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## Utilizing Indian Knowledge System to Explore the Pharmacological and Physiological Benefits of *Clitoria ternatea*

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**Abstract:** *Clitoria ternatea*, also known as Shankpushpi or Butterfly Pea, is an important medicinal plant referenced in Ayurveda. It is also a part of our traditional knowledge and belongs to Indian Knowledge System. The herb is known for its therapeutic properties and provides benefit by healing neurological, gastric, skin, and reproductive disorders. Increasing attention is being devoted to this herb for its healing properties, from modern drugs research and commercial products. It is found to be rich in phytochemicals like flavonoids, anthocyanin, saponins and tannins and various studies have established their presence. It has been validated that it is rich in antioxidants, has immune-boosting effects, is anti-inflammatory, boosts brain function, supports healthy skin, hair, heart and digestive health, reduces stress and regulates blood sugar. The present review explores the pharmacological and physiological characteristics of *Clitoria ternatea*.

**Keywords:** *Clitoria ternatea*, Indian Knowledge System, Ayurveda, Phytochemicals, Neurological disorders, Reproductive disorders, Therapeutic

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### Introduction

Plants have been used in India's traditional systems, like Ayurveda, Siddha, Unani, etc., since many years for not only the treatment of various diseases but also for the prevention of disease in the body. These traditional systems are constituents of the Indian Knowledge System and offer remedy for the mind, body and spirit and often use plant substances as central to the remedy (Pandey *et al.*, 2013).

Plants have formed the basis of many healing practises all over the world and function as a traditional method for treatment. There are a huge range of plants which can be categorised as medicinal plants, which provide pharmaceuticals for treating health issues. Active compounds like alkaloids, flavonoids and essential oils derived from plants are used to treat conditions ranging from basic to complex health disorders. Plants like

ginger, garlic, turmeric, aloe vera, chamomile, peppermint, lavender, ginseng etc. have long been known, to be used as therapeutic agents. They are supposed to provide relief in a large number of health problems like respiratory infections, nausea, IBS or irritable bowel syndrome, infections, cardiovascular issues, burns, wounds, depression, mental health, etc. (Koulivand *et al.*, 2013; Hewlings *et al.*, 2017; Ingrosso *et al.*, 2022). Among these recognized botanicals *Clitoria ternatea* is also distinguished for its various medicinal properties.

*Clitoria ternatea* is classified as: Kingdom- Plantae, Subkingdom- Tracheobionta (Vascular plants), Superdivision- Spermatophyta (Seed plants), Division- Magnoliophyta (Flowering plants), Class- Magnoliopsida (Dicotyledons), Subclass - Rosidae, Order- Fabales, Family- Fabaceae (Legume family), Genus- *Clitoria*, Species- *ternatea*, Common Name- Butterfly Pea, Aparajita, Blue Pea Vine.

The butterfly pea is a perennial leguminous plant of the family Fabaceae and the subfamily Papilionaceae. Its scientific name is *Clitoria ternatea* L. It grows wild in tropical Asia. *Clitoria ternatea* is also known by the names Blue-pea, Kordofan pea (Sudan), Cunha (Brazil), Pokindong (Philippines) as well as Aparajita or Shankupushpam in Hindi. About 60 species have been found to occur in tropical zones although a few species could also occur in zones that are termed temperate.

*Clitoria ternatea* in Ayurveda is referred as Shankpushpi. It is one of the most common ingredients used in formulations aimed at improving cognitive functions, relieving stress, and ensuring well-being. It has been used for aeons, and classical Ayurvedic texts mention of its power to rejuvenate the brain, sharpen memory and cure mental illnesses. This plant is a perennial and native to tropical Asia. Siddha and folk medicine utilize it to remedy many diseases like gastrointestinal difficulties as well as reproductive health problems as outlined by Oguis *et al.* (2019).

*Clitoria ternatea* has different names in various languages which clearly indicates its popularity for different purposes including ornamentation, worship, medicinal uses etc. The popular names given to *Clitoria ternatea* in Asian region are Butterfly Pea (English), Aparajita (Hindi), Shankpushpam (Tamil), Sankupushpam (Telugu), SankaPushpa (Kannada), Aparajita (Bengali), Sankupushpam (Malayalam), Anchan (Thai), Bunga Telang (Indonesian), Butterfly Pea (Filipino), and Vishnukrantha (Sanskrit).

The recent scientific studies on this plant are gradually validating the claims of the traditional practitioners. The plant is effective due to its large phytochemical constituents which include flavonoids, anthocyanins, saponins and many more.

It would be useful to bridge traditional knowledge with modern science by establishing synchronicity of these two systems in detail. It would be helpful to view the different applications of the *Clitoria ternatea* in human health as contained in India's traditional knowledge system and supporting it by recent times. We need to focus on the pharmacological features and mechanisms of action of the plant to clarify its potential for tackling modern healthcare issues.

