

Phyto Constituents and Pharmacology of *Gloriosa superba* L.: A Medicinally Potent Plant Species

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Abstract: *The Gloriosa superba L. is a persistent climber and is used as an ayurvedic therapeutic herb to treat diseases in several parts of Africa and Southeast Asia. Because of its irresponsible harvesting from wild as it is expansively utilized by medicinal business for its colchicines substance, the plant was under vulnerable category. It is listed in the red data book. With searching of different reports on FT-IR investigation, GC-MS analysis and other techniques found numerous phytoconstituents that contributed more or less for pharmacological activities, miscellaneous uses including toxic consequences. The entire plant keeps numerous biological activities such as antioxidant, antibacterial, antimicrobial, anti-fungal, hepatoprotective, anti-diabetic and many more properties. The number of bioactive constituents with total 14 pharmacological activities have been assembled with available literature. Therefore, based on the aforementioned consideration, this article reviews the most updated information of the phytochemical properties and pharmacological effects of G. superba extract, including its miscellaneous uses.*

Keywords: Colchicines, phyto constituents, antioxidant, anti-diabetic, pharmacology

1. Introduction

The Medicinal plants form the backbone of conventional systems of medicine in India. Pharmacological reports have approved the significance of medicinal plants as prospective resource of bioactive compounds [1]. The phytochemicals from medicinal species provide as lead compounds in drug finding and design. They are prosperous resource of novel medicines that forms the constituents in conventional systems of medicine, current medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates, bioactive principles and lead compounds in synthetic drugs [2]. In modern situation WHO projected 80% of the community from the entire world are concerned towards conventional remedy. The medicinal plants species are usually recognized as people's friend, offering the food, energy and medicine [3]. India was sourced through its wealthy conventional awareness and has heritage of herbal results and medicines and improved its prosperity with unstable biodiversity [4]. Medicinal plant property are chief foundations of Indian conventional and current medicine [5,6].

The *Gloriosa superba* is generally recognized as Malabar glory and it is a perennial creeper in the family Liliaceae, indigenous to Africa [7]. The plant is a indigenous of tropical Asia and Africa. It is occurring throughout tropical India, from the North-West Himalayas to Assam and the Deccan peninsula [8, 9]. The plant more or less scattered all over India and also growing in forests of Tamil Nadu state. In several Districts, cultivators farming the plant species due to its valuable seeds. The tuber is a prosperous supply of alkaloid colchicine [10]. It is one of the chief remedial plants in India cultivated for its seeds which are exported to urbanized nations for pharmaceutical applications. However, not much is recognized about the chemical composition of the plant leaves and tubers [11]. The several of the therapeutic plants were the best supply to obtain a range of novel herbal products [12].

Its stem is slight and develops at the rate of 20 feet per year. The leaf are ovate in outline about 6-8 inches elongated thread like at the apex that assists to climb on the trees [7]. The stem is soft, leaves are not stalk, twisting set or sub-opposite (6-7 x 1.5-1.8 cm) in measurement, lanceolate, acuminate, entire, glabrous. Flowers are axillary, solitary, big, borne on long, scattering pedicels, actinomorphic, hermaphrodite; lanceolate, keeled within at base, extended persistent, yellow and red; stamens are spreading, hypogenous; anthers are extrose, medifixed, versatile, opening by longitudinal opening; ovary is superior, 3-celled; number of ovules; style is deflected at base, projecting from the flower more or less horizontally [13,14]. This plant encloses 0.2-0.3 percent colchicins and gloriosine alkaloids. The plant is utilized as an ayurvedic medicinal herb to treat diseases like arthritis, gout, ulcers, and bleeding [7]. The plant is one of the endangered with the medicinal plants, which is a prominent tuberous climbing species with bright wavy border yellow and red blooms that become observable since November to March every year [15].

