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Allamanda cathartica Linn. Apocynaceae: A mini review

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Abstract

Allamanda cathartica Linn. (Family –Apocynaceae) is a perennial shrub, found in various parts of the world. The common name of the plant is Golden Trumpet flower, and in Bengali, it is known as Harkakra. The plant is also known to deal with heat and different toxic products; it activates blood circulation and diuresis. It works well against snake bite. In traditional medicinal practices, the plant is used to cure skin infection, cold and cough, and various other inflammations. The plant possesses various secondary metabolite substances like flavonoids, polyphenols, iridoids, tannins, and alkaloids. Various pharmacological studies concluded some notable bioactivities of the plant such as anti-inflammatory, anti-microbial, wound healing, etc. This review aims to explain the overviews of the various uses and prospects as well as agricultural, taxonomical, phytochemical, pharmacological, and toxicological areas of the *Allamanda cathartica*.

Keywords: *Allamanda cathartica*, Harkakra, traditional medicine, phytopharmacology

Introduction

Allamanda cathartica Linn. belongs to the family Apocynaceae is widely growing imperishable ornamental shrub. Botanical surveys proposed that *Allamanda cathartica* was popularized in the Caribbean land by at least the mid-nineteenth century. In 1864 AHR Grisebach, observed that the plant was cultivated in St. Vincent, St Kitts, Jamaica, and Antigua [1]. In 1873, FA Sauvalle spotted this plant species for Cuba, and in 1879, HFA Eggers explained that the plant species are cultivated at the Virgin Islands [2, 3]. In Puerto Rico, the species is noted as a cultivated and natural plant, and it comes from Bello Espinosa. From the beginning of the last century, the plant species is differentiated as a cultivated and escaped by Ignaz Urban for the peninsula of Jamaica, Cuba, St. Kitts, Antigua, Guadeloupe, St Thomas, Barbados, Trinidad and Puerto Rico Martinique [4]. *Allamanda cathartica* was first reported in Australia as confirmed species in 1945, and by 1992 it was accepted as a weed in Queensland. In 2005 JF Morales explained *Allamanda cathartica* as it is escaped from cultivation and naturalized in the Atlantic Coast [5]. In the global compendium of weeds, *Allamanda cathartica* is described as a vine-like woody shrub [6]. This species reproduces by vegetative propagation by cuttings and sexually by seeds [7]. *Allamanda cathartica* has been highly used as an ornamental or garden flowering plant in tropical and subtropical regions of the world. This plant species are fast-growing.

The family Apocynaceae comprises about 415 genera and about 4555 species extensively scattered around the world [8]. The plant is a perennial shrub or woody vine. Sometimes twinning or clambering with rich in milky latex and it is much branched mostly 3-9m in length. Leaves are ovoid, elliptical, wrinkled, and the apex is edged; the margins revolute and undulate, the base is intense; upper surface shiny, dark green, glabrous, with a sharp mid-vein; lower surface yellowish green, with the condense mid-vein. Petioles are 5-10 mm long; stems are cylindrical, naked and grayish. Flowers are formed in axillaries cymes-calyx greenish, five wedged sepals, 12-18 mm long. Capsules ellipsoid, covered with plentiful spines, infrequent; seeds several, oval, constrict, 1.2-1.5 cm long, with a sulcy, wing-like margin [9]. The whole plant parts possess various medicinal properties such as anti-bacterial, anti-viral, anti-inflammatory, antipyretic, and analgesic activity [10].

Taxonomic Classification

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta

Class: Dicotyledonae
Order: Gentianales
Family: Apocynaceae
Genus: *Allamanda*
Species: *Allamanda cathartica*

Identification

Botanical Name: *Allamanda cathartica* Linn.

Common Name: Yellow Allamanda

Regional Common Name

Bengali-Harkakra, Malayalam-Kolaambi, Marathi-Pivlee Ghunti, Telugu-Allenandatheega, Kannad -Arasinhu, Hindi-Pilaghanti.

