The anti-arthritic behavior of the hydroalcoholic extract and ethyl acetate fraction of *H. indicus* was massively greater than the chloroform and residual fractions. Both of these fractions had an anti-arthritis impact corresponding to methotrexate, according to histopathological study. The anti-arthritic function of H. indicus root extract is preferable to that of the standard drug diclofenac sodium, according to an in vitro assay using the prevention of protein denaturation process. The existence of flavonoids, phenols, polyphenols, and steroids can clarify the anti-arthritic properties [37].

Anti-ulcer activity

At concentrations of two hundred and four hundred mg/kg, the alcoholic root extract possessed a substantial lowering in ulcer index. In Wistar rats, the root extract at 200mg/kg showed a 73.59 percent ulcer shielding effect and four hundred mg/kg possessed 76.82 percent ulcer protection, while omeprazole 20mg/kg showed 78.91 percent ulcer protection after oral administration of indomethacin 20mg/kg induced a gastric ulcer. Significant antiulcer properties of ethanolic extract of *Hemidesmus indicus* root could be either due to cytoprotective action of the drug or by strengthening of gastric mucosa and thus enhancing mucosal defense[38]. The combined ethanolic extracts of H. indicus and Ficusreligiosa orally ingested in albino rats at doses of hundred, two hundred, four hundred, and eight hundred mg/kg body weight displayed great anti-ulcer action in the pylorus ligation model, but the less notable trend in the aspirin-induced ulcer model [39].

Larvicidal activity

Aqueous extracts of *Hemidesmus indicus* roots showed significant larvicidal activity against Culexquinquefasciatus larvae at concentrations of 1,2,3,4 and 5% up to three days. The aqueous extract had a larvicidal effect on Culexquinquefasciatus mosquito larvae, which were responsible for the transfer of Wuchereriabancrofti-caused lymphatic filariasis. On the 2ndday, the samples exhibited a hundred percent mortality at a concentration of five percent [40].

Anticonvulsant activity

By using the standard drug phenobarbitone, ethanolic root extract at various doses, hundred and two hundred mg/kg dramatically decreased the duration of tonic extensor phase and postictal depression in the Maximal ElectroShock method, as well as the duration of clonus in the pentylenetetrazol method in adult albino rats. As a result, the ethanolic extract has antiepileptic features. In rats, 100, 300, and 500 mg/kg b.w. of aqueous root extract significantly reduced the time spent in the hind limb extensor process (MES method) and the onset of convulsions (INH [41].

Antipsychotic activity

An aqueous extract of *Hemidesmus indicus* roots reconstituted in two percent aqueous tragacanth was given orally at doses of hundred, three hundred, and five hundred mg/kg. The measurements were taken after oral dose administration of the extract in a single dose study, while in a multiple-dose study, the animals were provided an adequate oral dose of the extract every day for thirty days and the measurements were validated on the fifteenth and thirty days [42]. Apomorphine-induced Stereotyped attitude and Haloperidol-induced catalepsy designs were used to monitor antipsychotic function. The extract reduced dramatically the stereotyped attitude triggered by apomorphine in rats and potentiated the catalepsy triggered by haloperidol, illustrating antipsychotic property in rats.

Nootropic effect

In both acute and chronic tests in mice, ethanolic extract of *H. indicus* strengthened tolerance index and reaction time in object recognition tests, potentiated haloperidol-induced catalepsy, and raised the extent of onset of death in sodium nitrite-induced respiratory arrest. In mice, the n-butanol fraction of ethanolic root extract of *H. indicus* boosted literacy skills and memory. As a result, the root extract has been said to be an effective memory restorer [43].

Antigenotoxic effect

The aqueous extract of H. indicus roots exhibited significant antigenotoxic function against a cisplatin-enhanced cytogenetic problem when ingested in a split dose regime (ten, twenty, and forty mg/kg body weight per day) for five consecutive days by orally administered in Swiss albino mice, and the extract guarded the bone marrow cells in an opposite dose-dependent way [44,45].

