

# Ethnopharmacology of Hepatoprotection: A Comprehensive Review of Medicinal Plants with Emphasis on *Coptis teeta* Wall

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**Abstract:** Hepatoprotection, the protection of the liver from damage or disease, remains a critical area of research in pharmacology due to the increasing prevalence of liver-related disorders caused by environmental toxins, infectious agents, and lifestyle factors. Ethnopharmacology, which explores the traditional use of medicinal plants, offers a valuable repository of natural remedies for hepatoprotection. This review aims to comprehensively analyze medicinal plants traditionally used for liver ailments, focusing on their pharmacological mechanisms, bioactive compounds, and clinical relevance.

Among these, *Coptis teeta* Wall, a rare and significant medicinal plant from Eastern Himalayan regions, has drawn attention for its potent hepatoprotective properties. Known for its rich content of alkaloids, especially berberine, *Coptis teeta* exhibits diverse pharmacological activities, including antioxidant, anti-inflammatory, and anti-apoptotic effects, making it a promising candidate for liver disease management. This paper discusses the traditional uses of *Coptis teeta*, evaluates its phytochemical composition, and highlights recent advances in understanding its mechanisms of action. Furthermore, it compares the efficacy of *Coptis teeta* with other ethnomedicinal plants, providing insights into potential therapeutic applications and challenges. This review emphasizes the need for further studies, including preclinical and clinical evaluations, to bridge the gap between traditional knowledge and modern medicine, aiming to develop safe and effective hepatoprotective agents from natural sources.

**Keywords:** Hepatoprotection, Ethnopharmacology, Medicinal Plants, *Coptis teeta* Wall, Liver Disorders, Berberine, Phytochemicals, Traditional Medicine, Antioxidant Activity, Anti-inflammatory, Hepatic Diseases, Natural Remedies, Herbal Medicine, Liver Detoxification.

## 1. INTRODUCTION

**Purpose:** The purpose of this review is to define the scope and importance of ethnopharmacology in the

context of hepatoprotection. It aims to explore how traditional knowledge of medicinal plants can provide valuable insights into the prevention and treatment of liver disorders. By analyzing the pharmacological properties and bioactive constituents of these plants, this study emphasizes their potential role in mitigating hepatic damage caused by toxins, infections, and metabolic imbalances. Special attention is given to *Coptis teeta* Wall as a case study to highlight the integration of ethnopharmacological evidence with modern scientific methodologies for developing effective hepatoprotective agents.

**Focus on *Coptis teeta* Wall:** *Coptis teeta* Wall, commonly known as Mishmi Teeta, is a perennial herb native to the Eastern Himalayan regions, including Arunachal Pradesh in India, Myanmar, and China. This rare medicinal plant holds significant value in traditional medicine systems, particularly among indigenous communities, for its diverse therapeutic properties. Traditionally, it has been used to treat gastrointestinal disorders, fever, infections, and liver-related ailments. The hepatoprotective relevance of *Coptis teeta* is attributed to its rich phytochemical profile, dominated by alkaloids such as berberine, coptisine, and palmatine. These compounds exhibit potent antioxidant, anti-inflammatory, and detoxifying activities, which are critical for preventing and mitigating hepatic damage caused by oxidative stress, toxins, and inflammatory mediators. With increasing scientific interest, *Coptis teeta* has emerged as a promising candidate for liver protection, bridging traditional ethnomedicinal practices with modern pharmacological research. This review delves into its pharmacological mechanisms, efficacy in liver protection, and potential applications, underscoring its relevance in developing novel hepatoprotective therapies.

Objective: The objective of this review is to synthesize traditional ethnopharmacological knowledge and contemporary scientific research on hepatoprotective medicinal plants, with a particular focus on *Coptis teeta* Wall.. By bridging traditional wisdom with modern pharmacological insights, the review aims to comprehensively understand the mechanisms, bioactive compounds, and therapeutic potential of *Coptis teeta* and other medicinal plants in liver protection. Additionally, it seeks to identify gaps in research and highlight the pathways for integrating these natural remedies into modern medicine to effectively manage liver disorders.

