



## ***Clerodendrum splendens*: A Review**

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### **ABSTRACT**

*Clerodendrum* Genus consists of around 400-500 species i.e. *C. inerm*, *C. trichotomum*, *C. phlomidis*, *C. serratum*, *C. chinense*, *C. indicum*, *C. petasites* and one of the focused species in this review *Clerodendrum splendens* is a climbing evergreen plant which comes under family Verbenaceae. It is a widely studied medicinal plant which are traditionally use from long term in various cultures to treat the several diseases such as asthma, ulcers, venereal infection, rheumatism, scrofulous illness, cure cough, spleen in youngsters etc. This review article provides a comprehensive overview of the botanical characteristics, traditional uses, phytochemical composition, and pharmacological activities of *Clerodendrum splendens*. The phytochemical study of *C. splendens* confirmed the presence of different type of secondary metabolites like flavonoids, polyphenols, terpenoids, saponins, polyterpenes, tannins, catechin, alkaloids etc and it act as antimalarial anti-inflammatory, antioxidant, antimicrobial, antidiabetic, immunomodulatory activity, and also has wound healing properties. The article also discusses the potential therapeutic applications, and future perspectives of this plant. The information presented in this review is based on extensive research and references from scientific literature.

**KEYWORDS:** *Clerodendrum splendens*, Extracts, Phytochemical constituents, Pharmacological activity.

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### **INTRODUCTION**

*Clerodendrum splendens* is a member of the Verbenaceae family and is found throughout the world's tropical and subtropical regions [1-3]. It is made up of scent tress, bushes, and herbs. It is a climbing evergreen plant having beautiful red blooms that bloom during the winter seasons of the year [4]. *Clerodendrum splendens* is both cultivated and wild in Egypt [5]. It can be grown through seeds and cuttings. It is used as an ornamental plant around dwellings because of its vivid, appealing red flowers [6,7].

*Clerodendrum splendens* is a 3.7meter tall shrub. It has simple, opposing dark green leaves [8-10]. The flowers of the plant are red in colour and consist of 5 sepals due to which it is also known as are pentamerous plant. The microscopic examination of the flowers reveals that the inner epidermis frequently has glandular trichomes and that the sepals are wide, have blunt borders, and are cupped on the abaxial side. Five imbricate and aestivated petal lobes are present; the centre lobe is thicker, and the borders gradually get thinner. The anther dehisces longitudinally through the stomium and is dithecous with four chambers. The pollen grains are spherical, with a thin, smooth infinite an exine that is somewhat echinate. Stem is void, cylindrical in shape having dark green surface with a distinctive odour [11].

The chemical research on *Clerodendrum splendens* resulted in the isolation an identification of several secondary metabolites including carbohydrates, steroids, terpenoids, and flavonoids [12-15]. Triterpenes and steroids are found in extract of chloroform and petroleum ether, alkaloids and flavonoids are found in ethyl acetate extract, tannins glycosides, carbohydrates, flavonoids are found in aqueous extracts whereas alkaloids, flavonoids, and tannins are found in ethanol extract [16-18].

The different parts of this plant like root and leaves are used as herbal medicine to treat the diseases like asthma, rheumatism, spleen in youngsters, ulcers, shingles, and malaria [19]. Barks and leaves use to cure coughs, scrofulous illness, buboes, venereal infections and other ailments. Many in vivo and invitro investigations have revealed that *Clerodendrum splendens* have antioxidant, antibacterial and anti-inflammatory activities [20-23].

*Clerodendrum* have various species includes *C. serratum*, *C. indicum* and *C. trichotomum* which are traditionally used as anti-inflammatory. The plant exhibits a wild range of folk medicine mainly for the treatment of Asthma [24-27].

## PLANT PROFILE

Kingdom	Plantae
Type	Vine
Family	Lamiaceae to Verbenaceae
Genus	Clerodendrum
Species	C. splendens
Plant habit	Climber
Flower	Showy
Leaf	Evergreen [28].

