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EXPLORATION OF INDIAN SARSAPARILLA *HEMIDESMUS INDICUS* (L.)

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ABSTRACT: From the primordial times' plants are standard as a chief resource for mankind. In the traditional system of medicine, Indian sarsaparilla *Hemidesmus indicus* (Family Asclepiadaceae) is a commonly well-known medicinal plant. This plant contains various phytoconstituents belonging to flavonoids, tannins, glycoside, sterols, and volatile oil. In the traditional system, the plant Hemidesmus indicus is used for loss of voice, cough, menstrual disorders, asthma, abdominal swelling, fever, skin diseases, ulceration due to syphilis and anthelmintic, *etc*. **Aim and Objective:** In this review article, we aim to represent an exhaustive update on the ethnobotanical review, phytoconstituents review, pharmacological review, toxicity study, and marketed formula. **Materials and Method:** Widely used international databases such s PubMed, Scopus, Google search, and JSTOR were searched, and various books like the flora of Orissa, Pharmacology of medicinal plant and natural product, the Indian meteria medica *etc*. were also searched. **Result:** *Hemidesmus indicus* played an important role in traditional Indian medicine. The important pharmacological uses of *H. indicus* are Anti-inflammatory, Anti-leprotic, Anti-oxidant, Anti-arthitic, Anti-microbial, Anti-diarroheal, woud healing, Anti-carcinogenic, Hypoglycemic activity. This review also represents a list of Ayurvedic marketed formulas where *H. indicus* an active ingredient. **Conclusion:** The studies represent an updated review on traditional, pharmacological, phytochemical feature on *H. indicus* with toxicity knowledge. The crude extract of *H. indicus* displays an array of pharmacological activities. Further, it also protects radiation including DNA damage. This plant is not widely utilized. Hence, this review was committed to exploring the hidden potential and many uses in the direction of mankind.

INTRODUCTION: From ancient times, humans can find so many drugs from plants, animals and mineral sources to treat various diseases and ailments, but it was not known which constituent was responsible for the medicinal activity. Probably all life forms are affected by the disease. The disease has been the basic problem faced by humans too since prehistoric times. Along with the diseases, Nature has created its cure in the form of vegetables, minerals and animals [1].

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The relationship between man and plants has been close enough throughout the development of human culture. In understanding human diseases, there has been continued interest in the drugs from the plant kingdom [2]. Evidence for the existence of a well-organized system of medicine in India can be traced back to the archaeological remains of

Harappa and Mohenjo-Daro, from where even Silajit has been reported. Ayurveda is the oldest Indian indigenous medicine system, probably with its roots in the Indus Civilization. In the Vedic period, the Osadhisukta of the Rigveda is the oldest documented knowledge about plants and herbal medicines [3]. The indigenous knowledge about plants and plant products is rather detailed and sophisticated. It has evolved into a separate shastra (branch of learning) called Dravya-Guna Vijnyan Shashtra. The codified traditions have about 25,000 plant drug formulations from such studies. In addition to this, over 50,000 formulations are believed to be existing in the folk and tribal traditions. These points to the deep passion for an exhaustive knowledge of medicinal plants. That has existed in the land from time immemorial. The Vedas, epic poems contain rich material on the Herbal role of that time [4].

The Indian System of Medicine (ISM): This is a traditional system of medicine that encompasses three systems, namely Ayurveda, Siddha and Unani, practiced by Vaidyas, Siddhas and Hakkims, respectively. The medicines (or) formulations that come under Ayurveda, Siddha, and Unani treatment system are called the Indian System of Medicines. The Drug and Cosmetic Act defines the ISM as "Ayurvedic, Siddha and Unani drug includes all medicines, intended for internal or external use in the diagnosis, treatment, mitigation or prevention of diseases or disorder in human beings or animals [5].

