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Phytochemical and pharmacological profile Of *Ixora coccinea* Linn.

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Abstract

Traditional system of medicinal consists of large number of plants with various medicinal and pharmacological importances and hence represents a priceless tank of new bioactive molecules. Medicinal herbs are moving from fringe to mainstream use with a greater number of people seeking remedies and health approaches free from side effects caused by synthetic chemicals. India officially recognizes over 3000 plants for their medicinal value. It is generally estimated that over 6000 plants in India are in use in traditional, folk and herbal medicine. This article aims to provide a comprehensive review on the phytochemical and pharmacological aspects of *Ixora coccinea*.

Key-Words: Medicinal herbs, *Ixora coccinea*, comprehensive review

Introduction

Medicinal plants have been of age long remedies for human diseases because they contain components of therapeutic value[1]. Plants are used in modern medicine where they occupy a very significant place as raw material for important drugs[2]. Plants are considerably useful and economically essential. They contain active constituents that are used in the treatment of many human diseases. Plants are rich sources of ecologically developed secondary metabolites, which are potential remedies for different ailments.

Ixora coccinea Linn (Rubiaceae) is known as Jungle of Geranium (or) Flame of the woods or vetchi in Ayurveda. It is a common flowering shrub native to Asia. It is name derived from an Indian deity. Although there are some 400 species in the genus *Ixora coccinea* is a dense, multi – branched ever green shrub commonly 4-6 ft (1-2-2m) in height, but capable of reaching up to 12ft (3.6m) height. It is traditionally used as hepatoprotective, Chemoprotective, anti-microbial, anti-oxidant, anti-nociceptive, anti–mitotic and anti-inflammatory activities. Decoction of roots used for nausea, hiccups and anorexia. Powered roots used for sores and chronic ulcers In indo – china , root decoction used to clarify the urine, poultice fresh leaves and stems for sprains, eczema, boils and contusions[3].

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Botanical study

Kingdom	: Plantae
Order	: Gentianales
Family	: Rubiaceae
Subfamily	: Ixoroideae
Tribe	: Ixoreae
Genus	: *Ixora*
Species	: *coccinea*

Fig 1: *Ixora coccinea*

Macroscopy

The plant is a dense, multi – branched evergreen shrub, commonly 4-6 ft (1-2-2m) in height, but capable of reaching up to 12ft (3.6 m). Leaves are oblong are about 10cm long, with entire margins and are carried in opposite pairs or whorled on the stem. They are sessile to short – petiolate, blades elliptic, oblong or obovate, usually leathery, base cordate to rounded, apex rounded, mueronate or shortly tapering ; stipules

basally sheathing , lobes Triangular and strongly acon – tipped. Flowers sessile; calyx lobes short, triangular, persistent ,corolla tube usually 1-1.5 inches long , lobes lanceolate to ovate, less than 0.25 inches long , acute or sometimes obtuse fruit thinly fleshy and reddish black.

Microscopy

The leaf is dorsiventral, hypostomatic and mesomorphic. It has thick midrib projecting both adaxially and abaxially. The midrib has adaxial broadly conical hump and wide semicircular abaxial past. The midrib is 1.1 mm thick. The adaxial past is 400µm wide. The abaxial part is 900 µm thick. The epidermal layer of thin midrib consists of small, squarish, thick walled cells with prominent cuticle, the cells are with prominent cuticle and the cells are 22 µm thick. The lower semicircular midrib has parenchymatous ground tissue. The cells are wide thin walled, angular and compact. Calcium oxalate crystals are occasionally seen in some of the parenchyma cells. The vascular system of the midrib consists of an adaxially flattened closed cylinder of xylem and phloem; within the cylinder are two small rectangular segments of vascular bundles. The outer cylinder has a thin layer of xylem fibers and short radial files of narrow, thick walled angular xylem elements. The abaxial epidermis has comparatively small cells which are square in shape, the cuticle is thicker; stomata are present on the lower epidermis. These are two layers of palisade cells along the upper part. The cells are wide, cylindrical and the palisade zone in 60µm in height. The spongy parenchyma cells are in 4 (or) 5 rows. They are large thin travelled, spherical lobed and form wide air – chambers. The vascular strands of the lateral veins are circular with thick cylinder of fibers and small central case of xylem and phloem[4].

Chemical constituents

The essential oil of *Ixora coccinea* flower was obtained by hydrodistillation and analyzed by Gas chromatograph (GC). Fifty-four components have been identified in the essential oil of *Ixora coccinea* flower, representing 99.97% of the total components detected. The oil is composed mainly of triterpenes 62.60%, monoterpenes 31.73%, sesquiterpenes 3.35% and an ester 2.29%. The major constituents of triterpenes were ursolic acid (27.34%), oleanolic (20.16%) and lupeol (15.10%). *Ixora coccinea* flower is of ursolic acid chemotype. Geranyl Acetate (8.74%) is the major monoterpenes, followed by Linalyl acetate (6.79%), Neryl acetate (6.49%), α–Terpineol acetate (4.91%), and Borneol acetate (4.77%); Ethyl cinnamate (2.29%) an ester while the sesquiterpenes are Cyperene (2.72%) and α–Copaene (0.63%)[5].

