



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

An In-Depth Analysis of *Coptis teeta*: Chemical Constituents, Ethnomedicinal Applications, and Therapeutic Prospects for Managing Diverse Health Conditions

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ARTICLE INFO

Published: 13 May 2025

Keywords:

Coptis teeta Wall, Chemical Constituents, Berberine, Traditional Uses, Cultivation and Pharmacological Activities.

DOI:

10.5281/zenodo.15396284

ABSTRACT

Coptis teeta is a medicinal herb native to the eastern Himalayas. Its rhizome is rich in alkaloids such as berberine, palmatine, jatrorrhizine, coptisine, columbamine, and epiberberine, along with various secondary metabolites including lignans, phenylpropanoids, flavonoids, phenolic acids, saccharides, and steroids. These compounds exhibit antimicrobial properties and are effective in treating a range of ailments such as malaria, jaundice, diarrhea, fever, and dysentery. The plant's leaves, known for their cold, pungent, and bitter qualities, are used for their antibiotic, stomachic, and anti-inflammatory effects. In Indian traditional medicine, *Coptis teeta* is commonly employed to address conditions like intestinal catarrh, general weakness, recovery from illness, dysenteric disorders, indigestion, and malarial fever. This review highlights the plant's chemical composition, traditional applications, cultivation methods, and pharmacological properties.

INTRODUCTION

The plant kingdom is one of nature's vital life-support systems provided to the blue planet. Since plants can fulfill nearly all human needs, early humans likely learned to use them for medicinal purposes in response to hunger, injuries, accidents,

insect or snake bites, and deaths.¹ In tribal communities where traditional medicine remains the primary form of healthcare, the use of traditional healing practices dates back to ancient times.² With the increasing global interest in exploring, studying, and integrating traditional health systems, evaluating the wealth of traditional medicine has become essential.³ Many tribes in

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



Northeast India have their own documented healing traditions, and the indigenous communities of Arunachal Pradesh possess extensive knowledge of medicinal plants and their uses.⁴ However, scientific validation of these traditional claims remains largely incomplete.⁵ One notable plant group is the *Coptis* genus, which belongs to the Ranunculaceae family of flowering plants. This genus comprises 15 species, all native to Asia. *Coptis* plants are recognized for their medicinal properties and distinctly bitter taste. The earliest known mention of these plants appears in the first Chinese materia medica text, compiled during the Eastern Han dynasty (25–220 AD). For over two millennia, *Coptis* has been a staple in traditional Chinese medicine, used to treat various ailments such as malaria, jaundice, diarrhea, fever, and dysentery.⁶ *Coptis teeta* Wall is a stemless, perennial herb characterized by its golden-yellow rhizome, sturdy roots, and greenish flowers, and is commonly found in alpine regions.⁴ *C. teeta*, native to the Mishimi Hills of Arunachal Pradesh, India, is known as Mishmi teeta in Assamese, Mamira or Tiktamuulaa in Ayurvedic practices, and Maamisaa or Maamiraa in Unani medicine.⁷ *Coptis* species contain a range of protoberberine alkaloids, including berberine, coptisine,

jatrorrhizine, palmatine, and berberastine, which contribute to various biological activities.⁸ In Japan, a concentrated extract from roasted rhizome powder is employed to treat scabies, while the *Coptis* species is utilized for managing severe headaches. Additionally, ointments prepared from the rhizome and leaves are used to treat Eczema marginatum.⁹ In Indian traditional medicine, it is commonly employed as an antibiotic, stomachic, and anti-inflammatory to address intestinal catarrh, debility, recovery after illness, dysentery, and dyspepsia.¹⁰

Taxonomical Classification :

Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Order : Ranunculales

Family : Ranunculaceae

Genus : *Coptis*

Species : *teeta*¹¹

Vernacular Names:

