

Received on 08 February 2014; received in revised form, 08 May 2014; accepted, 04 December 2014; published 01 January 2015

AN UPDATE ON AYURVEDIC HERB VISHNUKANTA (*CLITORIA TERNATEA* LINN.): A REVIEW

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ABSTRACT: *Clitoria ternatea*, commonly known as Butterfly pea, is a medicinal plant belonging to the family Fabaceae. The plant is reported to be used in lithiasis, insect bites, skin diseases, asthma, burning sensation, ascites, inflammation, leucoderma, leprosy, hemicrania, amentia, and pulmonary tuberculosis. It is commonly called “Shankpushpi” in the Sanskrit language where it is reported to be a good “Medhya” (brain tonic). The major phytoconstituents found in *Clitoria ternatea* are the pentacyclic triterpenoids such as taraxerol and taraxerone, ternatins, alkaloids, flavonoids, saponins, tannins, carbohydrates, proteins, resins, and starch. Various secondary metabolites including triterpenoids, flavonols, anthocyanins, and steroids have been isolated from *Clitoria ternatea* Linn.

Keywords: Pharmacognosy, Microscopy, Macroscopy, Phytochemistry, Pharmacology

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INTRODUCTION: Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins, and lesser costs¹. Medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization¹. There exists a plethora of knowledge, information, and benefits of herbal drugs in our ancient literature of Ayurvedic (Traditional Indian Medicine), Siddha, Unani, and Chinese medicine².

Clitoria ternatea L. (Family: Fabaceae) is a perennial twining herb; stems are terete, more or less pubescent. The roots have a sharp, bitter taste and are useful in severe bronchitis, asthma, inflammation, and fever³. The fatty acid content of *Clitoria ternatea* seeds includes palmitic, stearic, oleic, linoleic, and linolenic acids⁴. The seeds also contain beta-sitosterol⁵. *Clitoria ternatea* possesses nootropic, anxiolytic, antidepressant, and anticonvulsant⁶, sedative⁷ antipyretic, anti-inflammatory, and analgesic activities.

It enhances memory⁸ and increases acetylcholine content in rats⁹. Thus *Clitoria ternatea* merits further phytochemical, pharmacological and clinical investigations for the development of an effective natural remedy from Ayurvedic Rasayana to provide therapeutically effective lead compounds or extracts.

	<p>QUICK RESPONSE CODE</p> <p>DOI: 10.13040/IJPSR.0975-8232.IJLSR.1(1).1-9</p>
	<p>The article can be accessed online on www.ijlsr.com</p>
<p>DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJLSR.1(1).1-9</p>	

Plant Profile:**Family:** Fabaceae**Synonyms:** Albiflora, Bracteata, and Mearnsii**FIG. 1: CLITORIA TERNATEA****Vernacular names:** ¹⁰

Sanskrit	:	Girikarnika, Vishnukranta
Assamese	:	Aparajita
Bengali	:	Aparajita
English	:	Clitoria
Gujarati	:	Gokarni
Hindi	:	Aparajita
Kannad	:	Girikarnika Balli, Girikarnika
Malayalam	:	Shankhapushapam
Marathi	:	Gokarna, Aparajita
Oriya	:	Aparajita
Punjabi	:	Koyal
Tamil	:	Kakkanam
Telugu	:	Dintena

Scientific Classification: ¹¹

Kingdom	:	Plantae
Subkingdom	:	Viridiplanta
Infrakingdom	:	Streptophyta
Division	:	Tracheophyta
Subdivision	:	Spermatophytina
Infrodivision	:	Angiospermae
Class	:	Magnoliopsida
Superorder	:	Rosanae
Order	:	Fabales
Family	:	Fabaceae
Genus	:	Clitoria L.
Species	:	<i>Clitoria Ternatea</i>

Description: *Clitoria ternatea* has fine twining stems, 0.5-3 m long. The leaves are pinnate, with 5-7 elliptic to lanceolate leaflets, 3-5 cm long and shortly pubescent underneath. Flowers are solitary, deep blue to blue mauve; very short pedicellate and 4-5 cm long. Pods are flat, linear, beaked, 6-12 cm long, 0.7-1.2 mm wide and slightly pubescent with up to 10 seeds. The seeds are olive, brown or black in color, often mottled, 4.5-7 mm long and 3-4 mm wide ¹². The root system of *Clitoria ternatea* consists of a fairly stout taproot with few branches and many slender lateral roots. Multicellular trichomes, with two basal cells smaller than the terminal cells, are present. In Transverse section, leaf shows a dorsiventral structure.

