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GLORIOSA SUPERBA L.: A DIMINISHING WONDER

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ABSTRACT
Gloriosa superba (Flame lily) is a creeper plant belonging to the family Colchicaceae. This plant has been used asa remedy in classical times. In rustic regions of Asian continents, the plant has been used as ethnomedicine. It has antimicrobial, antioxidant, anti-inflammatory, anthelmintic, and anti-coagulant properties. This plant is a rich source of important phytochemicals like colchicines and colchicocides, which are very expensive, as these are used in modern medicine, this plant is also exported from India. Colchicine has the potential for treating fatal diseases like cancer and it is also used to treat the hyper-inflammatory phase in COVID-19 patients. It is also used in prevention of cardiac diseases like pericarditis. In recent years, *G. superba* is copiously used as a source of colchicine to treat gout because colchicine is a substitute for those who are unable to tolerate non-steroidal anti-inflammatory drugs used in gout. Literature data revealed that this species is also used to cure disorders like rheumatism, arthritis, cholera, impotence, typhus, etc. This species is on the border of extinction and is included in the 'Red Data Book' by the International Union for Conservation of Nature. Current communication tried to cover an overall review of various medicinal and pharmacological aspects of *G. superba*.

KEYWORDS: "*Gloriosa superba*"; "Ethnomedicine"; "Phytochemical"; "Colchicine", "Glory Lily".

INTRODUCTION

Medicinal plants are a rich source of many phytochemicals which are used as important ingredients in ethnomedicines and pharmaceutical industries. These have been used as remedies since prehistoric times. Today despite the discovery of many modern medicines, the majority of people in the world rely on natural herbal medicines and these are becoming exceedingly renowned as a natural alternative to chemically synthesized drugs.[1]

Gloriosa superba is an attractive climber plant belonging to family Colchiceaceae. It is known as 'Glory Lily'in English and 'Kalihari' in Hindi. The genus *Gloriosa* includes 12 species, there is lack sufficient data about other species of the genus. Commercially, seeds and tubers of glory lily are sold and these are used to produce medicine by pharmaceutical industries. This plant species is also used as an ornamental plant throughout the world. Glory lily has been used as a remedy for thousands of years. However, it is a non-edible plant and if ingested can be lethal. As per Ayurvedic literature, it can be used to treat diseases like asthma, piles, indigestion, fever, snake bites, wound infections, skin infections, leprosy, internal parasites and relieve delivery pain, and has abortifacient properties. However, this species is on the border of extinction and is included in the 'Red Data Book' by International Union for Conservation of Nature.[2, 4 & 5]

Scientific Classification

Kingdom	Plantae
Division	Tracheophytes
Sub-division	Angiospermae
Class	Liliopsida
Order	Liliales
Family	Colchicaceae
Genus	*Gloriosa*
Species	*G. superba*

Geographical distribution

The native habitual of *G. superba* is Africa and tropical Asian countries like Malaysia, Burma, Sri Lanka, and India. In India, it is generally found in western parts like Odisha, Tamil Nadu, and Kerala and it is distributed as rare plant species in states like Uttar Pradesh. It is also cultivated in some parts of India like Odisha, Chattisgarh, Goa, and Tamil Nadu. The farmers of Tamil Nadu contribute a major share of world consumption of 800-1000 tonnes per annum. India is the major exporter

of glory lily, the provisional export value of this plant species was 53 million in the years 1996-97 and this value has enhanced approx 15% in the year 2015.[6 & 7]

Botanical description

Glory lily is a perennial herb, the stems grow up to four meters. It has an underground fleshy rhizome and the stem climbs using tendrils. Leaves are 13-20 centimeters in length, lance-shaped, sessile, and have tendrils on tips. Flowers are axial, solitary, and actinomorphic and have six bright red to orange tepals of approximately six centimeters in length each. The ovary is superior with numerous ovules and there are six extrorse anthers up to four centimeters long. It has a six-twelve centimeters long capsule fruit having red seeds. Glory lily is cross-pollinated by butterflies but it is not self-incompatible.[4,5,6,7 & 8]

Soil

Glory lily grows best in a red loamy soil. Proper drainage is required but waterlogged soil should be avoided. Soil with a pH around 6.0-7.0 is suitable for this plant.[8]

Climate

Moderate daytime temperatures and cool night temperatures are suitable for this plant. Glory lily is propagated through tubers, planting is distributed from June-July, and fruits are harvested between 160-180 days after the sprouting of tubers.[9]

Fertilizers

Before planting about 10 tons of 'Farm yard Manure' (FYM) is added per hectare (ha). Nitrogen, phosphorus, and potassium (NPK) are applied at a ratio of 120:50:75 respectively. Nitrogen is applied in split doses, all phosphorus, all potassium, and half of the nitrogen is applied with FYM, and the remaining half of the nitrogen is applied one and two months after planting.

