

A Review on Clitoria Ternatea

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Abstract: *Clitoria ternatea*, a perennial twining herb indigenous to tropical Asia, has been widely recognized in traditional medicine for its memory-enhancing and anxiolytic effects. Various parts of the plant contain a diverse array of bioactive constituents, including tannins, resins, starch, taraxerol, taraxerone, alkaloids, flavonoids, saponins, proteins, anthocyanins, and carbohydrates. Traditionally, it has been used to manage a broad spectrum of health conditions such as jaundice, migraine, throat and eye infections, skin disorders, asthma, joint inflammation, earaches, skin eruptions, fever, urinary tract infections, constipation, snake bites, headaches, indigestion, leprosy, and disorders of the central nervous system. Moreover, *Clitoria ternatea* has historical applications in treating gonorrhoea, stress, and infertility, and as a natural food colorant. In Ayurvedic medicine, it is extensively utilized for its numerous therapeutic properties, which include anti-inflammatory, analgesic, antimicrobial, and anxiolytic activities

Keywords: *Clitoria ternatea*, Pharmacognostic studies, Pharmacological activities, Phytoconstituents, Traditional uses

I. INTRODUCTION

Clitoria ternatea, commonly known as butterfly pea, is a perennial climbing herb belonging to the Fabaceae family (formerly Papilionaceae). It features terete, sparsely pubescent stems and imparipinnate leaves with petioles measuring 2–2.5 cm. The plant bears solitary, axillary flowers—most often bright blue or occasionally white—with a distinct orange center. The seeds, typically golden brown and smooth, number between 6 and 10 per pod.

Two main varieties are widely cultivated as ornamental plants: the blue-flowered and white-flowered types, commonly found in gardens across Bangladesh and other tropical regions. Known for its aesthetic appeal, butterfly pea also holds great medicinal value, as nature has long provided a foundation for the development of therapeutic agents. Medicinal plants like *C. ternatea* serve as vital resources in various traditional systems of medicine and are frequently incorporated in formulations to treat numerous ailments.

The plant likely originated in tropical Asia and is now distributed widely across humid, lowland tropical regions in Africa, Asia, and Central America. It thrives in both low and medium altitudes and is found growing wild in thickets and cultivated gardens. The plant adapts well to clay-rich soils and is used as a forage, cover crop, and green manure, although it has not been formally developed as a pasture cultivar.

In Ayurveda, different parts of *C. ternatea* have been used to formulate “medha” (brain tonic) preparations aimed at enhancing memory and intellect. Scientific studies have confirmed its pharmacological actions, including antihistaminic, antidepressant, and hypoglycemic effects.

Taxonomy

- **Kingdom:** Plantae
- **Phylum:** Angiosperms
- **Order:** Fabales
- **Family:** Fabaceae
- **Genus:** *Clitoria*
- **Species:** *ternatea*



Vernacular Names

The genus name *Clitoria* is derived from the flower's resemblance to the female clitoris. The species name "*ternatea*" refers to the Ternate Island in eastern Indonesia. Many local names reference this anatomical resemblance.

- **Sanskrit:** Ashphota, Aparajita, Saukarnika, Ardrakarni, Girikarnika, Supuspi, Mohanasini, Vishadoshaghni, Shwetanama, Vishnu-Kranta, Ashwakhura
- **Hindi/Bengali/Oriya:** Aparajita
- **Gujarati:** Bismar, Garani, Koyala
- **Kannada:** Billisaiuga, Satugadagida
- **Telugu:** Dintana, Gilarnika, Neela-ghentana, Sankhupuvvu
- **Tamil:** Kakkanam, Kakatan, Kavachi, Kuruvilai
- **Punjabi:** Dhanattar
- **Rajasthani:** Koyalri, Titlimatar
- **English:** Butterfly pea, Blue pea vine, Mussel-shell climber, Pigeon wings

Cultivation

Clitoria ternatea is a fast-growing, deep-rooted climbing legume well suited to a range of soil types (pH 5.5–8.9), including calcareous and clay soils. It thrives in both heavy rainfall and drought-prone regions. Propagation is typically through seeds, and the plant demonstrates excellent regrowth after grazing or cutting. In northern Australia, it is grown successfully as green manure and a cover crop, with seeds usually sown during the early to mid-wet season. Light grazing during the wet season promotes optimal growth and persistence.