English	Indian gold thread
Assam.	Mishmi tita;
Arabic	Mamira-chini;
Hindi	Mamira, Haladiya Bachnag, Mishmitita;
Sanskrit	Supita, Tiktamula, Mishamitita;
Tamil.	Pitarohini, Pitarokini, Peetarogini, Pidarokini, Mamiran;
Marathi.	Pitmula haldiya bachnag;
Urdu.	Mameeran, Mameesa (mamira, Mamiran), Mamiran-i- chini, Mamira. ¹²

Distributions:

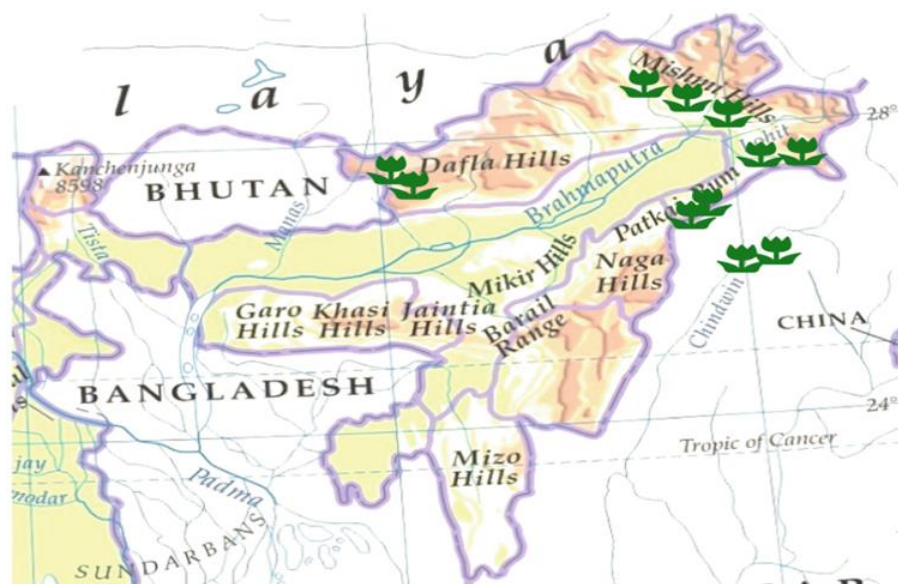
Coptis teeta plant is commonly found in the Himalayan regions of China, India, Nepal, and Bhutan, particularly in the temperate zones of the Himalayas and East Asia, including northern

China. In India, native species are limited to the Himalayan states of Arunachal Pradesh, Darjeeling, West Bengal, and Sikkim, typically thriving at elevations between 2,500 and 3,000 meters. Specific sightings have been recorded in the Lohit, Siang, Upper Subansiri, and Dibang



Valley districts of Arunachal Pradesh.¹³ In the late nineteenth century, the British explored the local flora and its uses among the indigenous people of Arunachal Pradesh. Mishimi teeta is one of the

valuable medicinal plants found in the region. Reports of *Coptis teeta* have only been recorded from China's Yunnan province and the Indian state of Arunachal Pradesh.^{5,14}



Botanical Descriptions

C. teeta, native to the eastern Himalayas, is a small, herbaceous, perennial, evergreen, and stemless medicinal plant. It features a horizontal to slightly angled rhizome measuring 5–15 cm in length and grows to a height of 30–50 cm. The plant has smooth, petiole-round leaves, 6–12

inches long, with shiny, slimy, ovate-lanceolate leaflets. Its small, symmetrical, whitish flowers, often with dark hair follicles, are pedicelled and typically appear singly or in groups of up to three. The plant produces capsule-shaped fruits containing numerous black seeds, each reaching up to 6 mm in length.^{15,16}



Chemical constituents

The cold, pungent, and bitter rhizomes of *Coptis teeta* are rich in chemical compounds that help inhibit various microorganisms and effectively

treat a range of illnesses. Berberine, the plant's main active ingredient, makes up 6–8.5% of the root. The rhizomes also contain several alkaloids, including columbamine, palmatine, jateorrhizine, epiberberine, and coptisine (also known as coptina). Additionally, they comprise sugar, lignin, coloring compounds, albumin, fixed oils, and extractives. Standardizing the physico-chemical properties of *Coptis teeta* is important for maintaining its identity, purity, and potency during cultivation and conservation.¹⁷

