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PHYTOCHEMICALS AND PHARMACOLOGICAL PROPERTIES OF *CLITOREA TERNATEA*: A REVIEW

Komal Verma¹; Laxmi Devi²; Mehemud Allam Kuresi³;
Himanshu Singh*⁴; Alok Kumar Shukla⁵

Author (s) affiliations:

^{1,2,3}Research Scholar, Babu Sunder Singh College of pharmacy Lucknow, UP India

⁴Assistant Professor, Babu Sunder Singh College of pharmacy Lucknow, UP India

⁵Professor & Director, Babu Sunder Singh College of pharmacy Lucknow, UP India

Corresponding author:

Himanshu Singh,

Assistant Professor, Babu Sunder Singh college of pharmacy Lucknow, UP India

Email id: himanshusinghbph@gmail.com

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ABSTRACT:

Clitoria ternatea refers an herb (annual twining) found in India, Philippines, Madagascar & China. It belongs to family- *Fabaceae*. The present review was based on the description, phytochemicals, and pharmacological properties of *Clitoria ternatea*. The literature survey was done thorough PubMed, Scopus and Google Scholar. The root was utilized in induction of abortion in the past, and the paste is often used to treat abdominal inflammations, sore-throats & mucus problems. According to the results of the initial phytochemical screening, the plant included proteins, alkaloids, anthraquinone, anthocyanins, cardiac glycosides, phenols, tannins, phlobatannin, carbohydrates, saponins, triterpenoids, phenols, flavonoids, flavonol glycosides, and volatile oils in addition to steroids.

Keywords: *Clitoria ternatea*, phytochemicals, pharmacological properties, antioxidant.

INTRODUCTION

Clitoria ternatea refers an herb (annual twining) found in India, Philippines, Madagascar & China. It belongs to family- *Fabaceae*. The roots are effective in severe bronchitis, asthma, frenetic fever because they have shown laxative, diuretic, anthelmintic & anti-inflammatory actions (Pulok *et al.* 2008; Dnyaneshwar *et al.* 2011). The root was utilized in induction of abortion in the past, and the paste is often used to treat abdominal inflammations, sore-throats & mucus problems. *C. ternatea* has shown to have nootropic, anticonvulsant, anti-inflammatory etc. (Parimala *et al.* 2003). It improves memory and raises the amount of acetylcholine in rodents (Rai *et al.* 2002).



a. Whole plant



b. Flower, seeds of CT

Fig 1. Different parts of *Clitoria ternatea*



Taxonomy

Kingdom:	Plantae
Order:	Fabales
Family:	Fabaceae
Subfamily:	Faboideae
Genus:	<i>Clitoria</i>
Species:	<i>ternatea</i>

Chemical constituents

According to the results of the initial phytochemical screening, the plant included proteins, alkaloids, anthraquinone, anthocyanins, cardiac glycosides, phenols, tannins, phlobatannin, carbohydrates, saponins, triterpenoids, phenols, flavanoids, flavonol glycosides, and volatile oils in addition to steroids. The fatty acids palmitic, stearic, oleic, linoleic, and linolenic are present in *Clitoria ternatea* seeds. Additionally, seeds included watersoluble mucilage, delphinidin 3, 3', 5'-triglucoside, beta-sitosterol, anthoxanthin glucoside, and a very basic tiny protein known as finotin (Manalisha et al. 2000).

Pharmacological properties

Anti-inflammatory & analgesic

C. ternatea methanol extract had substantial antipyretic efficacy. *C. ternatea* roots methanol extract was observed to decrease both carrageenin-induced paw edema & acetic acid-induced vascular permeability in rodents when given orally (Devi et al. 2004). In another study, petroleum ether extract (60-80°C) from *C. ternatea* flowers demonstrated considerable anti-inflammatory efficacy at both dose levels.

Anxiolytic

In rats, oral administration with an alcoholic CT extract at a concentration of 460mg/kg significantly delayed the time it took to cross the labyrinth induced by chlorpromazine. *C. ternatea*- 100mg/kg treatment resulted in a significant rise in inflexion ratio & discrimination index indicating that the species has nootropic effect (Chauhan et al., 2012).

