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Chapter 4

An over view on *clitoria ternatea*: An important medicinal plant

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Abstract: *Clitoria ternatea* is creeper of fabaceae family herb known for its medicinal properties and it is used as a memory booster, improves intellect, cure mental illness, antistress and anxiolytic agent from long ago and it is commonly used to cultivate as an ornamental species and is valued for its various medicinal applications. These plant flowers are edible and are particularly notable for their high concentration of anthocyanins and consume it as beverages and natural additive colour for food. Utilizing this legume for animal production can enhance nutritional intake while alleviating grazing pressure on natural habitats. This chapter discusses the distribution, botanical description, medicinal uses, phytochemical content, and other importance and its methods of propagation. In global climate change, C. ternatea exhibits several adaptation mechanisms that help it thrive in varying environmental conditions. Additionally, the plant contains essential phytochemical compounds beneficial for the pharmaceutical, textile, medicinal, and food industries.

Keywords: Memory booster, cure mental illness, improves intellect, anthocyanins, beverages, natural food colour etc.

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1. Introduction

Diversity:

The *clitoria ternatea* is also known as a butterfly pea plant. It has a variety of flowers with different colors.

i) Light Blue color flower, ii)Dark blue color flower, iii) White color flower iv) Mauve color flower

Origin and Distribution:

Clitoria ternatea originated in tropical Asia and has since been widely distributed to various regions, including: This plant is widely distributed to the world across tropical and subtropical areas of southern and eastern Africa, Madagascar, India, China etc.

This plant mostly used in Malaysia, China, Thailand, Japan etc., as food and beverages, natural colouring agents and commercial use.

Raining season is best environment for its growth and reproduction that's why it is mostly seemed in tropical and subtropical regions of India.

India:

Our country is the largest country which is embedded with 3000 plus medicinal plants which are recognised, and one of the largest producer of medicinal plants and herbs in world.

Clitoria ternatea is commonly found as an escape in hedges and thickets across India, thriving at altitudes up to 15 cm, and is also present in the Andaman Islands. It can be cultivated as a forage legume, either alone or in combination with perennial fodder grasses, in regions such as Punjab, Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, and Karnataka.

This plant is suitable for use as green manure and a cover crop. It not only suppresses many perennial weeds but also enriches the soil through nitrogen fixation. Although *Clitoria ternatea* is now widely distributed in humid, lowland tropical areas, occurring both naturally and in cultivation, there have been no developed improved pasture cultivars. It is cultivated throughout India and has naturalized in more tropical regions.

II) Plant Description:

Clitoria ternatea is commonly known as shankupushpi in India it is a Sanskrit name of *C. ternatea*. it is a perennial herbaceous climber of fabaceae family. It is a creeper it spread like bush.

Taxonomical Classification of *Clitoria ternatea*:

- **Kingdom:** Plantae
- **Division:** Magnoliophyta
- **Class:** Magnoliopsida
- **Subclass:** Rosids
- **Order:** Fabales
- **Family:** Fabaceae
- **Subfamily:** Papilionoideae
- **Genus:** *Clitoria*
- **Species:** *ternatea* (Linnaeus)

Clitoria ternatea flowers, including measurements of petal sizes, corolla layers, and colour variations. Here's a brief summary of the key points:

Petal Size and Corolla Structure:

- Enlarged wing petals result in a **double-layered corolla**.
- Enlarged wing and keel petals result in a **multi-layered corolla**.
- Typical flower petal measurements

Flower Colour Variations:

- Common colours: **Blue** and **White**.
- Blue occurs in various **shades**, while additional colours like **Lilac, Mauve, and Lavender** were also found.

Nutritional analysis of clitoria ternatea flowers

- Protein – 0.32%
- Fiber – 2.1%

- Carbohydrates – 2.2%
- Fat – 2.5%
- Moisture – 92.4%

The morphology of this plant has following features:

Leaves:

- Pinnately compound leaves consisting of 5–7 leaflets.
- Leaflets are ovate to elliptic in shape, with a rounded base and apex.

