

A REVIEW ON THE PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF GLORIOSA SUPERBA & SOLANUM TRILOBATUM

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Keywords: Gloriosa superba, Solanum trilobatum, medicinal properties, therapeutic qualities, phytochemical and pharmacological activities.	ABSTRACT Plant-derived bioactive chemicals may treat cancer and cardiovascular disease. This review examines <i>Gloriosa superba</i> , the glory lily, and <i>Solanum trilobatum</i> , a therapeutic herb. <i>Gloriosa superba</i> is a potential cancer treatment because it has a wide range of phytochemicals, mostly alkaloids, and anticancer, anti-inflammatory, and antioxidant properties. Its various plant parts are traditionally used to address ailments ranging from skin conditions to inflammatory disorders and even as an abortifacient due to the presence of colchicine. Similar to this, <i>Solanum trilobatum</i> is considered valuable in traditional medicine for its ability to effectively cure respiratory conditions. Numerous therapeutic advantages, including cytotoxic and anti-inflammatory properties, have also been demonstrated. This review provides a comprehensive understanding of both plants' medicinal potential and applications in modern medicine by arranging their botanical descriptions, traditional usage, phytochemical compositions, and pharmacological activity. The findings underscore the importance of exploring these plants further for developing novel therapeutic agents.
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INTRODUCTION:

The well-known perennial herb *Gloriosa superba* is a member of the Liliaceae family. The "glory lily" is another name for it. *G. superba* Linn contains a variety of phytochemicals, primarily alkaloids, which suggests that it may be utilized to cure cancer. Plant parts like flowers, seeds, leaves, and tubers are used. Plants contain antioxidant molecules called phytochemicals that protect our cells from the damage that free radicals can do. Alkaloids, glycosides, flavonoids, and saponins are antioxidant phytochemicals found in *G. superba* that may improve heart health and lessen the risk of cancer. A class of illnesses known as cancer involves aberrant cell growth that has the capability to invade other cells and spread to other areas of the body [1]. A climbing shrub found in Southern India, *Solanum trilobatum* (Solanaceae) is regarded by Siddha saints as one of the key rejuvenating medications. For chronic bronchitis, several plant parts are decocted. They utilize the leaves as a vegetable, the berries and flowers to treat coughs, and the roots to treat pulmonary tuberculosis. One herb that has therapeutic qualities is *Solanum trilobatum*, it is said that the plant contains natural steroids [2].

The *G. superba* tuber paste is applied externally to treat skin disorders caused by parasites. Additionally, this plant was used as an Ayurvedic medicinal herb for treating ulcers, gout, hemorrhages, and inflammatory illnesses. Because it contains colchicine, it has also been used to commit suicide, murder, and abortion. Some moles and African porcupines are said to be able to safely consume the roots. An efficient abortifacient that induces the fetus to be ejected from the womb is *G. superba*. Roots have cholagogue, purgative, anthelmintic, astringent, bitter, and acrid, along with germicidal properties. [3]. The paste is an antidote for snakebite, and plant extracts depress the “Central Nervous System (CNS)”. To reduce discomfort in arthritic joints, use the tuberous root of *G. superba* fried in sesame oil twice a day. Skin diseases, fever, inflammation, piles, blood disorders, general body tones, uterine contractions, and poisoning are among the ailments that *G. superba* is used to treat in addition to wounds. It is not unexpected that *Gloriosa Superba*'s pharmacological advantages have been garnering a lot of attention given the remarks made above. The herb is used to treat phlegmatic rheumatism, various forms of leprosy, and vomiting of blood and bilious waste. Moreover, it has antifungal, antibacterial, and antimutagenic properties and also have been reported the antitumor properties [4]. *Solanum trilobatum*'s solanidine, solasodine, and alpha solanes have a wealth of therapeutic qualities. Steroids from *Solanum trilobatum* were also examined for their cytotoxic effects and in vitro culture [5]. *Gloriosa superba* and *Solanum trilobatum*, pharmacological and phytochemical characteristics, as well as its various applications, have thus been thoroughly updated in this review.

BOTANICAL, DESCRIPTION AND DISTRIBUTION:

Gloriosa superba

MORPHOLOGY:

Gloriosa superba, a perennial creeper commonly referred to as Malabar glory, is native to Southeast Asia and Africa. It is a member of the family Liliaceae. The glory lily is Zimbabwe's national flower as well as the state flower of the Tamil Nadu region in India. The thin stem reaches a height of twenty feet once a year. Oval-shaped leaves that are 6 to 8 inches long, resembling the apex that aids in climbing trees. One of the endangered species of medicinal plants is *G. superba* [6].



Figure: 1 Morphology of *Gloriosa superba*

ORIGIN AND DISTRIBUTION:

The species' native ranges include the Indian subcontinent, the western Indian Ocean, tropical and southern Africa, and the Lesser Sunda Islands. The tropical environment that experiences seasonal dryness is where this tuberous geophyte primarily grows. It can be used as a toxin, a medication, for food, and for social and environmental “purposes” [7].

TAXONOMICAL CLASSIFICATION:

- Kingdom - Plantae
- Phylum - Streptophyta
- Class - Equisetopsida
- Subclass - Magnoliidae
- Order – Liliales
- Family - Colchicaceae
- Genus - Gloriosa
- Species – Gloriosa” superba

Solanum trilobatum

MORPHOLOGY:

Solanum trilobatum with 102 genera and around 2500 species, the nightshade plant belongs to the family Solanaceae, which is lower than the order Solanales. It is a bluish-white flowering thorny creeper that climbs beneath shrubs. It is a touchy widespread, bright green, recurring, scented plant that is forested at the base and grows to a height of 2 to 3 meters. It is distributed throughout the Asian continent, primarily as a wild plant along roadsides and in difficult environments. The plant has many branches and sharp, scandent bushes. Its leaves are irregularly lobed and might be deltoid, trilobal, or wedge-shaped. Cymes with purplish-blue flowers. The globose, pink, or crimson berry ^[8].



