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Blossoming potential: A comprehensive review on the medicinal marvels of *Clitoria ternatea* Linn. in health and wellness

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Abstract

Clitoria ternatea, commonly known as butterfly pea, is a versatile plant widely distributed in tropical and subtropical regions. This review compiles and synthesizes recent scientific findings on the medicinal uses of *Clitoria ternatea*, highlighting its pharmacological properties and potential therapeutic applications. The plant has been traditionally utilized in various traditional medicine systems for its diverse pharmacological activities. It encompasses studies on the phytochemical composition of *Clitoria ternatea*, emphasizing the presence of bioactive compounds such as flavonoids, alkaloids, and polyphenols. These compounds contribute to the plant's antioxidant, anti-inflammatory, and antimicrobial properties, which have been investigated through *in vitro* and *in vivo* experiments. Furthermore, *Clitoria ternatea* has demonstrated promising neuroprotective effects, with implications for neurological disorders such as Alzheimer's and Parkinson's diseases. The potential anti-diabetic and anti-hyperlipidemic activities of the plant have also been explored, suggesting its utility in managing metabolic disorders. In addition, the review discusses the plant's impact on the cardiovascular system, highlighting its hypotensive and vasodilatory effects. *Clitoria ternatea* has shown potential in improving cardiovascular health, which may be attributed to its ability to modulate lipid profiles and regulate blood pressure. Traditionally it is used as an aphrodisiac and fertility enhancer. This comprehensive review provides valuable insights into the medicinal potential of *Clitoria ternatea*, emphasizing its diverse pharmacological activities and therapeutic applications. The findings underscore the importance of further research to unlock the full therapeutic potential of this plant and facilitate its integration into modern medicine.

Keywords: *Clitoria ternatea*, antimicrobial, anti-inflammatory, analgesic activity

Introduction

Clitoria ternatea, commonly known as butterfly pea, is a botanical gem that has been revered for both its ornamental beauty and its storied history in traditional medicine. Originating in tropical and subtropical regions, this vibrant blue flowered plant has captured the attention of healers and herbalists across diverse cultures for its perceived medicinal properties. As scientific interest in botanical remedies continues to grow, *Clitoria ternatea* has emerged as a subject of intense investigation, sparking a renewed appreciation for its potential therapeutic applications. The vibrant petals of this plant conceal a wealth of bioactive compounds, propelling it into the spotlight for its diverse pharmacological properties. Throughout history, various cultures have harnessed the medicinal potential of *Clitoria ternatea* for addressing a wide array of health concerns. Traditional medicine systems, especially in Ayurveda and traditional Chinese Medicine, have valued this plant for its purported benefits in promoting overall well-being. The phytochemical composition of *Clitoria ternatea* has been a focal point of research, revealing the presence of flavonoids, alkaloids, and polyphenols among its constituents. These compounds are known for their antioxidant, anti-inflammatory, and antimicrobial properties, suggesting a broad spectrum of potential health benefits. This review aims to provide a comprehensive exploration of the medicinal uses of *Clitoria ternatea*, amalgamating centuries-old traditional knowledge with contemporary scientific findings. The enchanting blue petals of this plant conceal a pharmacological treasury, rich in bioactive compounds that have sarked interest in various fields of medicine.

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From traditional remedies handed down through generations to cutting-edge research in laboratories, the multifaceted nature of *Clitoria ternatea* beckons us to uncover the depth of its healing potential. As we navigate the contemporary landscape of scientific inquiry, we explore recent studies and experiments that shed light on the pharmacological activities of *Clitoria ternatea*. From antioxidant and anti-inflammatory properties to its impact on neurological and cardiovascular health, the plant unfolds as a versatile player in the realm of natural medicine. This review endeavours to synthesize the diverse facets of *Clitoria ternatea*'s medicinal journey, offering a nuanced understanding that spans both traditional wisdom and modern scientific scrutiny. Through this exploration, we hope to contribute to the ongoing dialogue surrounding the integration of botanical remedies into mainstream healthcare, with this plant poised as an intriguing candidate in this evolving narrative.

