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A Bajpay
C.S.I.R., National Botanical
Research Institute, Lucknow,
Uttar Pradesh, India

RC Nainwal
C.S.I.R., National Botanical
Research Institute, Lucknow,
Uttar Pradesh, India

D Singh
C.S.I.R., National Botanical
Research Institute, Lucknow,
Uttar Pradesh, India

Correspondence
A Bajpay
C.S.I.R., National Botanical
Research Institute, Lucknow,
Uttar Pradesh, India

Coptis teeta: A potential endemic and endangered medicinal plant of Eastern Himalayas

A Bajpay, RC Nainwal and D Singh

Abstract

Coptis teeta, is a non-timber forest product (NTFP) that grows in northwest Yunnan (China), Bhutan and northeast India, specially in temperate regions of Arunachal Pradesh. Rhizome of this plant is very famous in traditional medication in North East India and China, for prevention and treatment of a number of human diseases. Destructive commercial harvesting for centuries and deforestation, this species has entered into the Chinese Red Data Book, due to its high market demand, commercial harvesting pressure on wild populations that were already dwindling as a result of deforestation and population reach at risk of extinction. On the basis of the various reports and studies *Coptis teeta* contains many alkaloids such as berberine, palmatine, jatrorrhizine, coptisine, columbamine, and epiberberine and various secondary metabolites, lignans, phenylpropanoids, flavonoids, phenolic acids, saccharides and steroids are also present in *Coptis teeta*. Thus, the qualitative and quantitative analysis of several high-content constituents in *Coptis* extracts will help us for better evaluation and regulation of drug quality. Due to its versatile nature and many pharmacological benefits the cultivation and propagation of *Coptis teeta* should be done with proper care and patience.

Keywords: *Coptis teeta*, tribal medication, pharmacological activity, chemical constituents and cultivation

Introduction

Coptis teeta Wall. is a perennial herbaceous plant belongs to family - Ranunculaceae, Somatic chromosome number $2n=18$ (Pandit and Babu, 1993) ^[17]. **Plant:** small (30-50 cm), stemless, perennial, flowering, evergreen and herbaceous. Leaves are 5 – 20 cm long, pinnatifid, lamina 3-lobed, glabrous; petioles 10 – 20 cm long. Inflorescence paniced; flowers small, few flowered, white or yellowish in colour. Rhizomes are horizontal to oblique (5–15 cm long) with fibrous roots, bitter in taste, external skin yellowish brown and pith yellow–orange which covered with numerous nodes and rootlets. A follicle, multi-seeded, black coloured seed. Flowering occurs (February - April) and Fruiting occurs (May- July), (Latif *et al.*, 2008; Payum T., 2017; Bhatee and Beniwal, 1988) ^[13, 18, 3]. This plant has been listed in Red Data Book as it is an endangered species. At present, it is jeopardy in the forests, lot of factors contributing to the endangerment of this species. Due to over-exploitation for its medicinal uses, deforestation as well as for slow re-productive success of this plant it is declining on an alarming rate in the Eastern Himalayan regions of India. *Coptis teeta* Wall. is a perennial herbaceous medicinal plant which is native to Arunachal Pradesh (Mishmi Hills) India and distributed in temperate regions such as Arunachal Pradesh, Sikkim and Bhutan. Its rhizome is brownish yellow, which is widely used as a medicine in Ayurveda, Siddha and Unani medical system. The people of Arunachal Pradesh also have predated knowledge on Mishmi teeta/*Coptis teeta* and their uses. But in this part it only exist in the form of a traditional medicinal plant having numerous uses, there is no written data or record is available, but it is now a necessity to maintain the record of the plant before it becomes completely extinct. *Coptis teeta* has been reported only from Arunachal Pradesh in India and Yunnan in China. It grows at the elevation height of 1700 mts - 2800 mts. In IUCN Red List of threatened species it is mentioned as endangered species in Red List Category. Approx 90 percent population of *C. teeta* is found in India, therefore it is considered as a representative of the global population. R. Wilcox and Captain Bedford from Mishmi Hills of Indian flora reported *C. teeta* in 1852 first time.

It is cultivated in a small scale in its natural habitat viz., India (Arunachal Pradesh) and China (Yunnan). Forest department of Arunachal Pradesh has taken up the responsibility of cultivation of this plant in small areas of Dibang Valley and Lohit districts. The local tribal people also started cultivation of this plant in some places of Arunachal Pradesh. The current price of *Coptis teeta* is about Rs.2000/kg. It is not easy to grow and cultivate the plant. It is climate and region specific crop.

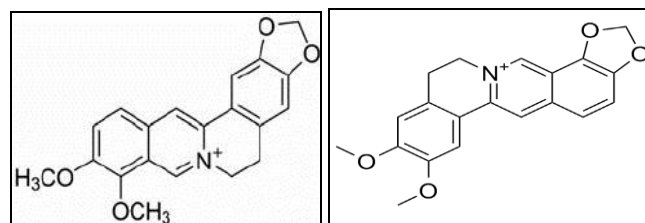
Temperate region covered with snow during winter is the best climate to grow and cultivate the plant, Selvam (2012).

