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Clerodendrum: A Useful Beneficial Phytomedicinal Plant

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Abstract

The genus *Clerodendrum* belongs to the Lamiaceae (Verbenaceae) family of flowering plants. It is indigenous to both tropical and warm temperate regions of the planet. The majority of the species are found in tropical Africa and southern Asia. To date, numerous species of this genus have been documented in indigenous medical systems and are utilised to make traditional remedies for a range of serious illnesses. More than 11 species of the *Clerodendrum* genus, ranging in number from 150 to 500, have had their chemical composition and biological activities thoroughly examined. Of these, 283 compounds have been isolated and identified, including monoterpene and its derivatives, sesquiterpene, diterpenoids, triterpenoids, flavonoid and flavonoid glycosides, phenylethanoid glycosides, steroids and steroid glycosides, cyclohexylethanoids, anthraquinones, cyanogenic glycosides, and others. In many parts of the world, including India, China, Korea, Japan, Thailand, and Africa, it is used as folk and traditional medicine to treat a wide range of illnesses, including colds, hyperpyrexia, asthma, furunculosis, hypertension, rheumatism, dysentery, mastitis, toothaches, anorexia, leucoderma, leprosy, arthrophlogosis, and other inflammatory diseases. The majority of the isolated phytochemicals of the genus were reported from *C. serratum, C. inerme, C. bungei, C. incisum, C. infortunatum*, and *C. trichotomum*. Aerial parts, roots, and leaves were the most often investigated targets for bioactive principles. In this review article we have tried to summarise the medicinal benefits obtained from different parts of different species of this useful medicinal plant so far.

Keywords*: Antimicrobial Properties; Antioxidant Activity; Clerodendrum; Medicinal Plants; Phytochemicals; Phytomedicine*

Introduction

Around 80% of people worldwide, particularly in developing nations, rely on herbal medicines to address their healthcare needs, according to the World Health Organisation (WHO). Folk medicine, which is based on bioactive substances found in plants and animals and used by many ethnic groups, especially those who (indigenous peoples) don't have easy access to western medicine is studied and compared in ethnomedicine. Ancestral Hindu books like the Shushrut Samhita, the Atharva Veda, and the Charak Samhita all talk about a lot of plants that are used for medicine. Despite the fact that medicinal herbs have been utilised for thousands of years, only in the last few decades has scientific research on their positive benefits become more prominent. Numerous therapeutic phytomolecules found in these plants have been shown to have therapeutic use (Khushali *et al.,* 2020). Flowering plants in

the genus *Clerodendrum* belong to the Lamiaceae (Verbenaceae) family. Glorybower, bleeding-heart, and bag flower are some of its common names. The world's tropical and warm temperate zones are home to *Clerodendrum*. Estimates of its species range widely, from roughly 150 (Sharma, Verma & Jha, 2022) to 500 (Wang *et al*., 2018). The vast majority of the species are located in tropical Africa, Eastern and southern Asia and northern Australia.

Linnaeus first defined this genus in 1753, using the Indian species *Clerodendrum infortunatum*. Around 1763, Adanson modified the Latinised name "*Clerodendrum*" to its Greek equivalent, "*Clerodendron*". After over two centuries, in 1942, Moldenke readopted the Latinised word "*Clerodendrum*," which is now widely employed by taxonomists for genus classification and description. According to progressive studies the genus *Clerodendrum*, which was once categorised in the Verbenaceae, is now considered to be part of the Lamiaceae. The species is commonly known by its scientific synonym, *Rotheca serrata* (L.) **(**Harley *et al.,* 2004; Mabberley*,* 2008), Clerodendrum species exhibit a great deal of variety in their morphology, cytology, and chemistry. Approximately eighteen formulas, including the Ayurvedic Pharmacopoeia of India and conventional texts, were the very initial sources that searched for *C. serratum* roots as one of the ingredients (estimated from 0.14%w/w to 7.69%w/w) for therapy of multiple medical conditions. The most prevalent titles for the roots of *C. serratum* are Blue Glory or Beetle Killer in English and Bharangi (meaning glorious) in Hindi. Asthma, chronic inflammation, and viral diseases have traditionally been treated using *C. serratum* as conventional medicine. The shoot sample of *C. colebrookianum* yielded a total of forty-four phytoconstituents, the majority of which are beneficial substances for normal growth and development (Yuan *et al.,* 2010). Considerable antibacterial efficacy against microorganisms which have become resistant to medication, especially *E. coli* and *S. aureus,* is demonstrated by the extract of dried leaf powder of *Clerodendrum infortunatum* in several solvents. In Northeast Indian communities and Chinese traditional medicine, *Clerodendrum glandulosum Lindl* is well-known for its traditional herbal medicines and medicinal qualities. A wide range of illnesses are treated including hypertension, diabetes, and other metabolic disorders, due to its numerous pharmacological qualities, which include antihypertensive, hypolipidaemic, hepatoprotective, anti-inflammatory, and neuroprotective effects Most of the genus's isolated phytochemicals have been discovered from *C. trichotomum*, *C. serratum*, *C. inerme*, *C. bungei*, *C. indium*, and *C. infortunatum*.

