

Unveiling the Medicinal Activity and Potential Health Benefits of Butterfly Pea (*Clitoria ternatea*)

Sandipa Mahapatra*, Manaswini Mahapatra and Jyoti Prakash Sahoo*

Faculty of Agriculture and Allied Sciences, C.V. Raman Global University, Bhubaneswar, Odisha (752 054), India

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Corresponding Author

Jyoti Prakash Sahoo and Sandipa Mahapatra

✉: jyotiprakash.sahoo@cgu-odisha.ac.in,
sanjuktamahapatra82@gmail.com

Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Mahapatra, S., Mahapatra, M., Sahoo, J.P., 2024. Unveiling the Medicinal Activity and Potential Health Benefits of Butterfly Pea (*Clitoria ternatea*). *Biotica Research Today* 6(4), 198-201.

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Abstract

The extensive utilization of Butterfly Pea (*Clitoria ternatea*) plant in traditional medicine stems from its abundance in biologically active compounds. Both its above-ground and underground components are employed in treating a spectrum of ailments such as diabetes, high blood pressure, retinal damage, edema and indigestion. Extract from the *Clitoria ternatea* flower exhibits a myriad of health benefits, including antibacterial, antioxidant, anti-inflammatory, cytotoxic and antidiabetic properties. These attributes render *Clitoria ternatea* flowers promising for incorporation into functional foods, given their broad therapeutic spectrum, safety and efficacy. From *Clitoria*, a range of primary and secondary plant metabolites have been extracted, including apuriginin, clitorin, triterpenoids, anthocyanins, steroidal glycosides and flavonols. Various pharmacological activities of *Clitoria ternatea* are included in this article, encompassing its nootropic, anticonvulsant, antidepressant, anxiolytic, antistress, antioxidant, anti-inflammatory, hyperlipidemic, antidiabetic, analgesic, cytotoxic, antiplatelet and hepatoprotective properties.

Keywords: Blue tea, Butterfly Pea, Health Benefits, Non-Caffein

Introduction

The butterfly pea, scientifically known as *Clitoria ternatea* L., belongs to the Fabaceae family and thrives in tropical regions, particularly Southeast Asia. Within the ancient Ayurvedic system of medicine, which has been practiced for centuries in India, medicinal plants play a central role in treating various ailments and serving as potential sources for drug development. Among these, *Clitoria ternatea* is classified as Medhya drugs, renowned for enhancing cognitive functions.

Clitoria ternatea, commonly referred to as Butterfly Pea, owes its distinct blue hue to anthocyanins present in its flowers. This natural pigment serves decorative purposes (Dhangar *et al.*, 2023). Beyond its aesthetic appeal, every part of the Butterfly Pea plant offers valuable health benefits. The flowers contain ternatins (*i.e.*, polyacylated anthocyanins and flavonol glycosides), which possess a spectrum of therapeutic properties including antioxidative, antidiabetic, antiobesity, anti-inflammatory, anticancer, antihyperlipidemic and antiasthmatic effects. These health-promoting qualities are attributed to the rich array

of phytochemical compounds present in *Clitoria ternatea* flowers, particularly flavonoids and anthocyanins (Dhangar *et al.*, 2023).

Anthocyanins, natural antioxidants abundant in the flowers, contribute to skin health by retarding aging processes and providing protection against oxidative stress. Additionally, the vibrant blue pigment of *Clitoria ternatea* flowers is utilized as a natural food dye, enhancing the visual appeal of various culinary creations. Overall, the butterfly pea flowers offer a potent combination of health benefits, ranging from antioxidative and anti-inflammatory properties to potential anti-diabetic and anti-cancer effects (Dhangar *et al.*, 2023).