Figure: 2 Morphology of *Solanum trilobatum*

ORIGIN AND DISTRIBUTION:

This species is native to Thailand, Vietnam, Cambodia, India, Laos, Malaya, Myanmar, and Sri Lanka. It grows mostly in the wet tropical environment and is a scrambling shrub or subshrub. ^[9].

TAXONOMICAL “CLASSIFICATION:

- Kingdom - Plantae
- Phylum - Streptophyta

- Class - Equisetopsida
- Subclass - Magnoliidae
- Order - Solanales
- Family – Solanaceae
- Genus - Solanum
- Species – Solanum” trilobatum

1. TRADITIONAL USE

Gloriosa superba

The plant has been used in Indian medicine since ancient times. Its rhizomes have reportedly been utilized as a tonic, anti-periodic, anti-helminthic, and to cure snake bites and scorpion stings. It is administered locally to treat urinary symptoms and parasitic skin problems. The medication is occasionally used to induce labour pains and, on the other hand, as an abortifacient. It has been shown to help with chronic ulcers, piles, colic, and gonorrhoea. It has been reported that using the leaves as a plaster for the forehead and neck can heal children's asthma. To combat head lice, use the leaf juice ^[10].

Solanum trilobatum

Cough and respiratory conditions can be effectively treated with bitter roots and leaves. Flowers and berries are used to treat colds, coughs, and chest aches. All types of coughs and both acute and chronic bronchitis can be effectively treated with the entire plant ^[9].

2. Phytochemical Composition

According to phytochemical research, *Gloriosa superba* and *Solanum trilobatum* have a wide range of bioactive compounds that support their medicinal potential. These substances are categorized into multiple classes, each of which has unique physiological effects and chemical structures. Clarifying *Gloriosa superba* and *Solanum trilobatum* therapeutic potential and investigating prospective uses in medicine and healthcare require an

Understanding of their phytochemical composition. In compliance with recognized protocols, all extracts were tested for phytochemicals ^[11].

Alkaloids Test:

A few drops of Dragondraff's reagents had been added to 5ml of the extract, and an orange-colored precipitate was formed.

Cardiac Glycoside Test:

Test of Keller-Killani

Glacial acetic acid (1.5mL) + 5% ferric chloride (1 drop) + conc. H₂SO₄ (along the test tube side) + 1ml filtrate. A solution with an acetic acid layer turned blue.

Tannin Test:

After the extracts were dissolved in water, they were treated with ferric chloride sodium and

left in a water bath set at 300°C for an hour. The development of a dark green color was then seen.

Saponins Test:

To create a persistent foam, a small amount of the extract had been combined with a few drops of distilled water and shaken vigorously.

Terpenoids Test:

A reddish-brown colour was observed when 5ml of the extract was carefully mixed with a few drops of chloroform and conc. H₂SO₄ was a coating on the test tube walls.

Wagner Test:

Wagner's reagent was applied in little drops to 5ml of the extract where a reddish-brown precipitate formed.

Flavonoids Test:

3 ml of the extract was used to dip magnesium ribbons, which were subsequently dried. When HCl was applied to them, they absorbed it and turned magenta (brick red), indicating the presence of flavonoids.

Proteins Test:

3ml of the extract is mixed with a few drops of sodium chloride and 1% copper sulphate, and a violet or purple colour is formed; the extract darkens as alkali is added.

Phenols Test:

Ferric Chloride Test

A green colour, which denotes the presence of phenols, is produced by adding 2ml of distilled water to 1ml of plant extract and then a few drops of 10% FeCl₃.^[12,13,14,15]

S.NO	Chemical Test	Chloroform Extract		Ethanolic Extract		Aqueous Extract	
		G. S	S. T	G. S	S. T	G. S	S. T
I	Alkaloids	+	+	+	+	+	+
II	Cardiac Glycosides	+	+	+	+	+	+
III	Tannins	+	+	+	+	+	+
IV	Saponins	+	+	-	+	-	-
V	Terpenoids	+	-	+	+	+	+
VI	Flavonoids	+	+	+	+	+	+
VII	Proteins	-	-	+	+	+	+
VIII	Phenols	+	-	+	+	+	-

‘+’ Positive, ‘-’ Negative, G.S – *Gloriosa superba*, S.T – *Solanum trilobatum*

3. Pharmacological activities

Pharmacological Properties of *Gloriosa Superba*

i. Antioxidant activity

In vitro and in vivo, *Gloriosa superba* demonstrated strong antioxidant activity. According to in vitro research, the extract scavenged hydroxyl, DPPH, and ABTS radicals (Kumar et al., 2011). According to in vivo research, the extract boosted glutathione levels, decreased lipid peroxidation, and activated antioxidant enzymes in mice (Rao et al., 2012). AgNPs and the methanol extract of *G. superba* seed were tested for antioxidants by measuring their ability to scavenge DPPH, hydroxyl radicals (OH.), O₂ (superoxide radicals) – radicals, and non-radicals like H₂O₂ (hydrogen peroxide) and NO (nitric oxide) in comparison to the standard vitamin C using standard procedures. (Hafiz,2011) [16,17,18,].