## SYNONYMS

Flaming glory bower, Pagoda flower, Bleeding heart vine [29].

## GEOGRAPHICAL SOURCE

Clerodendrum native to tropical western Africa. It is broadly found in equatorial areas of the world. Clerodendrum have various species which is widely found in Asia, Africa Australia and also in United States of America [30].

## FEATURES OF GENUS CLERODENDRUM

The Clerodendrum name obtained from the two Greek words, 'klero' which means 'chance' and 'dendron' which means 'tree' i.e 'chance tree' or the tree which may or may not show good luck [31]. The genus Clerodendrum consists of around 400-500 species.

The characteristics features of plant C. splendens belonging to Genus Clerodendrum are concluded:

Leaves: Leaves are simple, entire or toothed, opposite or in whorls of 3 or 4.

Stamens: Four, didynamous, inserted in the corolla tube.

Fruit: Drupes, four-grooved, with fleshy mesocarp and bony smooth or wrinkled endocarp.

Seeds: Four or two pairs of pyrenes.

Corolla: Tubular, white, blue, violet or red, straight or curved cylinders often widened towards the throat.

Habit: Evergreen trees, shrubs or lianes.

Gynaecium: Tetralocular ovary, terminal elongated style and bifid stigma.

Calyx: Bell-shaped or tubular, truncate or five-toothed.

Inflorescences: Axillary or terminal, lax cymes, corymbs, panicles or heads [32-34].

## CHEMICAL CONSTITUENTS

The reported chemical constituents of *Clerodendrum splendens* showed the presence monoterpenes, diterpenes, sesquiterpenes, Flavonoids, phenylethanoid, flavonoid glycosides, steroids and steroid glycosides, cyanogenic glycosides, cyclohexyl ethanoids, anthraquinones [16-18].

Terpenoids: Terpenoids are the type of secondary metabolites which contain Monoterpenoids, diterpenoids, triterpenoids, tetraterpenoids and iridoid glycosides. The various chemical constituents have been separated from these terpenoids present in C. splendens that are  $\alpha$ -amyrin, 15a-methoxy dihydroepicaryoptin, lutein, Oleanolic acid-3-acetate monomelittoside, melittoside, betulinic acid,  $\beta$ -amyrin, friendelin, taraxerol, 3-hydroxy lanost-7-en-29-carboxylic acid,  $\beta$ -Friedo-olean-5-ene-3 $\beta$ -ol, glucopyranoside that are responsible for different biological activities like analgesic, anti-inflammatory, antinociceptive activity [35-37].