Antidiarrhoeal activity

In rats, an aqueous and ethanolic extract of *H. indicus* roots declined faecal droppings, intestinal transit, and intestinal fluid leakage, lowering the diarrheal impact. At 200 mg/kg b.w., the ethanolic extract improved faecal score by 75.5 percent, intestinal fall by 51.2 percent, and intestinal fluid leakage by 56.6 percent [46,47].*H. indicus* root powder or water extract may be applied to oral rehydration salt solution to boost anti-diarrheal potential by raising water, sodium, and potassium ions, not glucose absorption from the sac, whereas intestinal absorption was unchanged. In albino rats, a methanolic root extract exhibited excellent antidiarrheal function. Aqueous root extract was seen to influence water absorption, as well as sodium, and potassium ions, from the jejunum[48].

CONCLUSION

The plants have long been used in the cure for a variety of ailments. Roots would be used in a range of herbal options on the market. Although *H. indicus'* phytochemistry and pharmacology have been extensively studied, there have been few findings on the toxicology of extracts of plant parts in various solvents. Proofs from the above findings tell that the plant exhibits pain, inflammation, fever, and arthritis reducing, liver and kidney shielding, against venom, acne, psychotic, diarrhea, mutagens, ulcer, etc and also wound curing, antimicrobial and anticancer properties. To describe the innovative medicinal benefits of the plant, as well as to detect and differentiate the specific compound required for the specific behavior, serious efforts for high-quality studies are needed. Moreover, pharmacokinetics and bioavailability analyses of this plant are deemed necessary to completely comprehend the mechanisms of action of potential biological activities for future drug production [49, 50].

REFERENCES

1. Siddique NA, Bari MA, Badruzzaman ATM, Khatun N, Rahman MH, Sultana RS, Matin MN, Shahnewaz S, Rahman MM. (2004). Collection of indigenous knowledge and identification of endangered medicinal plants by questionnaire survey in Barind Tract of Bangladesh. J. Biol. Sci. 4: 72-80.3.
2. Anonymous. (2005). Quality standards of Indian Medicinal Plants, ICMR, New Delhi; 2005. 2:119-128.4.
3. Nayer TS, Beegam AR, Mohanan N, Rajkumar G. (2006). In; Flowering plants of Kerala, A Handbook/ Tropical Botanical Garden and Research Institute. Thiruvananthapuram, Kerala, India; p.89-90
4. Nayer TS, Beegam AR, Mohanan N, Rajkumar G. (2006). In; Flowering plants of Kerala, A Handbook/ Tropical Botanical Garden and Research Institute. Thiruvananthapuram, Kerala, India.p.89-905.
5. Sethi A, Srivastav SS, Srivastav S. (2006). Pregnane glycoside from *Hemidesmus indicus*.Indian J Heterocycl Chem. ; 16:191-192.6.
6. Austin A.(2008). A review on Indian Sarsaparilla, *Hemidesmus indicus* (L.) R. Br. J Biol Sci. 8(1):1-12.
7. Magaji MG, Anuka JA, Abdu-Aguye I, Yaro AH, Hussaini IM. (2008). J. Med. Plants Res. 2(2): 39-44. 9.
8. Farook SM, Atlee Kannan S, Kumar S, Davey MS. (2011b). Assessment of Analgesic, Anti-pyretic and Anti-inflammatory activity of Hydro-alcoholic fraction of *Hemidesmus indicus* root in experimental animals. Scholars Research Library. Der Pharmacia Lettre. 3(1):442-447.10.
9. Lakshman K, Shivaprasad HN, Jaiprakash B, Mohan S. (2006a). Anti-inflammatory and antipyretic activities of *Hemidesmus indicus* root extract. African Journal of Traditional Complementary and Alternative Medicine. ;3(1):90 –94.
10. Aiyer K.N (1951). Pharmacognosy of Ayurvedic Drugs of Travancore, Cochin. Central Research Institute, Trivandrum. 4: 145-150.
11. Alam M.I and Gomes A. (1998). Adjuvant effects and antiserum action potentiation by a herbal compound 2-hydroxy-4-methoxy benzoic acid isolated and purified from the root extract of the Indian medicinal plant "Sarsaparilla." Toxicon.36: 1423-1431.
12. Alam M.I and Gomes A. (1998). Viper venom-induced inflammation and inhibition of free radical formation by pure compound (2-hydroxy-4-methoxy benzoic acid) isolated and purified from anantamul (*Hemidesmus indicus* R. Br.)root extract. Toxicon. 36(1):207-215.