International Common Name

English: Buttercup Flower, Golden Allamanda, Yellow Bell, Yellow Trumpet Vine; **Spanish:** Canario, Campana de oro; **French:** Lianejaune; Monettejaune; **Chinese:** Ruanhuangchan; **Australia:** Golden Trumpet Vine; **Brazil:** Alamanda, Carolina, Santamaria; **Cuba:** Barber, Barbera; **Cook Islands:** Aramena, Puapua, Tiareregarenga; **Dominican Republic:** Mantequilla; **Germany:** Allamande, Goldtrompete; **Tonga:** Pua, Pula

Synonym

Allamanda aubletii Pohl, *Allamanda cathartica* var. *hendersonii*, *Allamanda cathartica* var. *grandiflora*, *Allamanda hendersonii*, *Allamanda latifolia*, *Allamanda cathartica* f. *salicifolia*.



Fig 1: The Plant of *Allamanda cathartica* Linn.

Botanical Morphology

Habitat

Allamanda cathartica, (Figure 1) mainly a garden or ornamental plant but it can also be found in forest edges, disturbed areas, abandoned gardens, roadsides, and farms [10, 11, 12, 13]. It has also been documented flourishing on riverbanks and near swamps and lagoons and settled places [4, 14, 15]. The type of the plant is perennial, and the propagation method is a vegetative and medicinal woody shrub, vine or climber and grows in tropical and subtropical parts of the world [16, 17].

Stem

This plant is a shrub or woody vine, much branched with growth form up to 3-9 m long, latex is abundant and milky. The nature of stem is grayish, glabrous, and cylindrical (Figure 2).



Fig 2: Stem and Leaf

Foliage

Leaves (Figure 2) are arranged in whorls of 3 to 4; blades 7-14 × 2-4 cm, elliptical, oblong, the base is acute, the apex is acuminate, the margins are undulate and revolute; upper surface is glabrous, shiny, dark green with a prominent mid-vein; lower surface yellowish green, thick; stipules transformed into 4 small glands, petioles 4-12 mm long.

Flowers

Flowers (Figure 3) are organized in auxiliary cymes. The calyx is green, five lanceolate sepals which are 11-17 mm long; corolla yellow in color. The tube 6-10 cm long, the limb has five rounded and revolute lobes with 9 cm in diameter.



Fig 3: Flower

Fruits

Capsules are ellipsoid, enclosed with spines, infrequent; seeds are plentiful, compressed, and oval, 1.5-1.8 cm long, with a faded, wing-like edge [9].

Genetics

Chromosome number of *Allamanda cathartica* Linn. is $2n = 18$ [18].

Physiology

Allamanda cathartica is a perennial plant species, and a fully established individual grows very fast, adding approximately 1.5-3.5 m to elongated length every year. In summer and full sunlight, this species produces flowers and grows best [7, 11].

Reproduction

Allamanda cathartica, mostly pollinated by insects, has hermaphroditic flowers. Flowers develop to be self-incompatible, and seeds are hardly produced by cultivated varieties [11].

Environmental Impact

Allamanda cathartica is an invasive species with the potential to alternative vegetation by displacing native species. It is a fast-growing vine-like woody shrub, and in just one or two growing seasons, it can form dense colonies and completely native vegetation. Different parts of *Allamanda* sp. contain a toxic iridoid lactone, allamandin which is toxic to humans and other animals if ingested. The sticky, milky sap of the plant can cause skin irritation [7, 11].

Chemical Constituents

The whole plant of *Allamanda cathartica* Linn. contains several phytochemicals. Among them, Plumieride, plumericin, and allamandin are essential. The parts of the plant contain various phytoconstituents.

These are as follows

Leaves

Leaves consist of ursolic acid, β -amyrin, and β -sitosterol. It also contains sesquiterpenes and plumericin. Plumieride and a long chain ester have been isolated and identified from leaves.

Stem and Bark

The stem contains ursolic acid, β -amyrin, and β -sitosterol. Stem also contains triterpenoids, glucoside, and alkaloid.