Flowers:

- Flowers are Solitary, funnel-shaped that measure approximately 4 cm by 3 cm.
- Flower colours can vary, including white, pink, light or dark blue, and blue with a yellow base.
- Each flower has five petals; the lower petal is enlarged to form a banner, while the upper two petals are slightly fused to create the keel.

Fruit:

- The fruit is a dry, brown legume that is linear-oblong in shape with 6 to 11cm length and 0.7–1 cm width with a long-pointed tip.
- Each fruit contains 6–10 seeds.

Roots:

- The plant has deep-rooted systems that produce nodules, which fix nitrogen and enhance soil quality.
- ***Clitoria ternatea*** is a perennial herbaceous plant that can grow as a creeper.

III) Cultivation:

Clitoria ternatea can grow well in rainy season with well drained, porous and fertile soil, with more water and full sunlight but this plant is not drought resistance. This plant is susceptible to spider mites and white flies etc.,

- **Micropropagation:** through invitro propagation also we can cultivate this plant easily.

IV) Phytochemicals:

The bioactive compounds which are naturally present in plants are called as phytochemicals which are having medicinal value for treating diseases without side effects to our bodies. They are present in whole plant, some phytochemicals are present in leaves, some in flowers, some in root and some in stem.

We can do phytochemical analysis by dried plant powder or plant parts powder like leaf powder etc., which are shade dried.

Alkaloids, flavonoids, tannins, glycosides, resins, steroids, saponins, phenols etc., are some phytochemical compounds present in this plant.

The major bioactive compounds present in ternatea is **ternatin** (phenolic compound) and flavonoids (**kaempferol, quercetin, myricetin**)

Ternatin: mood enhancement, stress busting, brain health, skin and hair health etc.,

Kaempferol: neuroprotective, cardioprotective, anticancer, antidiabetic etc.,

Quercetin: immune function, cardiovascular benefits, brain health, diabetes etc.,

Myricetin: anti-obesity, anti-arthritic, wound healing etc.,

Some fatty acids also present in this plant seed. They are

- **Palmitic acid - 19%**
- **Stearic acid - 10%**
- **Oleic acid - 52%**
- **Linoleic acid - 17%**
- **Linolenic acid - 4%**

We can do phytochemical analysis of plants through qualitative and quantitative analysis. In that for phytochemicals we do preliminary qualitative analysis. Like test for alkaloids, test for amino acids, test for carbohydrates, test for fixed oils and fats, test for glycosides etc.,

In qualitative and quantitative analysis we do gas chromatography, HPLC (high performance liquid chromatography), HPTLC (high performance thin layer chromatography), OPLC (optimum performance laminar chromatography) .

Further we do some methods for detection.

V) Medicinal importance:

Traditionally, it has been used as:

- **Venomous bites, stings:** Effective against snake bites and scorpion stings.
- **Respiratory issues:** Chronic bronchitis and sore throat.
- **Digestive disorders:** Indigestion and constipation.
- **Infectious diseases:** Fever and skin diseases.
- **Musculoskeletal ailments:** Rheumatism, arthritis, and swollen joints.
- **Mental health:** Supports mental health conditions like epilepsy, insanity, and migraines. It is also used to enhance muscular strength and as a complexion tonic.
- **Eye and ear conditions:** Used for treating eye disorders and ear-related ailments.
- **Venereal diseases:** Known to help with syphilis.
- **Ethnobotanical uses:** Treats urinary tract issues such as infections, burning sensations, frequent urination, and low urine output. It is also used post-surgery for purification following tumour removal.
- The blue-flowered variety contains anthocyanins and delphinidin glucoside. Pharmacologically, *C. ternatea* is noted for enhancing cognitive functions and learning abilities. **Cognitive enhancement** (improving learning and memory) and treatment for **neuronal degenerative disorders**. **Nootropic** (cognitive-enhancing) and **anticonvulsant** activities .**Antimicrobial** and **insecticidal** properties. **Antipyretic, Antioxidant**, **hepatoprotective** (liver-protecting), **antidiabetic** properties. **Platelet aggregation inhibitory** activity, which may help prevent blood clotting.