Phytochemical Constituents:

Phyto-components such as 2-Octylcyclopropene-1-heptanol; Hexadecanoic acid ethyl ester; Timonacic; Phytol; 9,12-Octadecadienoic acid and 1,2-Benzenedicarboxylic acid were identified in the ethanolic extracts of the *Gloriosa superba* rhizome by GC-MS. These phytoconstituents are playing very much important role in biological activity [16]. Plant contains gloriosine, N- formyldeacetylcolchicine, demethylcolchicine, colchicine and lumicol-chicine, colchicoside, 2-hydroxy-6- -sitosterol β -methoxybenzoic acid, chelidonic acid and glucoside [17,18]. It documented that Colchicine influences cell membrane configuration indirectly by restraining the production of membrane components [19]. However, Gloriosine also has an antimitotic consequence [20]. The report of GC-MS analysis by Nikhila et al. [21], confirmed that the methanolic tuber extract possess 17 diverse kinds of bioactive compounds with different disease curing potentialities. The initial compound recognized was 2-Methoxy-4-vinylphenol, while β -Amyrin trimethylsilyl ether. Additionally it investigated

the phyto-components using GC-MS analysis of tuber *Gloriosa superba* L with ethanol extract, were collected from various habitats of Tamil Nadu state, India. The total 15, 13, 8, 14 and 13 phyto-components were determined from different 5 ecotypes, respectively [22]. Also physico-chemical constituents of *G. superba* gum exudate were analyzed using recommended chemical techniques. The FT-IR investigation indicated the existence of functional groups that are typical for polysaccharides. Gas chromatography-mass spectrometry spectrum of the gum exposed the presence of 1-piperoylp, 1-penta-decarboxylic acid, 9-octadecenoic acid, and stigmasta-5, 22- dien-3-ol [23]. Additionally other colchinoids like 3-demethyl colchicine, gloriosine, colchicoside have been isolated from *G. superba* [24,25]. Twenty five compounds were identified in ethanol extract of rhizome *G. superba* using GC-MS analysis, including 5-Hydroxymethylfurfural, Benzoic acid, 2-hydroxy-6-methoxy, Benzene,1,4-bis (1,1-dimethylethyl)-, n-Hexadecanoic acid, Oleic acid Octadecanoic acid, Octadecanoic acid, Stigmasterol, Colchicine [26].

Phytochemistry and Pharmacological actions of *Gloriosa superba* L.:

The tubers are typically employed for the management of inflammation, ulcers, bleeding piles, white discharge, scrofula, skin diseases, leprosy, indigestion, helminthes, snake bites, intermittent fever, baldness and debility [27, 28]. In the Chhattisgarh state of India, numerous conventional healers and herbalists have been treating cancer patients by means of *Gloriosa superba* Linn for many years [29]. However the tuberous root supply of glory lily, boiled with *Sesamum* oil is useful double a day on the joints, affected with arthritis decreases pain. It is also used to care for intestinal worms, bruises, infertility, skin trouble and weakness [15]. Also root tuber is assorted with seeds *Psoralea corylifolia*, *Nigella sativa* and *Vernonia anthelmintica* and is prepared to a paste and is applied superficially for several skin diseases [30]. Conventionally, the rural women desire plant for gynecological disorders such as abortion, menstrual difficulty, conception abnormality, sterility, delivery troubles, etc rather than current medicines [31]. The Gond people of Madhya Pradesh in case of stimulated abortion they crush rhizome/tuber of the plant assorted through ghee and used orally [32]. The entire fraction of plant *G. superba* are used as therapeutic function in Siddha, Ayurveda and Yunani methods of remedy. The tubers is efficient against paralysis rheumatism, snake bites, intermittent fevers, wounds, anti fertility, gonorrhoea, leprosy, piles, weakness, dyspepsia, flatulence, hemorrhoids, helminthiasis and inflammations [33,34,35]. Roots are acrid, anthelmintic, antipyretic, bitter, digestive, expectorant, extremely poisonous and supporting discharge of the placenta. Root paste is valuable against paralysis, rheumatism, snake bite and insect bites [11]. The tuber is utilized for the management of bruises and sprains, colic, chronic ulcers, haemorrhoids, cancer, impotence, nocturnal seminal emission, and leprosy and also for including labour pains and abortions [36]. The huge number of clinical investigations, Colchicine is being assessed for the management of broad range of therapeutic situations such as cancer, cardiovascular troubles, SARS-COV-2 and many more [24,25].