Modern Drugs from Ayurveda: Ayurveda, the traditional Indian system of medicine, is as old as the Indian culture and civilization. The earliest-recorded knowledge about Ayurveda is found in the Rigveda and the Atharvaveda, both of the second millennium BC. The Atreya Samhita is perhaps the oldest medical book globally; it survives from Takshashila University, going back to the mid-I Millennium BC. The Atharvaveda lists eight divisions of Ayurveda: internal medicine, surgery of head and neck, ophthalmology, surgery, toxicology, psychiatry, pediatrics, gerontology or the science of rejuvenation, and the science of fertility. At about 500 BC at the University of Banaras, Sushruta, a surgeon, who developed the operative techniques of rhinoplasty (plastic surgery), wrote the Sushruta Samhita, which describes a highly developed surgery. The physician Charaka revised and supplemented the Atreya Samhita; in his book, the Charaka Samhita is a vast work on internal medicine. More than 600 animal, plant, and mineral origins drugs are used in the Charaka and about 650 in the Sushruta Samhita [6].

Indian Ayurvedic system certainly has given birth to number of important and modern drugs, viz. ajmalicine, reserpine, leurocristine, L-dopa, cardiac glycosides, sennosides *etc* [6]. The importance of plants as a source of useful antihypertensive drugs was supported by the isolation of reserpine from Rauwolfia serpentina by Muller *et al* in 1952. Veratrum alkaloids were other antihypertensive agents from plant sources [7]. Many medicinal plants have been reported to have anti-inflammatory activity; notable among these are *Mesua ferrea*, *Azadirachta indica*, *Glycyrrhiza glabra*, *Cyperus rotandus*, and *Curcuma longa* [8].

Herbal Drugs-Current Scenario: Use of herbal medicines is widely spread in developing and developed countries. The use of plant-based health products was also increased in other European countries. Export-Import Bank reports reveal that the global trade of plant-derived and plant-originated products is around US $60 billion (with a growth of 7% per annum). India holds a stake of US $1 billion, which is expected to reach 3 trillion US$ by the end of 2015.

World Health Organization (WHO) has attempted to identify all medicinal plants used globally and listed more than 20,000 species. NAPRALERT database documents ethnomedicinal uses alone for 9,200 of 33,000 species of monocots, dicots, gymnosperms, pteridophytes, bryophytes, and lichens, suggesting that 28% of plants on earth have been used ethnomedicinally. India is also considered one of the potential exporting countries of medicinal plants. India has 2.4% of world's area with 8% of global biodiversity. It is one of the 12 mega-diversity hot-spot regions of the world, the other countries being Brazil, Colombia, China, South Africa, Mexico, Venezuela, Indonesia, Ecuador, Peru, USA, and Bolivia. Only about 10% of the known medicinal plants of India are restricted to non-forest habitats. According to a report, one-fifth of all the plants found in India are

used for medicinal purposes. Graph 1 shows the estimated domestic demand of India's top 20 medicinal plants [9]. A systemic literature survey is the main basis for planning any scientific work. Due to the same reasons, a literature review regarding the *Hemidesmus indicus* has been done.

2.1 Plant Review:

Hemidesmus indicus

Botanical name: *Hemidesmus indicus* Linn.

Family: Asclepiadaceae

2.1.1 VERNACULAR NAMES [10-11]

Odia	Onontamula, Thapa, Sugandhi
Hindi	Anantamula, Magrabu
Sanskrit	Anantamula, Naga-jihva, sariva, gopimula.
Bengali	Anantamula
Telgu	Gadisugandhi, Muttarapulagamu,
Tamil	Sugandhi-pala, Alasugondhi
Urdu	Nannari, Saribam
English	Aushbah
Sambalpuri	Indian sarsaparilla.
Gujrati	Bas-Khapri
Marathi	Durivel, Uplasari, Sariva
Malayalam	Anantamula, Uplasari
	Narunari

2.1.2 Synonyms [12]: *Periploca indica.*

2.1.3 SYSTEMATIC CLASSIFICATION [13]:

Kingdom	Plantae
(unranked)	Angiosperms
(unranked)	Eudicots
(unranked)	Asterids
Order	Gentianales
Family	Apocynaceae
Subfamily	Asclepiadaceae
Genus	Hemidesmus
Species	Indicus

2.1.4 Habitat [12, 14, 15]: This climbing twiner plant is found throughout India, common in Bengal, Bombay presidency, and extending to Travancore and Ceylon. West Bengal, including the Sundarbans, Bihar, Uttar Pradesh, Madhya Pradesh, South India; Bangladesh & Sri Lanka. Common in hedges and waste places in the plains and coast and in hills up to 1200 m. wild.