All along the veins, prismatic crystals of calcium oxalate are present. The vein-islet number is 7.5, and palisade ratio is 6.0. The pods are (5-10 cm) long, flat, and 6-11 seeded ^{13, 14}. Cortex is composed of 10-12 layers of thin-walled almost polygonal or tangentially elongated cells, packed with mostly compound starch grains ^{15, 16}. All the ray cells are fully packed with starch grains, and few contain calcium oxalate crystals ^{17, 18, 19}.

Habitats: *Clitoria ternatea* is a deep-rooted, tall slender, climbing legume with five leaflets and a deep blue flower. It is well adapted to a variety of soil types (pH 5.5-8.9) including calcareous soils. It is surviving in both the extended rainfall regions and prolonged periods of drought. Propagation is done through seed. It exhibits excellent regrowth after cutting or grazing within a short period and produce high yields also ²⁰. *Clitoria ternatea* L. is well adapted to heavy cracking clay soils in northern Australia ²¹. It is also used as a cover crop and green manure. The seeds are normally sown from the beginning until the middle of the wet season. It persists best when grazed lightly during the wet season ²².

Distribution: It is found commonly as an escape in hedges and thickets throughout India to an altitude of 15 cm and in the Andaman Islands. It can be grown as a forage legume either alone or with perennial fodder grasses in Punjab, Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Madhya-Pradesh, Andhra-Pradesh and Karnataka ²³.

Plant Parts Used: Leaves, Seeds, Bark, Fruits, Sprouts, Stem

TABLE 1: CHEMICAL CONSTITUENTS

Part Used	Chemical Constituents
Leaves	3 monoglucoside, 3- rutinoside, neohispidoside, aparajitin, beta-sitosterol, and essential oil, kaempferol- 3- o- rhamnosyl, 3- o- rhamnosyl Glycoside ²⁴ .
Root	β - carotene, stigmast- 4- ene- 3, 6, diene taraxerol & teraxerone, starch, tannins & resins, flavonoids ²⁵ .
Flower	delphinidin-3, 5-diglucoside, delphinidin- 3 β - glucoside, and malvidin- 3 β – glucoside, kaempferol, p-coumaric acid ²⁶ .
Seeds	greenish-yellow fixed oil ²⁷ , palmitic, stearic, oleic, linoleic, and linolenic acids ²⁸ .

Traditional Uses:**Medicinal Uses in Asian Indian Medicine:****Root:**

- According to Chhattisgarh state, it is used as a diuretic, the crushed fresh root bark is taken with a cup of warm milk 20 days for 2 weeks.
- The root is used in the treatment of various diseases, like indigestion, constipation, fever, arthritis, and eye ailments.
- The root is also employed in cases of ascetics, enlargement of the abdominal viscera, sore throat and skin disease ²⁹.
- They are also demulcent and given in chronic bronchitis.
- Though they are purgative, they cause griping and tenderness, and hence are not recommended ³⁰.
- Root is administered with honey and ghee as a general tonic to children for improving mental faculties, muscular strength and complexion tonics and in epilepsy and insanity ³¹.
- The root-juice of the white-flowered variety is blown up the nostrils as a remedy for hemicrania.
- The decoction or powder of root is given in rheumatism and ear-diseases.

Leaves:

- In Assam, juice of leaves is mixed with salt and applied around ears in headache and swelling of adjacent gland to relieve pain.
- Juice is used as an anti-dote against snake-bite ³².

- Leaves are used as poultices for swollen joints.
- In the traditional system of medicine particularly in Ayurveda, the roots, seeds, and leaves of *clitoria ternatea* have long been widely used as a brain tonic and are believed to promote memory and intelligence ³³.

Flowers:

- According to Irulas of the Kodiakkara *clitoria ternatea* paste of flowers is applied to cure infections of the eye and for headache.
- Flowers are used as an antidote for snake-bites ³⁴.
- Among the two varieties, the white-flowered one is found to be therapeutically more active and hence preferred.
- The blue-flowered variety is generally used as a substitute for the white-flowered one. The roots have an acrid and bitter taste and are credited with purgative, laxative and diuretic properties.