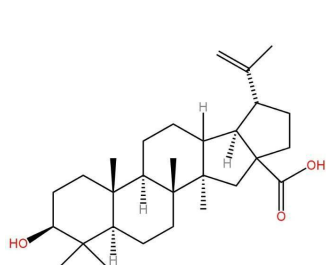


Fig.3 Betulinic acid

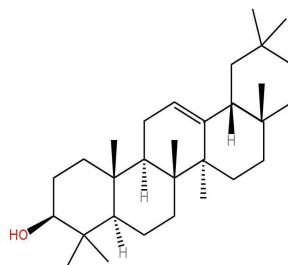


Fig.4  $\beta$ -amyrin

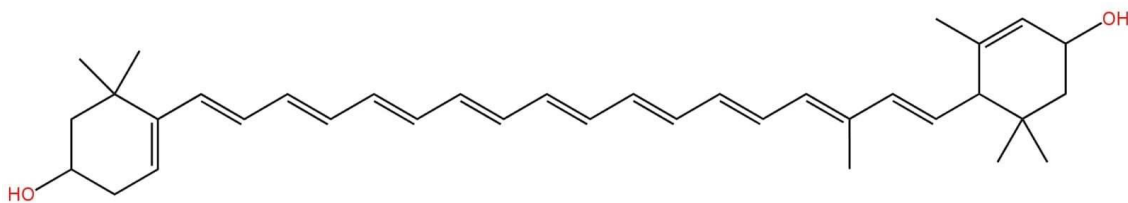


Fig.5 Lutein

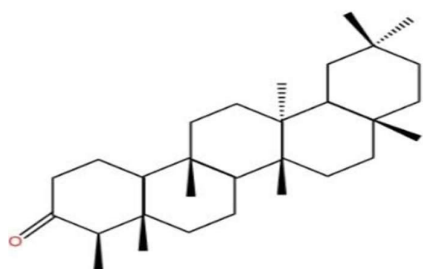


Fig.6 Friendelin

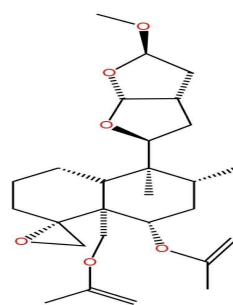


fig.7 Clerodeinin A

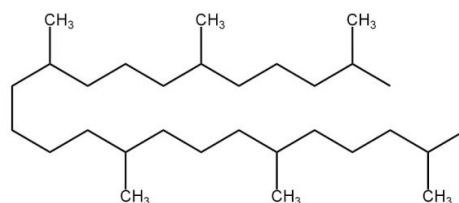


Fig.8 Squalene

Flavonoids: Flavonoid aglycones and glycoside, phenylpropanoid glycosides as well as phenolic acid compounds are isolated from aerial and leaves parts of this plant which include Apigenin, 3',4',7-trihydroxyflavone-7-O-b-D-glucoside, vitexin and isovitexin-7-O-b-D-glucoside, Hispidulin, Hispidulin-7-O-(6-O-trans-caffeoyl)-b-D glucoside, Kaempferol-3-O-b-D-glucoside, Quercetin, Scutellarein, luteolin, methyl rosmarinate, trans-caffeic acid, neochlorogenic acid which are exhibited various activities like antidiabetic, anti-inflammatory, antihypertensive activity [38-41].

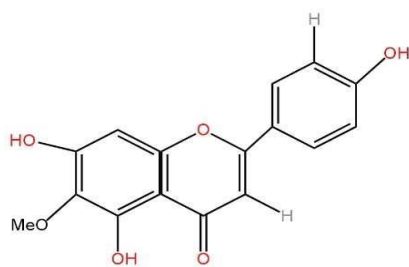


Fig.9 Hispidulin

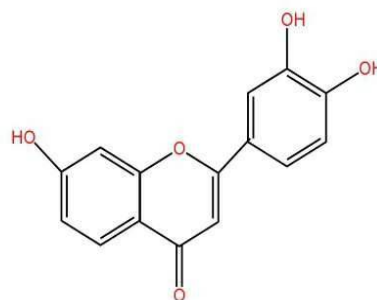


Fig.10 Luteolin

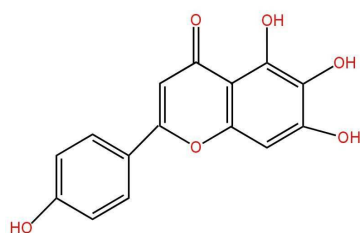


Fig.11 Scutellarein

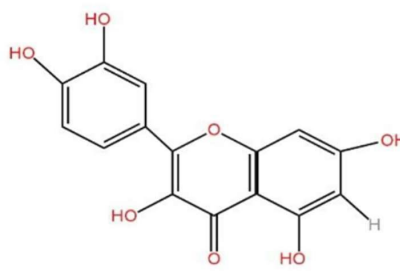


Fig.12 Quercetin

Steroids: The steroidal chemical constituents have been obtained from the flowers and leaves of this plant that are  $\beta$ -sitosterol,  $\beta$ -sitosterol-3-O- $\beta$ -D-glucoside, 22-dehydroclerosterol, stigmasta-5,22-diene-3-ol,

dehydroclerosterol, stigmasta-4,25-dien-3-one, clerosterol-3-O- $\beta$ -D-glucoside, (22E)-stigmasta-4,22,25-trien-3-one, stigmasterol, stigmasterol-3-O- $\beta$ -D-glucoside these are possess immunomodulatory, antioxidant, antidiabetic, antimicrobial activity and also used for treatment of rheumatoid arthritis [42-45].

