

Pharmacological Activities and Bioactive components of a Traditional Plant- Butterfly Pea: A review

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Abstract: From the traditional aspect, the aromatic plant have been given value since the ancient time, such plant are the treasure of the mankind. Similarly, *Clitoria ternatea* also known as 'butterfly pea' has been considered the best medicine for many CNS related problems such as memory stimulant, nootropic, anti-stress, anxiolytic, anti - depressive, anticonvulsant, tranquillizing, and sedative agent from ancient time. The possession of the wide verity of the phytochemical classes could possibly pronounce its necessity in the modern medicines age. In this review article the phytochemicals, classes of chemicals and pharmacological activities are discussed.

Keywords: *Clitoria ternatea*, *Phytochemical studies*, *Pharmacological activity*, *Medicinal uses*

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Introduction

Medicinal plant species have widely employed by mankind for their curative benefits since the dawn of civilization. Over centuries, nature has provided medical substances, and an astounding amount of contemporary medications have been identified from natural origin¹. Almost all of these discoveries were made dependent on

how the substances were used as conventional healers. Conventional medication approaches centered on plants tended to perform an essential role in health management, through about 80% of the world's population reliance on conventional medications for their fundamental health care². Ayurveda and Unani are two historic

Indian medicinal systems that have lasted for over 3000 years, mostly via the use of plant-based medications. Such component's materia medica comprises a sound tradition of native herbal approaches that have contributed in the health management of India's most rural populations³. Numerous plants are mentioned as medicine in ancient scriptures such as the Rig Veda (4500-1600 BC) and Atharva Veda. Plant secondary metabolites are a rich supply of complex compounds that are appreciated and utilised by humans for their pharmacological and other qualities, in addition to their inherent function⁴.

The ayurvedic system of medicine in India has detailed a significant number of therapeutic medications centered on plants or plant products, and analyzing their morphological and pharmacological or pharmacognostical properties might help researchers comprehend their efficient components and mechanism of activity. Furthermore, the chemical contents, pharmacological effects of extracts, and pharmacognostical categorization of a wide variety of tropical plants have not been thoroughly investigated. The current review concentrated on many characteristics of the medicinal herb *Clitoria ternatea* (L)⁵.

Traditional Beliefs

Aparajita or "Shankpushpi" is a well-known Ayurvedic medication that has been used as a brain tonic, nerving tonic, and laxative since medieval periods. Ayurvedic writings classify it as a "Medhya-Rasayana." Because the petals of the plant *Clitoria ternatea* mimic a conch shell, it is known as "Shankpushpi" in Sanskrit, where it is said to be a virtuous "Medhya" (brain tonic) medication and thus utilized as a medication for "Masasika Roga" (mental illness)⁶.

Plant Profile

Clitoria ternatea, popularly referred as Butterfly pea, is an annual leguminous twiner that belongs to the Fabaceae family and subclass Papilionaceae. *Clitoria* Linn. consists of 60 species, the majority of which are prevalent in the tropics, with a rare species found in temperate regions. *Clitoria ternatea* is the greatest commonly sighted variety⁷. The plant is mostly utilised as a fodder since it is very attractive to livestock and has a wide range of climate tolerance. Such a variety is native to the Molluca archipelago's Ternate Island, and it's currently commonly cultivated as an ornamental, fodder, or medicinal plant⁸. The plant is native to tropical Asia, however it

has subsequently spread over South and Central America, the East and West Indies, China, and India⁷.

Vernacular Name⁸:

Name	Language
Aparajit	Hindi
Kordofan pea	Sudan
Kokkattan	Tamil
Vishnukanta	Sanskrit
Butterfly-pea/ Mazerion	English

Plant Description

Clitoria ternatea has 0.5-3 m long tangled delicate stems. The leaves are pinnate, with 5-7 elliptic to lanceolate leaflets that are 3-5 cm long and hairy beneath the surface (Fig. 1). Flowers are solitary, deep blue to blue mauve in colour, with a very short pedicellate and a length of 4-5 cm⁹. Flat, linear, beaked pods with up to 10 seeds are 6-12 cm long, 0.7-1.2 mm diameter, and somewhat pubescent⁷. The seeds are olive, brown, or black in colour, and are 4.5-7 mm long and 3-4 mm wide, with a mottled appearance¹⁰.

Ecology

Clitoria ternatea favors humid and sub-humid environments with average yearly temperatures varying from 15 to 28 degrees Celsius. *Clitoria ternatea* (butterfly-pea, n.d.) may flourish in dry and semiarid ecosystems with yearly rainfall ranging from 500 to 900 mm and surviving for up to 5-6 months with only 400 mm of rainfall. Generally developed in full sun, but shade-tolerant to a degree. It may grow in a variety of soil types, varying from sandy to deep alluvial loams and dense clays, with a pH of 5.5 to 8.9⁸.