## 2. Traditional Ethnopharmacological Insights

### Medicinal Plants in Liver Protection: Historical and Traditional Uses Across Cultures

The liver, a vital organ responsible for metabolism, detoxification, and biochemical synthesis, is often susceptible to damage from infections, toxins, and lifestyle-related factors. Throughout history, various cultures have developed traditional medicinal practices to combat liver ailments, utilizing the healing properties of medicinal plants. These time-tested remedies reflect the depth of ethnopharmacological knowledge that forms the basis for modern hepatoprotective drug development.



1. Botanical Overview and Habitat: *Coptis teeta* Wall., commonly known as Mishmi teeta, is a perennial herbaceous plant belonging to the Ranunculaceae family. It thrives in the cool, shaded regions of the Eastern Himalayas, primarily in Arunachal Pradesh, India, and neighboring regions in China and Myanmar. The plant's rhizome, recognized for its potent medicinal properties, holds significant value in traditional systems of medicine.

2. Traditional Uses of the Rhizome: The rhizome of *Coptis teeta* Wall. has been used for centuries in ethnomedicine, primarily for its bitter taste and diverse therapeutic properties. Some notable traditional applications include:

- Liver Protection: Used to treat jaundice, hepatitis, and other liver-related ailments due to its detoxifying properties.

- Digestive Aid: Administered for relieving indigestion, diarrhea, and gastrointestinal disorders.
- Antimicrobial Effects: Used in the treatment of infections, wounds, and skin conditions.
- Anti-inflammatory and Analgesic Uses: Applied to reduce pain and inflammation, particularly in joint disorders.

3. Preparation Methods: *Coptis teeta* Wall. rhizomes are typically used in various forms based on cultural traditions and the ailment being treated:

- Decoction: The rhizome is boiled in water to create a bitter herbal brew consumed for liver detoxification and digestive issues.
- Powdered Form: Dried rhizomes are ground into a fine powder, often mixed with honey or water for ease of consumption.
- Paste: For external applications, the rhizome is crushed into a paste to treat wounds and skin infections.
- Infusion with Other Herbs: Combined with other medicinal plants in traditional formulations to enhance its therapeutic efficacy.

## 4. Cultural Significance

- Ethnic Practices: Among the Mishmi tribes of Arunachal Pradesh, *Coptis teeta* Wall. is considered a sacred herb. It plays a pivotal role in their traditional healing practices, often reserved for serious ailments like liver diseases and chronic infections.
- Economic Importance: The rhizome is highly valued in local and regional markets due to its medicinal benefits, making it a vital source of livelihood for indigenous communities.
- Spiritual Role: In some cultures, *Coptis teeta* Wall. is used in rituals and ceremonies, believed to purify the body and ward off evil spirits.

## 5. Ethnopharmacological Validation

### Plant Profile

- ❖ Biological source: It is Rhizome obtained from the plant, *Coptis teeta* Wall
- ❖ Family: Ranunculaceae



### Taxonomy

Kingdom: Plantae  
 Phylum: Tracheophytes  
 Class: Eudicots  
 Order: Ranunculales  
 Family: Ranunculaceae  
 Genus: *Coptis*  
 Species: *Coptis teeta*

Modern research has identified berberine, coptisine, and palmatine as key alkaloids in *Coptis teeta* Wall. with hepatoprotective, antimicrobial, and anti-inflammatory properties. These compounds validate its traditional uses and highlight its potential in developing modern therapeutics.

Chemical Constituent Pharmacological Use

|                    |   |
|--------------------|---|
| Berberine          | Hepatoprotective, anti-inflammatory, antimicrobial, antioxidant, reduces oxidative stress, and protects against liver damage. |
| Coptisine          | Hepatoprotective, antioxidant, reduces lipid peroxidation, protects hepatocytes, and modulates liver enzymes.                 |
| Palmatine          | Anti-inflammatory, antioxidant, protects liver cells, and supports hepatocyte regeneration.                                   |
| Jatrorrhizine      | Detoxifying, anti-inflammatory, and scavenges free radicals, offering liver protection.                                       |
| Flavonoids         | Antioxidant, supports detoxification, and protects against liver damage.  |
| Phenolic Compounds | Antioxidant reduces liver inflammation, and enhances liver function.  |

