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A REVIEW ON ETHNOBOTANY, PHYTOCHEMISTRY AND PHARMACOLOGICAL POTENTIAL OF TRILLIUM GOVANIANUM

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ABSTRACT

Trillium govanianum (Wall. ex D. Don) commonly known as Himalayan Trillium or Nagchhatri, is a perennial herb belonging to the family Melanthiaceae. It is native to the temperate and sub-alpine regions of the Himalayas, primarily found at 2,500 to 4,000 meters. The plant is highly valued in traditional medicine due to its rich phytochemical profile, including steroidal saponins, alkaloids, and flavonoids, contributing to its therapeutic potential. *T. govanianum* is traditionally used to treat wounds, inflammation, and infections. Recent pharmacological studies have demonstrated its antimicrobial, antioxidant, anti-inflammatory, and anticancer properties, highlighting its potential for drug development. Despite its medicinal importance, the species faces a serious threat of extinction due to overharvesting and habitat destruction. Conservation efforts are crucial to protect this valuable medicinal plant and ensure sustainable utilization. Future research should focus on developing efficient propagation techniques and exploring its bioactive compounds for potential pharmaceutical applications.

KEYWORDS: Trillium govanianum, Himalayan Trillium, Medicinal plant, Phytochemicals, Conservation Pharmacological properties.

INTRODUCTION

Native to the Himalayan region, and parts of India, Nepal, and Bhutan, the Himalayan Trillium is one of the flowering plants referred to as ***Trillium govanianum***. Synonyms for *T. govanianum* are *Trillium govanianum (Wall.ex D.Don) Kunth*, in a native language

commonly called Nag Chattri or Teen Patra. This species belongs to the genus Trillium and is part of the Melanthiaceae family which is known for having stunning large, ovate leaves and a single flower that is usually white which turns pink. It can often be seen in shady, wet areas such as forest floors. It is found in India, Pakistan, Bhutan, Nepal and China between the altitudinal ranges of 2500−4000 meters above mean sea level, and is primarily grown as an ornamental garden plant in temperate climates.

The rhizome of *T. govanianum* contains a significant amount of steroidal saponins which upon hydrolysis yields more than 2.5% diosgenin, which is utilized in the production of steroidal and sex hormones. The corticosteroid hormone derived from this plant is utilized in various formulations such as sex hormones, cortisone, and related preparations for conditions like rheumatism and menstrual regulation. Additionally, it is also employed in treating digestive issues. In traditional medicine, the rhizomes of this plant species are used by local people to treat wounds, dysentery, skin boils, infections, as well as menstrual and sexual disorders.

T. govanianum is currently facing overexploitation. The uprooting of this medicinal plant from its natural habitat, driven by the demands of the pharmaceutical industry, poses a global threat to the population of Nag Chhatri, which occupies a limited geographical area. In India, before 2008, the plant was not included among the 960 medicinal plant species being traded. However, due to its significant health benefits and increasing demand, it is now being traded illegally. This has resulted in it being classified as a threatened medicinal plant by the International Union for Conservation of Nature (IUCN). The commercial growing of this herb is not very common, but it is strongly recommended. There is a lack of information regarding its cultivation. Only a small amount of information exists on various aspects of T. govanianum.

OBJECTIVE

1. Ethnopharmacological Significance
2. Pharmacological Activity
3. Conservation and sustainable Utilisation.

Botanical description

Trillium govanianum is a perennial herbaceous plant that has a thick, fleshy underground rhizome and a tall, slender, unbranched stem typically measuring 20 to 50 centimetres in

height. It is known for its unique leaves and flower arrangement. The leaves grow in groups of three, are broadly oval to elliptical, have smooth edges, and exhibit strong veining. Its flowers appear one at a time at the end of a stem and have three petals and three sepals. The sepals are green and shaped like narrow leaves, while the petals come in various colours such as reddish-purple, maroon, and sometimes yellowish-green. The flower features six stamens and a three-lobed ovary at the top. After pollination, it generates a fleshy berry-like fruit. The tiny seeds are mainly spread by animals and gravity, helping the species thrive in its natural environment. *Trillium govanianum* is quite active during the summer, really coming to life from May through September, but it takes a break in the winter. You can find this plant growing at elevations between 2,400 and 4,000 meters above sea level. It grows well in moist, well-drained soil that's rich in humus and packed with organic matter. It typically grows in shady spots on forested slopes and in alpine meadows.