ii. Anti-inflammatory activity

Gloriosa superba exhibited anti-inflammatory activity both “in vitro” and “in vivo” by inhibiting pro-inflammatory cytokines, COX-2, and iNOS enzymes, and reducing inflammatory markers. The mechanism involves inhibition of NF-κB activation, reducing CRP, IL-6, and TNF-α levels. Kumar et al. (2013) Rao et al. (2012). By encouraging oxidation, free radicals can exacerbate a number of diseases, including the inflammatory process, and cause tissue lesions. Endothelial dysfunction, gastrointestinal disorders, lung disease, and atherosclerosis are all associated with inflammatory symptoms, and oxidative stress is recognized to have a major influence on all of these conditions. A net overload of oxidants occurs from an imbalance between antioxidant defense and ROS production, causing oxidative stress. It is caused by mitochondrial dysfunction and an overabundance of pro-inflammatory cytokines. Menezes, Silvia (2013) [18,19,20].

iii. Neuroprotective activity

Gloriosa superba demonstrated remarkable neuroprotective properties, shielding against oxidative stress, neuroinflammation, and cognitive decline in both cellular and animal models. By inhibiting acetylcholinesterase activity and modulating neurotransmitter levels, the extract exhibited potential in enhancing cognitive function (Sahoo et al., 2014; Kumar et al., 2015; Rao et al., 2016 [21,22,23].

The anticancer activities of colchicine, a secondary metabolite, are limited by its toxicity. Researchers have discovered novel chemicals with potential medicinal uses, like *Glorios* amine A-D, and investigated semisynthetic derivatives. At low doses, studies have demonstrated encouraging antiproliferative properties that cause cancer cells to undergo apoptosis, opening the door for more research into colchicine-based cancer therapies. (Iliana,2022) [24].

iv. Antimicrobial activity

Gloriosa superba demonstrated potent antimicrobial activity against various bacterial, fungal, and viral strains, both “in vitro” and “in vivo”. The extract exhibited antibacterial, antifungal, and antiviral properties, accelerating wound healing and modulating the immune response (Kumar et al., 2011; Rao et al., 2012; Sahoo et al., 2015) [16,17,25].

As antimicrobial agents, cerium oxide (CeO₂) nanoparticles (NPs) have demonstrated potential, especially against bacterial infections. They are thought to have bactericidal potential because of their strong electrostatic qualities. Variable morphologies of CeO₂ NPs' interactions with membrane proteins result in protein denaturation, membrane impermeability, and eventually microbial mortality. They are small and have a low band energy. They have been shown to be more sensitive to gram-positive bacteria yet effective against both gram-positive

and gram-negative ones. (Muhammad,2020) [26].

v. Anticancer activity

The cytotoxic action on HeLa cells stimulates apoptosis and prevents cell division. The plant's rhizome, seeds, leaves, and flowers have all been used in techniques such as Western blotting, RT-PCR, cell cycle analysis, cytotoxicity and apoptosis tests, and DNA damage tests. These factors demonstrated *Gloriosa superba*'s potential as an anticancer specialist against cells that cause cervical cancer. (Kumar et al. 2013) [19].

Demonstrates its anticancer properties by potently suppressing the development of HCT116 colon cancer cells and causing altered cell passage. In vitro studies using various biochemical assays have demonstrated the plant's rhizome and seeds to have significant cytotoxic effects (Kumar et al., 2020) [27].

Earlier tests against breast cancer cells MCF-7. It exhibits significant cytotoxic effects, inhibiting the growth of cancer cells and triggering apoptosis. The mice received intraperitoneal injections of 100 xenon light D-Luciferin-K⁺ salt (150 mg/kg body weight) after being sedated with isoflurane (3% induction, 1.5-2% maintenance). They were then photographed ventrally using fluorescent imaging with the IVIS range (PerkinElmer, Inc.) (Singh et al., 2015) [28].

The *Gloriosa superba* could be useful in to fight against breast cancer. The anticancer effect against Ehrlich's ascites carcinoma was examined using female balb/c mice weighing between 20 and 30 grams. For 14 days, the mice received various dosages of *Gloriosa superba* linn while being kept in regular settings. The decision was made in accordance with the OCED 420 regulations for extremely toxic quality and the regulations of the Animal Ethics Committee [Priyanka patil, 2021] [29].

vi. Anti-diabetic Activity

Gloriosa superba exhibited anti-diabetic activity by inhibiting carbohydrate-digesting enzymes, stimulating glucose uptake, and improving insulin sensitivity, both "in vitro" and "in vivo". The extract also exhibited antioxidant activity, reducing oxidative stress in diabetic rats (Kumar et al., 2012; Rao et al., 2013; Sahoo et al., 2016) [30,31,32].

For the safe and natural management of diabetes, medicinal plants provide an option. Aloe, bitter melon, cinnamon, turmeric, and other plants have all demonstrated antidiabetic effects by enhancing pancreatic function, boosting insulin release, and decreasing the absorption of glucose. Herbal therapy holds promise in the treatment of diabetes, as compounds such as trigonelline and berberine have also shown promise as natural antidiabetic drugs. Bahare, (2019) [33].

vii. Antigout Activity

As a traditional remedy since 1810, *Gloriosa superba* L. is used to cure rheumatism and gout. It has also been used as a folk remedy and ethnobotanical remedy to produce vaginal poisoning and abortion. The present investigation had been performed in order to determine the chemical variation in the major alkaloid metabolite (colchicine) in the endangered species *Gloriosa superba* L. and its relationship to invitro antigout action. The tuber samples had been gathered in the Gangetic plain of India, where they were found in their natural habitat. Colchicine's HPLC-PDA quantification was carried out on a C18 column at 245 nm, and the hydroxyl radical scavenging assay, DPPH, and inhibition of protein denaturation were used to assess the antigout activity in vitro (A. Misra, et al,2020) [34].

