

## Preserving and Harnessing *Trillium govanianum*: A Pathway to Medicinal Innovation

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The perennial herbaceous plant *Trillium govanianum*, a member of the Trilliaceae family, is recognized for its wide geographic distribution and significant medicinal properties. *Trillium govanianum* Wall. ex D. Don, belonging to the genus *Trillium* (family: Melanthiaceae or Trilliaceae), is an endangered medicinal herb native to the Himalayan region which is commonly referred to as Himalayan trillium, Nagchhatri, Teenpatra, Matarzela, Triflower, or Birthroot. *Trillium govanianum* holds great medicinal value, particularly in its native regions. Traditionally, indigenous communities have utilized *Trillium govanianum* for its purported health benefits. The rhizomes, leaves and flowers of *Trillium govanianum* have been utilized for their medicinal properties. These parts are rich in bioactive compounds, including alkaloids, flavonoids, tannins, and saponins, which offer a variety of pharmacological benefits. These benefits encompass anti-inflammatory, antioxidant, analgesic, antidiabetic and anticancer properties. Despite its notable medicinal potential, *Trillium govanianum* is at risk of extinction. Unfortunately, the population of this species has significantly decreased in the wild due to overexploitation. Although it was not included among the 960 traded medicinal species in India prior to 2008, its significant health benefits and growing demand have resulted in illegal trade. As a result, the International Union for Conservation of Nature (IUCN) has classified it as a threatened medicinal plant. Thus, it is need of the hour, to conserve this important endangered medicinal plant species.

### Taxonomic Classification

Scientific name: *Trillium govanianum*

Kingdom: Plantae

Order: Liliales

Family: Liliaceae

Genus: *Trillium* L.

Species: *T. govanianum*

Part used: Leaf, fruit, Rhizome and stem

### Geographical Distribution

Himalayan trillium grows in sporadic locations between 2700 and 4000 meters above sea level in the Himalayas, Bhutan, Nepal, and China. Because of how different it is, some have even considered it to be a different genus of Trillidium. The plant and Himalayan Paris are somewhat similar.

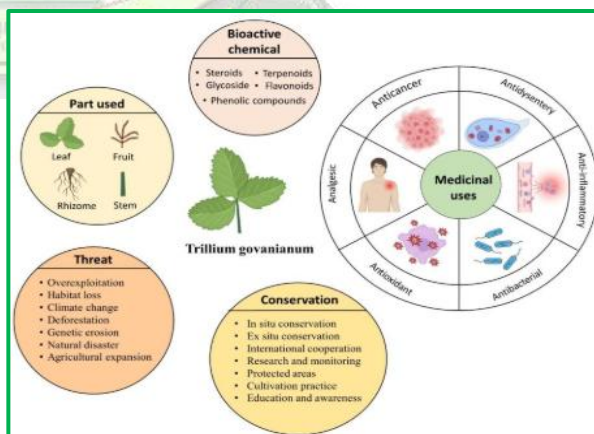




Fig.1 *Trillium govanianum* (Nag Chhatri) in natural habitat

## Morphology

*Trillium govanianum* is a perennial herb that grows in patches in shaded forests with rich soils that are high in humus. Thick, creeping, stem-erect and unbranched rootstocks are present. The leaves are 0.5-1.5 cm long, acute, and broadly ovate. They are grouped in a whorl at the top of the stem, with a single stalked flower in the center. Brown-purple flower. The fruit is a red, globular berry with a diameter of about 2 cm. The seeds are ovoid, numerous and have a pulpy lateral appendage.

**Fruiting and flowering time:** May, June and September

## Phytochemical composition

Trillarin, which is present in roots of *Trillium govanianum*, hydrolyzes to produce 2.5% diosgenin, a corticosteroid hormone. The plant's corticosteroid hormone is extracted and used in a variety of preparations, including sex hormones, cortisone and related preparations for the treatment of rheumatism, menstrual flow regulation and other conditions. It is also used to treat issues pertaining to the stomach. This drug is in high demand in international markets due to its potent medicinal properties.

## Post Harvest and Agrotechnology

**Propagation and soil requirement:** The primary method of propagating *Trillium govanianum* involves dividing and sowing rhizomes that are developing buds. Many research publications report on seed multiplication, yet do not describe the specifics of seed collection, dormancy, or viability. The only method of propagation is by planting rhizomes with growing tips. This grows well in slightly acidic to neutral soils with a pH range of 5.6–7.5. The plant likes soil that is loamy and sandy. The soil must be moist and rich in humus for the plant to thrive, so regular irrigation is necessary to keep the soil moist. A 1:1:1 mixture of forest soil, sand and vermicompost is used to prepare raised beds for polyhouses and nurseries. Because these are dense and fleshy, bulbs need rich, nutrient-rich soil to grow and develop.