Traditional Uses:

The Mishmi and neighboring tribes are well known for their extensive ethnopharmacological knowledge of traditional medicine, depending on the region's rich biodiversity to meet their healthcare needs. Locally called M. teeta, *C. teeta* is used to treat various conditions such as jaundice, diabetes, hypertension, cough, and malarial fever. A small quantity of the powdered rhizome, taken twice daily with water, is effective in relieving fever, digestive disorders, and headaches.¹⁸ In Arunachal Pradesh, traditional knowledge has long guided the use of M. teeta rhizomes for treating various medical conditions. The Adi, Galo, Memba, Nyi-shi, and Tagin tribes primarily use the entire *C. teeta* plant—especially the leaves and rhizome—to address ailments such as malaria, dandruff, diarrhea, loose bowel movements, stomachaches, and insect bites. Additionally, *C. teeta* is employed in treating numerous inflammatory conditions, as well as eye, skin, stomach, urinary, and jaundice-related issues. It is also used to manage diseases associated with cancer, inflammation, excess heat, dampness, toxicity, colds, coughs, digestive problems, fever, eye infections, loss of appetite, headaches, backaches, and skin allergies. Moreover, *C. teeta* is commonly used to treat serious infections like meningitis, tuberculosis, bacterial dysentery, typhoid, empyema, and whooping cough.¹⁷

De Philipps and Krupnick (2018) also highlighted the significance of *C. teeta* in Myanmar, where its roots are traditionally used to aid digestion, reduce fever, relieve constipation, regulate bowel movements, and enhance vitality. To treat malaria, the roots are soaked in alcohol. Additionally, the roots are ground and mixed with *Piper longum* Linn. to form pea-sized pellets, which are taken each morning and evening to treat coughs, bronchitis, asthma, and excessive phlegm. A combination of crushed roots, powdered *P. longum*, and juice from *Abutilon indica* Linn. leaves is used to create peppercorn-sized pellets, consumed twice daily to improve digestion, reduce swelling, and address diarrhea and other digestive issues. For children suffering from pneumonia, a paste made from the root, one *Syzygium aromaticum* Linn., and one *Piper nigrum* Linn., mixed with mother's milk, is administered. Additionally, a topical application of crushed roots mixed with a small amount of *Aloe vera* Linn. sap and leaves or sap from *Mayoe* (*Calotropis procera*) is used to treat snakebites.¹⁹ Tibetans use the roots of *C. teeta* to address intestinal issues, anthrax, dysentery, and pus-related infections, whereas the Lhoba community applies them to control bleeding, relieve pain, and reduce inflammation and toxicity during wound care.²⁰

Cultivation:

The ideal period for collecting *Coptis* germplasm is from the onset of the rainy season to the beginning of winter, when the plants are at their peak health and vigor. Using a small iron rod, carefully extract healthy specimens from the forest. Immediately cover the root zone of *C. teeta* with *Sphagnum* moss to maintain moisture and humidity during transportation. In North India, the optimal time for planting *Coptis* is between September and October. After collection, transplantation should be done without delay. For transplanting, 12-inch-diameter earthen pots filled



with a potting mix (in a 2:1 ratio of garden soil to leaf mould) are recommended. Once transplanted, the plants require light irrigation. The first harvest typically occurs four to seven years later, when the rhizome reaches about 1.5 cm in diameter. However, with proper care through feeding, weeding, and watering, daughter plants may begin to emerge within six months. The life cycle of a *C. teeta* plant spans eight to ten years, characterized by harvesting and vegetative propagation.²¹

Pharmacological activities of *Coptis teeta*

Both fresh and dried rhizomes of *Coptis teeta* are commonly used as medicine. The bitter taste of the leaves and rhizomes is attributed to the presence of berberine and coptine. In raw rhizomes of *Coptis teeta*, berberine and coptine are among the primary active compounds, comprising about 6–8.5% of their content..