Tribal society of Arunachal Pradesh uses this plant to cure malaria, stomach pain, diarrhoea, loose motion and insect bite etc. It is also used to cure inflammation, eye diseases, skin diseases, stomach problems, constipation, jaundice and urine disorders, cancer and inflammation, clearing heat, eliminating dampness, purging fire and detoxification. It is oftenly used for the treatment of bacillary dysentery, typhoid, tuberculosis, epidemic cerebrospinal meningitis, empyrosis, pertussis, and other diseases. Rhizomes is bitter in taste due to several alkaloids (Berberine, Coptisine and Palmatine etc.) which are effective in inhibiting various microbes and play a safe and effective role in treatment for many ailments (Bhatee and Beniwal, 1988; Payum T., 2017 and Latif *et al.*, 2008) [3, 18, 13]. The berberine (6–8.5%) is a main active ingredient of this plant. It has versatile pharmacological activities like; Antimicrobial and Antibacterial activity, Anti-diarrheal activity, Anti-hypertensive activity, Anti-arrhythmic activity, Anti-hyperlipidemic activity, Anti-inflammatory activity, Anti-depressant activity, Antioxidant activity, Anti trachoma, Cholesterol reduction activity and Anti - diabetic activities. Vernacular names; Hindi - Mamira; Assamease - Mishmi tita; English - Gold thread; Arabic - Mamira; Sanskrit - Supita; Tamil; Pitarohini.

Chemical constituents

The rhizomes of *Coptis teeta* are pungent and bitter, cooling

herb that contains several chemical compounds that are effective for inhibiting various microbes and also used to cure many ailments being safe and effective. The root contains 6–8.5% of berberine, which is the main active ingredient of the plant. It also contains various alkaloids like coptisine or coptina, Palmatine, Jateorrhizine, Epiberberine and Columbamine. It also contains fixed oil, albumin, coloring compound, lignin, extractive, and sugar. For the purpose to cultivate and maintain the identity, purity, and strength is it fruitful to undertake the physico-chemicals standardization of *Coptis teeta*. (Latif *et al.*, 2008 and Payum T., 2017) [13, 18].



Chemical structure of Berberine Chemical structure of epiberberine

Pharmacological activities of *Coptis teeta*

The fresh and dried rhizomes of *Coptis teeta* are widely used as a drug. The bitter taste of the leaf and rhizome is due to the berberine and coptine. The raw rhizomes of *Coptis teeta* contains major active compounds as berberine and coptine (6–8.5%).

Table 1: Organic acids concentrations (mg/g) in *Coptis teeta* plant (Li *et al.*, 2018) [15].

S No.	Organic acids	<i>C. teeta</i> (mg/g)
1.	Quinic acid	27.85 ± 1.55
2.	Acetic acid	0.18 ± 0.01
3.	Malic acid	15.25 ± 0.69
4.	Tartaric acid	0.46 ± 0.02
5.	Oxalic acid	0.34 ± 0.01
6.	Citric acid	1.53 ± 0.06
Other compounds isolated from <i>Coptis teeta</i> plant (Meng <i>et al.</i>, 2018) [16].		
7.	3,4-Dihydroxyphenethyl alcohol	
8.	3,5-Dihydroxyphenethyl alcohol-1-O-β-d-glucopyranoside	
9.	Protocatechuic acid	

Antimicrobial and Antibacterial activity: Berberine inhibits the intestinal secretory response of *Vibrio cholerae* and *Escherichia coli* enterotoxins without causing histological damage to the intestinal mucosa (Sack, 1982) [19]. *Shigella dysenteriae*, *Salmonella Paratyphi* and various *Klebsiella* species which causes many intestinal infections like diarrhea are also inhibited by Berberine (Wagner, 2000) [23].

Anti-diarrheal activity: The tribe of north east India uses the rhizome of *Coptis teeta* for curing diarrhea disease. Berberine shows the anti diarrheal properties by inhibiting the transit of the small intestine, anti-diarrheal properties of berberine may cure by delay small intestinal transit (Eaker and Sninsky, 1989) [4].

Anti-hypertensive activity: Berberine has potential to control blood pressure (Watt, 1972; Lahiri *et al.*, 1958; Anonymous, 1976; Hui *et al.*, 1991) [24, 12, 1, 5].

Anti-arrhythmic activity: Berberine and its derivatives tetrahydroberberine and 8-oxoberberine also has the cardiovascular effects and the report of a study described that berberine has positive inotropic, negative chronotropic, anti-

arrhythmic, and also vasodilator properties. Both of the derivatives of berberine have anti-arrhythmic activity. Various heart problems like irregular heartbeat, heart failure can be cure by the use of rhizome of *C. teeta*. (Lau *et al.*, 2001) [14].