From ancient times Ayurveda and traditional medicine have been using herbs like *Aloe barbadensis* Miller, *Echinacea purpurea*, *Zingiber officinale*, *Curcuma longa*, *Allium sativum*, *Matricaria chamomilla*, *Clitoria ternatea* and this can be categorised as use of Indian Knowledge System (IKS). *Clitoria ternatea* was used traditionally to colour foods and also for curing stress, infertility and gonorrhea disease condition. Both ayurveda and clinical pharmacology have made extensive use of it.

Traditional medicine uses the whole plant of *Clitoria ternatea*, which contains tannins, resins, starch, and many other bioactive chemical compounds. The plant can be used in treatments including jaundice, migraines, urinary tract infection (UTI), ear and eye infections, skin

disorders, and other forms of treatment (Verma *et al.*, 2024). It is being used for treating liver diseases, stress and inflammation as Nithianantham *et al.* (2011) has observed its positive influence on hepatoprotection. Nair *et al.* (2015) have studied the protective effect of *Clitoria ternatea* petals against Lipopolysaccharide (LPS)-induced inflammation in macrophage cells.

#### *Phytochemical profile of Clitoria ternatea*

*Clitoria ternatea* is rich in several bioactive chemicals that boost immunity and has proven antioxidant, antidepressant, and anti-inflammatory properties. It is found to be rich in flavonoids, anthocyanin, saponins and tannins and various studies have established their presence.

**Flavonoids:** *Clitoria ternatea* is found to have antioxidant property due to the presence of flavonoids namely Quercetin and Kaempferol. These flavonoids increase its antioxidant properties. Antioxidant chemicals can actively neutralize reactive oxygen species (ROS) and protect cells against oxidative damage. Quercetin has been observed to be very good at stabilizing free radicals and preventing lipid peroxidation. Kaempferol has important anti-inflammatory functions as it has the nature of downregulating the expression of inflammatory mediators, including cytokines and enzymes such as cyclooxygenase. Researchers have found that flavonoids reduce oxidative stress, help repair cells, and strengthen the body. Recent research by Mahajan *et al.* (2022) shows that it may help to slow down the progression of chronic diseases like diabetes and cancer.

**Anthocyanin:** *C. ternatea* contains anthocyanin pigment which is known to be pH dependent. This enables it to act as an indicator species for the environment they are present in. This quality has been extensively used commercially in food packaging as a food freshness pH indicator (Hasanah *et al.*, 2023). The anthocyanin pigments are widespread in the flowers of the plant. They show high antioxidant activity and are found

capable of protecting neuronal cells from oxidative stress and apoptosis. It is found to protect nerve cells and reduces inflammation. It also helps to improve neuro-plasticity to enhance cognitive skills. Margret *et al.* (2015) have confirmed that *C. ternatea* could be a prospective brain drug against neurodegenerative diseases and depression.

**Saponins and Tannins:** *C. ternatea* is also known to show anti-diabetic and antimicrobial properties due to the saponins contained in them. Saponins help to boost the immune system and also shows cytotoxic effects on cancer cells. At the same time, tannins present in *C. ternatea* help in the healing of wounds. Moreover, they also protect the mucosal lining from irritation (Chakraborty *et al.*, 2018).

#### *Traditional and clinical applications of Clitoria ternatea*

*Clitoria ternatea* has been used since ages for its medicinal reasons aside from many reasons of its traditional usage. Apart from being just an ornamental plant *Clitoria ternatea* has many uses for treating health issues in traditional medicine. These traditional ways have been validated scientifically and many researchers have found that this traditional Indian knowledge can be utilised along with therapeutic treatments. Using *Clitoria ternatea* for treating problems like digestive disorders, stress, anxiety, skin, hair care and reproductive health has been an age-old practice in traditional treatment methods.

**Stress and anxiety:** As per the Ayurveda, this plant has an anxiolytic and anti-depressive quality. The plant has proven qualities that it can reduce anxiety and depression. It helps to live easier with mental health problems by relieving tension and anxiety and acting as a relaxant. Moreover, it also reduces dependency on allopathic drugs as observed by Mukherjee *et al.* (2008).

**Digestive health:** *C. ternatea* has been used for a long time to assist with our digestive functions. *C. ternatea* contains antibacterial properties beneficial to humans. All components of *C. ternatea* potentially have antibacterial effects on

various bacterial infections and helps in controlling growth of bacteria and fungi including *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, etc. (Jamil and Pa'ee *et al.*, 2018).

**Reproductive wellness:** This herb has long been known to improve reproductive health and fertility for a long time. It has the ability to enhance estradiol or estrogen, which is a sex hormone, necessary for reproduction thereby enhancing reproductive vigour. It has been used historically in therapies connected to fertility (Goh *et al.*, 2021).