2.1.5 Morphology [12, 15, 16]:

Leaf: Leaves are opposite, short-petioles, very variable, elliptic-oblong to linear-lanceolate (1-4 in x 0.3-1.5 in.), often variegated with white above, sometimes silvery-white and pubescent beneath.

Stem: There are elongated and cylindrical.

Root: Roots are woody, aromatic, cylindrical, 0.2-0.7 inch or more thickness, somewhat tortuous, seldom branched, brownish or purplish, with a short fracture at the periphery and fibrous at the center. The surface of the young root is generally smooth, but in older roots, the surface is transversely cracked and longitudinally fissured. Bark has no characteristic taste or odor and is easily separable from the inner tissue surrounding the central wood. In fresh condition, the inner cortical tissue is merely white in color, but on exposure, it becomes dark brown; it has a characteristic fragrance and aromatic sweetish taste.

Flower: Flowers are greenish outside, purplish inside, crowed in subsessile, axillary cymus, clothed with numerous ovate, acute imbricating bracts. Calyx is 2.5 mm long, glabrous outside, lobes 1.5 mm long, ovate, acute, and has numerous ciliolate margins. Corolla 5-6 mm long, greenish outside, purple inside; tubes very short; lobes velvet, fleshy 4 mm long, ovate-oblong, acuminate. Follicles 10-15 cm by 6 mm, cylindrical, tapering to a point at the apex, straight or sometimes slightly curved striate, glabrous.

2.2 Ethno-Botanical Review: Decoction of leaves of Saarivaa, *i.e.,* white variety of *H. indicus* was prescribed by Charakains to allow complexion, loss of voice, cough, menstrual disorders, and dysentery, whereas the entire plant is prescribed for treating asthma, cough, abdominal swelling, and aching limbs. Krishna Saarivaa, *i.e.,* black variety, has been indicated by Sushruta in respiratory infection and was tingdiseases [17].

Conventionally therapeutic ghee comprising *Hemidesmus indicus* accompanied by a few other plants is used in chronic fever, asthma, cough, hiccup, headache, burning of body, and vitiation of digestive fire [18]. The roots of *H. indicus* R. Br. are bitter, astringent, aromatic, refrigerant, anthelmintic, and tonic. They were also useful in burning sensation, leprosy, epileptic fits, diarrhea, and arthralgia. The leaves are useful in vomiting, wounds, and leucoderma. The steams are bitter, laxative, and useful in inflammations, hepatopathy, nephropathy, and blood purifier. The plant is also

used as anthelmintic, emollient, leprosy, skin diseases, general debility, expectorant, tonic, and demulcent. Latex is good for conjunctivitis. Syrup prepared from the root of H. indicus was made official in the British Pharmacopoeia (BP) of 1864 and included in Indian Pharmacopoeia. This syrup is prescribed for dyspepsia, loss of appetite, fever, skin diseases, and ulceration due to syphilis, chronic rheumatism, and leucorrhoea in the Ayurvedic system. It also has demulcent and diuretic properties. Infusion of root powder is used as a blood purifier and possesses sudorific properties. This infusion and milk and sugar are used in children as tonic in cases of chronic cough and diarhhoea. Parts of Anantmul, roots of Bala (Pavoniaodorata), tubers of mustaka (Cyperusrotundus), ginger and kutki root (Picrorhizakurroa) are prescribed by Ayurvedic experts to clear bowels and relieve fever. The stems are bitter, laxative, and useful in inflammations, hepatopathy, nephropathy and blood purifier. The roots are astringent, aromatic, refrigerant, anthelmintic, and tonic and useful in burning sensation, leprosy, epileptic fits, diarhhoea and arthralgia. Roots are also used in various diseases and disorder by different tribes.

Birhore: In venereal diseases.

Munda: In reddish urine.

Santal: In impotency, postnatal complaints, skin diseases, spermatorrhoea, toothache, galactagogue,

Oraon: As a cooling agent and tonic in debility, laziness, and nervous disorder.

Orissa (Mayurvhanj): In diarrhea, stomachache.

Asur: In urinary complaints [12]. Ayurvedic outdated grips that the roots of the *Hemidesmus indicus* plant will convey the user to profound states of sleep and through the four gates of dreaming, as written about by Carlos Castaneda, the art of dreaming. It is used to help the experienced conscious dreamer achieve lucidity during the dream or REM phase of sleep. The ayurvedic doctor also gave it to men suffering from low libido and sexual importance; it is supposed that one of the active compounds shaped by the roots expands male testosterone levels and so sexual desire, sperm count and overall sexual performance.