Antimicrobial and Antibacterial activity:

Berberine reduces the intestinal secretory response triggered by *Escherichia coli* and *Vibrio cholerae* enterotoxins without causing histological damage to the intestinal mucosa (Sack, 1982). Additionally, berberine inhibits certain species of *Klebsiella*, *Shigella dysenteriae*, and *Salmonella Paratyphi*, which are responsible for diarrhea and other intestinal diseases (Wagner, 2000).²³

Anti-diarrheal activity

A tribe in northeastern India uses the rhizome of *Coptis teeta* to treat diarrheal diseases. The anti-diarrheal effects of berberine are evident in its ability to slow down small intestinal transit, which may help prevent diarrhea by delaying the movement through the small intestine (Eaker and Sninsky, 1989).²⁴

Anti-hypertensive activity

Liu et al.²⁵ investigated the effects of berberine, an alkaloid from *Rhizoma coptidis*, on endoplasmic reticulum stress and its underlying mechanisms in spontaneously hypertensive rats (SHRs). They found that berberine activates adenosine monophosphate-activated protein kinase, which reduces endoplasmic reticulum stress and scavenges reactive oxygen species, thereby decreasing endothelium-dependent contractions. This leads to the downregulation of COX-2 in the carotid arteries of SHRs. Additionally, Guo et al.²⁶ studied the impact of berberine on blood pressure, pro-inflammatory cytokines, kidney failure, and the renin-angiotensin system in SHRs. Their findings showed that berberine can alleviate hypertension-induced kidney damage, delay its onset, and reduce its severity. Berberine also inhibits the renin-angiotensin system and pro-inflammatory cytokines such as Interleukin 6 (IL-6), IL-17, and IL-23, which are involved in the development of hypertension.

Anti-arrhythmic activity :

Research indicates that berberine possesses anti-arrhythmic, positive inotropic, negative chronotropic, and vasodilatory properties. It also exerts notable cardiac effects, similar to its derivatives, tetrahydroberberine and 8-oxoberberine, both of which demonstrate anti-arrhythmic activity. The rhizome of *Coptis teeta* can be utilized to treat various heart conditions, such as arrhythmias and heart failure.²⁷

Anti-hyperlipidemic activity:

Berberine helps reduce LDL and total blood cholesterol levels, thereby lowering the risk of heart attacks and neurological hemorrhages. Extracts from *Rhizoma coptidis* are effective in reducing the pathological damage caused by hypercholesterolemia by decreasing serum cholesterol levels. Additionally, it reduces liver



cholesterol without affecting fecal cholesterol, indicating that the cholesterol-lowering effect results from inhibited cholesterol synthesis rather than increased excretion. Moreover, oral administration of *Rhizoma coptidis* extract lowers blood levels of thiobarbituric acid-reactive substances, suggesting that it can help prevent hypercholesterolemic diseases by reducing lipid peroxidation.^{28,29,30}

Anti-inflammatory activity:

The ethanol extract of *Coptis rhizome* showed the strongest anti-inflammatory effects. In splenocytes treated with berberine in vitro, the main immune response to red blood cells and antibody production varied depending on the method of application.^{31,32}

Anti-depressant activity:

Yamahara (1976) reported that berberine reduces neurotransmission and exhibits antidepressant effects. Berberine demonstrated significant biological activity, including some activation within the central nervous system. Its antidepressant properties were assessed using forced-swim and tail-suspension tests. Neurochemical analysis revealed that berberine (5 mg/kg, administered intraperitoneally) increased serotonin and norepinephrine levels in the brains of mice.³⁴

Antioxidant activity:

After being identified in large amounts in the rhizome of *Coptis teeta*, berberine's antioxidant properties were studied. Antioxidant activity was assessed through various in vitro methods, using inhibitory concentration to evaluate free radical scavenging. Research by Tan et al. (2007)³⁵ and Lone et al. (2014)³⁶ showed that the ethanolic root extract of *Coptis teeta* possesses strong antioxidant potential. This plant is highly valued by the

pharmaceutical industry and is also utilized in the Ayurvedic system of medicine.