Anti-hyperlipidemic activity: Berberine reduces total blood cholesterol, LDL cholesterol which can be a cause of heart attack and brain hemorrhage (Zhou *et al.*, 2008; Kong *et al.*, 2004; Kim *et al.*, 2009) [28, 10, 9].

Anti-inflammatory activity: Anti-inflammatory properties of ethanol extract of *coptis* rhizome showed the highest inflammation reducing effect. The in vitro treatment of splenocytes by the berberine showed the primary immune response to red blood cell and antibody synthesis was influenced in a different manner depending on its mode of application (Ivanovska and Philipov, 1996; Jiang *et al.*, 2015) [6, 8].

Anti-depressant activity: Berberine act as an anti-depressant which reduces neurotransmission levels (Yamahara, 1976) [25]. Berberine possessed a wide range of biological activity

including some central nervous system activity. The antidepressant activities were assessed in forced-swim and tail-suspension tests. The neurochemical study revealed that berberine (5 mg/kg, i.p.) increased the level of norepinephrine, serotonin in the rodent brain (Kulkarni and Dhir, 2009)^[11].

Antioxidant activity: Berberine found in a good amount in *Coptis teeta* rhizome, had been analysed for its antioxidant activity. A number of *in vitro* methods were performed to estimate the antioxidant activity through inhibitory concentration for scavenging free radicals. Lone *et al.*, 2014^[22]; Tan *et al.*, 2007)^[21] reported that the ethanolic root extract from *Coptis teeta* have highly potential anti-oxidant activity. Since the plant is being used in Ayurveda system of medicine and is a boon for the entire pharmaceutical industry.

Anti trachoma: Berberine has a long history of use for eye problems in north east India and China. A study showed that in the treatment of trachoma, berberine was more effective as compare to sulfacetamide in eradicating Chlamydia trachoma is from the eye and preventing relapse of symptoms (Babbar, 1982)^[2].

Cholesterol reduction activity: It was reported that berberine lowers cholesterol level through a mechanism different than the statin drugs. Kong *et al.*, 2004^[10], suggested potential uses of berberine as an alternative to the statins and as a complementary therapy that might be used with statins in an attempt to achieve better control upon high cholesterol level.

Anti - diabetic activities: Several studies evaluating efficiency of berberine for the treatment of type 2 diabetes. Berberine also has the property to reduces and maintains the blood sugar level and it happens by two different mechanisms that are by inhibiting the absorption of sugars from the intestine and by stimulating and enhancing the production of insulin. (Yanxia *et al.*, 1995; Yin *et al.*, 2008)^[26,27].

Cultivation of *C. teeta*

Favorable time duration for *Coptis* germplasm collection is, beginning of the rainy season to beginning of the winter season when the plants having most vigorous and strongest condition. Healthy plants should be collect carefully with the help of a small iron rod from the forest. Root zone of *C. teeta* should cover immediately with *Sphagnum* moss which maintains moisture and humidity for survival of plant during transportation. After collection immediate transplanting required, the favorable time of *Coptis* planting in North Indian climatic conditions is September - October. Earthen pots having 12 inches diameter are ideal for transplanting with potting mixture (2:1 ratio) leaf mold and garden soil. After transplanting, the plants irrigate slightly. After six months, by proper feeding, weeding and watering some daughter plants will started to emerge, however four to seven years may takes to first harvest, when the rhizome diameter reaches about 1.5 cm. Although the life cycle of a *C. teeta* plant is 8- 10 years, characterized by vegetative reproduction and harvesting (Huang and Long, 2007)^[7].

Table 2: Growing conditions of *Coptis teeta* in poly-house (fan- pad types)

Plants collection	September - October (Before dormancy)
Propagation	Seed, rhizomes, plantlets separation and Micro-propagation
Nursery rising	May to September from seed and March- April from Rhizome cutting (1 inch long)
Planting	One year old seedling, six months old rooted cutting and immediate after separation of plants should be planted
Soil and Planting mixture	It performs well in acidic soils (pH = 3.7-5.0) and contain high organic matter (up to 32.1). Two parts of leaf mould and one part of sandy soil
Temperature and humidity	Temperature 25 – 30 °C and humidity 60-70%
Planting distance	Seedling : 30 x 30 cm (P x R), Rhizome cutting 30 x 30 cm and 35 x 35 cm for plant lets
Irrigation	Heavy watering is not required, mist watering should be done
Harvesting	Harvesting is done during winter season 6 year after planting
Price in local Market	Dry rhizomes 2000 Rs/kg (Selvam, 2012)



Coptis teeta plant with rhizomes and pot cultivation

Conclusion

At the end after studying various detailed reports on *C. teeta* the conclusion can be drawn on it that *Coptis teeta* is distributed in the Eastern Himalayas region and is a highly threatened and endangered important medicinal plant. This study also hints of a number of valuable compounds

contained in this herb, which are biologically active against numbers of health problems like anti-cancer and anti-diarrhoea. To see the importance of this highly demand herb, it needs attention for protection, propagation and further studies for the welfare of ecosystem and mankind.

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