Botanical Description

- **Habit:** Twining climber
- **Root:** Branched taproot with nodules
- **Stem:** Aerial, slender, pubescent, and twining
- **Leaf:** Imparipinnately compound with alternate phyllotaxy, stipules present, and reticulate venation
- **Inflorescence:** Solitary and axillary
- **Flower:** Bracteate, bisexual, complete, zygomorphic, and hypogynous with a papilionaceous corolla
- **Calyx:** Five synsepalous sepals, valvate aestivation
- **Corolla:** Five apopetalous petals, blue or white, imbricate aestivation
- **Androecium:** Ten stamens (diadelphous: 9+1), basifixed anthers, dehiscing longitudinally

II. PHYTOCHEMICAL CONSTITUENTS AND THEIR MEDICINAL USES

Leaf

- *Phytochemicals:* Alkaloids, reducing sugars, flavonoids, steroids, glycosides

Uses:

- Supports management of neurodegenerative diseases and diabetes
- Helps regulate excessive perspiration

Flower

- *Phytochemicals:* Saponins, tannins, alkaloids, glycosides, phytosterols, carbohydrates

Uses:

- Anti-inflammatory and analgesic properties
- Ethanol extracts possess antidiabetic activity

Root

- *Phytochemicals:* 1,1-diphenyl-2-picrylhydrazyl (DPPH)



Uses:

- Potent antioxidant
- Decoction used as a demulcent for bladder and urethral irritation
- Root bark is both diuretic and laxative

Seed

- *Phytochemicals:* Nucleoproteins similar to insulin, delphinidin-3,3,5-triglucoside, amino acids, pentosans, mucilage, adenosine, anthoxanthin glucoside, fixed oils, glycosides, flavonoids, alkaloids, cinnamic acid derivatives, and tannic acid

Uses:

- Cathartic and diuretic
- Effective in treating swollen joints, dropsy, and abdominal organ enlargement

Chemical Constituents in Butterfly Pea Extract

The **hydrophilic fraction** of *Clitoria ternatea* (butterfly pea) flower extract contains:

- Flavonol glycosides
- Anthocyanins
- Flavones and flavonols
- Phenolic acids
- Cyclotides

The **lipophilic fraction** includes:

- Terpenoids
- Alkaloids
- Fatty acids

The ethanol extract of *Clitoria ternatea* has been shown to contain various bioactive phytochemicals including terpenoids, flavonoids, tannins, and steroids, which are believed to contribute to its antioxidant activity. Among its primary constituents, pentacyclic triterpenoids such as taraxerol and taraxerone have been identified. Phytochemical screening of the roots indicates the presence of alkaloids, saponins, carbohydrates, proteins, starch, resins, and tannins—anthocyanin pigments responsible for the flower's vivid coloration.

In addition, the plant exhibits anti-fungal activity attributed to defensin-like proteins. Aabgeena et al. reported a lectin in the seeds, designated *Clitoria ternatea* lectin (CTL), which agglutinates trypsin-treated human B erythrocytes and demonstrates potential for cancer-related research. A high-yield purification method has been developed for CTL.

III. PHARMACOGNOSTICAL DESCRIPTION

Clitoria ternatea, also known as butterfly pea, is a member of the family Fabaceae (Leguminosae) and subfamily Papilionaceae. It grows as a long-lived perennial herb ranging from 90 to 162 cm in height. Morphological variations occur due to differing growth conditions. The plant has both blue- and white-flowered varieties. It exhibits cleistogamous (self-pollinating) and chasmogamous (insect-pollinating) floral mechanisms.

Flowers are axillary, solitary, and measure 60 to 120 mm in length. The calyx is 13 to 20 mm long, while the corolla ranges from 38 to 50 mm. Pods are 50 to 100 mm long and contain 8 to 11 seeds. The pinnate leaves consist of 5 to 7 leaflets, elliptic to orbicular in shape. Roots are buffy brown, thick, and fibrous, with nitrogen-fixing properties, contributing to soil fertility.