13. Bahati J.R, Goyal R.K and Shah G.B. (2006). Hepatoprotective activity of Hemidismus indicusR.Br. in rats. Indian Journal of Experimental Biology. 44: 399-402.
14. Chatterjee Ipshita, Chakravarty A.K, and Gomes A. (2006). Daboiarussellii and Najakaouthia venom neutralization by lupeol acetate isolated from the root extract of Indian sarsaparilla Hemidesmus indicusR.Br. Journal of Ethnopharmacology. 106: 38–43.
15. Chatterjee R.C and Bhattacharya B.K. (1955). A note on the isolation of β-sitoserol from Hemidesmusindicus. Journal of the Indian chemical society, 32: 485.
16. Daniel S, Fabricant and Norman R. Farnsworth. (2008). The Value of Plants Used in Traditional Medicine for Drug Discovery. Program for Collaborative Research in the Pharmaceutical Sciences, 123-130.
17. Das Sarita and NiranjaliDevaraj S. (2006). Antienterobacterial activity of *Hemidesmus indicus* R. Br. root extracts. Phytotherapy Research, 20(5): 416-421.
18. Ananthi R, Chandra N, Santhiya ST. (2010). Protective effects of *Hemidesmus indicus* R.Br. root extract against cisplatin-induced cytogenetic damage in mouse bone marrow cells. Genetics and Molecular Biology. 33(1):182-185.
19. Anonymous, (1989). The Ayurvedic Pharmacopoeia of India. 1st Edn., Ministry of Health and Family Welfare, Department of Health, Govt. of India, New Delhi, pp: 107-108.
20. Anonymous, (2005). Quality Standards of Indian Medicinal Plants. Vol. 2. Indian Council of Medical Research, New Delhi, pp: 119-128.
21. Anoop, A and M. Jegadeesan, (2003). Biochemical studies on the anti-ulcerogenic potential of *Hemidesmus indicus* R.Br. var. *indicus*. J. Ethnopharmacol., 84: 149-156.
22. Bopanna, K.N., N. Bhagyalakshmi, S.P. Rathod, R. Balaraman and J. Kannan, (1997). Cell culture-derived *Hemidesmus indicus* in the prevention of hypercholesterolemia in normal and hyperlipidaemic rats. Ind. J. Pharmacol., 29: 105-109.
23. Ch. Mohan, S. Shridhar, B. Mohan, SB. Krishnaveni and Karnakar Reddy. (2015).Antibacterial activity and Phytochemical Screening Of *Hemidesmus indicus* L.B. BR. International Journal Oo Pure and Applied Bioscience. .3(2):221-225.
24. Dutta, M.K., T.K. Sen and S. Sikdar, (1982). Some preliminary observation on the antiinflammatory properties of *Hemidesmus indicus* in rats. Ind. J. Pharmacol., 14: 78-78.
25. Evans, D.A., S. Rajasekharan and A. Subramoniam, (2004). Enhancement in the absorption of water and electrolytes from rat intestine by *Hemidesmus indicus* R. Br. root (water extract). Phytother. Res., 18: 511-515.
26. Gupta, P.N., (1981). Antileprotic action of an extract from Anantamul. (*Hemidesmus indicus* R. Br.), Lepr. India, 53: 354-359.
27. Hartwell, J.L., (1967). Plants used against cancer survey. Lloydia, 30: 379-436.
28. Joshi, C.G. and N.G. Nagar, 1952. Antibiotic activity of some Indian medicinal plants. J. Sci. Ind. Res., 2: 261-263.
29. Lalla, J.K., S.Y. Nandedkar, M.H. Paranjape and N.B. Talreja, (2001). Clinical trials of ayurvedic formulations in the treatment of acne vulgaris. J. Ethnopharmacol., 78: 99-102.
30. Mandal, S., P.C. Das, P.C. Joshi, A. Das and A. Chatterjee, (1991). Hemidesminin, A new coumarino-Lignoid from *Hemidesmus indicus* R. Br. Ind. J. Chem., 30: 2094-2094.
31. Mohammed Moideen, M, Verghese, R Krishna Kumar, E Dhanapal, CK(2011). Res J Pharm BiolChem Sci. 2(3), 643-651.
32. Nayar, T.S., A.R. Beegam, N. Mohanan and G. Rajkumar, (2006). Flowering Plants of Kerala, A Handbook. Tropical Botanic Garden and Research Institute, Thiruvanathapuram, Kerala, India.
33. Prabakan, M., R. Anandan and T. Devaki, (2000). Protective effect of *Hemidesmus indicus* against Rifampicin and Isoniazid-induced hepatotoxicity in rats. Fitoterapia, 71: 55-59.
34. Rao, G.M., M. Venkateswararao, A.K.S. Rawat, P. Pushpangadan and A. Shirwaikar, (2005). Antioxidant and antihepatotoxic activities of *Hemidesmus indicus* R. Br. ActaPharmaceut., 47: 107-113.
35. Ratha, M, Subah. K, Senthilkumar. G And Paneerselvam. A. (2012). Screening Of Phytochemical And Antibacterial activity of *Hemidesmusindicus*;Europian Journal of Experimental Biology (L.) And Vetiveriazizanoids (L.); 2(2):363-368.
36. Ravishankara, M.N., N. Shrivastava, H. Padh and M. Rajani, (2002). Evaluation of antioxidant properties of root bark of *Hemidesmus indicus* R. Br. (*Anantmul*). Phytomedicine, 9: 153-160.
37. Shetty, T.K., J.G. Satav and C.K. Nair, (2005). Radiation protection of DNA and membrane *in vitro* by extract of *Hemidesmusindicus*. Phytother Res., 19: 387-390
38. Siddique, N.A., M.A. Bari, A.T.M. Naderuzzaman, N. Khatun and M.H. Rahman, (2004). Collection of indigenous knowledge and identification of endangered medicinal plants by questionnaire survey in Barind Tract of Bangladesh. J. Biological Sci., 4: 72-80.
39. Subramaniam, S Abarna, A Thamizhiniyan, T (2012). Int J Pharm Sci Res. 2012, 3(1), 227-234.
40. Sultana, S., N. Khan, S. Sharma and A. Alam, (2003). Modulation of biochemical parameters by *Hemidesmus indicus* in cumenehydroperoxide-induced murine skin: Possible role in protection against free radicals-induced cutaneous oxidative stress and tumor promotion. J. Ethnopharmacol., 85: 33-41.
41. Tabassum, Das Saumaya And MazumderAvijit. (2015). Ethanobotnical Review of *Hemidesmus indicus* R.BR. International Journal Of Current Research. 7(12):24251-24256
42. Vijaylakshmi K Shyamala, R Thirumurugan, V Sethuruman, M Rajan, S, Badami, S Mukherjee, PK. (2010). Ancient Science of Life. 29(4), 35-40.