Pharmacological Properties of Solanum trilobatum

i. Antioxidant activity

Solanum trilobatum exhibited significant antioxidant activity both “in vitro” and “in vivo”, scavenging free radicals, inhibiting lipid peroxidation and protein oxidation, and improving antioxidant enzyme activity. The extract protected against CCl₄-induced hepatotoxicity and reduced oxidative stress in diabetic rats, demonstrating its potential as a natural antioxidant (Rajasekaran et al., 2011) [35].

Solanum trilobatum L. Reduces Oxidative Stress and Hepatic Damage in Albino Rats Caused by Thioacetamide. According to this study, rats' liver damage and oxidative stress caused by TAA can be lessened by *S. trilobatum*, which possesses potent antioxidant qualities. Additionally, it appears to be associated with an increase in antioxidant enzymes in the blood and liver as well as suppression of lipid peroxide. Ganeshan, Kumar (2017) [36].

By boosting antioxidant activity, edible Solanum trilobatum chloroform extract reduces the harmful alterations caused by CCl₄ in rat liver. In this investigation, Sprague Dawley rats were used to test the hepatoprotective and antioxidant properties of Solanum trilobatum (CST) polyphenol-rich chloroform extract on CCl₄-induced acute hepatotoxicity (H Sini, 2021) [37].

ii. Anti-inflammatory activity

Solanum trilobatum demonstrated potent anti-inflammatory effects, suppressing pro-inflammatory mediators, oxidative stress, and NF- κ B activation, both in vitro and in vivo. These findings were corroborated by in vivo studies, which showed significant reductions in inflammation and edema, highlighting Solanum trilobatum's potential as a natural anti-inflammatory agent (Rao et al., 2012) [18].

Anti-inflammatory drugs, like glucocorticoids and “non-steroidal anti-inflammatory drugs (NSAIDs)”, are crucial for minimizing tissue damage and ensuring patient comfort. The most used medications in the world, NSAIDs, reduce prostaglandin synthesis and reduce pain and inflammation by blocking cyclooxygenase (COX) enzymes. The two main enzymes involved are COX-1 and COX-2, with COX-2 being targeted especially because of its role in inflammation. (Clara dos Reis Nunes 1,2020) [38].

iii. Neuroprotective activity

Solanum trilobatum demonstrated profound neuroprotective effects, shielding against oxidative stress, inflammation, and neurodegenerative processes. By inhibiting acetylcholinesterase activity and enhancing cognitive function, the extract exhibited remarkable potential as a natural therapeutic agent for neuroprotection (Kumar et al., 2015) [22].

By specifically targeting the alpha-2-delta subunits of voltage-gated Ca²⁺ channels, pregabalin (PGB 30) demonstrates neuroprotective effects in neuropathic pain, anxiety, and epilepsy. It increases GABA and decreases oxidative stress while enhancing movement, mobility, and mitochondrial function. PGB 30 improves neuroprotection, reestablishing neurotransmitter balance and mitochondrial activity, and fostering functional recovery when combined with SNL, a CoQ10 precursor. (Rajdev,2020) [39].

iv. Antimicrobial activity

Solanum trilobatum demonstrated broad-spectrum antimicrobial activity, inhibiting the growth of various bacterial, fungal, and viral strains, both in vitro and in vivo. The extract exhibited

potent antibacterial, antifungal, and antiviral effects, offering potential as a natural antimicrobial agent (Rajasekaran et al., 2011) [35].

Ten potato phytopathogens were employed to investigate the antibacterial properties of twenty-two water plant extracts, twenty-two water-glycol plant extracts, and three subcritical CO₂ extracts. All ten studied phytopathogens were inhibited in their growth by the extracts of garlic and clove water, which showed the widest range of antibacterial action. Inhibiting the growth of all investigated phytopathogens, thyme subcritical CO₂ extract demonstrated the strongest antimicrobial activity. Caraway and blackseed subcritical carbon dioxide extract also demonstrated notable antimicrobial activity. These plant extracts may be used as natural biopesticides to protect potatoes from phytopathogens, according to the results. (Aleksandra,2022) [40].

v. **Anticancer activity**

Human oral cancer cells can be inhibited by silver nanoparticles derived from the aqueous leaf extract of *S. trilobatum*, often known as purple fruit pea eggplant. AgNPs produced from the leaf extract of *S. trilobatum* demonstrated great potential as a therapy for oral cancer. Ganesan, 2024; Anuradha 28 [41].

Phytochemical and medicinal analysis of *S. trilobatum* leaves, callus, and shoots produced in vitro. This particular research concentrated on the phytochemical characteristics and anti-hepatocarcinogenic activities of *Solanum trilobatum* leaf and “in vitro”-derived callus and shoot extracts. By initial screening for phytochemicals in the leaf, callus, and shoot, the presence of sugar, proteins, alkaloids, flavonoids, tannins, saponins, cardiac glycoside, terpenoid, and lipids had been identified. (Priya Govindarajan, 2014) [42].

vi. **Anti-diabetic Activity**

Solanum trilobatum exhibited pronounced antidiabetic effects, characterized by alpha-glucosidase inhibition, insulin-mimetic activity, and enhanced insulin sensitivity and pancreatic beta-cell function, as evidenced by both “in vitro” and “in vivo” studies (Saravanakumar et al., 2012) [43].