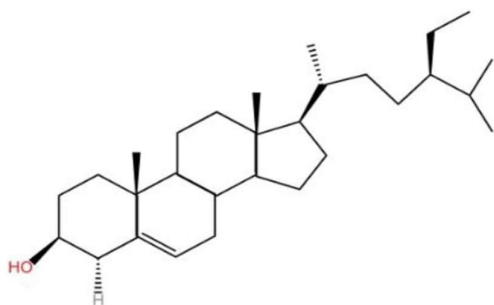


Fig.13 b-Sitosterol

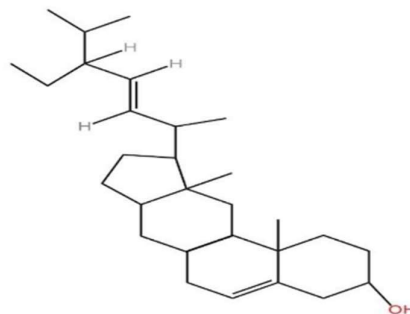


Fig.14 Stigmasta-5-22-diene-3-ol

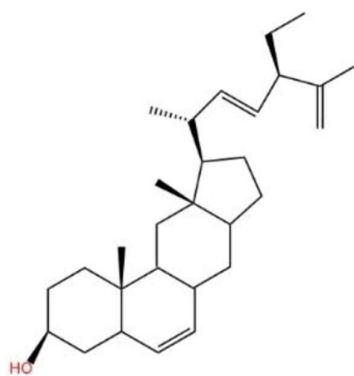


Fig.15 Colebrin A

Some are various chemical constituents which are extracted out from the plant include Oleic acid is a fatty acid, 1,2-benzene dicarboxylic acid also known as phthalic acid, P-xylene is an aromatic hydrocarbon, limonene is an organic compound found in citrus fruits and plant, linalool is a terpene alcohol found in flowers of this plant, 5-O-ethylcleroidicin D, due to the presence of these chemical compounds its shows various pharmacological Activity [46-48].

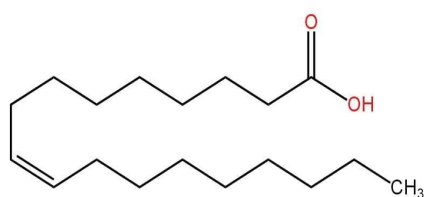


Fig.16 Oleic acid

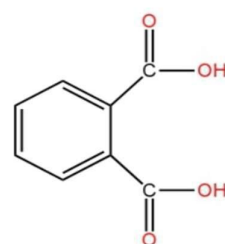


Fig.17 1,2- benzene dicarboxylic acid

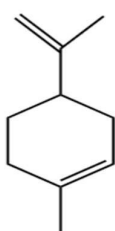


Fig.18 Limonene

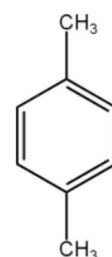


Fig.19 p-xylene

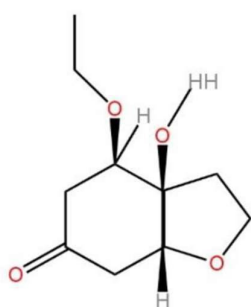


Fig.20 5-O-Ethylcleroidindicin D

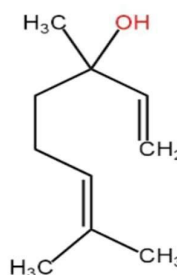


Fig.21 Linalool

### PHYSICOCHEMICAL PARAMETERS OF *Clerodendrum splendens*

The physicochemical test was performed and found the moisture content-5.62%w/w, the extractive value of petroleum ether extract-8.4%w/w, chloroform soluble extract-6.0%w/w, ethanol-5.7%w/w, water soluble 3.5%w/w, total ash value- 6.79% w/w water soluble ash value-0.1%w/w, the acid insoluble ash value-0.21%w/w [49].