Flower

Flowers contain quercetin, kaempferol, hesperetin and few other flavonoid compounds.

Roots

Roots consist of lactone, allamandin, and iridoids. The root contains chemical constituents such as triterpenoids, alkaloid and glucoside. Plumieride and an ester also isolated from roots.

In a research study, the plant pigments of some ethno medicinal plants were estimated. The research investigation showed that total chlorophyll and total carotenoids content fluctuated in different medicinal plants. Other two plant pigment research studies observed that plant pigments content might vary due to the different ecological factors like air pollution, and it may show variation due to seasonal changes also. Some other important bioactive compounds can be varied with the plant parts as well. The biomolecules of *Allamanda blanchetii* and *Allamanda cathartica* was estimated in a research study where the flower of the plants was showed a higher amount of secondary metabolites than other plant parts [10, 19, 20, 21, 22, 23].

Remedial Uses

Allamanda cathartica plant parts such as leaves, flower, root, and stem are used in traditional medicine for giving protection to human from ancient time. Different ethno pharmacological reports suggest that the roots are used against jaundice, malaria, and an enlarged spleen. The flowers act as a laxative, and also used as an antibiotic against *Staphylococcus spp.* In Trinidad, it is also used for treating malaria and jaundice. In Guiana, the latex is employed for colic and also used as purgative in Southeast Asia. Leaves are used against cough and headaches. *Allamanda cathartica* flower extracts show potential anti-inflammatory and anti-oxidant activities. Plumieride, the primary compound of flower extracts has potential anti-inflammatory activities. It has also been recorded as a medicinal plant for the medication of various conditions such as feverish infections like dysentery,

gonorrhoea, and hepatitis. The leaf extracts have visible anti-fertility potency in male, membrane stabilizing activity and anti-microbial property against multiple drug-resistant pathogens. The milky sap is also accepted for its anti-bacterial and possibly anti-cancer activities [9, 10, 24, 25, 26, 27].

Pharmacological Activities

Anti-oxidant Activity

Anti-oxidant properties of *Allamanda cathartica* leaves extract was detected by the ABTS method. The ABTS radical scavenging assay showed hydrogen donating ability and chain breaking capacity of the extracts to free radicals. Root extracts of *Allamanda cathartica* the enzymatic antioxidants such as superoxide (SOD), peroxidase (POD), catalase (CAT) and polyphenolic contents are highest. POD, which is a skin protecting compounds can help to remove hydrogen peroxide from tissue, whereas SODs can remove oxidative stress in several life-threatening complications. The root showed the highest enzymatic anti-oxidant activity than leaf and stem [28].

Anti-inflammatory Activity

The anti-inflammatory activity of the ethyl acetate flower extract from Golden Allamanda was observed. In hypotonic stress condition, when RBC is subjected, it releases hemoglobin. This release is prevented by anti-inflammatory drugs because of the membrane stabilization of the drugs against hypotonicity, which causes hemolysis. This method is used as an *in-vitro* condition to determine the anti-inflammatory effect of various compounds. It has been showed that quercitrin compounds have significant anti-inflammatory properties [24].

Wound healing Activity

The water extract of the plant showed wound healing properties in both incision and excision wound models on Sprague-Dawley. Noticeable increase in the weight of the granulation tissue and hydroxyproline content, high skin breaking strength, decrease in the period of epithelialization, high rate of wound contraction was showed in animals served with the water decoction of the plant. It was observed from the histological studies of the granulation tissue that the treated group exhibit the existence of a lesser number of inflammatory cells, and expanded collagen formation than the control group. The leaf decoction has the highest amount of wound healing properties compared to the reference and control group [29].

Membrane Stabilizing Activity

The membrane stabilizing the effect of various organic and water-soluble compounds of the methanolic decoction of the leaves was determined by evaluating their capacity to obstruct the hypotonic solution and heat-induced hemolysis of human erythrocytes cells. In an experiment showed it was observed that hemolysis was inhibited by the water-soluble fractions where acetylsalicylic acid was used as standard drug [30, 31].