It is also used as Alterant, Anthelmintic, Aphrodisiac, Carminative, Demulcent, Expectorant, Gout, Epilepsy and Diarhhoea.

2.3 Pharmacological Review:

2.3.1 Anti-arthritic Activity: Plant root has self-justifying activity against arthritis. The action might be credited to the presence of trepans, sterols, and phenolic mixtures in hydroalcoholic root extract and ethyl acetate fraction [19]. Anti-cancerous action Methanolic root extract of *H. indicus* has remarkable anticancer potentials against MCF7 Brest cancer cell line, cytotoxic effect against HT29 colon cancer cell line and Ehrlich Ascites Tumor too [19-21]. Moreover, it significantly enhanced antitumor activity of three commonly used chemotherapeutic drugs-methotrexate, 6-thioguanine and cytarabine [19].

2.3.2 Antimicrobial Activity: *H. indicus is* conventionally recycled in Indian folklore medicine for the behavior of various bacterial and fungal infections. *H. indicus* showed a Maximum zone of decrease against *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Escherichia coli*.

Chloroform extract of *H. indicus* displayed promising activity beside clinical isolates of Helicobacter pylori. 95% ethanolic and aqueous extract were active against *Diplococcus pneumonia*, *Corynebacterium diptheriae*, *Streptococcus viridans*, and Streptococcus pyogenes.

It was found that acetone, ethyl acetate, and methanol fraction of *H. indicus* established high activity against ESβL (Extended-spectrum β-lactamase) creating multidrug unaffected enteric bacteria. Chloroform and 95% ethanol extracts of *H. indicus* presented antifungal activity against *Aspergillus niger* too. Clinical judgments of "RENALKA" syrup [containing extracts of *Tribulus terrestris*, *Crataeva magna*, *H. indicus*, *Cyperus rotundus*, *Vetiveria zizanoides*, *Asparagus racemosus*, and *Elletaria cardamomum* and Trikatu] is done for effectiveness in curing and relieving Urinary Tract Infection symptoms. The drug was found to be safe and effective against *E. coli, Bacillus sp, Proteus sp., Klebsiella sp.*, and *Pseudomonas* sp [20].

2.3.3 Anti-diarrhoeal Activity: *H. indicus* methanolic extract caused more important anti-diarrhoeal activity than standard drugs. It was originated that *H. indicus* aqueous extract rises water absorption and Na+-K+ from jejunam [21].

2.3.4 Anti-inflammatory Effect: This is found that ethyl acetate extract of *H. indicus* root display much anti-inflammatory result in acute and subacute inflammation. Oral administration of *H. indicus* root extract jammed both neurogenic and inflammatory pains. Comparative studies on the anti-inflammatory activity of *H. indicus* are also prepared in carrageenan-convinced rat paw oedema. Ethanolic extract of root exhibits significant anti-inflammatory activity at a dose of 350 mg/kg p.o. compared to control [22].

2.3.5 Anti-leprotic Activity: *Hemidesmus indicus* root aqueous extract was orally controlled at 2% concentration in mice. Mice were infected with Mycobacterium leprae and observed that cutaneous hypersensitivity stimulation was delayed. It also had immunomodulatory and immunosuppressant activities. Phagocytosis was too decreased [23].

2.3.6 Antioxidant: Antioxidant and free radical scavenging activity Doxorubicin (Dox) is an anthracycline antibiotic widely used to treat cancers, including hematological malignancies, and many carcinomas, and soft tissue sarcomas. Still, its clinical use is restricted due to its toxicities to cardiac tissues.

The Dox-induced cardiotoxicity is mediated by lipid peroxidation, free radical formation and mitochondrial damage, and decreased Na+–K+ ATPase activity. Antioxidant enzymes-CAT,SOD, and GPx, in addition to GSH levels in heart tissue, reduced radically after doxorubicin injection.