Seeds:

- Seeds are considered for colic, dropsy, and enlargement of abdominal viscera.
- They are also used in swollen joints ³⁵.
- 50 gm crushed seeds are taken with a cup of water once a day for 3 days. According to Rajshahi district in Bangladesh seeds are boiled in water, and the water strained through a cloth. 1/32 kg of the strained water is to be taken for 7 days in urinary problems ³⁶.
- *Clitoria ternatea* seed powder mixed with pepper was given in constipation. This was information given by villagers from Dharapuram Taluk, Tamil-nadu ³⁷.

Other uses:

- *Clitoria ternatea* is a highly palatable forage legume generally preferred by livestock over other legumes.
- It exhibits excellent regrowth after cutting or grazing within a short period and produce high yields.

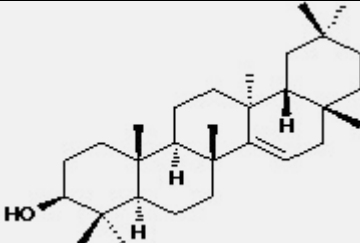

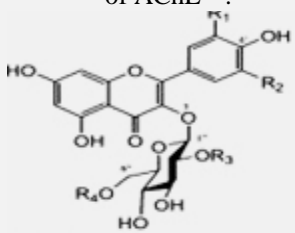
- It can be grown with all tall grasses for rotational grazing, hay or silage.
- Butterfly pea is also used as a cover crop and green manure.
- Due to its attractive flower colors it is also grown as an ornamental plant³⁸. The young shoots, leaves, flowers and tender pods are eaten as a vegetable in Kerala (India) and the Philippines.
- In Malaysia, the leaves are employed to impart a green color to food and the flowers to impart a bright blue color to rice cakes.
- The climber yields a useful green fodder throughout the year, particularly during the dry period and also dry feed³⁹.
- It is grown either alone or with other perennial grasses in Punjab, Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Karnataka in India. Besides suppressing many perennial weeds, it enriches the soil by fixing Nitrogen.
- It is also used as drought-resistant pasture in arid and semi-arid regions⁴⁰.

TABLE 2: PRELIMINARY PHARMACOLOGICAL ACTIVITIES OF ALCOHOLIC EXTRACTS OF *C.TERNATEA* LINN.

S. no.	Activity	Plant Part/ Extract	Dose/ Model	Result
1	Memory enhancement Activity	Root/ Alcohol	Electroshock model induces amnesia.	This improved dendritic arborization of amygdaloidal neurons correlates with the increase in passive avoidance learning and memory in the <i>Clitoria ternatea</i> treated rats ⁴¹
2	Anti-epileptic activity	Aerial Part/ Methanol	100 mg/kg p.o. / pentylenetetrazol (PTZ) and maximum electroshock (MES) –induced seizures in mice	CT significantly delayed the on the set of convulsions and also delayed the duration of tonic hind limb extension in MES-induced convulsions ⁴²
3	Anti-inflammatory activity	Root/ Methanol	150 mg/kg b.w. p.o/ In mice with the acetic acid-induced writhing response and mechanical stimulus by tail clip method	The study was obtaining the anti-inflammatory activity of the methanolic extract from the roots of <i>Clitoria ternatea</i> Linn ⁴³
4	Anti-oxidative activity	Flower/ Aqueous Extract	Determining the levels of enzymatic and non-enzymatic antioxidants	The antioxidant potential of aqueous leaf extracts of <i>Clitoria ternatea</i> was evaluated ⁴⁴
5	Immunomodulatory activity	Petals/ Ethanol	alloxan-induced diabetic rats	These results further indicate that these plant extracts have immunomodulatory effects that strengthen the immune system ⁴⁵
6	Blood platelet aggregation inhibition	Flowers/ Ethanol	Platelet aggregation inhibitory activity in rabbits	The results of various reported studies showed significant inhibition of collagen and adenosine diphosphate (ADP) induced aggregation of platelets ^{46,47}
7	Larvicidal activity	Seed/ Ethanol	The larvae of all the three species with LC ₅₀ values 65.2, 154.5 and 54.4 ppm, respectively for <i>A. stephensi</i> , <i>A. aegypti</i> and <i>C. quinquefasciatus</i>	The most promising mosquito larvicidal activity ^{48,49}
8	Anti-diabetic activity	Leaves/ Ethanol	400 mg/kg body weight	Significantly reduced serum glucose, glycosylated hemoglobin, total cholesterol, triglycerides, urea, creatinine and the activity of gluconeogenic enzyme glucose-6-phosphatase, but increased serum insulin, HDL cholesterol, protein, liver, and skeletal muscle glycogen content and the activity of glycolytic enzyme glucokinase ^{50,51}
9	Hepatoprotective activity	Leaves/ Ethanol	400 mg/kg/ CCl ₄ induced liver damage in rats	It can be concluded that possible prophylactic and therapeutic hepatoprotective effect of <i>Clitoria ternatea</i> leaves may be due to the presence of flavonoids which contribute to its antioxidant property ⁵²
10	Local anesthetic activity	Aerial/ Ethanol	Corneal anesthesia in rabbits and Plexus	Actively take part as Local anesthetics ⁵³