Scientific Classification⁹

Kingdom	Plantae
Division	Spermatophyte
Sub-division	Angiospermae
Class	Fudicots
Sub-class	Rosids
Order	Fabales
Family	Fabaceae/ Legminosae
Sub-family	Faboideae / Papilionoideae

Tribe	Phaseoleae
Sub-tribe	Clitoriinea
Genus	Clitoria
Species	Clitoria Ternatea Linn.

*Traditional Uses*¹¹

Chemical Components of Clitoria Ternatea

Leaves- the *Clitoria ternatea* consists of essential oils, phyto-sterols and flavonoids which mostly exist with glycosides linkage¹¹. The other constituents are β – sitosterol, Kaempferol and its various glycosides like Clitorin. Additionally, it has several lactones like Aparijitin which is δ – lactone of 2-methyl-4-hydroxy-n-pentacosanoic acid¹². An important alkaloid, Oxymatrine has been recently identified in the leaves of CT. It has profound impact on cardiac tissues, preventing cardiac fibrosis (formed by excessive collagen – I and III expression on cardiac tissue), preventing cardiac ischemia, arrhythmia, heart failure and myocardial injuries¹³. The compounds are highly effective against Hepatitis B and C. The mucilage in CT leaf is composed of methyl-pentosan, anhydro-pentosan, and anhydro-galactan¹¹.

Flowers- The existence of anthocyanins, Terantins, which have been found as existing in five forms (A1, A2, B1, B2, D1 and D2) with varied grades of glycosylation of acylated, malonylated glyco-derivative of Delphinidin, is responsible for the blue colour. It also contains Quercetin, Myricetin, and Kaempferol, among other things. Glucose or rhamnose sugar chains are used to glycosylate them all¹⁴.

Roots- Indole acetic acid, kinetin, and gibberellic acid, a pentacyclic diterpene plant growth hormone, are all present in considerable concentrations. In particular, they are all heavily implicated in plant growth¹². Due to the high amount of Indole acetic acid, it is reasonable to believe that the CT root contains a big store of tryptophan. Other amino acids synthesised by the root include – amino butyric acid (GABA), which is a key inhibitory neurotransmitter¹⁵.

Seeds- It has a high concentration of proteins and polypeptides. One of them is nearly identical to insulin, with the exception of a few amino acid changes. Finotin, a cyclic insecticidal peptide, is synthesised only by the seeds. Some of the proteins in the reserve have anti-trypsin action. Fatty acids such as stearic, linoleic,

linolenic, and oleic acid are also abundant in the seeds¹⁶. It also produces water-soluble antioxidants such as anthocyanin glucosides, such as Delphinidin 3, 3', 5'-triglucoside, which is used as a food colour. p-hydroxycinnamic acid, – sitosterol, rutin, and adenine, as well as their glucoside derivatives, are also present¹⁷.

Pharmacological Activity

Antioxidant Activity

M.K. Jayanthi et al., 2021, have studied the *Clitoria ternatea*. The antioxidant properties were tested and phytochemical screening was done in three kind of organic solvents and inorganic solvent (Methanol, chloroform and water). The study revealed that the presence of various phytochemicals such as alkaloids, carbohydrates, flavonoids and saponins confirm the activity of the antioxidants¹⁸. The similar study was done with the Jeyaraj, E. J., et al., (2021). The antioxidant profile was examined using the different organic extracts of the *Clitoria ternatea* in the ethanol, methanol and acetone. The extract were then analyzed through the LC-MS analysis and found 28 kinds of specific chemicals which are actively participating in the blocking and reducing the super oxide ions. Mainly Kaempferol hexosyl-rhamnosyl-rhamnosid

which was found in the extract of water and ethanol could possibly be the reason to inhibit the 70-80% cells¹⁹.

Diuretic Activity

M.K. Jayanthi et al., 2021 examined the diuretic activity in Wistar rats. The extract was administered in the Wistar rats at three different doses form 150, 300 and 400mg/kg once in day. The activity of the diuretics was compared with the help of furosemide as the standard drug. The diuretic activity was assesses by the two parameters urine volume and electrolytes presents in the urine. The results showed that 450mg/kg of the drug possessed the pronounced effect as the diuretic which could be helpful in the case of the high blood pressure and other toxicity conditions¹⁸.