Thrombolytic Activity

Analysis with the crude methanol decoctions of the plant leaves and its various fractions were executed to figure out the possible thrombolytic effects. *In vitro* thrombolytic model was carried out to detect their thrombolytic capacity. In the study, water and streptokinase were used as a control. The hexane and chloroform-soluble factions showed 32.18 \pm 0.58% and 34.51 \pm 0.67% clot lysis as compared to standard streptokinase, which showed 61.5% lysis of clot [30, 31].

Anti-dermatitis Property

Dermatophytoses disease is caused by the dermatophytes. Two strains of dermatophytes were collected and evaluation was done. The dichloromethane decoction of concentration of 50µg/disc showed a medium activity, whereas the concentration of 200µg/disc showed higher activity. The methanolic decoction of plant parts was not active against the strain [32].

Anti-fertility Activity

It is showed from various research works that the plant has an anti-fertility activity. The oral administration of the water decoction of leaf causes infertility and changes male reproductive endpoints in an animal model. Nonuniform degenerative changes were shown in testes those are treated with the decoction in seminiferous tubules as both are affected. The treatment also showed the negative results on viability, morphology, motility, histology, and the number of counts of spermatozoa present in caudaepididymidis. Serum levels of testosterone, creatinine, aspartate aminotransferase, and liver, and kidney were not affected by the study [27].

Hepato-protective Activity

Research has done to study the hepato-protective activity of the plant parts. The water and methanolic decoctions were made from roots and flowers to study the hepato-protective effect using an anti-tubercular drug such as Rifampicin, Isoniazid and Pyrazinamide, and toxicants like D-galactosamine and silymarin. The study concluded that root decoction at 1000µg/ml showed 86% protection, and 125µg/ml showed 50.24% protection. The flower decoction at 1000µg/ml showed 81% protection, and 125µg/ml exhibit 55.49% protection [26].

Anti-microbial Activity

The anti-microbial property of the flavonoid glycosides isolated from the plant was investigated by using disc diffusion method. *Staphylococcus aureus* and *Escherichia coli* were chosen for determining anti-microbial activity. The effect of Quercitrin was evaluated with doses of 10µg and 20µg of the drug. It was shown that the zone of inhibition of the isolated compound increased in case of *Staphylococcus aureus*, with an increase in the dose of the drug. It was shown that the growth was contained entirely in the case of gram-positive bacteria. The isolated compound shows moderate or no activity against gram-negative bacteria in the study. The anti-microbial property of the flavonoids, alkaloids, and steroids isolated from the plant leaf and flower was investigated by using disc diffusion method [25].

Toxicity Studies

Allamanda cathartica is reported to have an essential plant due to the presence of a cardio-toxic glycoside [33]. Dermatitis happens in the whole parts of the plants. It has been reported in a research study that the leaves and juice produce diarrhea with high consumption, though the responsible compounds are not identified, skin problem has also been reported in the study [34]. Cytotoxicity and genotoxicity were done by the hexane decoction of leaves. According to the results of genotoxicity, this was observed that the plant is not to be used as a medicinal plant. The ethanol decoction of flowers and the compound was orally administered in a dose of 2mg/kg body weight in animal model, and results showed that a single dose have no toxicity [35].

Conclusion

Allamanda cathartica Linn. have enormous prospects for botanical, phytochemical, and pharmacological activities. From the review work and explanation, it is observed that the plant has been widely used in the traditional medicine for several diseases and it possesses different significant phytopharmacological properties, as it is discussed in the review article. There are broad prospects of research to explore much more bioactivities of this plant and to find out the mode of action to know the physiological activities of the plant extracts as well. This garden or ornamental plant would be a vital source of natural products for the pharmaceutical industry in the future also [12, 13, 14, 15, 16, 17].

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Conflict of Interest

The author declares no conflict of interest.

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