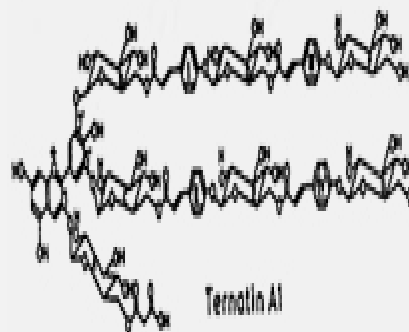
11	Anxiolytic activity	Aerial/ Ethanol	anesthesia 460 mg/kg	The animals treated with CT (100mg/kg) showed a significant increase in the inflection ratio and discrimination index which provides evidence for the species nootropic activity ⁵⁴
12	Antihelminthic activity	Leaves/ Ethyl Acetate and Methanol	Concentration of 50 mg/ml./Indian earthworms <i>Pheretima</i> <i>Posthuma</i> single I.V. dose	The methanol extract of the root is most potent and required very less time to paralysis and death of worms as compared to other extracts. The potency increases from leaves ⁵⁵
13	Diuretic activity	Dried Root/ Ethanol		Actively take part as diuretics ⁵⁶
14	Anti-microbial activity	Leaves, Root/ Ethanol	Inhibition (22±0.5 mm) against <i>E. coli</i> at 0.75 mg. Concentration and minimum with <i>M. flavus</i> of (14±1 mm) and the callus extract showed maximum zones of inhibition (16±2mm) against <i>S. typhi</i> while the lowest with <i>E. coli</i> and <i>S. aureus</i> (12±1 mm and 12±0.9mm)	Antibacterial activity was shown against <i>Salmonella</i> spp. and <i>Shigella dysenteriae</i> ; organisms causing enteric fever ⁵⁷

TABLE 3: PHYTOCHEMICAL STRUCTURE PRESENT IN *C.TERNATEA* LINN.

S. no.	Chemical Name	Chemical Structure
1	Taraxerol	 <p>Taraxerol is a Pentacyclic triterpenoid found in the root of <i>C. ternatea</i> L.⁵⁸.</p>
2	Physostigmine	 <p>Physostigmine is a Physostigmine was used as standard and showed inhibition of AChE⁵⁹.</p>
3	Kaempferol Quercetin	 <p>Two malonylated kaempferol and quercetin glycosides and one myricetin glycoside were isolated from the petals of <i>Clitoria ternatea</i>, together with eleven known flavonol glycosides. Their structures were identified by UV, MS, and NMR spectroscopic methods⁶⁰</p>

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Ternatins A1



Structure of ternatin A1, the largest ternatin in the major blue anthocyanins from *C. Ternatea* flowers⁶¹.