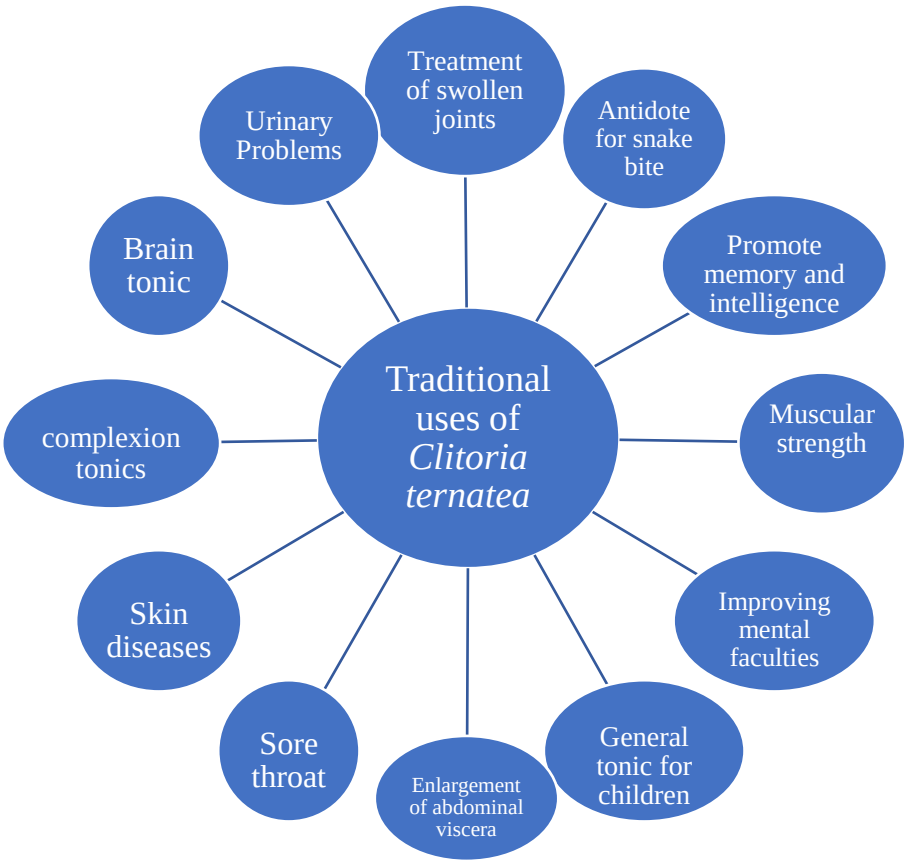

Fig. 1. Some major medicinal importance of *clitoria ternatea*

VI) Other importance:

It used as **Beverages, natural colouring agent and cosmetics leading to commercial sale of dried flowers etc.,**

Clitoria ternatea flower extract functions as a potent direct antioxidant, offering protection against free radicals produced from both external sources and endogenous biological processes. This chapter focuses on the protective effects of the flower extract against oxidative damage to biomolecules, linking it to its antioxidant properties. It explores evidence from **in vitro** studies, animal experiments, and human clinical research, all demonstrating the extract's ability to mitigate oxidative stress.

Among natural colours, blue is particularly challenging to work with due to the limited availability of edible natural sources.

- In some countries they use these plant flowers to colour their food by boil those flowers in water after water colour changed they used it for cooking and doughs of breads and cookies, pastries and rice etc.,
- Mostly these flower petals are used to garnish some dishes and used as a syrups.
- In some countries due to its medicinal importance they used to drink it as tea by boiling dried blue flowers as a beverage.
- Due to its usage, some people used it to cultivate these plants and dried the flowers and sold them as packets as a business.