Ayurvedic Properties and Traditional Uses

In Ayurveda, *Clitoria ternatea* is recognized as *Shankhapushpi* and classified as bitter, cold in potency, pungent post-digestively, and light and sharp in nature. It is a primary component of *Medhya Rasayana*, a formulation used to enhance cognitive function.



- **Root:** Traditionally used for its cooling, laxative, diuretic, anti-inflammatory, anthelmintic, and neuroprotective properties. It increases acetylcholine and acetylcholinesterase activity in the brain. Roots are also utilized in treating asthma, bronchitis, epilepsy, remittent fever, and whooping cough. Paste preparations are used externally for livestock treatment.
- **Seeds:** Employed both internally and externally. They have cathartic and purgative properties, used in liver disorders, ascites, spleen infections, and arthritis. Fried seeds mixed with ghee and fennel are used in digestive issues.
- **Leaves:** Used for emetic, diuretic, antiperiodic, and laxative purposes. The juice is detoxifying and is applied topically for glandular swellings and ear inflammation.
- **Flowers:** Used as a remedy for snake bites and scorpion stings. In Cuban traditional medicine, a flower-root decoction is used as an emmenagogue. Flower infusions are used to treat menstrual disorders and chlorosis. In diabetic mice, ethanolic flower extract significantly reduced blood glucose levels.
- **Stem:** Recommended for treatment of envenomation and possesses neuroprotective and anti-infective activity.

Pharmacological Properties

1. Antihistaminic Activity

The ethanol extract of *C. ternatea* root (ECTR) showed significant antihistaminic activity in mice. In clonidine-induced catalepsy models, ECTR at doses of 100–150 mg/kg IP significantly inhibited catalepsy ($p < 0.001$), comparable to chlorpheniramine maleate. However, ECTR did not inhibit haloperidol-induced catalepsy, indicating selective H1 receptor antagonism.

2. Antimicrobial Activity

Using the disc diffusion method, aqueous, methanolic, and chloroform extracts of *C. ternatea* flowers were tested against various pathogens including ESBL-producing *Salmonella enteritidis*, *S. typhimurium*, *Klebsiella pneumoniae*, *E. coli* strains, and *Pseudomonas aeruginosa*. Methanol extract demonstrated the highest antimicrobial activity with inhibition zones of 16–26 mm.

3. Cytotoxic Activity

Brine shrimp lethality bioassay revealed significant cytotoxic potential of methanolic extracts. LC50 values were:

- Leaves: 25.82 µg/mL
- Seeds: 110.92 µg/mL
- Stem-bark: 179.89 µg/mL

4. Proteolytic Activity

Enzymatic assays in cotyledons and germinating seeds detected increases in endopeptidase, carboxypeptidase, and arylamidase activities over a 9-day germination period. These findings suggest enhanced proteolytic potential during germination, supporting seedling development.

5. Antipyretic Activity

In yeast-induced pyrexia models in albino rats, methanolic root extract of the blue-flowered variety significantly reduced elevated rectal temperatures at doses of 200, 300, and 400 mg/kg body weight, p.o. The antipyretic effect was comparable to paracetamol.

6. Antioxidant Activity

The antioxidant activity of *C. ternatea* is primarily attributed to flavonoids and anthocyanins, particularly ternatins. Ethanolic and methanolic extracts of flowers and roots exhibit strong free radical scavenging activity, suggesting therapeutic potential against oxidative stress-related disorders.

IV. HEALTH BENEFITS AND THERAPEUTIC APPLICATIONS OF *CLITORIA TERNATEA*

Clitoria ternatea, commonly known as butterfly pea, offers a wide range of therapeutic effects supported by both traditional knowledge and emerging scientific research. The various pharmacological activities of this plant are



attributed to its rich phytochemical profile, including anthocyanins, flavonoids, saponins, and triterpenoids. The major health benefits are outlined below:

1. Cognitive Enhancement

Numerous animal studies have demonstrated that regular administration of butterfly pea extracts significantly increases the levels of acetylcholine, a neurotransmitter crucial for cognitive function. Elevated acetylcholine levels help reduce age-related memory loss, enhance memory retention, and improve overall brain function.