The crop requires irrigation immediately after planting and subsequently at 5 days intervals of time.[9]

Pest and diseases

Tuber rot is a major disease of *G. superba* and it is caused by Fungi *Macrophomina phaseolina* and *Fusarium* species. The leaves show concentric ring symptoms when get infected with fungi *Alternaria*. Crop pests such as moths *Polytela gloriosa* and *Chrysodeixis chalcites* are also main problems during cultivation.

G. superba is mainly cultivated for its seeds and tubers because various pharmaceutically important phytochemicals are extracted from these parts of plants. The average yield of glory lily is about 200-250 kg/ha of seeds and 300 kg/ha of tubers.[9, 10 & 11]

CHEMICAL CONSTITUENTS

Phytochemical analysis of tubers shows the presence of many micronutrients i.e. vitamin E, vitamin C, carbohydrates, alkaloids, flavonoids, phenols, saponins, glycosides, and minerals like Zinc, Copper, Manganese, Selenium, and Iron (**Table 1**). Elemental concentrations of minerals were estimated by the method of micro-scaled digestion in the microwave oven and Teledyne Leeman, ICP (Inductively Coupled Plasma) analysis.[12 & 13]

Seeds and tubers show the abundant presence of bioactive compounds in different concentrations (**Chart 1**). The seed shows fewer bioactive compounds than tuber in hexane, methanol, and chloroform solvent extracts. Biochemical analysis of tubers have illustrated the presence of flavonoids, tannins, glycoside, luterlin, Glucoside, β silosterol, long chain fatty acids, 2-hydroxy-6-methoxy benzoic and salicylic acid, alkaloids i.e. 3-O- demethylcolchicine-3-O-α-D-glucopyranoside, 1,2-didemethyl colchicine, β and γ Lumicolichicines, 2,3-didemethyl colchicine, N-formyl deacetyl colchicines and colchicocide. GC-MS analysis of the ethanolic extract of tuber shows the presence of Ethyl allocholate, n-Hexadecanoid acid, Squalene, Vitamin A aldehyde, and 9,12- Octadecadienoic acid (Z, Z) in different ecotypes of *G. superba*.[15]

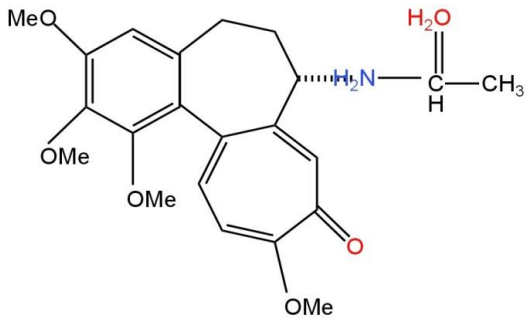

Figure 1: Chemical structure of Colchicine.

Leaf samples of *Gloriosa superba* collected from Kottayam region of South India show proteins, phenols, triterpenoids and tannins (**Table 2**). Flowers, seeds and tubers show high content of flavonoid. Alkaloids are absent or present in negligible amount in leaves and flowers extracts but found in ample amount in seeds and tubers extract.[16]

The presence of medicinally important colchicines-type alkaloids is a characteristic feature of the genera of the Colchicaceae family. Several colchicine-related alkaloids have been isolated from *G. superba* tubers and seeds (**Figure 1**). The colchicines content is lower in tubers, compared to the seeds (**Chart 2**). In recent years, *G. superba* is copiously used as a source of colchicine to treat gout because colchicine is a substitute for those who are unable to tolerate nonsteroidal anti-inflammatory drugs (NSAIDs) used in gout. Generally, colchicines appear to inhibit multiple pro-inflammatory mechanisms, while enabling increased levels of anti-inflammatory mediators. Colchicine is used to cure Behçet's disease, familial Mediterranean fever and in prevention of heart diseases like pericarditis. It also exhibit potential of the palliative treatment of gastric cancer.[17, 18, 19, 20 & 21]