Botanical classification	
Kingdom	Plantae
Division	Magnoliophyta
Phylum	Tracheophyta
Class	Liliopsida
Subclass	Liliidae
Order	Liliales
Family	Melanthiaceae
Genus	Trillium
Species	T. govanianum

Physicochemical Parameter of *Trillium govanianum*.

The rhizome of *Trillium govanianum* exhibits distinct physicochemical properties that are crucial for its medicinal potential. The total ash value in the rhizome is 12.5%, indicating the total mineral content present after complete incineration. Among the different types of ash, water-soluble ash is 4.0%, representing the portion that dissolves in water and gives insight into the presence of inorganic compounds. The acid-soluble ash is 2.4%, signifying the fraction of minerals that dissolve in acid, while the acid-insoluble ash is 0.8%, which refers to the amount of siliceous matter, such as sand and other impurities, that remain undissolved in acid.

The extractive values of the rhizome indicate the solubility of bioactive compounds in different solvents. The highest extractive values were observed for polar solvents like water (21.5%) and methanol (18.75%), in contrast to non-polar solvents. This suggests that the

rhizome contains a high concentration of polar phytochemicals, including sugars, saponins, glycosides, flavonoids, and steroids. These compounds are known for their medicinal properties, particularly their anti-inflammatory, antioxidant, and therapeutic effects. The dominance of these polar compounds highlights the potential of *T. govanianum* as a valuable medicinal plant.

The presence of saponins and glycosides contributes to the plant's pharmacological activities, including antimicrobial and anti-cancer properties, while flavonoids and steroids enhance its antioxidant and therapeutic potential. The high extractive values for water and methanol also suggest the feasibility of using these solvents for the effective extraction of bioactive compounds from the plant for medicinal formulations.

Physicochemical Analysis of *Trillium govanianum*

The phytochemical analysis of Trillium govanianum includes the detection of various bioactive compounds through standard qualitative tests. Alkaloids are recognized using Wagner's or Drage Dorff's reagent, while saponins are identified with the froth formation test. The presence of flavonoids is validated with the alkaline reagent and Shinoda test. Tannins and phenolics are assessed through ferric chloride and lead acetate tests, whereas glycosides are confirmed using the Keller-Killiani test. Additionally, steroids and triterpenoids are recognized through the Liebermann–Burchard and Salkowski tests. These analyses contribute to evaluating the plant's pharmacological potential and therapeutic applications.

Therapeutic uses

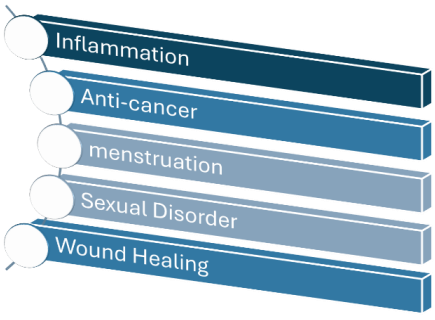
This substance has a long history of use in Ayurvedic and traditional folk medicine for a variety of therapeutic purposes. Some of its prominent medicinal applications are

1. **Anticancer potential -** Trillium govanianum has attracted interest due to its possible anticancer effects, which stem from the presence of bioactive steroidal saponins. These compounds show cytotoxic properties against various cancer cell lines for example, V79 fibroblast and K562 cells (Lui, 2005; Melo et al., 2004) by triggering apoptosis and blocking cell proliferation. Steroidal saponins in *T. govanianum* can damage cancer cells by disrupting their membrane integrity. The plant contains antioxidants that help neutralize free radicals, reducing oxidative stress linked to cancer progression. Research suggests possible use in treating breast, lung, and colon cancers, among others. Sharma et

al. (2016) reported less toxicity of T. govanianum extract towards normal cells but significant antiproliferative activity against cancer cells and reduced their viability. Could be explored as a natural source for developing novel chemotherapy drugs.