Taxonomic Classification

Kingdom: Plantae

Division: Mangoliophyta

Class: Magnoliopsida (Dicotyledons)

Order: Rosales

Family: Fabaceae /Leguminosae

Sub Family: Papilionaceae

Genus: *Clitoria*

Species: *ternatea*

Vernacular names

Bengali: Aparajitha

English: Conch flower, Winged leaved Clitoria, Butterfly pea flower

Gujarati: Garani, Koyal ni vel

Hindi: Khagin, Kalizer, Khajina, Koyal

Kannada: Koyala, Koyila, Girikarnike

Malayalam: Samkhupushpam

Marathi: Gokarni, Gokarnika

Tamil: Karuvilai, Kakkanam

Telegu: Gilarnikka, Dintan, Genduna

Sanskrit: Samkhakhya, Gokarnika, Asphota

Urdu: Neelofar

Plant Description

Clitoria ternatea, commonly known as butterfly pea, blue pea, or Asian pigeonwings, is a flowering plant native to South east Asia, known for its striking blue flowers and is cultivated for various purposes. It is a climbing or trailing herb, that can reach a height of 3 to 4 meters with branches and erect, cylindrical, hard basal stem. They are cultivated in tropical and subtropical regions worldwide with a variety of soil types, that can tolerate both acidic and alkaline conditions. The leaves are pinnately compound with 3 to 5 leaflets, each one ovate or elliptic in shape, and with a smooth texture. The flowers are vibrant, butterfly -shaped deep blue, pink or white coloured with a diameter of 3 to 5 centimetres. The fruits are slender, elongated pods with small round seeds.

Parts Used: Flower, Leaves, Root, seed

Chemical Constituents

The plant contains various bioactive compounds, including flavonoids, alkaloids, and anthocyanins, which contribute to its medicinal and dyeing properties. The different bioactive compounds isolated from this plant include flavonoids like

kaempferol, kaempferol 3-glucoside, kaempferol 3-robinobioside-7-rhamnoside, quercetin, and quercetin 3-glucoside and the acylated anthocyanins that were all derivatives of delphinidin 3, 3',5'-triglucoside (Saito *et al*, 1985) [26]. The other non-proteinaceous compounds like pentacyclic triterpenoids, taraxerol and taraxerone were also isolated (Banerjee and Chakravarti, 1963; 1964) [3, 4]. From *Clitoria ternatea*, in addition to taraxerol, novel norneolignans, clitorienolactones A-C were also isolated (Vasisht *et al*, 2016) [35]. The polyphenolic acids like gallic acid, protocatechuic acid, and chlorogenic acid were also found in this plant (Siti Azima *et al*, 2017) [30].

Pharmacological importance

Clitoria ternatea has been traditionally used in various cultures for its medicinal properties, while scientific research is ongoing, some potential health benefits have been reported.

Antimicrobial Activity

Reports are available on the antimicrobial activity of different extracts of *Clitoria ternatea* and the ethanol extract showed the maximum activity against bacteria and fungi. The protein finotin isolated from this plant showed inhibitory activities over a wide range of plant fungal pathogen and bacterial pathogen (Kelemu *et al*, 2004; Kamilla *et al*, 2009; Shahid *et al*, 2009; Nguyen *et al*, 2011, 2016b; Ajesh and Sreejith, 2014; Das and Chatterjee, 2014; Anthika *et al*, 2015) [15, 12, 28, 20, 19, 1, 7, 2].

Antioxidant Activity

Clitoria ternatea contains flavonoids, which are known for their antioxidant activity. Antioxidants help to protect the body cells from damage caused by free radicals, potentially reducing the risk of chronic diseases. (Kamkaen and Wilkinson, 2009; Talpate *et al*, 2014; Phrueksanan *et al*, 2014; Sushma *et al*, 2015) [13, 33, 22].

Anti-inflammatory Activity

The plant has been studied for its anti-inflammatory properties. Inflammation is linked to various health issues, including chronic diseases, and compounds in *Clitoria ternatea* may help to modulate inflammatory responses. (Devi *et al*, 2003; Singh *et al*, 2018) [8, 29].