### PHARMACOLOGICAL ACTIVITY

#### Antimicrobial activity:

Since the beginning of time, several plants have been used to treat infectious diseases [50]. The investigation of the antimicrobial activity was evaluated from the petroleum ether extract of leaf and bark of *C. splendens* plant that prevented the growth of different bacterial and fungal strains. To compare the zones of inhibition used the standard discs against microorganisms produced by the commercially available discs and plant extract against Gram positive and negative bacteria and antifungal standard disc were employed. The antifungal standard discs were used against fungal strains such as *A. niger* [35].

*Clerodendrum splendens* ethanolic leaves extract exhibited the anti-microbial activity by isolation of the phytochemical flavanone diglycoside [4].

The Anti-microbial activity of *C. splendens* leaves, cultivated in Egypt was screened against plasmodium falciparum and Trypanosoma curzi by using the chloroformic and methanolic extracts of *C. splendens* [9].

#### Anti-inflammatory activity:

With the use of a 70% ethanolic extract, a petroleum ether extract, and an acetate extract, the anti-inflammatory potency of the *Clerodendrum splendens* plant were assessed. The evaluation on 7-day-old chicks used the carrageenan-induced foot oedema model. The experiment was also carried out to find out the prophylactic effects of the on the oedema component of inflammation [30].

The methanolic leaves extract of *C. splendens* was performed which concluded the presence of phytochemical constituents such as terpenoids, alkaloids, flavonoids, tannins and related polyphenols possessing anti-inflammatory activity. The experiment was carried out by using Indomethacin as standard drug [1].

The anti-inflammatory property was determined from the n-hexane extract of *Clerodendrum splendens* leaves by isolating the composition of fatty acids in leaves of this plant [29].

The ethanolic extracts of *U. chamae* roots and *C. splendens* leaves were showed anti-inflammatory potency on rats' paw oedema caused by carrageenan. Both the extracts and the aspirin were found to prevent paw oedema in rats, with the aspirin showing the most inhibition compare to *C. splendens* [7].

#### Antidiabetic activity

Diabetes mellitus is a metabolic condition that raises blood glucose levels as a result of dysfunctional beta cells that produce insulin. The effect of ethanolic leaf extract of *C. splendens* on metabolic variables in diabetic wistar rats induced by alloxan were studied at a dose of 5mg/kg. Glibenclamide was utilized as the reference medication, and plant leaf extract at 200 and 400mg/kg in ethanol demonstrated anti-diabetic efficacy [8].

#### Antioxidant activity

The plant was discovered to have a significantly higher level of antioxidant properties The in vivo and invitro experiments were performed by many scientists revealed that *Clerodendrum splendens* has antioxidant qualities. Triantanol(1), (22E,24S)-stigmasta-5,22,25-trien-3-b-ol(2), and 3-O-D-glucopyranoside of (22E,24S)- Sigmasta-5,22,25-trien-3-b-ol(3) were obtained from the methanolic extract of *Clerodendrum splendens*. According antioxidant activity, compounds 1 and 2 prevent hepatic lipids from oxidizing. Additionally, compounds 1through 3 reduce the effect of Fe<sup>2+</sup> and the different

fractions of *C. splendens* were prepared such as CSF2, CSF3, CSG, CSB and CSEB. the IC50 values of these fractions were studied. It was found that all of these fractions inhibited hepatic lipids, though lower potentially compare to vitamin C, which is utilized as a reducing agent [2].