43. Weissner Wendy. (2014). Anantmul (*Hemidesmus indicus*): A Review Of Biomedical Studies And U.S. Products; Ayurveda Journal Of Health. (2014).7(4).
44. Lakshmi T, Rajendran R. (2013). *Hemidesmus indicus* commonly known as Indian Sarasaparilla-An Update. Int J Pharm Bio Sci. 4(4): 397 -404).
45. Mookan P, Rangasamy A, Thiruvengadam D.(2000). Protective effect of *Hemidesmus indicus* against rifampicin and isoniazid-induced hepatotoxicity in rats. Fitoterapia. 71:55-59.27
46. .Mohana Rao GM, Venkateswararao CH, Rawat AKS, Pushpangadan P, Shirwaikar A.(2005b). Antioxidant and Antihepatotoxic activities of *Hemidesmus indicus* R. Br. ActaPharmaceuticaTurcica. 47:107–113.28.
47. Baheti JR, Goyal RK, Shah GB. (2006). Hepatoprotective activity of *Hemidesmus indicus* R. br. in rats. Indian J. Exp. Biol. 44(5):399-402.
48. Ratha M, Subha K, Senthilkumar G, Panneerselvam A. (2012). Screening of phytochemical and antibacterial activity of *Hemidesmus indicus* (L.) and *Vetiveria zizanoides*(L.) Euro. J. Exp. Bio. 2 (2):363-36832.
49. Hiremath SP, Rudresh K, Badami S. (1997). Antimicrobial activity of various extracts of Strigasulphurea and *Hemidesmus indicus*. Indian J. Pharm. Sci. 59(3):145-147.