Morphology of *Clitoria ternatea*

The flowers of the pea plant measure approximately 4 cm in length and 3 cm in width, boasting 5 petals, 2 wings, 2 keels and a banner featuring a bright yellow mark at its center. This climbing legume exhibits slender leaves, ranging from 2.5-5.0 cm in length and 1.5-3.5 cm in width and maintains its evergreen status with a fibrous root system. Notably, its substantial nodules possess the ability to fix nitrogen, facilitated by Rhizobia bacteria, contributing to the plant's

Article History

RECEIVED on 18th April 2024

RECEIVED in revised form 23rd April 2024

ACCEPTED in final form 24th April 2024

vitality. *Clitoria ternatea* reproduces through black seeds, showcasing vibrant pods spanning approximately 7-11 cm in length (Oguis et al., 2019).

In the culinary realm, both the root and leaves find application in medicinal and herbal beverages. Among its derivatives, butterfly pea powder emerges as a globally favored product, renowned for its vivid blue hue. Traditional medicine primarily utilizes the root and seeds, while the tender leaves serve as an appealing garnish. Beyond its culinary allure, *Clitoria ternatea* offers a plethora of health benefits, including digestive promotion, vision enhancement, blood pressure regulation and skin revitalization, owing to its rich array of bioactive compounds such as anthocyanins, flavonoids, glycosides, steroids, resins and phenols (Gomez and Kalamani, 2003).

Chemical Constitution and Use of *Clitoria ternatea*

The chemical constitutions of *Clitoria ternatea* are indexed in figure 1. Moreover, the root was historically employed in treating ascites, abdominal swelling, sore throat and skin conditions. Despite its purgative qualities, it was often avoided due to the discomfort it could cause. However, when mixed with honey and ghee, it served as a tonic for children, enhancing cognitive abilities, muscular strength and complexion. Additionally, the root found applications in managing epilepsy and mental disorders. Seeds and leaves were revered as brain tonics, aiding memory and cognitive functions. The juice and flowers were utilized as antidotes for snakebites. Seeds were utilized in alleviating joint swelling, while crushed seeds, consumed with cold or boiled water, addressed urinary issues (Jeyaraj et al., 2021).

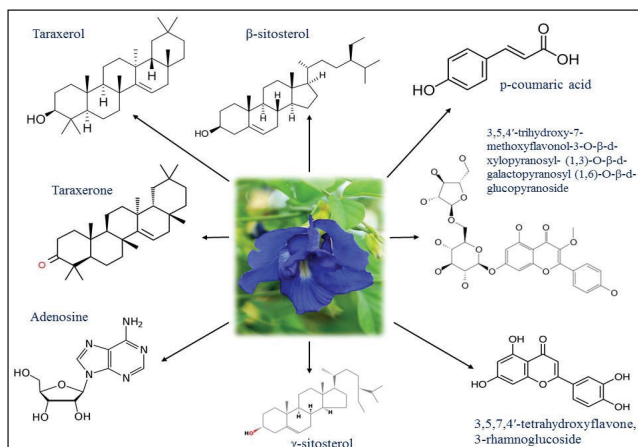


Figure 1: Active compounds of Non-Caffeinated Blue Tea (*Clitoria ternatea*)

Nutrients Availability in *Clitoria ternatea*

Butterfly pea flowers boast a wealth of anthocyanin compounds known as ternatins, akin to those found in renowned super foods like berries, cherries and red wine (Jeyaraj et al., 2021). Furthermore, the plant harbors various other antioxidants, including:

- **Kaempferol:** Extensively researched for its potential in combating cancer, kaempferol exhibits promising properties in test-tube studies, suggesting its ability to induce cancer cell death;

- **p-Coumaric acid:** Emerging research hints at the anti-inflammatory, antimicrobial and antiviral effects of p-coumaric acid, offering potential protection against various diseases; and

- **Delphinidin-3,5-glucoside:** This antioxidant has shown promise in stimulating immune function and triggering cell death in colorectal cancer cells, as suggested by a study.