The antioxidant activity was found due to the free radical scavenging property of *Clerodendrum splendens* plant which was evaluated by using various concentration of the methanol solution of 2,2'-diphenylpicrylhydrazyl (DPPH). the L-ascorbic acid was utilised to inhibit the DPPH free radical [43].

From the ethanolic extract of *Clerodendrum splendens* certain chemical constituents such as 3',5',5'-trihydroxy 4'-methoxy flavanone 7-O-b-D glucopyranosyl methyl glucopyranose flavanone diglycoside were isolated which showed the antioxidant activity [9].

#### **Antimalarial activity:**

Malaria is a disease condition caused by a plasmodium parasite which are transmitted by the bite of infected mosquitoes. It is a serious health problem, especially in tropical and subtropical countries. Every year 863000 deaths occur throughout the world. With an IC50 value of 10 microgram mL<sup>-1</sup>, the chloroform extract from the flower of *Clerodendrum splendens* demonstrated antimalarial efficacy against Plasmodium falciparum. Due to the presence of a bitter component, the antimalarial properties of many *Clerodendrum* species have been documented [17].

The Anti-malarial activity evaluated from ethanolic extract of *Clerodendrum splendens* plant by isolating the Flavanone diglycoside [7].

#### **Wound Healing:**

A wound is a cut or break in any tissue that can be caused by microbes, chemicals, or physical causes. The process of wound healing involves the skin or other organs mending after an injury [51]. The plant *Clerodendrum splendens* G. Don's ability to heal wounds was demonstrated in some in vivo and invitro research using excision and incision wound model. The increasing concentration of hydroxyproline (released from the breakdown of collagen protein) in the extracellular tissue of animals treated with the methanolic extract of *C. splendens* was used in invitro experiments to establish the extract's ability to promote wound healing [6].

#### **Immunomodulatory activity:**

Using the ion exchange and size-exclusion chromatography methods, the polysaccharides were extracted from the ethanolic extract of *Clerodendrum splendens* leaves and fractionated into two *Clerodendrum splendens*, neutral fraction and *Clerodendrum splendens*, acid fraction. By injecting the polysaccharide fraction intraperitoneally, Experimental Autoimmune Encephalomyelitis in mice was caused and its severity assessed. It was found that the fraction's immunomodulatory activity increased Mitogen-activated protein kinase phosphorylation, Macrophage nitric oxide and Cytokine production [15].

#### **Dietary relevant plant:**

The n-hexane extract of *Clerodendrum splendens* leaves evaluated the dietary relevance activity by isolating the fatty acids content such omega 6 and omega 3 using the Gas chromatography coupled with mass spectroscopic method [29].

#### **Oxytocic activity**

The Uterine contraction activity of ethanolic extract of both *U. chamae* and *C. splendens* were compared. It was found that *U. chamae* exhibited action similar to that of oxytocin. In comparison to *C. splendens*, *U. chamae* extract caused the guinea pig's uterus to contract more. As the levels of oxytocin and plant extracts rise, the uterine contraction also rises [4].

## **CONCLUSION**

*Clerodendrum splendens* is a traditional medicinal plant with a rich history and promising pharmacological activities. This review highlights its botanical, phytochemical, and pharmacological aspects, emphasizing its potential therapeutic applications. However, further research is required to completely understand its mechanisms of action, to improve dosage forms, and establish its safety and efficacy. By continuing to explore *Clerodendrum splendens*, researchers may be able to uncover new treatment modalities for various health conditions. *Clerodendrum splendens* holds immense potential for the development of novel therapeutics. This section identifies areas for future research, such as pharmacokinetics studies, formulation development, clinical trials, and identification of active compounds for drug discovery. The challenges and opportunities associated with harnessing the full potential of *Clerodendrum splendens* are also addressed.

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