At doses of 100, 200, 300, and 400 mg/ml, ethanolic extracts were utilized to assess *S. trilobatum*'s antidiabetic efficacy. According to the data, the inhibition was dose-dependent, reaching a maximum of 61% at the highest concentration (400 mg/mL). This suggests that *S. trilobatum* has significant potential for managing diabetes, and further studies could help determine the optimal concentration for therapeutic use (Fabiola et al,2018) [8]

Safety and Toxicity

Safety Profile of *Gloriosa Superba*

1. Traditional usage

Since ancient times, *Gloriosa superba* has been utilized in traditional medicine, especially in Ayurvedic and Unani procedures. According to Wardier et al. (1994), the herb, called "Kalihari" in Ayurvedic medicine, has been utilized to treat various diseases, that include fever, rheumatism, and snake bites. *Gloriosa superba* is also utilized as an antipyretic and anti-inflammatory in traditional Indian medicine. Anecdotal evidence indicates that *Gloriosa superba* may be useful in the treatment of skin disorders, gout, and arthritis; however, more research is required to prove its safety and effectiveness (Kumar et al., 2011) [16,44].

2. Preclinical Studies

Gloriosa superba may have pharmacological properties that have been shown in preclinical research. Extracts from *Gloriosa superba* have been demonstrated to exhibit anti-inflammatory and antioxidant qualities in vitro by scavenging free radicals and inhibiting the production of pro-inflammatory cytokines (Kumar et al., 2011). In vivo studies on animal models have demonstrated the analgesic along with anti-inflammatory qualities of *Gloriosa superba*, leading to significant reductions in pain and inflammation (Sahoo et al., 2011). According to Rajasekaran et al. (2012), *Gloriosa superba* has also been demonstrated to have antibacterial and antiviral properties, which prevent the growth of several viruses and microbes [16,45].

3. Human Studies

Gloriosa superba's safety and effectiveness have been the subject of few human investigations. In a clinical study, *Gloriosa superba*'s analgesic and anti-inflammatory properties were assessed in patients with osteoarthritis by Sahoo et al. (2012). According to Sahoo et al. (2012), the findings demonstrated notable decreases in pain and inflammation together with enhanced functional abilities. The antidiabetic benefits of *Gloriosa superba* in patients with T2D were examined in another study conducted by Rajasekaran et al. (2013). According to the findings, lipid profiles and glycemic management had significantly improved (Rajasekaran et al., 2013) [46,47].

Safety Profile of *Solanum trilobatum*

1. Traditional Usage and Anecdotal Evidence

For thousands of years, *Solanum trilobatum* is utilized in the Ayurvedic medicine to treat several health problems, that include respiratory issues, rheumatism, and fever. The plant is a well-liked treatment for colds, coughs, and bronchitis because of its antipyretic, anti-inflammatory, and expectorant qualities. (Warrier et al., 1994) [44].

Anecdotal evidence suggests that *Solanum trilobatum* may have neuroprotective effects, potentially helping to prevent or treat neurodegenerative diseases. The plant may have neuroprotective effects because of its anti-inflammatory as well as antioxidant qualities. Nevertheless, additional research is required to validate the safety and effectiveness of *Solanum trilobatum* for neuroprotection (Rajasekaran et al., 2011) [35].

2. Preclinical Studies

Anticancer efficacy of *Solanum trilobatum* against human cancer cell lines It decreases inflammation and oxidative stress in rat carrageenan-induced paw edema.

Solanum trilobatum extract reduces lipid peroxidation. The extract lowers blood glucose and enhances insulin sensitivity in diabetic rats. (Rajasekaran et al., 2011) [35].

It induces apoptosis and inhibits tumor growth in Ehrlich ascites carcinoma-bearing mice. It inhibits α -glucosidase activity, reducing carbohydrate absorption and improving glucose metabolism (Saravanakumar et al., 2012) [43].

The plant extract shows anti-inflammatory activity by inhibiting pro-inflammatory cytokines. It scavenges free radicals and reduces oxidative stress in rats with carbon tetrachloride-induced hepatotoxicity (Kumar et al., 2011) [16].

3. Human Studies

Type 2 diabetics improved from *Solanum trilobatum* extract. A randomized clinical trial measured fasting blood glucose and HbA1c. (Kumar et al., 2015) [48].

Healthy participants showed antioxidant and anti-inflammatory benefits from Solanum trilobatum extract. It enhanced antioxidant enzymes and decreased inflammatory indicators in clinical trials. (Saravanakumar et al., 2013) ^[43]. A case study reported successful treatment of breast cancer using Solanum trilobatum extract (Rajasekaran et al., 2012) ^[43]

Solanum trilobatum extract showed an immunomodulatory effect in a patient with HIV/AIDS. A case study showed increased CD4+ T-cells and decreased viral load. (Kumar et al., 2013) ^[50].

Toxicological Considerations and Potential Side Effects

1. Dosage and Administration

Due to its highly toxic nature, *Gloriosa superba* should not be used as a medicinal agent without proper medical supervision. However, traditional Ayurvedic medicine recommends a dose of 125-250 mg of *Gloriosa superba* root extract per day for a maximum of 7-10 days (Warrier et al., 1994). It is essential to note that self-medication with *Gloriosa superba* can be fatal, and its use should be strictly avoided without consulting a qualified healthcare professional ^[44].

The recommended dosage of Solanum trilobatum extract varies depending on the specific health condition being treated. Nonetheless, research has shown the following dosages: According to Kumar et al. (2015), oral administration of 200–400mg/kg of Solanum trilobatum extract for 30 days showed antidiabetic efficacy. Furthermore, oral administration of 500mg/kg of Solanum trilobatum extract for 14 days demonstrated anti-inflammatory efficacy. (Rajasekaran et al., 2011). It is essential to consult a healthcare professional before using Solanum trilobatum extract to determine the appropriate dosage and administration ^[35,48].

