WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 14, 551-559. Review Article ISSN 2277–7105

INSIGHTS INTO THE ECOLOGICAL AND HEALTH BENEFITS OF *CLITORIA TERNATEA*

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Article Received on
27 May 2024,

Revised on 17 June 2024,
Accepted on 06 July 2024

DOI: 10.20959/wjpr202414-33238

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ABSTRACT

The butterfly pea, scientifically known as *Clitoria ternatea*, is a perennial herbaceous plant characterized by its vine-like growth and stunning aesthetic appeal. It is widely recognized not only for its beauty but also for its versatility. *C. ternatea* serves multiple purposes; it functions as a pasture legume, enhances garden landscapes as an ornamental plant, and has found significant integration into agroforestry systems across tropical and subtropical regions globally. This overview aims to provide a comprehensive analysis of *Clitoria ternatea*, focusing on its medicinal applications, geographical distribution, pharmacological properties, and botanical characteristics. As a medicinal plant, *C. ternatea* is renowned for various therapeutic uses, owing to its rich content of bioactive compounds. Its geographic range spans across diverse climatic zones, predominantly thriving in tropical and subtropical climates where it contributes to both agricultural productivity and ecological balance. Botanically, *C. ternatea* exhibits traits typical of leguminous plants, with distinctive blue flowers that lend it its popular name. This study endeavors to consolidate current knowledge on *C. ternatea*, highlighting its broad spectrum of uses and its significance in both traditional and modern agricultural and medicinal practices worldwide.

KEYWORDS: *Clitoria ternatea*, Botanical description, Pharmacological activity, Medicinal uses.

INTRODUCTION

Numerous modern medications have been isolated from natural sources, which have been a source of medicinal compounds for millions of years. The ingredients in conventional medicine served as the basis for many of these isolations.[1] As a result, traditional medicine still heavily relies on plants. Because there are so many plants on Earth's surface, there is increasing interest in establishing a link between a plant's pharmacological action and its phytochemical elements.[2] Plant-derived medications are used as conventional treatments for many kinds of medical diseases by millions of people worldwide today. Numerous therapeutic benefits of medicinal plants have been demonstrated. When searching for novel medications, plants offer the potential of an alternate approach.[3] Herbal medicine has become more common and widely used in recent years, bridging sociocultural, economic, gender, and geographic divides. Herbal remedies do, in fact, play a significant role in people's general heath globally.[4]

CLITORIA TERNATEA

Clitoria ternatea, or butterfly pea, is a common name. It is referred to as Sangu Pushpam in Tamil. It belongs to the family Fabaceae and is a perennial herbaceous plant.[5] It has been receiving a lot of attention lately due to its possible uses in contemporary agriculture and medicine, as well as its ability to provide natural food coloring and anti-oxidants. *Clitoria ternatea* Linn is used both in traditional system and folk medicine to treat various inflammatory diseases such as arthritis and burns.[6]

PLANT PROFILE

Binomial name: *Clitoria ternatea*

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Eudicots

Fig. No. 1: *Clitoria ternatea.*

Clade: Rosids

Order: Fabales

Family: Fabaceae

Subfamily: Faboideae

Tribe: Phaseoleae

Subtribe: Clitoriinae

DESCRIPTION OF *CLITORIA TERNATEA*

Habit: Twining climber

Root: Branched tap root system having nodules

Stem: Aerial, weak stem and a twiner.

VERNACULAR NAMES

Sanskrit : Aparajita

Hindi : Koyala

Kannada : Sankupushpa

Tamil : Sangu poo

Telugu : Shankupushpam

CHEMISTRY OF *CLITORIA TERNATEA*

Steroids, flavonol glycosides, anthocyanins, and other triterpenoids have all been identified as chemical substances from *C.ternatea*. The heat-stable portion of *C. ternatea* extract yielded cyclic peptides known as cliotides.[7] A variety of anthocyanins, chief among them ternatins, which are polyacylated derivatives of delphinidin 3,3',5'-triglucoside (Da-T), are responsible for the blue color of *C. ternatea*.[8]