TABLE 4: QUALITATIVE ANALYSIS OF THE VARIOUS PHYTO-CONSTITUENTS ON THE ETHANOL EXTRACTS OF *CLITORIA TERNATEA* L. OF ROOT⁶²

S. no.	Phytochemical Test	Results
1	Test for alkaloids	
	Dragendorff's Test	++
	Mayer's reagent	++
2	Test for saponin	++
3	Test for flavonoids	++
4	Test for carbohydrates	
	Benedict's Test	++
	Molisch's Test	++
	Fehling's Test	++
5	Test for saponins	++
6	Test for terpenoids	++
7	Test for tannins	++
8	Ferric chloride test for Phenol	++
9	Test for proteins	--

TABLE 5: PHYSICAL ANALYSIS OF *C. TERNATEA* L. OF ROOT

S. no.	Parameter	Values
1	Foreign matter	Not more than 2 percent
2	Total Ash	Not more than 5 percent
3	Acid-insoluble ash	Not more than 2 percent
4	Alcohol-soluble extractive	Not less than 5 percent
5	Water-soluble extractive	Not less than 8 percent

Microscopic Characters of *C. ternatea* L. Root:

- Shows layers of rectangular, thin-walled, tangentially elongated exfoliating cork cells.
- The secondary cortex consists of rows of large, polygonal, thin-walled cells filled with starch.
- Grains, a few cells contain prismatic crystals of calcium oxalate in this region.
- Single or groups of lignified cortical fibers, distributed in the lower half of the cortex.
- Secondary phloem consists of usual elements.
- Phloem fibers in groups, a few solitary fibres also present, very long, thin-walled with the narrow lumen and pointed tips.
- Xylem fibers similar to those of phloem fibers, a few showing slit-like pits.
- Medullary 10 rays 1-5 cells wide, oblong, and pitted.
- Xylem parenchyma irregular in shape and pitted walls.
- Starch grains simple as well as a compound having components, single grains are measuring 3-13 μ in dia.
- Found in the secondary cortex, phloem and xylem parenchyma.

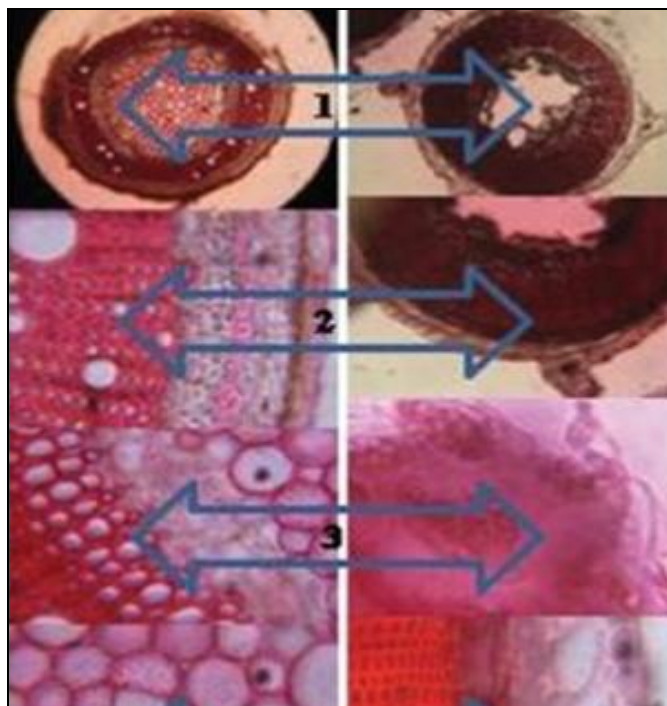


FIG. 2: TRANSVERSE SECTION OF *C. TERNATEA* L. ROOT

CONCLUSION: The widespread survey of literature exposed that *C. ternatea* L. is highly regarded as a universal solution in herbal medicine with diverse pharmacological activity range. This versatile medicinal plant is the unique resource of various types of chemical compounds, which are responsible for the various activities of the plant. Hence extensive investigation is needed to develop their therapeutic utility to combat diseases. As the global scenario is now altering towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs from *C. ternatea* L. should be emphasized for the organizer of various diseases. Further evaluation needs to be carried out on *C. ternatea* L. to discover the concealed areas and their practical clinical applications, which can be used for the benefit of mankind.

ACKNOWLEDGEMENT: Nil

CONFLICT OF INTEREST: Nil

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How to cite this article:

Alok S, Gupta N, Kumar A and Malik A: An update on Ayurvedic herb Vishnukanta (*Clitoria Ternatea* Linn.): a review. Int J Life Sci & Rev 2015; 1(1): 1-9. doi: 10.13040/IJPSR.0975-8232.IJLSR.1(1).1-9.

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