**Rhizomes planting:** Planting rhizomes with developing apical buds is only method used to propagate *Trillium govanianum*, seed propagation is not currently used. This species' smaller rhizomes are planted in rows either directly in the field (which has been prepared before planting) or in nursery polybags. Plants and rhizomes with smaller sizes can be planted more densely, spaced 10 cm apart and 15-20 cm row to row. Rhizomes are planted in the winter months of November through December when they are dormant, and they sprout in February and March.

**Nutritional requirement:** As a tuberous crop, *trillium govanianum* needs a lot of organic matter and soil nutrients, which can be added by adding 4000-5000 kg of vermin-compost per hectare. It's important to note that these are preliminary specifications for this species based on preliminary research and may vary based on additional studies or experiences.

**Weed control and irrigation:** For optimal growth, *trillium govanianum* also needs a high level of soil moisture (60–70%). Throughout the summer, water your plants two or three times to help them grow vigorously and survive in the nursery.

**Harvesting and maturity time:** The seeds of *Trillium govanianum* ripen in early September, while the plant flowers in May and June. Rhizome harvesting is best done in the middle of September. To harvest rhizomes for planting in nursery polybags or in beds to grow fresh plants for future production, dig the rhizome and cut off the apical portion with the bud.

**Post harvest:** After being removed from forests, the rhizome of *Trillium govanianum* is cleaned and dried to get rid of any dirt or residue. Rinsed rhizomes are spread out on tarpaulin to dry in the shade for four to five days. For sale, dried material is packaged in cotton or gunny bags.

### Therapeutic uses

**Anticancer activity:** With IC<sub>50</sub> values ranging from 5 to 16 µg/mL, the methanolic extract of *T. Govanianum*'s roots and its solid-phase extraction (SPE) fractions exhibit cytotoxicity against four human carcinoma cell lines: breast (MCF7), liver (HEPG2), lung (A549), and urinary bladder (EJ138).

**Anti-inflammatory and analgesic activity:** The tonic visceral chemical and acute phasic thermal nociception, as well as the significant improvement of paw edema, demonstrated the anti-inflammatory and analgesic responses of the crude methanol extract and its solvent fractions. Pennogenin and borassoside E, two other isolated compounds, also demonstrated a noteworthy degree of oxidative burst suppressive activity. Steroids and compounds derived from steroids may be the cause of the observed activities. Consequently, this plant species' rhizomes may offer a novel source of compounds that are useful for reducing pain and inflammation.

**Antioxidant activity:** The antioxidant activity was present in the rhizomes of *T. govanianum*. However, compared to ascorbic acid and BHT, the extract's and its fractions' antioxidant activity was lower. The presence of large sized fatty constituents in the extract or its fractions may be the cause of their low scavenging capacity.

**Antifungal activity:** Rhizomes of *Trillium govanianum* were used to isolate govanoside A, a new spirostane steroidal saponin, as well as three previously identified compounds, pennogenin, diosgenin, and borassoside E. Against *Aspergillus niger* ATCC 16888, *Aspergillus flavus* ATCC 9643, *Candida albicans* ATCC 18804, and *Candida glabrata* ATCC 90030, the compounds govanoside A and borassoside E demonstrated good to moderate activities.

### Conclusion

Conclusively, investigating the medicinal potential of *T. govanianum* presents a promising path towards the progress of healthcare. The complex composition of this herb is further illuminated by its genetic makeup, as demonstrated by the number of chromosomes and the sequence of its proteins. Furthermore, *T. govanianum*'s ethnobotanical importance and a variety of actions, such as antibacterial, analgesic, antifungal, and antioxidant properties, highlight the plant's use in medicine. Furthermore, because over 99% of the natural population perishes before seed set as a result of harsh environmental conditions, grazing, and illicit extraction, the herb is in urgent need of conservation and prioritization. Plants primarily reproduce through vegetative processes in the wild. Due to illicit exports and non-scientific extraction, this highly prized herb has been nearly completely destroyed in the higher altitude regions of Himachal Pradesh in recent years. The species' survival in the Himalayas is in jeopardy due to the rapid decline of this species in its natural habitat brought on by rampant extraction. The Indian Himalayas have seen population declines due to

unregulated indigenous harvesting practices; Munsiyari (Uttarakhand), Tirthan Valley (Himachal Pradesh), and Tunghnath (Uttarakhand) have seen the biggest declines. Furthermore, the plant is in danger in the Indian region of Kashmir and the Pakistani Chail Valley due to inappropriate collection practices. As a result, the species faces severe extinction and it is imperative that conservation efforts be given top priority and that appropriate measures be taken.