Antimicrobial

The antibacterial activity of alcoholic & aqueous extracts from in-vitro produced calli was investigated using the agar well diffusion technique against Gram^{-ve} bacteria- *Salmonella* spp. & *S. dysenteriae*, which cause enteric fever, were found to have antibacterial activity (Shahid et al., 2009). The leaf was discovered to have high antibacterial role against *E. coli* and *Vibrio cholera*, both of which cause dysentery, as well as *Staphylococcus aureus*, which causes



fever. The antibacterial activity of the leaf extract was higher than that of the root extract. In their method of action, both extracts were found to be bactericidal. Leaf extract's efficacy may be aided by quercetin. In another investigation, crude extract from *C. ternatea* seeds demonstrated a maximum zone of inhibition of 220.5mm against *Escherichia coli* at 0.75mg conc. & a minimum zone of inhibition of 141mm against *Micrococcus flavus*. The highest zones of inhibition (162mm) were found against *Salmonella typhi*, while the lowest were found against *E. coli* and *Staphylococcus aureus*, 121 & 120.9mm, respectively. *Clitoria ternatea*'s antibacterial activities were studied using agar disc & well diffusion techniques. Antibacterial activity against the investigated microbiological pathogens was found to be promising. When compared to the other extracts, methanolic extract was found to having a more potent inhibitory action (Anand et al. 2011).

Nephroprotective

The administration of *C. ternatea* ethanol extract has been found to have nephroprotective effect against APAP-induced nephrotoxicity. It offers experimental evidence that *C. ternatea* increased the level of myocardial enzymes (antioxidant), preserved histoarchitecture & improved performance of heart after APAP dosing (Sarumathy et al. 2011).

Anti-stress

Cold restraint stress generated ulcers, Li induced twitching in head, clonidine-induced hypothermia, sodium nitrite-induced respiratory failure & haloperidol induced catalepsy were used to test the anti-stress activity of aerial components in rats and mice (Chauhan et al. 2012).

Larvicidal

The mosquito's larvicidal activity of *C. ternatea* was the most hopeful in terms of research. *C. ternatea* seed extract methanol extracts were effective against all larvae of 3 species with LC50 values of 65.2, 154.5 & 54.4ppm for *A. stephensi*, *A. aegypti*, & *C. quinquefascitus*, respectively (Pendbhaje, 2011).

CNS depressant

Clitoria ternatea has a sedative impact on the brain, therefore it's used to treat symptoms including syncope, vertigo, and brain weakness. The effects of *C. ternatea* on cognition, anxiety, sadness, stress, and convulsions were investigated. The methanolic extract of *C. ternatea* was reported to have nootropic, anxiolytic, depressive, anticonvulsant, and antistress action utilising Pentylenetetrazol & maximal electroshock (Taranalli,2003).



Proteolytic

The functions carboxypeptidase and aryl amidase increased in cotyledons, peaking at day 9, while endopeptidases increased at day 3 before declining (Chauhan *et al.*,2012). The activity of endopeptidases and carboxypeptidases in the axial tissue increased until day 9 then decreased, and arylamidase was low. The increased activity of acidic endopeptidases and carboxypeptidases in germinating cotyledons indicates that they are involved in storage protein breakdown.

Antioxidant

C. ternatea flower extracts are utilised as a cosmetic ingredient in Thailand, and the chemical composition of the flowers suggests that they may have antioxidant properties. *C. ternatea* water extracts were shown to have higher antioxidant activity than ethanolic CT extract (Kamkaen and Wilkinson,2009).

Anthelmintic

C. ternatea leaves were tested for their ability to inhibit free-living nematodes using aqueous and methanol extracts. *C. ternatea* flowers, leaves, stems, and roots were tested for anthelmintic action on adult Indian earthworms *P. posthuma* in another study. When compared to other extracts, the methanolic root extract is the most effective and required the least amount of time to paralyse and kill the worms. From flowers, leaves, stems, and roots, the potency grows.

Respiratory system

It is used to treat common colds, coughs, and asthma because it acts as an expectorant and soothes the respiratory organs. Aside from that, the entire plant is smoked. Gargling throat symptoms are treated with decoction. When the root juice is mixed with milk, it relieves sticky phlegm in the cough and asthma. It can also be used to treat whooping cough when taken through oral route (Neelamma *et al.* 2016).

Anti-cancer

According to recent findings, plants and their components can operate as tumour suppressors, apoptotic inducers in cancer cells, and the most often used herbal medicine can decrease tumour angiogenesis, interfere with cell cycle progression, and promote immune activity. *Clitoria ternatea* extracts are well associated with other results on cancer suppressing or anti carcinogenic activities from various plant extracts (Ramaswamy *et al.*, 2011). Using the trypan blue dye exclusion method, the cytotoxic effects of petroleum ether and ethanolic CT flower extract were assessed *in vitro*. The plant extract concentrations employed were 10, 50, 100, 200 & 500g/ml, as well as a control. In both cases, increasing the concentration of the

extract resulted in a drop in cell count. All of the concentrations examined showed a dose-dependent increase in cytotoxic activity. For petroleum ether extract, a concentration of 10g/ml resulted in an 8 percent reduction, and a concentration of 500g/ml resulted in a 100 percent reduction. At 10g/ml concentrations, there was a 1.33 percent drop in cell count, and at 500g/ml, there was an 80 percent reduction in cell count (Kumar & Bhat, 2011).