Anti-urolithiatic Activity

Priyanga Rangasamy, et al., 2021 during their experiment on Blue *Clitoria* leaves extracts found that the extracts had antiurolithiatic action. By experimenting on different extracts, it was found that the methanolic extract having the best activity, inhibiting nucleation and aggregation by 73.2% 2.1% and 48.3% 3.1&% respectively. Hence, the aqueous extract of *C. ternatea* leaves is effective in situations requiring the

removal of excess fluids, such as hypertension and edema²⁰.

Anti-diabetic Activity

Borikar, S. P., et al., 2018 examined the antidiabetic activities of the dried flowers of the *Clitoria ternatea*. The methanolic extract of the dried flowers were administered in the SD rats for 100 and 200mg/kg for each animal. The diabetes was induced in animals by the single injection of the alloxan. The results showed that potential effect of the crude drug, the blood glucose was reduced by 396.8 to 102.8 mg/dl. The control group of animals was showed hyperglycemic as compare to the references group of animals. The blood glucose levels were tested up to 5 hours subsequently and results showed up as significant decrease in the higher dose 200mg/kg animals²¹.

The similar study was performed by the Minelko, M., et al., (2020). The protein was extracted from the flower of *Clitoria ternatea* and evaluated for its Antidiabetic properties by using alpha-amylase and genes modulated mice model. The results showed that extracted protein was more prominently decreasing the blood glucose levels by inhibiting the alpha-amylase (20.63%) at the dose of 1mg/mL. in vivo study also determined the effect in diabetic mice. the

results showed extracted protein up regulate the expressions of the gene PPAR γ and Tcf712. Hence, in accordance of the results it can be concluded that the protein extracted from the plant flower possibly can be used in the diabetes type-2²².

Anxiolytic Activity

Dhakad, P. K., et al., (2021) has confirmed the Anxiolytic activity of the plant *Clitoria ternatea*. The alcoholic extract was prepared and administered in the animals at the dose of 50, 100 and 200mg/kg. the study was evaluated as if the animal could enhance the inflexion ratio. The chlorpromazine was used at the standard drug and compared the efficacy with the test drug. The results showed that the crude drug has the potential the mind calmness and memory as well²³.

Another study was performed by the Kumar, D., & Dhobi, M. (2016). This study was performed on the Wistar rats; the activity was confirmed by the elevated plus-maze model. The extract was administered at the dose of 50, 100 and 200mg/kg each animal. The results showed that maximum Anxiolytic activity in animals at dose of 100mg/kg²⁴.

Anti-microbial Activity

Mushtaq, Z., Khan, et al., 2021 have examined the antimicrobial activities of the *Clitoria ternatea* plant. The flowers of the *Clitoria ternatea* were extracted in the ethanol. The extract was prepared using the 10 mL of ethanol to separate the anthocyanin. The evaluation was done with agar diffusion study. The gram negative and gram positive bacteria (*B. subtilis*, *S. aureus* and *E. coli*) were grown on the agar plate and exposed with extract at different concentrations. The results showed that zone of inhibition were obtained. The size of the zone of inhibition was 10, 7.8 and 12mm. The results revealed that extract of the *Clitoria ternatea* is having the properties such as antifungal and antimicrobial²⁵.

Similar study was performed by the Deorankar, P., et al., (2020). The extract of the root of *Clitoria ternatea* was prepared using water and ethanol. Both the extract was exposed against the microbes *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The microbes were grown in the agar plates and incubated at 37°C for 24 hours. After incubation the extract was exposed to the microbes and minimum inhibitory concentrations was obtained. The result showed that 60 µg/mL was the potential dose that can eradicate the growth of the microbes. The zone of

inhibition was observed at range 13 to 16mm respectively²⁶.

Conclusion

The pharmaceutical industry is focusing its efforts on the composition, manufacturing, and improvement of brand-new plant-based medications, as well as a complete evaluation of discoveries from the conventional medical system. *Clitoria ternatea* different extracts of plant part has been shown to have anti-inflammatory, anti-helminthic, Immunomodulatory, anti-asthmatic, anti-depressant, analgesic, antipyretic, antifungal, and properties in research. Several key phytoconstituents accountable for the action have been identified. *Clitoria ternatea* appears to have a lot of physiological capability, according to a scientific investigation. However the published findings and research support the security and productivity of *Clitoria ternatea*, the reliability of the facts is insufficient in regard to its bioactive secondary metabolites, bioavailability, pharmacokinetics, and medicinal benefits, which is based on clinical trials, on which adequate data is still to be identified. This evaluation's thorough material is thought to give exhaustive proof for the use of this

plant in diverse treatments and therapeutic advancement.

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