Medicinal Activity and Potential Health Benefits of *Clitoria ternatea*

Anti-Inflammatory Antipyretic and Analgesic Effects

Blue tea exhibits notable anti-inflammatory, antipyretic and analgesic effects, making it a versatile remedy for various ailments. Research suggests that compounds found in blue tea may help reduce inflammation, alleviate pain and lower fever. These properties contribute to its potential as a natural alternative for managing discomfort and inflammation-related conditions. Incorporating blue tea into one's wellness routine may offer holistic relief from inflammatory discomfort (Anonymous, 2023).

Antioxidant Effects

Blue tea demonstrates potent antioxidant effects, attributed to its rich content of anthocyanins and flavonoids. These compounds scavenge free radicals, protecting cells from oxidative damage and reducing the risk of chronic diseases. Research indicates that regular consumption of blue tea may contribute to overall health by combating oxidative stress and promoting cellular health. Incorporating blue tea into a balanced diet may offer a natural and effective way to boost antioxidant defenses (Anonymous, 2023).

Antiparasitic and Insecticidal Effects

Blue tea exhibits notable antiparasitic and insecticidal effects, showcasing its potential as a natural remedy against various pests and parasites. Research suggests that bioactive compounds present in blue tea may disrupt the life cycles of parasites and deter insect pests. These effects can be beneficial for both agricultural purposes and personal health, offering a natural alternative to synthetic pesticides. Incorporating blue tea extracts or infusions into pest management strategies may help control infestations while minimizing environmental impact (Anonymous, 2023).

Antimicrobial Effect

Blue tea demonstrates significant antimicrobial effects, showcasing its potential as a natural agent against various microorganisms. Research suggests that bioactive compounds present in blue tea, such as anthocyanins and flavonoids, possess antimicrobial properties. These compounds may inhibit the growth and proliferation of bacteria, fungi and other pathogens. Incorporating blue tea into daily consumption habits may support overall health by aiding in microbial control and promoting a balanced microbiome (Anonymous, 2023).

Anticancer Effect

Blue tea exhibits promising anticancer effects, attributed to its rich content of bioactive compounds like anthocyanins and flavonoids. Research suggests that these compounds

may help inhibit the growth and spread of cancer cells, as well as induces apoptosis, or programmed cell death, in cancerous tissues. Studies have shown potential benefits in various types of cancer, including breast, colon and skin cancer. Incorporating blue tea into a balanced diet may offer a natural and complementary approach to cancer prevention and treatment (Anonymous, 2023).

Central Nervous Effect

Blue tea demonstrates intriguing central nervous system effects, potentially impacting cognitive function and mood regulation. Research suggests that bioactive compounds present in blue tea, such as flavonoids and anthocyanins, may exert neuroprotective properties, promoting brain health and resilience against neurodegenerative conditions. Preliminary studies hint at the potential of blue tea to enhance cognitive performance, memory and mood regulation. Incorporating blue tea into one's daily routine may offer a natural way to support overall brain health and well-being (Anonymous, 2023).

Gastrointestinal Effect

Blue tea shows promising gastrointestinal effects, potentially aiding digestion and promoting gut health. Research suggests that bioactive compounds found in blue tea, including flavonoids and antioxidants, may help soothe digestive discomfort and reduce inflammation in the gastrointestinal tract. Preliminary studies indicate that blue tea consumption may alleviate symptoms of gastrointestinal disorders such as bloating, indigestion and irritable bowel syndrome (IBS). Incorporating blue tea into one's diet may offer a natural and gentle approach to supporting digestive wellness and gastrointestinal function (Anonymous, 2023).

Hypolipidemic Effect

Blue tea exhibits notable hypolipidemic effects, potentially aiding in the regulation of lipid levels in the bloodstream. Research suggests that bioactive compounds present in blue tea, such as flavonoids and anthocyanins, may help lower cholesterol levels by reducing the absorption of dietary fats and promoting their excretion. Preliminary studies have shown promising results in reducing LDL cholesterol, also known as "bad" cholesterol, while increasing HDL cholesterol, or "good" cholesterol. Incorporating blue tea into a balanced diet may offer a natural and complementary approach to managing lipid levels and supporting cardiovascular health (Anonymous, 2023).