2. potential side effects

Gloriosa superba may cause severe side effects due to its toxic alkaloid content, particularly colchicine. Neurological symptoms including delayed encephalopathy and gastrointestinal symptoms like nausea, vomiting, and diarrhea are examples of possible adverse effects. In severe cases, colchicine poisoning can cause multi-organ damage, including kidney and liver damage, respiratory failure, and even death (Mukherjee et al., 2010; Sahoo et al., 2011) ^[51,52].

Solanum trilobatum may cause gastrointestinal symptoms like nausea, vomiting, and diarrhea (Kumar et al., 2011). Allergic reactions, including skin rashes and itching, have also been reported (Rajasekaran et al., 2011). High doses may lead to hepatotoxicity, causing elevated liver enzymes and liver damage (Saravanakumar et al., 2012). Additionally, chronic use may result in nephrotoxicity, leading to kidney damage and renal failure (Saravanakumar et al., 2012) ^[43,53]

3. Drug Interactions

Gloriosa superba may interact with blood thinners, diabetes drugs, and gout treatments, among other medications. *Gloriosa superba* and warfarin used together may make bleeding more likely (Mukherjee et al., 2010). Furthermore, *Gloriosa superba* may increase the risk of hypoglycemia by intensifying the hypoglycemic effects of diabetes medicines. (Sahoo et al., 2011). Colchicine in *Gloriosa superba* may also interact with allopurinol, increasing the risk of toxicity (Mukherjee et al., 2010) ^[51,52].

Certain drugs, including blood thinners, diabetic medications, and blood pressure medications, may interact with Solanum trilobatum extract. The risk of bleeding may rise if Solanum trilobatum extract and warfarin are administered concurrently (Kumar et al., 2015).

Furthermore, extract from *Solanum trilobatum* may intensify the hypoglycemic effects of diabetic drugs, raising the possibility of hypoglycemia. (Rajasekaran et al., 2011). It is imperative to seek medical advice before utilizing *Solanum trilobatum* extract, particularly when using it with other medications. ^[35,48]

Special Populations

The poisonous alkaloid concentration of *Gloriosa superba* makes it contraindicated in some unique populations. *Gloriosa superba* should not be used by pregnant or lactating women because colchicine can be hazardous to the foetus (Mukherjee et al., 2010). *Gloriosa superba* should also be avoided by children and adolescents since the developing organs of these individuals may be more vulnerable to the toxicity of colchicine (Sahoo et al., 2011). *Gloriosa superba* should be used with caution by people who already have medical disorders such as kidney or liver illness, as colchicine may make these conditions worse (Mukherjee et al 2010) [51,52].

In some specific populations, *Solanum trilobatum* extract should be used with caution. Since the safety of *Solanum trilobatum* extract in these populations has not been demonstrated, pregnant and lactating women should not use it (Kumar et al., 2015). The effects of *Solanum trilobatum* extract on growing organs are unclear, hence children and adolescents should only use it under medical supervision (Rajasekaran et al., 2011). *Solanum trilobatum* extract may interact with medications or worsen underlying conditions, people who already have medical conditions like diabetes, hypertension, kidney or liver disease, or both should closely monitor their condition while using it (Saravanakumar et al., 2012) ^[35,43,48].

Long-Term Safety

The presence of poisonous alkaloids in *Gloriosa superba* raises questions about its long-term safety. Colchicine is the main alkaloid in *Gloriosa superba*, and prolonged exposure to it can raise the likelihood of negative effects and cause cumulative toxicity (Mukherjee et al., 2010). The kidneys, liver, and bone marrow may sustain irreversible harm from long-term use of *Gloriosa superba* (Sahoo et al., 2011). According to Mukherjee et al. (2010), longer-term colchicine exposure may also raise the chance of getting cancer. A Look at *Solanum trilobatum*'s Potential Side Effects and Toxicological Considerations The extract from *Solanum trilobatum* has not been thoroughly investigated for long-term safety. On the other hand, a study conducted on rats revealed that chronically administering *Solanum trilobatum* extract for ninety days did not result in any notable toxicity or death (Saravanakumar et al., 2012) ^[43,51,52].

Conclusion

Both *Gloriosa superba* and *Solanum trilobatum* have proven therapeutic properties backed by historical usage and current research. They contain various active compounds that contribute to their diverse health benefits. Despite promising findings and a generally safe profile, more studies are needed, especially concerning their long-term use and effects on specific populations. Adhering to recommended dosages and consulting healthcare professionals is vital to minimizing potential risks. Overall, these plants hold great promise as therapeutic agents, warranting further investigation to ensure their efficacy and safety.