Anti-convulsant

The anticonvulsant effect of an ethanolic extract of aerial portions of CT was tested in rats using the maximum electroshock seizure test and the pentylenetetrazol test. There were no significant effects in both the 230 and 460 mg/kg groups tests. A methanolic extract of aerial part's anti-stress activity. Cold-restraint stress-induced ulcers were used to test CT. Head twitches caused by lithium, hypothermia caused by clonidine in rats and mice, as well as sodium nitrite-induced respiratory failure and haloperidol-induced catalepsy. CT scanning was used in the treatment. The ulcer index was dramatically lowered by (100,200 & 400mg/kg). CT reduced ulcer index in a dose dependent manner and shown anti-stress properties activity. CT at dose- 100mg/kg reduced the no. of head injuries considerably twitches (Kulkarni et al. 1988).

Anti-diabetic

Methanolic, watery, petroleum ether & chloroform extract of *C. ternatea* leaves were tested for acute and subacute hypoglycaemic effects in Streptozotocin-induced diabetic rats. In Streptozotocin induced diabetic rats. *C. ternatea* extract (200 & 400mg/kg) dramatically lowered blood glucose levels. 400 mg/kg had a considerable hypoglycemic impact, while 200 mg/kg reduced glucose levels but not as much as 400 mg/kg. Subacute activity revealed that when using extract for a long time, a dose of 200 mg/kg is far more effective at controlling blood glucose levels than a dose of 100 mg/kg (Al-Snafi, 2016).

Anti-hyperlipidaemic

The anti-hyperlipidaemic role of *C. ternatea* & *Vigna mungo*, hydro-alcoholic extracts of root & seed of *C. ternatea* and hydro-alcoholic extract of *V. mungo* on experimentally induced hyperlipidaemia in rats. Results proved that the hydroalcoholic extracts of the roots & seeds of CT. In diet-induced hyperlipidaemic rats, the atherogenic index and the HDL/LDL ratio were likewise corrected after treatment (Solanki & Jain, 2010).

Anti-histaminic

Clonidine-induced catalepsy (mice) & haloperidol-induced catalepsy paradigm were used to test the antihistaminic activity of CT roots. Clonidine, a 2adrenoceptor agonist, causes catalepsy in mice that is blocked by histamine H1 receptor antagonists but not by H2 receptor



antagonists. Clonidine causes mast cells to produce histamine, which causes a variety of asthmatic symptoms. However, CPM & ECTR do not inhibit haloperidol-induced catalepsy. According to the findings, ECTR has antihistaminic properties (Taur & Patil, 2010).

Learning & memory

The findings of this investigation revealed that oral administration of CT root extracts at various doses greatly improved memory in rats. In newborn rat pups, CT aqueous root extract was used to increase learning and memory utilising open field behaviour test, passive avoidance test, and spatial learning test. Memory-enhancing qualities were found in CT root extract, which had little or no influence on general motor activity but increased retention and spatial learning ability at both time points of behavioural testing (Rai et al. 2000).

Antidepressant

In a study, antidepressant activity of methanolic CT extract of aerial portion at doses of 100 & 400mg/kg was observed utilising the tail suspension test. The length of immobility was dramatically reduced when CT was given orally. CT reduced overall immobility time and did not cause drowsiness or behavioural toxicity, although it did improve cognitive capacities. The calming effect of an alcoholic extract of CT's aerial section was tested in rats using the conditioned avoidance response test (Jain et al. 2003).

Hepatoprotective

The paracetamol-induced liver toxicity studies revealed that mice given the ME of CT leaf (200mg/kg) had significantly lower levels of ALT, AST and bilirubin, all of which were significantly higher in the paracetamol group. Therapy with CT leaf extract has also been shown to protect against histopathological changes (Nithianantham et al. 2011).

Wound healing

The effectiveness of CT seed and root extracts in promoting wound healing was evaluated in excision, incision and dead-space models in rats. These outcomes matched those obtained with cotrimoxazole ointment. The results showed that CT had an impact on the inflammatory, proliferative, and remodelling phases of wound healing (Solanki & Jain, 2012).

Local Anaesthetics

The LA action of an alcoholic CT extract (of aerial portion) was investigated. The foot withdrawal reflex in frogs was abolished by a 10% solution of alcoholic extract of CT aerial portion, but there was no surface anaesthetic effect on rabbit's cornea. Inducing local anaesthesia with an alcoholic extract of CT aerial component was almost as efficient as xylocaine (Kulkarni et al. 1988).



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CONCLUSION

The study examined *Clitoria ternatea* as a potentially useful medicinal plant with a broad spectrum of pharmacological actions. Due to its efficacy and safety, *Clitoria ternatea* may be used in a variety of pharmacological applications i.e., nootropic, anticonvulsant, anti-inflammatory etc.

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COMPETING INTEREST

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