Pharmacological actions

Anti-oxidant activity

Moni Rani et al reported the anti-oxidant activity of the methanol extract of *Ixora coccinea L* by DPPH free radical scavenging assay, reducing power and total antioxidant capacity using phosphor molybdenum method. Preliminary phytochemical screening revealed that the extract of the flower of *Ixora coccinea* possesses flavonoids, steroids and tannin materials. The methanolic extract showed significant activities in all antioxidant assays compared to the standard antioxidant in a dose dependent manner and remarkable activities to scavenge reactive oxygen species (ROS) may be attributed to the high amount of hydrophilic phenolics. In DPPH radical scavenging assay the IC50 value of the extract was found to be 100.53 µg/mL while ascorbic acid had the IC50 value 58.92 µg/mL. Thus *Ixora coccinea* extract showed strong reducing power and total antioxidant capacity[6].

Anti-inflammatory activity

Ratnasooriya et al reported the anti-inflammatory potential of an aqueous leaf extract (ALE) of Ixora coccinea (Rubiaceae) in rats by carrageenan-induced paw edema (acute inflammatory model) and cotton pellet granuloma tests (chronic inflammatory model) at oral (500, 1000 and 1500 mg=kg). In the former test, ALE significantly impaired both early and late phases of the inflammatory response and also the edema maintained between the two phases. In the latter test, it significantly suppressed granuloma formation (only highest dose tested). Collectively, these data show promising anti-inflammatory activity against both acute and chronic inflammation[7].

Anthelmintic activity

Surana et al reported the anthelmintic activity of Ixora coccinea roots in different extracts against Indian earthworm Pherituma posthuma. Chloroform soluble fraction showed good anthelmintic activity than Ethyl acetate soluble, Methanolic and petroleum ether extract[8].

Anti-asthmatic activity

Missebukpo et al reported the anti-asthmatic activity of hydroalcoholic extract of Ixora coccinea in an ovalbumin (OVA) induced asthmatic rat model. The extracts at a dose of 1000 and 1500 mg kg-1 supressed eosinophilia and significantly inhibited AHR in rat. Histopathological studies using hematoxylin and eosin showed the reduced inflammatory cell infiltration and repaired the damaged epithelial cells. In addition the extract at the same dose showed decreased the diameter of the blue spots compared with the control and inhibited the skin reactions induced by histamine. Thus they proved the anti-asthmatic properties of Ixora coccinea[9].

Anti-diarrhoeal Activity

Prabu et al reported the anti-diarrhoeal activity of aqueous extract of the leaves of Ixora coccinea against a castor oil induced diarrhoea model in rats. The gastrointestinal transit rate was expressed as the percentage of the longest distance which was traversed by the charcoal, divided by the total length of the small intestine. The weight and the volume of the intestinal content induced by castor oil were studied by the enteropooling method. Loperamide was used as a positive control. The plant-extract showed significant ($P<0.001$) inhibitor activity against castor oil induced diarrhoea and castor oil induced enteropooling in rats at the dose of 400 mg/kg. There was significant reduction in gastrointestinal motility by the charcoal meal test in rats[10].

Hypoglycaemic and Hypolipidaemic activity

Yasmeen and Prabu reported the hypoglycaemic and the hypolipidaemic activity of the aqueous extract of the leaves of Ixora Coccinea Linn in alloxan induced diabetic albino rats. The aqueous extract of leaves of Ixora Coccinea showed significant reduction ($p<0.01$) in the blood glucose levels and the serum lipid profile levels, with 400 mg/kg of body weight in the alloxan induced diabetic rats as compared to the controls[11.]

Hepatoprotective activity

Latha et al reported the hepatoprotective activity in ethanolic extracts of three different plants *Ixora coccinea* (IC), *Rhinacanthus nasuta* (RN), *Spilanthes ciliata* (SC) on the aflatoxin B1 (AFB1) -intoxicated livers of albino male Wistar rats. Biochemical parameters, including serum hepatic enzymes (glutamate oxaloacetate transaminase, glutamate pyruvate transaminase and alkaline phosphatase), were studied. Pre-treatment of the rats with oral administration of these plant ethanolic extracts, prior to AFB1 was found to provide significant protection against toxin induced liver damage, determined 72 hours after the AFB1 challenge (1.5 mg/kg, intraperitoneally) was evidenced by a significant lowering of the activity of the serum enzymes and enhanced hepatic reduced GSH status. Pathological examination of the liver tissues supported the biochemical findings. The three plant extracts, IC, RN and SC, showed significant anti-lipid peroxidant effects *in vitro*[12].