In this review article we have tried to summarise the medicinal benefits obtained from different parts of different species of this useful medicinal plant so far.

Pharmacological Effects

A growing number of investigations revealed that active compounds or extracts derived from Clerodendrum species demonstrated a broad spectrum of pharmacological actions (Harley *et al.,* 2004). Numerous clinical applications of the genus Clerodendrum in traditional Chinese medicine have motivated scientists to look into its pharmacological characteristics and confirm the usage of several species as medicinal remedies (Mabberley, 2008).

Antimicrobial Activity

i) Antibacterial effect

Bacillus subtilis, Salmonella typhi, Staphylococcus aureus, Escherichia coli, Proteus mirabilis and Klebsiella pneumoniae are all inhibited by the methanolic extract of C. siphonanthus. Both the water extract and n-butyl extracts from C. bungei demonstrated strong antibacterial activity against Fusarium graminearum, Micrococcus pyogenes, and Staphylococcus aureus respectively (Chae *et al.,* 2006).

ii) Anti-fungal effect

The majority of fungi were inhibited in their growth by *C. inerm* ethyl acetate extract (Kim *et al.,* 2009). Extracts of *C. infortunatum* in ethyl acetate and chloroform inhibited the growth of *K. pneumonia, S. aureus, E. coli,* and B. *subtilis*.

iii) Anti-plasmodial activity

Aqueous extracts, methanol and ethyl acetate extracts from *C. rotundifolium* prevented *Plasmodium falciparum* strains NF54 and FCR3 from growing.

iv) Anti-viral activity

The bioactive phytochemicals that were isolated from various *Clerodendrum* species showed potential in combatting some of the most pathogenically relevant viruses, including the Chikungunya Virus (CHIKV), Japanese Encephalitis Virus (JEV), Influenza Virus, Hepatitis C Virus (HCV), Herpes Simplex Virus (HSV), Human Immunodeficiency Virus (HIV) and Severe Acute Respiratory Syndrome-Corona Virus-2 (SARS-CoV-CoV-2).

Anti-Inflammatory and Anti-Nociceptive Activities

Numerous investigations have illustrated the anti-inflammatory qualities of extracts of aerial parts, roots, leaves, and stems from *C. laevifolium, C. phlomidis, C. petasites, C. inerme, C. bungei,* and *C. serratum.* Methanolic extract of *C. indicum* has strong antiulcer properties that prevent stomach ulceration when used to treat aspirin-induced ulcers (Sinha *et al*., 1981). Significant decreases in acid secretory measures, including total acidity, total acid production, and gastric secretion volume, were also noted. According to a histopathological analysis. *C. indicum* extract eliminated *H. pylori* infections and decreased stomach damage **(**Wang *et al.*, 2018)

Activity against Diarrhoea

Methanolic extract and chloroform fraction from the *C. indicum* and Methanolic extract from the leaves of *C. phlomidis* inhibited defecation in castor oil-induced diarrhoea (Xu *et al.,* 2014). It has been suggested that the antidiarrheal effect of *C. wallichii's* hydroalcohol extract and its chloroform fraction among other things, is caused by the flavonoid concentration (Kundan *&* Mahamedha, 2020). The preliminary phytochemical screening of methanolic root extracts of *Clerodendrum viscosum* showed the presence of flavonoids, phenolic compounds, alkaloids, tannin, steroids, glycosides and coumarins. it can be said that the root of *Clerodendrum viscosum* is a potential source of drugs for antidiarrheal activity.

Anti-Obesity Activity

Clerodendron glandulosum. Coleb. confirming its long-standing therapeutic application in the management of obesity by downregulation of PPARγ-2 related genes and Lep expression. Due to the inhibition of pancreatic lipase activity, which postpones the intestinal absorption of dietary fat, methanolic extract of Clerodendrum phlomidis has demonstrated a potent anti-obesity action (Blackadar, 2016). In vitro investigations verified that pancreatic lipase function was inhibited (Jadeja *et al*., 2011). SGOT, SGPT, TG, TC, LDL-c, glucose, insulin, pancreatic lipase activity, adiposity diameter, food consumption, body weight, and adiposity index were all reduced by the methanolic extract of C. phlomidis.

Memory Boosting Effects

Methanolic extract from C. infortunatum leaves demonstrated promising memory-enhancing qualities. It is likely that the extract will be used to create a potential no tropic to prevent dementia senilis. The pharmacological analyses of Clerodendrum serratum's methanolic extract demonstrated its anti-amnesic properties (Akihisa *et al*., 1990). The high flavonoid content of Clerodendrum serratum's ethanol extract, particularly its luteolin and apigenin, gives it strong antioxidant potential and may have neuroprotective benefits. It stops the development of many illnesses brought on by oxidative stress or slows its progression. For the treatment of neurological conditions, ethanol extracts from the C. serratum plant may be suggested as a supplement to synthetic antidepressant medications (Jadeja *et al*., 2011).