**Memory Enhancement:** *Clitoria ternatea* can positively affect cognitive behaviour. It can control anxiety, depression, stress, and convulsions produced due to toxins and drugs used for treatment like Pentylene tetrazol, a drug formerly used as a circulatory and respiratory stimulant but also produced anxiety as a side effect. The extract has shown potential for treating depression, epilepsy, anxiety and stress. The treatment reduced the time taken to take important decision, improved the ability to create discrimination in object recognition tests and also reduced ulcers caused by stress. Jain *et al.* (2003) proved significant progresses in memory retaining.

**Neuroprotection:** *Clitoria ternatea* has antioxidant properties that can reduce reactive oxygen species (ROS) and can help the brain repair process, thereby limiting inflammation, and sustaining the cellular life span. It controls the recycling of cells and its protective factors help neurons under stress. This suggests that *Clitoria ternatea* can work against stress-induced brain damage and cognitive decline in humans (Raghu *et al.*, 2016). *Clitoria ternatea* also has potential for treating neurodegenerative disorders like Alzheimer's (Margret *et al.*, 2015).

**Anti-Diabetic Activity:** *Clitoria ternatea* helps to keep blood glucose levels healthy by improving insulin use, lessening stress in the body, and helping cells take in more glucose. Managing diabetes is made easier due to the ability to control blood glucose levels and reduce the

problems arising from hyperglycemia as highlighted by its components like flavonoids and anthocyanins (Kalaiselvi *et al.*, 2021).

**Anti-Inflammatory and Anti-Arthritic Activity:** *Clitoria ternatea* is a well-known bioactive plant of the Ayurvedic medicinal system and has anti-inflammatory and anti-arthritic potential. The root of the plant has anti-inflammatory and anti-arthritic properties in ethanolic extract. This pigment may be due to the presence of terpenoids, flavonoids, and triterpenoids including taraxerol, taraxerone, rutin, quercetin, delphinidin, kaempferol, and malvidin as seen by Swathi *et al.* (2020).

**Skin and hair care:** *Clitoria ternatea* can be used traditionally as a tea or applied straight on skin to improve skin elasticity and also promote healthy hair. Extracts from this plant are known to reduce oxidative stress and damage that contribute to aging. It also acts as a protective agent against toxin induced cytotoxicity (Zakaria *et al.*, 2018).

**Weight management:** *Clitoria ternatea* tea has been shown to have strong antioxidant, and metabolic activities that may control cholesterol and obesity as seen by Purnomo *et al.* (2023). It resources a natural way to manage weight, especially when combined with aerobics. The aqueous extract of *Clitoria ternatea* significantly reduced total cholesterol and ameliorated insulin resistance. The findings of Wang *et al.* (2022) demonstrated that the aqueous extract of *C. ternatea* blue petals contains bioactive anthocyanins that exert substantial hypolipidemic and anti-inflammatory effects by promoting reverse cholesterol transport.

#### **Proven health benefits of *Clitoria ternatea***

Thus, proven health benefits of *Clitoria ternatea* in a nutshell can be summed up as: rich in antioxidants, anti-inflammatory properties, boosts brain function, immune-boosting effects, anti-stress and mood enhancer, supports heart health, antimicrobial properties, enhances digestive health, blood sugar regulation, weight

management, improves vision, supports healthy skin and hair and detoxification.

## Conclusion

*Clitoria ternatea* is a plant normally found in India and has massive therapeutic potential in different systems. This plant is highly praised in Ayurveda for its beneficial cognitive, adaptogenic and anti-inflammatory properties, completely merging with wholistic health systems.

The integration of *Clitoria ternatea* in traditional medicine is due to the availability of various types of phytochemicals in the plant itself and its therapeutic adaptability. Today a lot of studies confirm many traditional claims that the plant is useful. These claims are neuroprotective, anti-inflammatory, anti-oxidative and a lot many more. Recent studies support these claims, highlighting its medicinal properties, which include neuroprotective, antibacterial and metabolic advantages. Few studies showed its versatility in formulations for mental health, immunity and overall balance. Thus, bridging the gap between traditional knowledge and scientific evidence can be considered as a good bioresource for future health. As their ability to affect human systems is quite remarkable, further studies are warranted, especially in synergistic applications and modern therapy settings. However, study also shows that there is a lack of research related to clinical trials and the uniformity of the formulations so, more scientific study is required to fully understand and appreciate the use of the plant as medicine. The coming together of ancient wisdom and modern science catalyses advancement in integrative therapy, assured continuity and the wider acceptance of this plant resource. This article provides a comprehensive overview of the therapeutic qualities and functions of *C. ternatea* by discussing both its traditional uses as well modern use as per new scientific findings.

## Ethical Statement

This is a review article hence no Ethical Approval needed.

## Author Contributions

Each author has contributed equally in designing the research, conducting thorough analysis, drafting the manuscript, and refining its content. All authors have read and agreed to the published version of the manuscript.

## Conflict of Interest

The authors declare no conflicts of interest.

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