Anti trachoma:

In northeastern India and China, berberine has traditionally been utilized to address eye disorders. A study found that when treating trachoma, berberine was more effective than sulfacetamide in eliminating *Chlamydia trachomatis* from the eye and reducing the likelihood of symptom recurrence.³⁷

Cholesterol reduction activity:

Berberine has been found to lower cholesterol levels through a mechanism distinct from that of statin drugs. According to Kong et al. (2004), berberine could serve either as an alternative to statins or as an additional therapy alongside them to help manage high cholesterol more effectively.³⁸

Anti - diabetic activities

Several studies have evaluated berberine's effectiveness in managing type 2 diabetes. Berberine can help lower and stabilize blood sugar levels through two main mechanisms: by inhibiting the absorption of sugars in the intestines and by enhancing and stimulating insulin production.^{39,40}

Analgesic activity

Goswami et al.⁴¹ investigated the analgesic potential of *Coptis teeta* methanolic extract (MECT) using approved rodent models. In an acetic acid-induced abdominal constriction assay, MECT notably decreased the writhing response. These findings suggest that MECT may exert a peripheral analgesic effect by inhibiting local peritoneal receptors, possibly through cyclooxygenase (COX) inhibition. The strong analgesic action of MECT appears to result from



its active components blocking the release of pain mediators. To assess its central analgesic properties, the hot plate test, a model for thermal nociception, was conducted. MECT exhibited strong analgesic effects in the hot plate test, indicating involvement of both spinal and supraspinal mechanisms. Within 30 minutes of administration, both MECT and Tramadol, which act similarly to opioid agonists like morphine, elevated the pain threshold in the pain models. This similarity in peak analgesic effects is attributed to comparable drug metabolism rates. However, Tramadol was found to be more potent than MECT at a dose of 300 mg/kg.

Phosphodiesterase inhibition activity

The phosphodiesterase inhibition activity of berberine (as a standard) extracted from *C. teeta* was examined by Chit et al.⁴², who found that it can inhibit phosphodiesterase by $2.05 \pm 5.33\%$.

Anti-histaminic activity:

Using isolated guinea pig ileum, the Unani eye drop—containing Azadirachta indica A. Juss (flower), Cassia absus Linn. (seed), *C. teeta* (rhizome), Symplocos racemosa Roxb. (bark), Rosa damascena Mill., alum, and Berberis aristata DC. (stem wood)—demonstrated strong antihistaminic effects. The eye drop was able to counteract the tissue effects induced by histamine. Increasing doses of the test formulation progressively inhibited the histamine-induced contractions in the isolated guinea pig ileum.⁴³

Anti-malarial activity :

Goswami et al.⁵⁸ conducted an in vitro study to evaluate the anti-malarial activity of methanol extracts derived from *C. teeta*. Their findings revealed notable anti-malarial effects, with IC_{50} values of 0.7 $\mu\text{g/mL}$ against the Dd2 strain of *Plasmodium falciparum* and 0.08 $\mu\text{g/mL}$ against

the 3D7 strain. Further molecular investigations, including molecular docking, molecular dynamics simulations, and density functional theory analysis, indicated that noroxyhydrastinine—a bioactive compound found in *C. teeta*—shows strong potential as an effective anti-malarial agent.⁴⁴

CONCLUSION:

In Conclusion, *Coptis teeta*, a medicinal herb indigenous to the eastern Himalayas, is rich in bioactive substances and widely utilized in both traditional and modern medicine to treat ailments such as malaria, jaundice, and dysentery. Its extensive use by local communities highlights the need to safeguard traditional knowledge and investigate its potential for contemporary medical use.

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HOW TO CITE: Vrutika Kachare*, Durgeshwari Misar, Snehal Sidam, Princess Wankhade, Rajendra Ganjiwale, Deorao Awari, An In-Depth Analysis of Coptis teeta: Chemical Constituents, Ethnomedicinal Applications, and Therapeutic Prospects for Managing Diverse Health Conditions, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 5, 2088-2097. <https://doi.org/10.5281/zenodo.15396284>