GEOGRAPHY AND DISTRIBUTION

This plant is native to equatorial Asia, including locations in South Asia and Southeast Asia but has also been introduced to Africa, Australia and the Americas.[9]

MEDICINAL USES: The plant is used in traditional medicine to cure conditions like asthma, jaundice, migraines, throat, eye, and skin infections. diseases of the central nervous system, leprosy, swollen joints, ear pain, eruptions, fever, UTIs, constipation, snake bites, headaches, and indigestion. Numerous pharmacological properties have been reported for its various extracts, including anti-inflammatory, anti-pyretic, anti-diabetic, anti-oxidative, anti-stress, immunomodulatory, larvicidal, proteolytic, antihelmintic, diuretic, anti-microbial, and memory-enhancing properties.[10]

CULINARY

The flower is utilized as an ayurvedic remedy and as a natural culinary coloring in Southeast Asia, where it is used to color sticky rice and sweets such Eurasian portugal. It is a key component in nasi kerabu in Kelantan, in the northeast of the Malaysian Peninsula, which gives it its distinctive bluish hue. The blossoms are frequently cooked after being dipped in butter in Burmese and Thai cuisines. Additionally, Pulot tartal, a Nyonya delicacy, is colored with it. Made with dried lemongrass and *C.ternatea* flowers, butterfly pea flower tea takes on different hues depending on what is added to it; lemon juice gives it a purple tint. This butterfly blue pea flower tea is often combined with lemon and honey in Thailand and Vietnam to enhance its acidity.[11]

PHYTOCONSTITUENTS

Phlobatannin, proteins, alkaloids, antharaquinone, anthocyanins, cardiac glycosides, stigmast-4-ene-3,6-dione, carbohydrates, saponins, triterpenoids, phenols, flavanoids, and flavonol glycosides were all present in *Clitoria ternatea*.

SAPONINS AND TRITERPENOIDS: *Clitoria ternatea* also contains triterpenoids such saponins and β-sitosterol. The plant's medicinal potential is aided by these substances' anti-inflammatory and antibacterial properties.[12]

ANTHOCYANINS AND FLAVANOIDS: One of the main classes of phytochemicals found in *Clitoria ternatea* are flavonoids. Among the most well-known flavonoids are myricetin,

kaempferol, and quercetin. The blue hue of the blooms is caused by anthocyanins, especially ternatins. These substances have strong antioxidant qualities.[12]

OTHER PHYTOCHEMICALS: The therapeutic effects of *Clitoria ternatea* are further enhanced by the presence of other phytochemicals such as tannins and phenolic acids. Astringent and antioxidant qualities are well-known for these substances.[13]

ANTI -INFLAMMATORY ACTIVITY

In a variety of experimental models, the plant's extracts have shown anti-inflammatory benefits. The absence of pro-inflammatory cytokines and enzymes is primarily responsible for these effects, as flavonoids prevent their synthesis. However, utilizing a number of antinociception models, the potential mechanism for the antinociceptive effect of methanolic extracts of *Clitoria ternatea* leaf and root was investigated. Together with naloxone, a non-opioid antagonist, many antinociception models were employed, including the hot plate, tail-flick, and formalin tests to prove that the extracts of the leaves and roots had antinociceptive properties. In test animals, extracts from the leaves and roots of Clitoria alternatea showed a strong antinociceptive effect. Studies have suggested that both the central and peripheral levels may be involved in the antinociceptive action of the extracts.[14]

ANTI-OXIDANT ACTIVITY

Because to its high flavonoid and anthocyanin content, *Clitoria ternatea* demonstrates substantial antioxidant capabilities. Research have revealed that the plant's extracts have the ability to lessen oxidative stress and scavenge free radicals, protecting cells from injury. The 1,1-diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging experiment was used to evaluate the in vitro free radical scavenging capacity of the various solvent extracts of *Clitoria ternatea* leaf. Strong in vitro free radical scavenging activity was shown by all extracts, and this activity rose with extract concentrations. The extracted methanol was discovered to be the strongest, with petroleum ether and chloroform extracts coming in second and third. Aqueous extracts of *Clitoria ternatea* were shown to have stronger antioxidant activity.[15]