2. Pharmacological Activities

1) Anti-bacterial activity

The antibacterial activity of *Gloriosa superba* Linn. against *Streptococcus faecalis*, *Enterococcus faecalis*, *Klebsiella pneumonia* and *Proteus mirabilis* were conducted. Both Gram positive and Gram negative bacterial growth was inhibited by the acetone, dichloromethane, chloroform and methane with leaves and tubers extracts. Among four extract, acetone extract found most effective antibacterial potential followed by methanol extract at 25 and 100 % concentration against *E. faecalis* [8]. Moreover the methanol extract of rhizomes *Gloriosa superba* Linn (Colchicaceae) and its successive portions in different solvent systems were studied for antibacterial activities. Bioassay reveals, the crude residues and subsequent fractions exhibited mild to fair antibacterial activities. However Chloroform fraction showed maximum antibacterial sensitivity against *Staphylococcus aureus* (88%) followed by the crude residues (59%). The total phenol substance of the crude fractions, expressed no considerable association with the antimicrobial activities [37].

2) Anti-Fungal activity

The methanol extract of *Gloriosa superba* Linn (Colchicaceae) rhizomes and its succeeding fractions in unlike solvent systems were assessed for antifungal activities. The outstanding antifungal sensitivity was recorded by the n-butanol fraction against *Candida albicans* and *Candida glaberata* (90%) and against *Trichophyton longifusus* (78%) followed by the chloroform fraction against *Microsporum canis* (80%) [37]. Additionally the antifungal action of methanol extracts from several plant parts of *G. superba* were assessed by *in vitro*. With different extracts trailed, seed residues was establish to possess the maximum mycelial inhibitory action at full concentration while compared to the others followed by rind, rhizome, leaves and flower extract was also restrain the growth of *F. oxysporum*. At 25 % concentration, flower extract was displayed peak mycelial expansion decrease followed by seed, rind, leaves and rhizomes. It was indicated that seed and rhizome extracts were the peak budding supply as restrain the mycelial growth for *F. oxysporum* [38].

3) Anti-anxiety Activity

The investigation was carried out on Phytochemical screening of ethanolic and aqueous extracts displayed presence of carbohydrates, alkaloids and saponins. With ethanolic residues of shade dried plant substance significantly enlarged mean number of entries and meantime spent by mice in open arms of elevated plus maze apparatus at the dose of 300 mg/kg with respect to control, thereby producing anti-anxiety activity [39]. Moreover in Elevated Plus Maze trial, 80 and 120 mg/kg doses of the extract significantly enlarged the percent number of entries and time spent in open arms correlated to control. In Rota Rod Test model both doses of the ethanolic extract of the tubers of *Gloriosa superba* significantly declined (P<0.001) the fall of time of albino mice compared to that of control. The report clearly demonstrated that the ethanolic extract exerts an anxiolytic outcome on mice, and it could serve as a new approach for the treatment of anxiety [40].

4) Activity on Reproductive system

Assessing of the results of EyGS on vaginal cornification and deciduoma formation verified vaginal opening without cornified cells, decline in uterine mass, proliferation of uterus, and decline in deciduoma development. The EyGS formed shrink in the estrogen and progesterone intensities, and 80% contractions of the uterus correlated to oxytocin [41]. Additionally the report was to evaluated the action of the aqueous extract of *G. superba* (AL) root on the female reproductive system of rat. Phytochemical analysis displayed presence of flavonoids, tannins, alkaloids, and glycosides in the aqueous extract. Extract yield was 6 % and was found to be harmless at a amount as high as 550 mg/kg body mass. The antifertility examination confirmed before time abortifacient activity. No enlarge in uterus and ducidual mass was detected. Together the oxytocin and the extract formed dose reliant contractions [42].