Table 1: Composition of Glory lily tubers.[38]

Estimations	Tuber sample
Moisture content	18.70% approx.
Ash content	3.04% approx.
Aqueous extract	23.92% approx.
Selenium	593.809 (ppm)
Copper	17.240 (ppm)
Iron	12.441 (ppm)
Zinc	5.378 (ppm)

Table 2: Total Percentage composition of bioactive phytochemical in Glory lily plant.[39]

Bioactive compound	Percentage Composition
Flavonoid	50.87± 8.12
Protein	33.11± 4.45
Phenols	30.12± 3.35
Steroids	51.31± 2.85
Tannin	32.45± 5.12
Terpenoid	43.14± 4.11

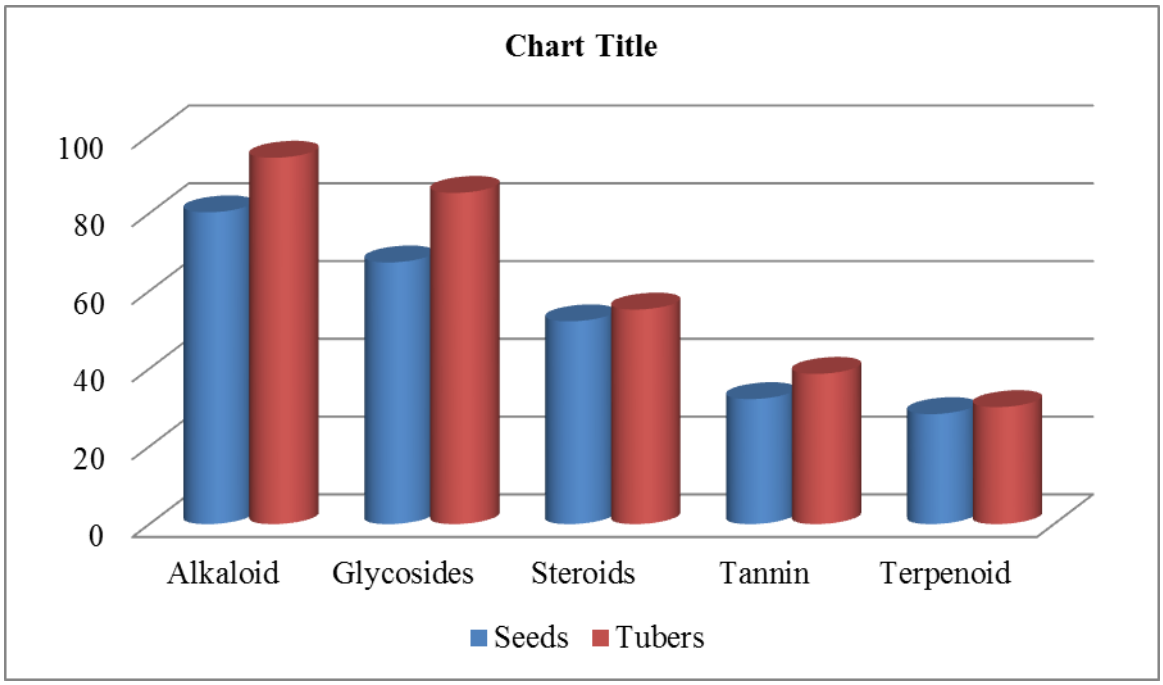

Chart 1: Quantitative phytochemical analysis of a methanolic extract of Glory Lily seeds and tubers (quantity is in percentage).[38]