H. indicus root extract, because of its antioxidant properties, suggestively compacts the oxidative stress and thus toxicity induced by doxorubicin. 70% methanolic extract of *H. indicus* root, which has huge amounts of flavonoids and phenolic compounds, displays high antioxidant and free radical hunting activities. It also chelates iron and has decreasing power. These *in-vitro* assays indicate that the extract contains constituents that can be a significant source of natural antioxidants [24].

2.3.7 Anti-venom Activity: Plant root extracts efficiently neutralized Viper venom convinced lethal, anticoagulant, haemorrhage, coagulant, and inflammatory activity. Lupeol acetate remoted from *H. indicus* root extract expressively neutralizes lethality, haemorrhage, defibrinogenation, and edema; tempted by Daboiarussellii venom. It also neutralized Najakaouthia venom-induced cardiotoxicity, neurotoxicity, and respiratory issues in experimental models; methoxy benzoic acid of *H. indicus* root has anti-venom potential [25].

2.3.8 Hepatoprotective Activity: Oral administration of 50% ethanolic *H. indicus* root extract significantly prevented rifampicin and isoniazid induced hepatotoxicity $26CCl_4$ and paracetamol-induced hepatic damage can be cured up to an extent, too by *H. indicus* root extract. Biochemical parameters, like alkaline phosphatase, SGOT, SGPT were found to be in the normal range only after oral administration [26].

2.3.9 Nootropic Effect: n-butanol fraction of ethanolic root extract of *H. indicus* ominously better learning power and memory in mice. Hence, *H. indicus* proved to be a useful memory restorative agent in treating dementia seen in Alzheimer's disease and other neurodegenerative disorders [27].

2.3.10 Wound Healing Activity: Leaves of *H.Indicus* have marked wound healing action and play a promising role in treating wounds, especially chronic wounds of diabetic and cancer patients. Alcoholic *H. indicus* root extract, formulated as 5% and 10% ointment, increases the rate of wound contraction and epithelisation [28].

2.3.11 Anti-acne Activity: The most common skin disorder of the pilosebaceous unit is Acne vulgaris, caused by bacteria Propionibacterium acnes, Staphylococcus epidermis, and Malassezia future. Most anti-acne drugs target Propionibacterium acnes and Staphylococcus epidermis as the main culprit. The study showed the roots of *Hemidesmus indicus* displayed strong inhibitory results *on P. acne* and *S. epidermis*. The minimum inhibitory concentration for *P. acne* and *S. epidermis* was 0.051mg/ml and 1.25mg/ml. But high concentrations were required to act as bactericidal agents [29]. Another study conducted by terpenoidal

fraction obtained during successive extraction of *Hemidesmus indicus* was evaluated for anti-acne activity. This terpenoid fraction showed potent anti-acne activity and minimum inhibitory concentrations determined by broth dilution. The assay was found to be 38ug/ml for both *P. acne* and *S. epidermis,* and minimum bactericidal concentrations were 38ug/ml and 46ug/ml respectively [30].

2.3.12 Anti-carcinogenic Activity: *H. indicus* shows that mouse skin action with extract prior to cumene hydroxide induced ornithine decarboxylase activity and DNA synthesis, which is considered a biochemical indicator to estimate the tumor-promoting potential of an agent. Thus, extract inhibited tumor growth in mouse skin and can be considered a potent chemopreventive agent [31]. Decoction of *Hemidesmus indicus*, + igellasativa, and Smilax glabra for its effect on diethyl nitrosamine (DEN)-induced hepatocarcinogenesis.

The carcinogenic potential was scored by comparing the number, area, and staining intensity of glutathione S-transferase placental form (GST-P) positive foci and the number of cell/cm2 of the positive foci in livers of rats. The decoction significantly inhibited DEN-mediated GST-P expression in rat liver and hence inhibited the early DEN initiated phase of hepatocarcinogenesis. The mechanism of action of decoction was not clear, but the authors hypothesized it to be either by detoxifying carcinogen, antioxidant activity, immuno-modulatory action, or cytotoxicity [32].