5) Anti Arthritic properties

The study was conducted on elite chemotype of *G. superba* from natural population in Eastern Himalayas based on their colchicine content through HPTLC calibrated method. The quantified data discloses that the substance of colchicine varies from 0.044 to 0.184% having maximum content in NBG-128. The incidence of bioactive polyphenolics with significant hydroxyl radical scavenging, suggesting inhibition of inflammatory mediator cells by extract is superimposed action of colchicine and other chemical inhibitors. The results of bioassay reflected a potentiating anti-arthritic and hydroxyl radical scavenging activity [43]. Also the evaluation was conducted on the consequence of chloroform extract of tubers *Gloriosa superba* in Freund's complete Adjuvant (FCA) induced arthritis using albino rats. The arthritis was stimulated in male albino rats by intradermal injection of FCA (0.1 ml) in right hind paw. The chloroform extract of tubers of *G superba* has displayed a dose dependent and much decreased paw edema and ankle diameter in treated category as compared with arthritic group. Acute management of rheumatoid rats with an extract of *G superba* tubers twisted a significant inhibitory outcome on rheumatoid arthritis (RA) [44].

6) Hepatoprotective Activity

The study was carry out to investigate the hepatoprotective activity of alcoholic extract of *G. superba* leaves against carbon tetrachloride (CCl₄) stimulated hepatotoxicity. Alteration in the intensity of biochemical markers of hepatic damage like SGOT, SGPT, ALP, Billirubin and Protein were checked in both CCl₄ treated and untreated groups. The CCl₄ (1ml) has superior the SGOT, SGPT, ALP and total Billirubin where declined in total protein level in liver. With the treatment of alcoholic extract of plant (200mg/kg) has brought back the distorted levels of biochemical markers to the near usual levels in the dose dependent manner [45].

7) Anti-diabetic Activity

A significant (P<0.01) decline in blood glucose level was observed at 150 and 300 mg/kg doses of extract in glucose loaded as well as STZ stimulated diabetic rats. The extract furthermore showed significant increase in the body weight and HDL levels and decrease in serum cholesterol, triglycerides, LDL, urea, SGPT and SGOT levels. The

results displayed that *G. superba* leaf extract possess potential anti-diabetic activity [46].

8) Anticancer Activity

With the application of Super Critical Fluid (CO₂) Extraction (SCFE) technology, Colchicine was extracted from *Gloriosa superba* seeds and further investigated for anticancer activity in six human cancer cell lines, such as A549, MCF-7, MDA-MB231, PANC-1, HCT116, and SiHa. The Purified colchicine exhibited the least cell cytotoxicity and antiproliferation and caused no G2/M arrest at clinically acceptable concentrations. Mitotic arrest was examined in only A549 and MDA-MB231 cell lines at 60 nM concentration [47]. Furthermore the dried rhizome *G superba* was extracted employing SDS and digested via pepsin. The incomplete distillation of the protein hydrolysate was carry out using reverse-phase HPLC. Fractions containing anticancer peptides, and their effects on apoptosis and protein expression using apoptosis trial and Western blot, respectively. Partially purified peptides of *G superba* rhizome verified anticolon activity in SW620 cells by inducing apoptosis through upregulation of p53 and down regulation of nuclear factor kappa B (NF-κB) [48].

9) Antiulcer Activity

With the use of hydroalcoholic and petroleum ether extract of *Gloriosa superba* Linn flower, Antiulcer Activity was reported by [49]. The extracts were tested orally at the doses of 100, 200 and 400 mg/kg using pylorus ligation, ethanol and cold stress as toxicants. Compared to standard, both the extracts displayed significant ulcer protection at the peak dose of 400mg/kg. However to sustain its antiulcer prospective, the plant was assessed for free radical scavenge ring activity by lipid peroxidation. The view of this report was might due to the presence of flavonoids and polyphenols in extracts. Additionally Preliminary phytochemical screening of the extract displayed the incidence of several compounds. The antiulcer activity of ethanolic extract of tubers of *Gloriosa superba* Linn was substantiated by the considerable attenuation of gastric amount, pH, free acidity, and total acidity in the gastric juice of pyloric-ligated rats in a dose-dependent approach [50].