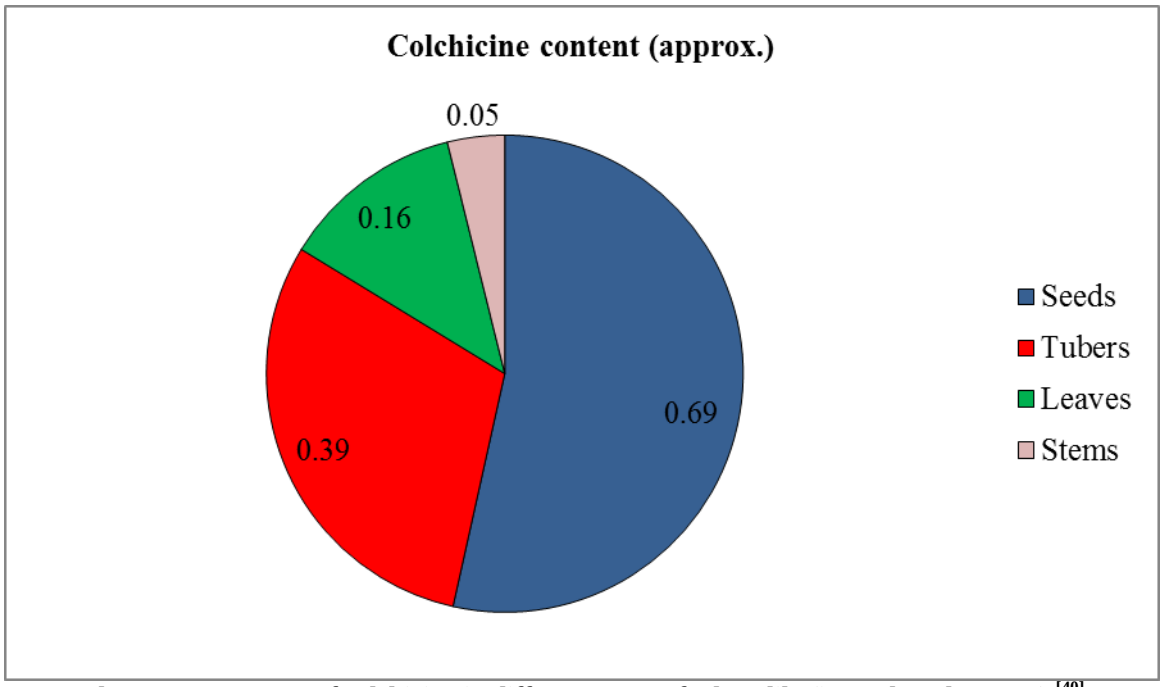

Chart 2: Percentage of colchicine in different parts of Glory lily (in methanol extract).[40]

PHARMACOLOGICAL USES OF*GLORIOSA SUPERBA*

Gloriosa superba has many bioactive phytochemicals which makes this plant species a wonderful medicine. Literature data revealed that this species used to cure disorders like arthritis, aches, diabetes, cholera, impotence, typhus, etc.

Anti arthritic: Due to action of colchicine on several biochemical reactions on inflammatory mediators, *G. superba* shows anti arthritic activity. Studies suggested that the effect of plant whole extract is more effective on the inflammation causing cells than pure colchicine and which may due to synergistic action of colchicine and other bioactive chemicals present in plant extract.[22]

Analgesic: Analgesic effect of *G. superba* has been shown by hydroalcoholic extract of the plant on acetic acid-induced writhing in mice, the number of writhing reduces with an increase in dose. Studies support the hypothesis of participation in the inhibition of prostaglandin formation.[23]

Uterotonic activity: The root extract of Glory lily treatments shows uterotonic activity both *in vivo* and *in vitro* assay of female rats but the height of contractions produced by the extract was a little lesser than that produced by oxytocin hormone. Hence, this plant can be used as a drug to induce labor during child delivery.[24]

Larvicidal effect: Glory lily shows a larvacidal effect on the mosquito *Aedes aegypti*, which is a causative agent of Chikungunya disease and hence this plant can be used as a biocide in the control of the mosquito.[25]

Antimicrobial activity: The crude extract of Glory lily shows excellent antifungal activity against *Trychophyton longifusus* which causes dermatophytosis on hair, skin, and nails; this plant also shows antifungal activity against two species of *Candida* i.e. *C. albicans* and *C. glaberata* which causes candidiasis. This plant shows good antibacterial activity *Staphylococcus aureus.*[26]

Anti-inflammatory activity: The methanol extracts of root tubers of Glory lily has shows good anti-inflammatory activity in percent inhibition of cycloxygenase assay and lipoxygenaese assay.[27]

Anthelmintic activity: Alcoholic extracts of *G. superba* show good anthelmintic activity, HCEM (Hot continuous extraction method) extracts shows better results than CHEM (Cold maceration extraction method) extracts.[28]

Antioxidant activity: The free radical scavenging activity of the plant extracts by the 1,1-diphenyl-2-picryl-hydrazil (DPPH) assay shows it has good antioxidant activity. The methanolic extract has the higher scavenging activity than petroleum ether and aqueous extract.[29]