Wound healing activity

Nayak et al reported the wound healing activity of alcoholic extract of the flowers of *Ixora coccinea* by using a dead space wound model in rats. Significant increases in granuloma tissue weight, tensile strength, hydroxyproline and glycosaminoglycan content were observed in extract treated rats. The prohealing actions seem to be due to increased collagen deposition as well as better alignment and maturation. The drug induced a hypertropic effect on the thymus gland but had no effect on the adrenals[13].

Antinociceptive activity

Ratna sooriya et al reported the antinociceptive potential of leaves of *Ixora coccinea* by three models of nociception (tail flick, hot plate and formalin tests). One of four doses (500, 750, 1000 or 1500 mg/kg, n=8/dose) of aqueous leaf extract (ALE) or 1 ml of distilled water was orally administered to male rats. The results showed that ALE possesses considerable antinociceptive activity (when evaluated in hot plate and formalin test but not in tail flick test). The antinociceptive activity of the ALE had a rapid onset (within 1 h) and a fairly long duration of action (up to 5 h) with a peak effect at 3 h. Further, the antinociceptive activity was dose-dependent and was not associated with harmful side-effects or toxicity even following subchronic administration. The antinociceptive action was mediated centrally at the supraspinal level mainly via dopaminergic mechanism. In addition, it is likely that antioxidant activity of the ALE could have played an auxiliary role in inducing antinociception. Dopaminergic and antioxidative activities of ALE could arise, respectively, from its quaternary base alkaloid and flavonoid constituents[14].

Cytotoxic and Antitumour activity

Latha and panikar reported the antitumour activity of *Ixora coccinea* L. (Rubiaceae) flowers was studied in comparison to intraperitoneally transplanted Dalton's lymphoma (ascitic and solid tumours) and Ehrlich ascites carcinoma (EAC) tumours in mice. Intraperitoneal administration of 200 mg/kg of the active fraction (AF) of the *I. coccinea* flower increased the life-span of DLA and EAC ascitic tumour-bearing mice by 113 and 68%, respectively. The AF showed less activity against solid tumours (DLA) as compared to ascitic tumours. The same active fraction showed 50% cytotoxicity to DLA, EAC and Sarcoma-180 (S-180) cells in vitro at concentrations of 18, 60 and 25 μg/ml, respectively. It was not toxic to normal lymphocytes, whereas it was toxic to transformed lymphocytes from leukaemic patients, acute lymphoblastic leukaemia (ALL) and chronic myelogenous leukaemia (CML) and K-562 suspension cell cultures. The AF inhibited tritiated thymidine incorporation in cellular DNA. Thus the anti-tumor activity of *Ixora coccinea* plant was proved[15].

Anti-ulcer activity

Arunachalam et al reported the anti ulcer activity of the fresh leaf extract of *Ixora coccinea* Linn (Rubiaceae)(MEIC) for its anti-ulcer activity in pyloric

ligation (PL) and hypothermic-restraint stress (HRS) induced gastric ulcer models in Albino rats. We found that MEIC, at doses of 100 and 200 mg kg-1 were found to be protective effect in PL (45.86 and 75.02%) induced ulcer models and significantly reduced free and total acidity by $P < 0.01$ and $P < 0.001$ respectively. In the gastric ulcer induced by hypothermic-restraint stress, both doses of MEIC also showed significant activity, and inhibited the gastric protective effect by 50.34 and 75.45% respectively. Conclusively, MEIC was found to possess potent anti-ulcerogenic property and could act as a potent therapeutic agent against ulcer disease[16].

Nano particle biosynthesis

Nagaraj et al reported the synthesis of gold nanoparticles in aqueous medium using flower extracts of *Ixora coccinea* as reducing and stabilizing agent. On treating chloroauric acid solution with extract, rapid reduction of chloroaurate ions is observed leading to the formation of the highly stable gold nanoparticles in solution. The synthesized nanoparticles are confirmed by colour changes and it has been characterized by UV-visible spectroscopy. Presence of this strong broad plasmon peak has been well documented for various Me- NPs, with sizes ranging all the way from 2 to 100 nm. The morphology and size of the biologically synthesized gold nanoparticles were determined using TEM. The images clearly showed that the average size of the nanotriangles is about 200 nm, while, the spherical like particles show very small size about 5-10 nm. This study also showed that gold nanoparticles with antibiotic show more inhibitory zones than compared to the standard antibiotics[17].

Conclusion

The extensive literature survey revealed that *Ixora coccinea* is important medicinal plant with diverse pharmacological spectrum. The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal property. The evaluation needs to be carried out on *Ixora coccinea* in order to uses and formulation of the plant in their practical clinical applications, which can be used for the welfare of the mankind.

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