2. Anticancer Properties

Clitoria ternatea contains bioactive compounds with potential anticancer effects. These compounds may penetrate cancerous cells and inhibit their proliferation, suggesting a possible role in the adjunctive treatment of cancer.

3. Anti-inflammatory Activity

Consumption of butterfly pea extracts and tea has shown to reduce inflammation, which may help in managing conditions such as body aches, migraines, headaches, and inflammation-related swelling or wounds.

4. Antihypertensive Effect

Regular intake of butterfly pea flower tea may help reduce elevated blood pressure, making it beneficial for individuals with hypertension.

5. Skin Health Enhancement

Rich in antioxidants, *C. ternatea* can delay the onset of signs of skin aging, prevent premature aging, and enhance skin tone and texture, contributing to healthier and more youthful skin.

6. Hair Health Support

The plant nourishes hair follicles, promotes hair growth, reduces hair fall, and helps in delaying the greying of hair. It is widely incorporated into hair care products such as shampoos and conditioners.

7. Digestive Aid

Antioxidants in butterfly pea tea help relax gastrointestinal muscles and facilitate digestion. Additionally, it exhibits anthelmintic properties that aid in eliminating intestinal worms.

8. Regulation of Blood Sugar

Butterfly pea flower tea helps regulate the absorption of glucose in the intestines, thereby stabilizing blood sugar levels. It holds potential as a dietary adjunct for individuals managing diabetes, particularly when used alongside standard treatments.

9. Antioxidant Effects

The presence of potent antioxidants like anthocyanins contributes to reducing oxidative stress and protecting cells from free radical-induced damage.

10. Anti-inflammatory Effects

Beyond topical benefits, systemic anti-inflammatory effects have been observed, which could support the management of chronic inflammatory diseases.

11. Cooling and Soothing Effects

The plant is traditionally known for its cooling nature, often used in Ayurvedic formulations to balance the body's internal heat and manage conditions such as fever and burning sensations.

12. Anti-aging Properties

The high antioxidant content slows down the aging process by protecting tissues from oxidative stress and inflammation.

13. Anxiolytic Properties

Clitoria ternatea has demonstrated anxiolytic effects, aiding in the reduction of anxiety and stress without the side effects associated with synthetic anxiolytics.

14. Antibacterial and Antifungal Properties

Extracts of *C. ternatea* show inhibitory effects against a broad spectrum of bacteria and fungi, supporting its use in treating infections and enhancing immune defense.



15. Support for Cardiovascular Health

Bioactive constituents in the plant contribute to improved heart health by reducing blood pressure, enhancing circulation, and exhibiting lipid-lowering properties.

16. Eye Health

The traditional use of butterfly pea flowers includes promoting clear vision and eye health, potentially due to the antioxidant properties beneficial to retinal tissues.

V. CONCLUSION

Clitoria ternatea is a multifaceted medicinal herb with significant traditional and pharmacological value. It is employed in the treatment of a wide range of health conditions, including neurological disorders, cancer, diabetes, nephrological and urinary disorders, respiratory diseases, and skin and hair ailments.

Scientific studies have identified numerous pharmacological activities in alcoholic extracts of the roots, leaves, and flowers, including antileprosy, anti-inflammatory, anthelmintic, immunomodulatory, antiasthmatic, antidepressant, anticonvulsant, analgesic, antipyretic, antifungal, proteolytic, and antihyperlipidemic effects. Several key phytoconstituents responsible for these activities have been successfully isolated.

Despite the promising evidence, comprehensive data regarding the plant's bioactive secondary metabolites, bioavailability, pharmacokinetics, and therapeutic mechanisms remain limited. Moreover, well-designed clinical trials are essential to validate the efficacy and safety of *C. ternatea* in human populations.

Nevertheless, the plant holds great potential as a source of new phytopharmaceuticals. Future research should focus on exploring its active principles and mechanistic pathways to pave the way for developing effective plant-based therapies rooted in traditional medicine systems.

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