Cognitive Enhancing Activity

Some studies suggest that *Clitoria ternatea* may have cognitive- enhancing effects. It is believed to improve memory and cognitive function, possibly due to its antioxidant and anti-inflammatory properties. (Taranalli and Cheeramkuzhy, 2000; Rai *et al*, 2001; Jain *et al*, 2003; Raghu *et al*, 2017) [34, 25, 10, 23].

Anti-Anxiety and Anti-Depressant Activity

There is some evidence to suggest that *Clitoria ternatea* may have anxiolytic (anxiety -reducing) and antidepressant effects. These effects could be attributed to its ability to influence neurotransmitters in the brain (Jain *et al*, 2003; Parvathi and Ravishankar, 2013; Margret *et al*, 2015) [10, 21, 18].

Antidiabetic Activity

Some research has explored the potential antidiabetic effects of *Clitoria ternatea*. It may help to regulate blood sugar levels and improve insulin sensitivity. (Daisy and Rajathi, 2009; Chusak *et al*, 2018b; Kavitha, 2018) [6, 5, 14].

Aphrodisiac Activity

In traditional medicine, *Clitoria ternatea* has been used as an aphrodisiac. It is believed to have properties that enhance sexual vitality, through scientific evidence supporting this claim is limited.

Analgesic Activity

Reports are available on the analgesic activity of alcoholic extracts of aerial parts of *Clitoria ternatea* using radiant heat, tail clip in rats and acetic acid induced writhing in mice. (Kulkarni *et al*, 1988; Kamilla *et al*, 2014; Sarwar *et al*, 2014) [16, 11, 27].

Anti-Cancer Activity

Preliminary studies have suggested that *Clitoria ternatea* extracts may have anticancer properties. However, more research is needed to understand the mechanisms and potential applications. (Kumar and Bhat, 2011; Shen *et al*, 2016; Zakaria *et al*, 2018) [17, 31, 36].

Anti-Ulcer Activity

Clinical studies were conducted in laboratory for the evaluation of ulcer index in experimental rats and mice, in which ulcer was induced by cold restraint stress and was found that the methanolic extract of *Clitoria ternatea* showed dose dependent anti-stress effect in mice (Jain *et al*, 2003) [10]. The ethanolic and chloroform extracts of this plant showed anti-ulcer effects in rats due to its antioxidant and anti-secretory effects. (Dwivedi *et al*, 2014; Rai *et al*, 2015) [9, 24].

Conclusion

The review of the medicinal uses of *Clitoria ternatea* underscores the remarkable potential of this plant as a valuable resource in traditional medicine and as a subject of contemporary scientific investigation. The wealth of bioactive compounds within *Clitoria ternatea*, including flavonoids, alkaloids, and polyphenols, contributes to its diverse pharmacological activities, ranging from antioxidant and anti-inflammatory effects to neuroprotective and cardiovascular benefits. The traditional uses of this plant in various medicinal systems have found support in modern scientific research, validating its historical reputation as a plant with multifaceted healing properties. The documented antioxidant and anti-inflammatory effects of this plant suggest its potential in combating oxidative stress and inflammatory conditions, which are implicated in various diseases. Moreover, the plant's neuroprotective properties open avenues for exploring its role in addressing neurological disorders, and its impact on metabolic health suggests potential applications in managing diabetes and related conditions. The cardiovascular benefits observed in studies also highlight *Clitoria ternatea* as a candidate for promoting heart health. The adaptogenic and anxiolytic properties of this plant contribute to its traditional use in stress management and mental well-being, presenting opportunities for further research in the field of mental health. Additionally, investigations into its effects on the reproductive system add depth to its traditional aphrodisiac and fertility-enhancing applications. As we move forward, it is evident that this plant holds promise as a natural remedy with a rich history and a growing body of scientific evidence supporting its medicinal applications. However, the review also emphasizes the need for continued research to fully elucidate the mechanism of action, optimal dosage, and potential side effects associated with the use of *Clitoria ternatea* in different therapeutic contexts. In summary,

Clitoria ternatea emerges from this review as a fascinating botanical ally, bridging traditional wisdom with modern scientific inquiry, and inviting further exploration into its full therapeutic potential for the benefit of human health and well-being.

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