Antihistaminic and Antiasthmatic Effect

Blue tea demonstrates potential antihistaminic and antiasthmatic effects, suggesting its role in managing allergic reactions and respiratory conditions. Research indicates that bioactive compounds in blue tea, such as flavonoids and anthocyanins, may help alleviate symptoms associated with histamine release and asthma exacerbation. Preliminary studies suggest that regular consumption of blue tea may reduce airway inflammation, bronchoconstriction and respiratory distress (Anonymous, 2023).

Immunomodulatory Activity

Blue tea demonstrates promising immunomodulatory

activity, potentially influencing the body's immune response and overall immune function. Research suggests that bioactive compounds found in blue tea, including flavonoids and anthocyanins, may help regulate immune cell activity and enhance immune system function. Preliminary studies indicate that regular consumption of blue tea may support immune health by promoting the production of immune cells and modulating inflammatory responses. Incorporating blue tea into one's diet may offer a natural and complementary approach to supporting immune function and overall well-being (Anonymous, 2023).

Diuretic and Anti-Urolithiasis Effect

Blue tea exhibits diuretic properties, potentially aiding in the increased production of urine and facilitating the removal of waste products from the body. Research suggests that bioactive compounds present in blue tea, such as flavonoids and anthocyanins, may contribute to its diuretic effect. Additionally, preliminary studies indicate that blue tea may possess anti-urolithiasis properties, potentially helping to prevent the formation of kidney stones (Anonymous, 2023).

Wound Healing Effect

Blue tea demonstrates promising wound healing effects, potentially accelerating the repair and regeneration of damaged tissues. Research suggests that bioactive compounds found in blue tea, including flavonoids and antioxidants, may contribute to its wound healing properties by promoting collagen synthesis and reducing inflammation. Preliminary studies indicate that topical application of blue tea extracts may enhance the closure of wounds and improve overall wound healing outcomes. Incorporating blue tea extracts into topical formulations or using blue tea poultices may offer a natural and complementary approach to supporting the healing process of wounds (Anonymous, 2023).

Anti-Ulcer Activity

Blue tea exhibits potential anti-ulcer activity, suggesting its role in protecting the stomach lining and reducing the risk of ulcer formation. Research indicates that bioactive compounds in blue tea, such as flavonoids and polyphenols, may help inhibit the growth of ulcer-causing bacteria and reduce gastric acid secretion. Preliminary studies suggest that regular consumption of blue tea may alleviate symptoms associated with ulcers and promote gastric mucosal healing. Incorporating blue tea into one's dietary habits may offer a natural and complementary approach to supporting gastrointestinal health (Anonymous, 2023).

Other Properties

Blue tea, also known as butterfly pea flower tea, is esteemed for its cooling properties in Ayurveda, making it beneficial for individuals with a "Pitta" constitution and those combating conditions linked to heat and inflammation. Its antioxidant-rich composition has potentially slower premature aging and promoting skin vitality. With anxiolytic qualities, blue tea aids in stress reduction and mood elevation, contributing to improved emotional well-being and cognitive function. Additionally, it may accelerate weight loss by regulating

appetite and purifying the digestive system, while enhancing skin health by stimulating collagen production and promoting skin rejuvenation. Furthermore, blue tea is lauded for its potential to stimulate hair growth and alleviate symptoms of various ailments including diabetes, cardiovascular issues and respiratory disorders (Anonymous, 2023).

Conclusion

Clitoria ternatea is more than just a wild herb; it's also recognized for its medicinal properties. With a myriad of traditional and medicinal applications, it holds promise in treating various conditions, including cancer, neurological disorders, nephrological disorders, hyperglycemia, urinary issues, goiter, respiratory ailments, and more. This article aims to delve into the active components of this plant, their pharmacological effects, and how they operate, drawing upon the comprehensive information provided.

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