Anti-cancerous activity: Plant extract of Glory lily when applied in 100 microgram concentration to the Hep-G2 cells (human liver cancer cells) then many cells lost their viability, cell death indicates cancer inhibition.[29]

Anti-anxiety activity: *G. superba* shows good anti-anxiety activity at the dose of 300 mg/kg in albino mice using the elevated plus maze model of anxiety.[30]

Anti-fertility activity: The study concluded that the extracts of *Gloriosa superba* show inhibition of pregnancy (antifertility effect) by a decrease in several implants in albino rats.[31]

Antithrombotic activity: The anticoagulant activity of the leaf extracts of *G. superba* when investigated using the thrombin-induced clotting time assay, illustrated good antithrombotic and anti coagulant activity.[32]

Anti-diabetic activity: A study has concluded that hydro-alcoholic extract of *G. superba* leaves has significant anti-diabetic activity. This may be due to the composition of flavonoids and phenolic constituents in the leaf.[33]

Green synthesis of pharmaceutically important nanoparticles: Studies report the green synthesis of nanoparticles (Nps) like Copper oxide (CuO) and Cerium oxide (CeO_2) by using *Gloriosa superba* extract as a fuel. CuO and CeO_2 Nps exhibit significant antibacterial activity against many pathogenic bacterial strains.[34 & 35]

ETHNOMEDICINAL USES OF*GLORIOSA SUPERBA*

Gloriosa superba is used as ethnomedicine by many tribal communities of India (**Table 3**). The medicinal properties of this plant species are also mentioned in various ancient scriptures of India like in Charak Samhita, Sushruta Samhita, Nighantu, etc. Ethnomedicinal use of Glory lily for bleeding piles, arthritis, conjunctivitis, asthma, and many more diseases has been reported. It is either used ectopically or taken orally.

Due to the presence of colchicines, *G. superba* is toxic if ingested in a high dose. Ingestion of tuber and seeds is fatal and causes gastric and intestinal irritation, vomiting, and purgation. However, this plant if ingested does not show any cardiovascular effect. A lethal dose is about 6 mg/Kg body weight and the fatal period is about 12–72 hrs after consumption. However, cow's urine processed (sodhana) tubers are less toxic and safer to use in therapeutics.[12, 36 & 37]

Table 3: Ethnomedicinal uses of Glory Lily by different tribal communities.[41]

Indian tribes/Region	Local name	Part used/mode of application	Used to cure
Malayali (Tamil Nadu)	Senganthal	Paste of rhizome applied over wounds	Wounds
Meerut (Uttar Pradesh)	Kalihari	Filtered decoction of the root in sesame oil	Pain in Joints
Bhils, Wanjaris (Maharashtra)	Kallavi	Paste of tuber (a) and Decoction of tuber (b) is applied over forehead	Sinusitis (a) and Asthma (b)
Kanjamalai hills (Tamil Nadu)	Kalappaikila Ngu	The juice of tuber is mixed with the Cow's milk (a) Tuber decoction of tubers mixed with Cow's milk (b) is taken orally	Aphrodisiac (a), gonorrhea and skin infections (b)
Oraon (West Bengal)	Ultachandal	Root paste and black pepper with goat milk are taken orally	Induces abortion
Bhil, Meena (Rajasthan)	Kalihari	Tuber paste is taken orally	Anti-venom in snake bite
Jaunsuri (Uttaranchal)	Langyla	Tuber powder, Leaf extract	Delivery pain relief, cure suppressed urination
Malayali (Tamil Nadu)	Kanvalipoo Kazhappaiki Angu	Paste of seeds and tubers	Inflammation, Epilepsy
Malwa, Nimar Vindhya (Madhya Pradesh)	Kalichari	Root paste	Diphtheria, Mumps

CONCLUSION

Gloriosa superba has been traditionally claimed for huge numbers of therapeutic actions and ethnomedicinal uses. Over-exploitation of the plant for its medicinal usage is responsible for the current status of this plant. Conservation of medicinal plants from extinction is a matter of greatest concern to mankind. This plant has to be explored further in the future. Enhancement of colchicine production of Glory lily to meet industrial requirements should be emphasized. Standardization of protocols for tissue culture and somatic embryogenesis is required to cope with low seed set problem of *Gloriosa superba*. Usage of this plant in other diseases and toxicity can be explored further by clinical trials. Enhancement of secondary metabolites can also be achieved by genetic engineering and developing transgenic plants.

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