10) Antioxidant activity

The *G. superba* tubers were extracted and used for the management against paracetamol induced toxicity with three groups of animals consisted control, administered with paracetamol (200 µg/kg) and received *G. superba* tubers aqueous extract (500 mg/kg/bw/po). The intensity of LPO was found to be enlarged throughout paracetamol intoxication with concomitant decline in the activity of enzymic and non- enzymic antioxidants. The antioxidant enzyme levels were reverted to near usual in rats, received plant tubers aqueous extract rats which outcome the antioxidant activity [51]. Also in vitro antioxidant action was conducted with the *G. superba* extract using Nitric oxide test with ascorbic acid as a standard. The entire phenolic and flavonoid substance was noted to be 22.3 ± 3 µg g⁻¹ Gallic acid equivalents and the flavonoid was 47 ± 5.4 µg g⁻¹ quercetin equivalents. The Nitric oxide scavenging action of the extract was establish to be capable and IC₅₀ of residues was 119.06±19. It displayed that the

hydro alcoholic leave extract of the plant has the influence of scavenging free radicals in vitro [52].

11) Anti-inflammatory activity

The study was conducted for analgesic, anti-inflammatory and toxic activity on Wistar rat model [53]. They documented that hydroalcoholic extract of aerial part of *G. superba* hold a moderate anti-inflammatory outcome and is harmless upto 2000 mg/kg body weight. It was substantiated by considerable declined in paw edema and cotton pellet stimulated granuloma scheme suggesting its action in the reproducing stage of inflammation. They attributed its analgesic, anti-inflammatory and wound healing action to the phytoconstituents exhibited in the plant. Furthermore alkaloids extracted from seeds and trialed oral administration of colchicine, 2-demethylcolchicine, 3-demethylcolchicine and N-formyl-N-deacetylcolchicine deacetylcolchicine at 2, 4, 6 mg/kg body weight of animals. By employing the formaldehyde inflammagen-stimulated inflammation form, the compounds were subjected to an anti-inflammatory investigation. It stated significant anti-inflammatory activity of colchicines, while reduced activity of other separated alkaloids [54].

12) Anticoagulant activity

Nalise Low Ah Kee *et al.*, [55] documented anticoagulant/anti-thrombotic prospective of methanolic extract achieved from leaves of *G. superba*. The investigation proclaimed that leaf extract of *G. superba* inhibited thrombin-activated with IC50 values of 2.97 mg/ml30.

13) Anthelmintic activity

The Suryavanshi *et al.*, [56] documented that *G. superba* tubers alcoholic extracts exhibited superior anthelmintic activity against earthworm *Eisonia fatida*. Furthermore both the extracts (ethanol and water) of whole plant of *G. superba* were assessed for activity against Indian earthworms *Pheretima posthuma*. Both extract trialed at 20-60 mg mL-1 dose level twisted considerable action ($p < 0.01$), while compared with piperazine citrate and both extract showed significant anthelmintic activity was documented by Bhushan *et al.*, [57].

14) Gastroprotective effect

With administration of Indomethacin caused considerable reduce in levels of SOD, GSH, GSHPx and enlarge in level of LPO. However reverse tendency was observed in rats pre-treated with test drug, that is raised in levels of SOD, GSH, GSHPx and decline in level of LPO. The consequences recommend that the gastroprotective action of methanolic extract of *G. superba* tuber can be supplied to its ingredients and antioxidant prospective [58].

3. Conclusion

Wonder lily has been conventionally claimed for a huge number of pharmacological activities and ayurvedic medicinal uses. Indiscriminate and unconsidered operations of the natural reserves by mankind is reportable for the present condition of this plant. To meet the business command, stress should be given to enlarge output and improvement of colchicine of Kalihari. It also authenticate

several toxic matters that are hazardous to the patient, even though the plant is invented to have distinct therapeutic properties. Consequently, there is a need for searching the real chemical composite present in the plant that is therapeutically significant so as to avoid the dangerous chemicals like gloriosine and colchicine. It has been declared as endangered species by IUCN and therefore there is a pressing need to protect the plant by insitu and ex situ multiplication in general and micropropagation in particular so as to meet the ever rising demand from the industries [59]. It is assumed that its phytoconstituents and biological activities stated in this evaluation can facilitate investigators to explore this plant to additional amount.

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