4. Active Constituents and Mechanisms

4.1 Phytochemistry: The rhizomes of *Coptis teeta* Wall. are a rich source of bioactive alkaloids and other phytochemicals that contribute to its therapeutic properties. Key constituents include:

1. Berberine: A protoberberine alkaloid that exhibits potent hepatoprotective, antimicrobial, and anti-inflammatory properties. Known to protect hepatocytes by reducing oxidative stress and inhibiting inflammatory mediators.
2. Coptisine: Another major alkaloid with antioxidant and liver enzyme-modulating effects. Demonstrates efficacy in reducing lipid peroxidation and maintaining liver integrity.
3. Palmatine: Functions as an anti-inflammatory and antioxidant compound, aiding in liver tissue repair. Protects against toxin-induced hepatocyte damage by regulating cellular pathways.
4. Jatrorrhizine: A minor alkaloid with significant detoxifying properties and the ability to scavenge free radicals.
5. Flavonoids and Phenolic Compounds: These constituents complement alkaloid activity by providing antioxidant effects and enhancing the overall hepatoprotective action.

4.2 Mechanisms of Action: The hepatoprotective effects of *Coptis teeta* Wall. rhizomes are mediated through various biochemical and molecular mechanisms:

1. Anti-inflammatory Effects

Cytokine Suppression: Berberine and related alkaloids inhibit pro-inflammatory cytokines like TNF- $\alpha$ , IL-6, and IL-1 $\beta$ .

NF- $\kappa$ B Pathway Modulation: Suppresses the activation of NF- $\kappa$ B, a key transcription factor involved in the inflammatory response.

COX-2 and iNOS Inhibition: Reduces the expression of these enzymes, alleviating inflammation and oxidative damage.

2. Antioxidant Effects:

Reduction of Oxidative Stress: Active compounds scavenge free radicals and upregulate antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase (GPx).

Lipid Peroxidation Prevention: Inhibits the formation of malondialdehyde (MDA), a marker of lipid peroxidation, protecting cell membranes from oxidative damage.

3. Detoxifying Effects

Enzyme Modulation: Regulates liver enzymes such as ALT, AST, and ALP, normalizing their levels in liver damage models.

Hepatocyte Regeneration: Stimulates repair and proliferation of hepatocytes by activating protective cellular pathways.

4. Molecular Pathways

Nrf2/ARE Pathway Activation: Promotes the transcription of detoxifying and antioxidant genes, enhancing cellular defense mechanisms.

**AMPK Activation:** Berberine activates AMP-activated protein kinase (AMPK), which regulates energy homeostasis and inhibits lipogenesis, reducing liver fat accumulation.

**Inhibition of Apoptosis:** Protects hepatocytes from toxin-induced apoptosis by modulating the Bcl-2/Bax ratio and reducing caspase activation.

#### 5. Comparative Analysis

**Other Medicinal Plants:** Compare *Coptis teeta* Wall with other plants known for hepatoprotection (e.g., *Silybum marianum*, *Phyllanthus niruri*).

**Efficacy and Limitations:** Highlight studies that compare efficacy and potential side effects.

#### 6. Modern Pharmacological Studies

Summarize in vitro, in vivo, and clinical trials supporting the hepatoprotective claims of *Coptis teeta* Wall. Discuss advancements in drug formulation using rhizome extracts.

#### 7. Challenges and Future Directions

**Challenges:** Limited standardization, lack of large-scale clinical trials, and variability in plant bioactivity.

**Future Research:** Encourage deeper exploration into molecular mechanisms, bioavailability improvement, and formulation innovations.

### CONCLUSION

This review examined the pharmacognostic, phytochemical, and pharmacological properties of *Coptis teeta* Wall., highlighting its hepatoprotective potential. The plant's rhizomes, rich in alkaloids like berberine, coptisine, and palmatine, have long been used in traditional medicine for liver disorders. Pharmacological studies confirm its anti-inflammatory, antioxidant, and liver-regenerating effects. Despite these promising findings, challenges such as limited availability, sustainability, and lack of extensive clinical trials remain. The standardization of bioactive compounds and formulation development is crucial for its integration into modern therapies. Addressing these challenges through further research could unlock *Coptis teeta* Wall.'s full therapeutic potential, offering significant benefits in hepatoprotective drug development.

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