In other study using same decoction for long term treatment of rats with decoction not only inhibited DEN induced GST-P expression but also the carcinogen mediated development of overt tumor and histopathological changes leading to tumor development. Also, a marked reduction of angiogenesis was observed in rats treated with DEN and decoction, but the mechanism by which decoction inhibits angiogenesis was not clear [33]. Chloroform division containing phytosterol and fatty acid obtained from crude methanolic extract of roots of *H. indicus* was for protective effect against cytotoxicity induced by *S. typhimurium* in human intestinal cell *S. typhimurium* treat with 100ug/ml of chloroform portion had 10 times less cytotoxicity compare to those cells which were infected by wild type bacteria. Adherence and invasive ability of *Salmonela typhimurium* once treated with chloroform fraction to Int 407 cells was decrease by 40 times and 10-15 times respectively.

Additional Int 407 cells infected with chloroform fraction treated *S. typhimurium* showed normal morphology with normal mitochondrial cristae. But few cells had one or two invaded bacteria, and cells with altered morphology were rarely observed [34]. *Hemidesmus indicus* (HI) root extract protects microsomal membranes by reducing lipid peroxidation and protecting DNA from radiation-induced strand breaks [35].

2.3.13 Anti-thrombotic Activity: The methanolic extract of roots of *H. indicus* inhibit platelet aggregation. Intravenous administration of root extract of *H. indicus* delayed the plasma recalcification time. However, authors also reported that the extract of *H. indicus* increases discharge and activation of enzymes, resulting in the metabolic degradation of lipids [36]. Another study investigated the anti-atherogenic effect of a polyherbal formulation called Caps HT2 having Hemidesmus indicus as one of the ingredients. The putative mechanism of action for the said effect is proposed to inhibit platelet aggregation, delay plasma recalcification time in rabbits, and enhance lipoprotein lipase activity [37].

2.3.14 Anti-hyperlipidaemic Activity: In normal rats, cell culture extract of *Hemidesmus indicus* (CCH) administered at a dose of 16mg/kg decreased low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL), cholesterol and significantly increased high-density lipoproteins (HDL): cholesterol ratio. In hypercholesterolemic rats, CCH administered at a dose of 2, 4, and 16 mg/kg showed a significant reduction in total cholesterol, triglycerides, LDL cholesterol, and phospholipids. The probable mechanism of action for the above effect can be an increase in liver LDL receptor activity with a concomitant decrease in hepatic triglyceride (TG) synthesis.

Also faecal excretion of cholesterol and phospholipids were increased in hyper-cholesterolemic rats after admin of CCH (4 and 16 mg/kg) [38]. The polyherbal formulation Caps HT2

was also found to possess hypolipidemic activity as it raised HDL cholesterol levels in hyperlipidemic rats [37]. In other *in-vivo* studies 2-hydroxy-4-methoxy benzoic acid (HMBA) present in *Hemidesmus indicus* may be responsible for its anti-hyperlipidemic action. Administration of HMBA 200ug/kg/day for 30days after oral administration of ethanol for 30days to rats decreased total plasma cholesterol, TG, lipoproteins, phospholipids, free fatty acids, and increased plasma lipoprotein lipase concentration [39].

2.3.15 Hypoglycemic Activity: Aqueous extract (500mg/kg) decreased blood glucose level within 5 h. in Streptozotocin-induced diabetic rats. Also restored the decreased level of metabolic enzymes of glucose and hepatic metabolizing enzymes to normal level[40].

2.3.16 Toxicity Studies: The plant was toxic to the liver, but no toxicity was observed in the kidney and lungs. Dried stem administered at a dose of 25% shows hepatotoxic activity with dispersed hydropic degeneration and focal hepatocellular necrosis. It also reported hepatomegaly and sclerosed glomeruli when aqueous-alcoholic extract of *H. indicus* was administered [40].

2.4 Phytochemical Review [40, 41]:

2.4.1 Leaves: It contains Coumarinolignoids viz. hemidesminine, hemidesmin-1, and hemidesmin-2. Flavonoids *viz*. hyperoside and rutin. 2.50% tannins.

2.4.2 Stem: Glycosides such as Indicine and Hemidine. Pregnane glycoside such as Hemidescine and Emidine. Pregnaneo-ligoglycosides *viz*. demicunine and heminine. Desinine, Indicusin, Medidesmine, Hemisine and Demicine. Steroidal compounds *viz*. Calogenin-3-o-β-Ddigitoxopyranosteroid, desminine steroid, hemisine steroid. Triterpenoids *viz*. 3-keto-lup-12-ene-21->28 olidetriterpene, lup-12-ene-3-β-ol acetate triterpene.