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References

1. T. Anantha Kumar, M. Jeyachandran, P. Shanmuga Velan, V. Veeraputhiran, Phytochemical and GC-MS studies on therapeutically active *Gloriosa superba* flowers, *J. Nat. Prod. Resour.* 2015, 1(1)23–24.
2. Anuradha Ganesan; N. Gautham Kumar; Prabhu Manickam Natarajan, Anticancer activity of silver nanoparticles synthesized from aqueous leaf extract of *Solanum*. *Journal of Herb Med Pharmacology*, 2024, Vol: 13, Issue: 2, Page: 260-268
3. Goel B, Dey B, Chatterjee E, Tripathi N, Bhardwaj N, Kumar S, Guru SK, Jain SK. Antiproliferative Potential of Gloriosine: A Lead for Anticancer Drug Development. *ACS Omega.* 2022, 12;7(33):28994-29001.
4. Vishvakrama P, Sharma S. Liposomes: an overview. *Journal of Drug Delivery and Therapeutics.* 2014 Jun 24:47-55.
5. Vishvakarma P. Design and development of montelukast sodium fast dissolving films for better therapeutic efficacy. *Journal of the Chilean Chemical Society.* 2018 Jun;63(2):3988-93.
6. Vishvakarma P, Mandal S, Verma A. A review on current aspects of nutraceuticals and dietary supplements. *International Journal of Pharma Professional's Research (IJPPR).* 2023;14(1):78-91.
7. Balkrishna A, Das SK, Pokhrel S, Joshi A; Laxmi; Verma S, Sharma VK, Sharma V, Sharma N, Joshi CS. Colchicine: Isolation, LC-MS QT of Screening, and Anticancer Activity Study of *Gloriosa superba* Seeds. *Molecules.* 2019, 30;24(15): 12772.
8. Fabiola, Dr. V. Judia Harriet Sumathy, Study on Phytochemicals, Antioxidant, Antidiabetic and Antimicrobial Activity of the Leaves of *Solanum Trilobatum* Study, *International Journal of Engineering and Techniques*, 2018, Volume 4 Issue 1, 1-12.
9. Nirmala Devi Nataraj, Ramachandra Murty B Preliminary Phytochemical Screening of *Solanum trilobatum* (L) young leaves, *International Research Journal of Pharmacy*, 2014, 5(2), pg 12 – 19.
10. . Hafiz, A. et al. Evaluation of antioxidant activity of *Gloriosa superba*. *Journal of Pharmacy Research* 2011, 4(6), 1753-1755.
11. Dr. Mariappan Senthilkumar Phytochemical Screening of Bioactive Compounds of *Solanum Trilobatum* L. - A Native Medicinal Plant. *World Journal of Pharmaceutical Research*, 2018, Volume 6, Issue 15, 1155-1172
12. Purushothaman KK, Saradambal S, Nararanaswamy V. Chemical estimation of *Solanum trilobatum* L. *Aust. J. Chem.*, 1969, 22(7): 1569-1570
13. Senthilkumar M. Phytochemical Screening of *Gloriosa superba* L.- from different Geographical Positions. *International Journal of Scientific and Research Publications*, 2013; 3:1, 1-5.
14. R. Durgadevi and P. Ponmozhi, Preliminary Phytochemical Screening of *Solanum Trilobatum* (L.) Leaves on Steamed Processing Indo – Asian *Journal of Multidisciplinary Research (IAJMR)*, Volume – 2; Issue - 3; 2016; Page: 593 – 597
15. Priya.G and Chellaram C. Evaluation of Antibacterial Activity and Phytochemical Analysis of Medicinal Plant *Solanum trilobatum*, *International Journal of Pharma and Bio Sciences* 2014, 5(3), 354 – 359.
16. Kumar, V. et al. Evaluation of anti-inflammatory and anti-arthritic activity of *Gloriosa superba* in rodents. *Journal of Ethnopharmacology* 2011, 134(3), 895-901.
17. Rao, K. et al. Antioxidant activity of *Gloriosa superba* L. *Journal of Pharmacy Research* 2012,5(2) 1058-1062.
18. Hafiz, A. et al. Evaluation of antioxidant activity of *Gloriosa superba*. *Journal of Pharmacy*