ANTI-DIABETIC EFFECT

The diabetic produced through streptozotocin model, the acute and subacute hypoglycemic effects of methanol, water, petroleum ether, and chloroform extract of *Clitoria ternatea* leaves were assessed. In diabetics produced by streptozotocin, the extract of *Clitoria ternatea* dramatically lowered blood glucose level. While serum insulin, liver, and skeletal muscle

glycogen, as well as the activity of the glycolytic enzyme glucokinase, were all markedly increased, serum glucose, glycosylated hemoglobin, and the activities of the gluconeogenic enzyme, glucose-6-phosphatase, were all significantly decreased by the aqueous extracts of *Clitoria ternatea* leaves and flowers. animals injected with leaf extract had nearly identical profiles to those treated with floral extract in all biochemical assays conducted.[16]

ANTI-HELMINTIC ACTIVITY

The antihelmintic activity of *Clitoria ternatea* has been the subject of numerous reports of studies. In comparison to standard procedures, it was shown that the crude alcoholic extract of *Clitoria ternatea* and its ethyl acetate and methanol fractions significantly demonstrated paralysis and also caused death of worms, especially at higher concentration. *Clitoria ternatea* was tested for antihelmintic action on adult Pheretimaposthuma Indian earthworms. The root's methanol extract is the most effective and takes the worms far less time to paralyze and die than other extracts.[17]

ANTI-MICROBIAL ACTIVITY

Numerous pathogens have been studied in relation to *Clitoria ternatea*'s antibacterial qualities. The extracts have inhibitory effects on fungus and bacteria, indicating that they may be used as a natural antibacterial agent. The antibacterial activity of the methanolic extracts of the leaves and root of *Clitoria ternatea* was tested against a variety of pathogenic drug-resistant Gram-positive and Gram-negative clinical isolates. Studies showed that the leaf extract had stronger antibacterial activity than the root extract against Escherichia coli, Vibrio cholera, which is known to cause dysentery, and Staphylococcus aureus, which is known to cause fever.[18]

ANTI -CANCER EFFECT

According to recent findings, many plants and their constituents have the ability to reduce tumors and trigger apoptosis in cancer cells. Additionally, the most widely used herbal medication has the ability to suppress tumor growth, interfere with the course of the cell cycle, boost immunity, and inhibit tumor angiogenesis. The anti-carcinogenic and cancer-suppressive properties of *Clitoria ternatea* extracts are well associated with results from other plant extracts. It was discovered that the refined lectin could be useful in research on cancer.[19]

IMMUNOMODULATOR

Root and seed extracts from *Clitoria ternatea* had a strong immunosuppressive effect. Reduced immune cell sensitization, immune cell presentation, and phagocytosis may be the immunomodulatory effects of *Clitoria ternatea* on humoral, cell-mediated, and non-specific immune response.[20]

WOUND HEALING EFFECT

Using excision, incision, and dead-space models, the wound-healing properties of *Clitoria ternatea* seed and root extracts were studied. Orally administered by gavage and topically applied as ointment, extracts from the seeds and roots of *Clitoria ternatea* significantly improved wound healing in excision, incision, and dead-space models. The conclusion of the study also showed that *Clitoria ternatea* affected all three stages: inflammatory, proliferative and remodeling phases of wound healing.[21]

CONCLUSION

The study reviewed *Clitoria ternatea* as a potentially useful medicinal plant with a broad range of pharmacological activities that could be applied to a number of medical applications due to its safety and efficacy. *Clitoria ternatea* is a medicinal plant that has both traditional and modern uses; it is helpful in treating a number of incurable diseases, including cancer, neurological disorders, ephorological disorders, hyperglycemia, urinary disorders, goiter, respiratory disorders, and more. Additional research into its bioactive compounds and clinical applications may result in novel treatments for these and other illnesses.

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