2.4.3 Roots: Pregnane glycoside *viz*. Hemindicusin. Coumarinolignoids *viz*. Hemidesmin-1 and Hemidesmin-2.Others - β-amyrin acetate, α-amyrin, β-amyrin, lupeol acetate, β-sitosterol, hexadecanoic acid, hexatriacontane, lupeoloctasonate. Oil contains 80% crystalline matter, glucose, hemidesmol, hemidesterol, 2-hydroxy-4-methoxy benzaldehyde, resin acid, glucoside, α-amyrintriterpene, β-amyrintriterpene, and benzaldehyde.

2.4.4 Flowers: Flavanoid glycosides *viz.* Hyperoside, Isoquercetin and Rutin

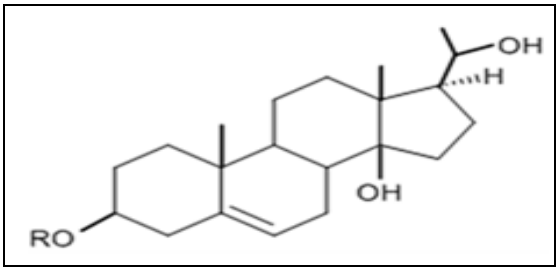

FIG. 1: INDICINE

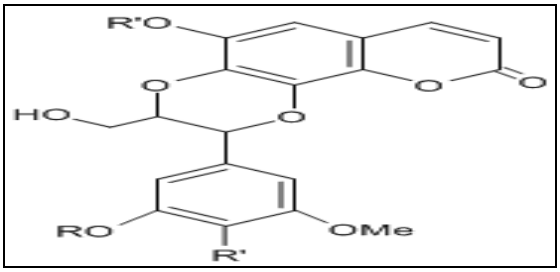

FIG. 2: HEMIDESMIN

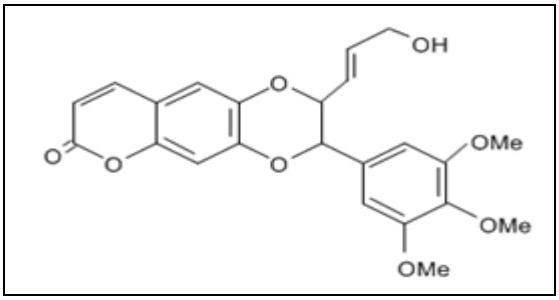

FIG. 3: HEMIDESMININE

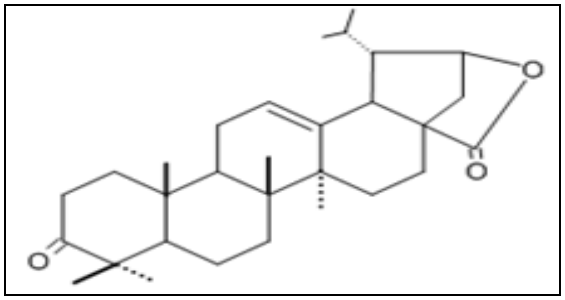

FIG. 4: KETO-LUP-12-EN-21-28-OLIDE

2.4.5 Marketed Formulations:

1. Praas, Komal Herbals, Inc., United States Used as tonic, as restorative agents, prevent health stresses; helps enhance memory power, prolongation of antioxidant capabilities [42].

2. Skinelle, Tablets CharakPharma, India. Used for treatment of Acne vulgaris and premenstrual acne.

3. ELGER, Healing Power, Inc., New York. To provide resistance against all airborne allergies.

4. Renalka, Syrup Himalaya Herbal Healthcare, India. Used in variety of urinary disorders viz. burning micturition, recurrent urinary tract infection and dysuria.

5. Psorcure, Oil and ointment Clinic Psoriasis, Canada. Treatment of Psoriasis.

6. Uriflow, Merazon Health Products, Inc., USA. Used in kidney stone.

CONCLUSION: This article represents the pharmacological, phytochemical, ethnobotanical, toxicity, and safety guideline of this plant material. This review also displays a list of marketed formulas where *H. indicus* is an active ingredient. So, further investigation of this plant *H. indicus* which, will be helpful for the study of biological activities.

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CONFLICTS OF INTEREST: We declare that we have no conflicts of interest.

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