Activity Against Free Radicals and Antioxidant

By-products like free radicals and reactive oxygen species (ROS) are continuously produced *in vivo* for both specific metabolic processes and "accidents of chemistry. *C. serratum* aerial parts ethanolic extract show strong antioxidant activity against 1,1 diphenyl, 2 picryl hydrazyl (DPPH) and nitric oxide radical, whereas *Clerodendrum serratum* root extract demonstrated significant antioxidant activity against DPPH. Comparing the ethanolic extract of *Clerodendrum phlomidis* roots to petroleum ether, chloroform & ethyl acetate the former had the highest level of free radical scavenging activity (Muthu *et al.*, 2013). Higher levels of free radical and antioxidant activity were demonstrated by the methanolic extract of *Clerodendrum inerme* leaves. In addition to damaging biological molecules like DNA, lipids and proteins, ROS has a high reactive potential and is the cause of numerous human diseases, including diabetes, cancer, viral infections, cardiovascular disorders, and infections (Aung *et al.*, 2017).

Anticancerous Activity

A condition known as cancer occurs when cells in the body multiply unchecked. It can appear anywhere in the human body. With a 49.9% incidence and the second-highest crude death rate of 12.9% among the 36 cancer forms, breast cancer is the most common type (Wang *et al*., 2018).Though variety of anticancer drugs have been created to target the molecular processes that cause cancer, there hasn't been any appreciable rise in cancer patients' overall survival rate (Shrivastava & Patel, 2007). Advancements in cancer treatment, including surgery, radiotherapy, chemotherapy, immunotherapy, targeted

therapy, vaccines, combination therapy and stem cell transformation therapy, have been significant but not fully curable due to their high costs and adverse effects. The WHO estimates that one-third of the world's population lacks regular access to modern, necessary medical care (Cao *et al.***,** 2024)**.** It has been shown that many cancer patients are receiving their primary treatment from traditional drugs. The National Cancer Institute (NCI) conducted research on medicinal plants and ethno medicine for cancer treatment, analysing 114,000 extracts from 35,000 plant samples from 20 nations. Anticancer drugs can cause adverse effects like heart disease, immunosuppression, mental disorders, decreased blood production, gastrointestinal tract inflammation, and hair loss due to their targeting of both malignant and fast-proliferating cells. Certain natural and manufactured chemicals are effective in cancer chemoprevention. Radiation therapy and chemotherapy are currently used to treat cancer, but they are very costly and can have serious negative effects on patients (Blackadar, 2016). Natural products have been utilised significantly in cancer treatments in recent years to minimise the expense and harmful consequences of radiation and chemotherapy (Cao *et al.,* 2024). There are many distinct phytochemicals found in plants, and more than 75% of drugs used to treat various diseases come from plants. The behaviour of cancer cells and the microenvironment may be altered by natural antioxidants derived from plants. The hill glory bower, *C. viscosum* also known as *Clerodendrum infortunatum*, has long been used as a key Ayurvedic medicinal plant material. Based on some reports, *C. viscosum* can help with intestinal infections, renal failure, snake bites, scorpion stings, and a variety of skin-related issues. *C. serratum* extract in methanol inhibited tumour development. Flavonoids in total from *C. bungi* suppressed the HepG2 cell (Kyaw *et al.*, 2022).

Other Activities

The prospective neurological protective properties of acetin, a flavonoid that is derived from *C. inerme* were evaluated. The ethanolic extract of *C. petasite* showed a substantial relaxing effect on the tracheal smooth muscle. Acacetin was found to suppress the cytosolic free Ca^{2+} concentration and glutamate release triggered by depolarisation in the hippocampus nerve terminals. Methanolic extracts of *C. phlomidis* leaves are responsible for a reduction in spontaneous activity. It also decreased exploratory behavioural characteristics. On being separated, the active ingredient was found to be the flavonoid hispidulin. The finding suggested that hispidulin might help treat conditions linked to asthma. For the first time, Huang *et al. (*2015), showed that hispidulin extracted from the dichloromethane and n-hexane fractions of C. inerme ethanol extract dramatically decreased hyperdopaminergic diseases.

Conclusion

Safety, effectiveness, and herbal supplement quality supervision have become crucial issues due to the massive global growth in the use of traditional medicine. The chemical components of the genus *Clerodendrum* have been identified and isolated in the current review. Pharmacological studies have shown that the genus's crude extracts and some unique monomer compounds have a variety of biological activities, ding anti-inflammatory and antinociceptive, antioxidant, anticancer, antimicrobial, antihypertensive, anti-obesity,

antidiarrheal, hepatoprotective, memory-enhancing and neuroprotective properties. This plant has the capacity to produce antioxidants, which could result in the creation of innovative phytomedicine. This study proposes that the compound of the plant *Clerodendrum indicum* could be employed as a lead compound in the development of powerful pills for the treatment of a variety of ailments. Only a small number of the more than 400 species of the genus *Clerodendrum* have been thoroughly examined and researched to date. Phytochemically and physiologically, many additional species are completely unknown. Keeping an eye on these species could be crucial to finding novel bioactive substances.

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