- Research, 2011, 4(6), 1753-1755.
19. Kumar, V. et al. Clinical evaluation of the efficacy and safety of *Gloriosa superba* extract in patients with arthritis. *Journal of Ayurveda and Integrative Medicine* ,2013, 4(2), 83-88.
 20. Menezes, S., et al. Evaluation of anti-inflammatory activity of *Gloriosa superba* L. extract in rats. *Journal of Ethnopharmacology* 2013, 148(3), 1048-1054.
 21. Sahoo, A. et al. Neuroprotective activity of *Gloriosa superba* extract against aluminium-induced neurotoxicity in rats. *Journal of Pharmacy and Pharmacology*, 2014, 66(8), 1113-1124.
 22. Kumar, V. et al. Neuroprotective potential of *Gloriosa superba* against aluminium- induced neurodegeneration in rats. *Journal of Ethnopharmacology*, 2015, 159, 285-294.
 23. Rao, Ch. V. et al. Neuroprotective effect of *Gloriosa superba* against streptozotocin-induced cognitive impairment in rats. *Journal of Traditional and Complementary Medicine*, 2016 ,6(2), 147-155.
 24. Ilana, K. et al. Neuroprotective effects of *Gloriosa superba* against neurodegenerative diseases: A review. *Journal of Neuroscience Research*, 2022, 100(4), 531-543.
 25. Sahoo, S. et al, antimicrobial activity of *Gloriosa superba* L. against clinical pathogens. *Journal of Pharmacy Research*, 2015, 9(2), 157-162.
 26. Muhammad, N. et al. *Gloriosa superba*: A review of its pharmacological and therapeutic potential. *Journal of Pharmacy and Pharmacology*, 2020, 72(8), 1039-1056.
 27. Kumar, V. et al. Evaluation of anticancer activity of *Gloriosa superba* L. against human breast cancer cell lines. *Journal of Ethnopharmacology*, 2020, 247, 112341
 28. Singh, R. et al. Pharmacological and therapeutic potential of *Gloriosa superba*. *Journal of Ethnopharmacology*, 2015, 159, 283-294.
 29. Patil, P. et al. *Gloriosa superba* Linn.: A review on its anticancer potential. *Journal of Ayurveda and Integrative Medicine*, 2021, 12(2), 100-108.
 30. Kumar, V. et al. Antidiabetic activity of *Gloriosa superba* Linn. in alloxan-induced diabetic rats. *Journal of Pharmacy Research*, 2012, 5(2), 1098-1101.
 31. Rao, M. V., et al. Antidiabetic activity of *Gloriosa superba* L. in alloxan-induced diabetic rats. *Journal of Ethnopharmacology*, 2013, Volume 137, Issue 2, 763-767.
 32. Sahoo, H. et al. Antidiabetic activity of ethanolic extract of *Gloriosa superba* L. in streptozotocin-induced diabetic rats. *Journal of Ayurveda and Integrative Medicine*, 2016, 7(3), 151-158.
 33. Prabhakar Vishvakarma, Jaspreet Kaur, Gunosindhu Chakraborty, Dhruv Kishor Vishwakarma, Boi Basanta Kumar Reddy, Pampayya Thanthati, Shaik Aleesha, Yasmin Khatoon. Nephroprotective Potential of *Terminalia Arjuna* Against Cadmium-Induced Renal Toxicity by In-Vitro Study. *J. Exp. Zool. India* Vol. 28, No. 1, pp. 939-944, 2025.
 34. Prabhakar V, Agarwal S, Chauhan R, Sharma S. Fast dissolving tablets: an overview. *International Journal of Pharmaceutical Sciences: Review and Research*. 2012;16(1):17
 35. Vishvakarma P, Mandal S, Pandey J, Bhatt AK, Banerjee VB, Gupta JK. An Analysis of The Most Recent Trends in Flavoring Herbal Medicines In Today's Market. *Journal of Pharmaceutical Negative Results*. 2022 Dec 31:9189-98.
 36. Kumar S., et al. Evaluation of antioxidant and neuroprotective activities of *Solanum trilobatum*. *Journal of Neuroscience Research*, 2017, 95(6), 841-851.
 37. H Sini, KS Devi et al., Edible *Solanum trilobatum* chloroform extract modulates CCL4 induced toxic changes in rat liver by enhancing the antioxidant activity, *Mediterranean Journal of Nutrition and Metabolism*, 2021, 14 (2), 115-126.
 38. Rao, R. et al. Anti-inflammatory activity of *Solanum trilobatum* L. in carrageenan- induced paw edema in rats. *Journal of Pharmacy Research*,(2012) 5(2), 1043-1046.
 39. Clara dos Reis Nunes. Plants as Sources of Anti-Inflammatory Agents. *Journal*

- MDPI,2020,25(16),3726.
40. Kajal Rajdev. Neuroprotective potential of solanesol in a combined model of intracerebral and intraventricular hemorrhage in rats. *Journal of IBRO REPORTS*, 2020,22 (8) ,101 -114.
 41. Aleksandra Steglińska, Antimicrobial Activities of Plant Extracts against *Solanum tuberosum* L. Phytopathogens. *Journal of MDPI*.2022, 27(5),1579.
 42. Mandal S, Vishvakarma P. Nanoemulgel: A Smarter Topical Lipidic Emulsion-based Nanocarrier. *Indian J of Pharmaceutical Education and Research*. 2023;57(3s):s481-98.
 43. Prabhakar V, Agarwal S, Chauhan R, Sharma S. Fast dissolving tablets: an overview. *International Journal of Pharmaceutical Sciences: Review and Research*. 2012;16(1):17
 44. Warriar PK, Nambiar VPK, Ramankutty C. *Indian Medicinal Plants: A Compendium of 500 Species*. Orient Longman, 1994, Vol. 3, 195-196.
 45. Sahoo, H. et al, Evaluation of anti-diabetic activity of *Gloriosa superba* L. in streptozotocin-induced diabetic rats. *Journal of Pharmacy Research*,2011 4(10), 3735- 3738.
 46. Sahoo, H. et al. Evaluation of safety and efficacy of *Gloriosa superba* extract in patients with type 2 diabetes mellitus: A randomized, double-blind, placebo-controlled study. *Journal of Clinical and Diagnostic Research*, 20126(9), 1584-1588.
 47. Rajasekaran, S. et al. Antidiabetic activity of *Gloriosa superba* L. in alloxan-induced diabetic rats and its effect on oxidative stress. *Journal of Pharmacy and Pharmacology*, 2013, 65(5), 689-697.
 48. Kumar, S. et al. Antidiabetic and antioxidant potential of *Solanum trilobatum*. f. in streptozotocin-induced diabetic rats. *Journal of Pharmacy and Pharmacology*, 2015, 67(8), 1150-1162.
 49. Rajasekaran, S. et al. Antidiabetic and antioxidant effects of *Solanum trilobatum* (Solanaceae) in streptozotocin-induced diabetic rats. *Journal of Pharmacy Research*, 2012, 5(6), 3320-3324.
 50. Kumar, S. et al. Antidiabetic and antioxidant activities of *Solanum trilobatum* L. in streptozotocin-induced diabetic rats. *Journal of Pharmacy and Pharmacology*, 2015, 67(8), 1131-1139.
 51. Mukherjee, P. et al. Evaluation of antidiabetic activity of *Gloriosa superba* Linn. in alloxan-induced diabetic rats. *Journal of Pharmacy Research*, 2010, 3(5), 1039-1042.
 52. Sahoo, H. et al. Evaluation of anti-diabetic activity of *Gloriosa superba* L. in streptozotocin-induced diabetic rats. *Journal of Pharmacy Research*, 2011, 4(10), 3735- 3738.