Microencapsulation of *Clitoria ternatea* phytochemicals: such as anthocyanins and other bioactive compounds can enhance stability and bioavailability of these sensitive compounds. In their free form, anthocyanins are prone to auto-oxidation and degradation, which can limit their effectiveness, especially in terms of colour stability, industrial applications, and product shelf-life. Microencapsulation technology addresses these challenges by encapsulating active compounds in a protective microscopic shell or coating, thereby controlling their release and protecting them from environmental factors.

This process increases the active compounds life by preventing unwanted reactions and degradation, thus maintaining the efficacy of the ingredients. In the food industry, microencapsulation is utilized to protect sensitive ingredients, and to manage their controlled release or delivery in a targeted manner. Techniques for microencapsulation include atomization, spray coating, coextrusion, and emulsion-based processes.

In studies on *C. ternatea*, different coating agents and drying methods have been explored to retain the bioavailability of the flower extract's active components and stabilize its physical properties, particularly the colour intensity. These advancements highlight microencapsulation's potential in enhancing the practical applications of *C. ternatea* extracts in various industries.

VII) Methods of propagation:

In Vitro Propagation of *Clitoria ternatea*:

Plant tissue culture, a key technique in biotechnology and has a key role in crop improvement programs. Tissue culture method has gained recognition for its potential in generating novel genotypes with desirable traits. In the case of *Clitoria ternatea*, leaf explants have shown successful shoot regeneration alongside callus formation.

- Research has shown that using MS medium supplemented with auxins (NAA or IAA) and BAP (0.5 mg/L) induced a significant number of multiple shoot buds directly from young shoot tip explants. This method has proven advantageous for micropropagation of *Clitoria* species, enabling the production of a higher number of multiple shoots.
- The formation of multiple plantlets through shoot tip culture has practical application in raising hybrid seedlings from challenging crosses and inducing in vitro mutagenesis. This technique can be particularly useful for mass production, germplasm storage, and maintenance of *Clitoria ternatea* plants.
- **In Tissue culture** the plant were conducted to evaluate its regeneration potential **in vitro**. The explants taken from aseptic seedlings were cultured on Driver and Kuniyuki (DKW) medium, supplemented with some hormones which are useful to promote its growth. The goal was to get effective result.
- These results indicated that BAP was effective in inducing shoot formation, while NAA promoted root development. This highlights the role of specific hormone combinations in optimizing tissue culture protocols for *Clitoria ternatea*.
- This species holds significant economic value due to its medicinal uses, including applications as an anticonvulsant, antidepressant, and treatments for indigestion, constipation, arthritis, and eye ailments..Here are some methods for cultivating the butterfly pea plant: Prepare Seeds: In the spring, lightly scratch the surface of the seeds with a nail file and soak them in water overnight.
- **Plant Seeds:** Sow seeds directly into the ground or start them as seedlings. For direct planting, sow seeds put in the soil then raise seedlings, plant them in 2 cm deep.
- **Provide Support:** Use a trellis, fence, or wall to support the climbing plants.
- **Thin Seedlings:** If growing in pots, thin the seedlings to one or two per container once they reach about 6 inches tall.
- **Protect from Pests:** Apply insecticides to control insect pests and acaricides for mites.
- **Replant Damaged Seeds:** If seeds grow imperfectly or if some 2.5–5 cm and spaced 20–30 cm apart.
- Are damaged or die, replant with new seeds.
- **Weed:** Regularly pull out weeds to loosen the soil around the plants.

- **Add Soil:** If the soil around the plant begins to erode or if roots emerge above ground, add more soil to cover them.

VII) Side effects of C.ternatea:

There are some minor effects only came from consumers like Nausea, Stomach pain and Diarrhea after using this flower tea or like colour additive but there is no scientific evidence for these side effects.

IX) Limitations of C. ternatea:

Pregnancy and breast feed

Allergies

Underlying health conditions

These are some limitations of these plant , when above conditions are there they may take doctor suggestions on that particular period.

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