2. **Anti-microbial potential** - Studies suggest that steroidal saponins are responsible for its antibacterial and antifungal activity. The antibacterial activity of methanol, ethanol, acetone and distilled water extracts of T. govanianum rhizome was studied in vitro against three human pathogenic bacteria i.e., Escherichia coli, Staphylococcus aureus and Yersinia pestis following agar well diffusion method using different concentrations (25%, 50%, 75% and 100%) of plant parts extracts. Rahman et al. (2017) studied the activity of the hydro-methanolic extract of T. govanianum against fungal strains, i.e. Trichophyton rubrum and *Microsporum canis* observed significant inhibitions of 80 and 75%, respectively, while chloroform soluble fraction showed 90% inhibition. Antifungal activities of saturated and unsaturated fatty acids were also reported by Qiong et al. (2011).

3. **Anti-inflammatory action** – T. govanianum is known for its anti-inflammatory properties, which come from its ability to reduce oxidative stress and influence inflammatory mediators. Its effectiveness in lowering inflammation can be linked to its role in suppressing the release of reactive oxygen species (ROS) and its content of steroidal saponins like diosgenin. According to research on *T.govanianum* rhizomes methanol extract (MeOH-ext), is indicated that its fractions at 50, 100 and 200mg/kg exhibit significant anti-inflammatory activity comparable to the standard anti-inflammatory drug, diclofenac sodium.



Conservation and sustainable utilisation

Trillium govanianum is facing extinction primarily due to overharvesting, habitat destruction, and its slow reproductive cycle. The rhizomes of *T. govanianum* are highly valued for their

medicinal properties, including anti-inflammatory, anti-cancer, and aphrodisiac effects. Due to rising global demand, especially in traditional medicine and the pharmaceutical industry, large quantities are being harvested unsustainably. The plant has low seed germination rates and limited seed dispersal, making natural regeneration difficult. Additionally, climate change is shifting the suitable altitude ranges, further threatening its survival. Low genetic diversity in wild populations makes the species more vulnerable to diseases and environmental stress. Despite being classified as an endangered species, illegal harvesting and trade continue due to high market demand. Conservation efforts remain limited, with insufficient programs focused on cultivating the plant or regulating its collection.

To protect *Trillium govanianum*, we need to focus on sustainable harvesting practices and strong trade regulations to avoid taking too much from nature. Programs like tissue culture and controlled farming can help ease the pressure off wild populations. It's also super important to safeguard its natural environment through reforestation and conservation efforts. Plus, we should be looking into seed banking and genetic preservation to keep biodiversity alive. Getting local communities involved in conservation via awareness programs and incentives for cultivation can make a big difference, too. By pushing for better policies and diving deeper into research about its growth and ecological needs, we can help ensure this species sticks around for the long haul.

CONCLUSION

Trillium govanianum is a remarkable herb known for its medicinal benefits, thanks to its range of bioactive compounds like steroidal saponins, alkaloids, and flavonoids. Traditionally, it’s been used for a variety of health purposes, and its pharmacological properties—such as its antimicrobial, anti-inflammatory, and anticancer effects—make it a strong candidate for future drug development. However, the rising interest in this plant in herbal medicine, combined with unregulated harvesting and habitat loss, has caused a major drop in its natural population, putting it at risk of extinction. To ensure we can use *T. govanianum* sustainably, it's important to implement immediate conservation efforts, which should include protecting its habitat and developing cultivation methods. What's more, future research should look into improving propagation techniques and discovering new bioactive compounds to fully release their pharmaceutical potential, all while supporting biodiversity conservation.