Review Article

Received on: 27/08/2015
Accepted on: 30/09/2015
Published on:12/10/2015

QR Code for Mobile users

Conflict of Interest: None Declared !

Ethnopharmacological activity of *Clitoria ternatea* with special reference to Neuroprotective and Antidiabetic effect

Mukesh Kumar Yadav[a*], Santosh Kumar Singh[b], J S Tripathi[a]

[a]Department of Kayachikitsa, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005, Uttar Pradesh.

[b]Centre for Experimental Medicine and Surgery, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005, Uttar Pradesh.

Abstract:

Clitoria ternatea (Family: Fabaceae) commonly known as 'Butterfly pea', a traditional Ayurvedic medicine, has been used as memory enhancer, antistress, anxiolytic, antidepressant, anticonvulsant, tranquilizing and sedative agent. The extracts of *Clitoria ternatea* possess a wide range of pharmacological activities including antimicrobial, antipyretic, anti-inflammatory, analgesic, diuretic, antidiabetic properties. This review is an effort to explore the chemical constituents and the pharmacological study of *Clitoria ternatea*, which have long been in clinical use in Ayurvedic medicine.

Introduction:

'Medhya Rasayana' is one of the major aspects of Ayurvedic pharmacology which ascribed intellect promoting activities of medicinal plants (Mukherjee, 2002; Govindarajan et al., 2005). Several aspects on integrated approaches of drug development from Ayurveda have explored many potential lead components from herbs. *Clitoria ternatea* is commonly called *butterfly pea* or *conch flower* or *shankapushpi* and in Indian traditional medicine is known as *Aparajita* (Hindi), *Aparajita* (Bengali), and *Kakkattan* (Tamil). Butterfly pea is a highly palatable forage legume generally preferred by livestock over other legumes. It exhibits excellent regrowth after cultivation within short –period and produce high yields also. It can be grown with all tall grasses for rotational grazing, hay or silage. Butterfly pea has potential to be used as nutraceutical and pharmaceutical. The flavonoid quercetin has been shown to reduce upper respiratory infections in humans while delphinidin and malvidin identified in butterfly pea flowers may inhibit various forms of cancer. In the traditional (Asian) Indian systems of medicine of Ayurveda, the roots, seeds and leaves of *Clitoria ternatea* have long been widely used as a brain tonic and has been said to promote memory and intelligence (Mukherjee et al., 2007a).

Morphology:

The plant is a perennial climber, tall, slender, climbing herbaceous vine with five leaflets, white to purple flowers, and has deep roots. Butterfly pea is self-pollinated however segregating genotypes have been identified, indicating partial out crossing probably exists.

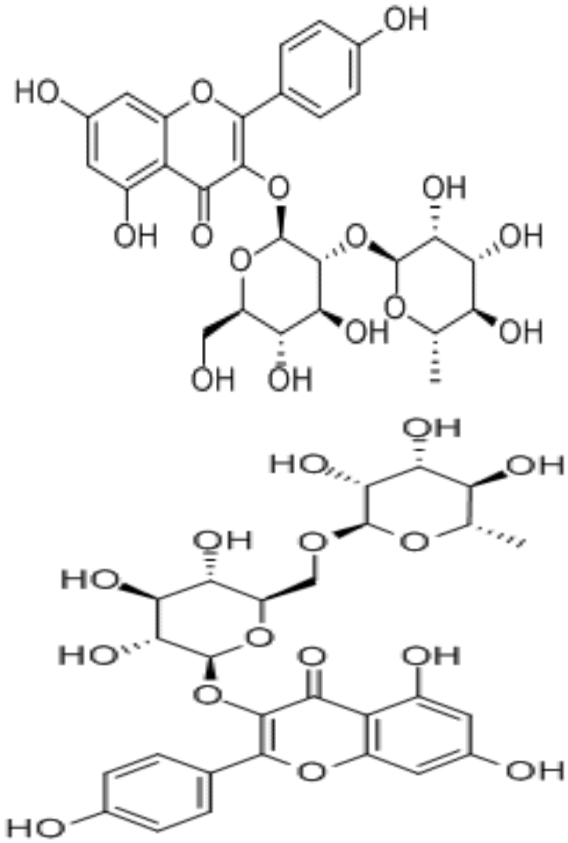
Fig. (1) *Clitoria ternatea* (flower)

Leaves- The plant possesses imparipinnate leaves consisting of five to seven leaflets, 6–13 cm long. The leaflets are ovate or oblong; 2–5 cm long and subcoriaceous, rubiaceous stomata with wavy cell walls are present on both upper and lower epidermis of the leaflets.

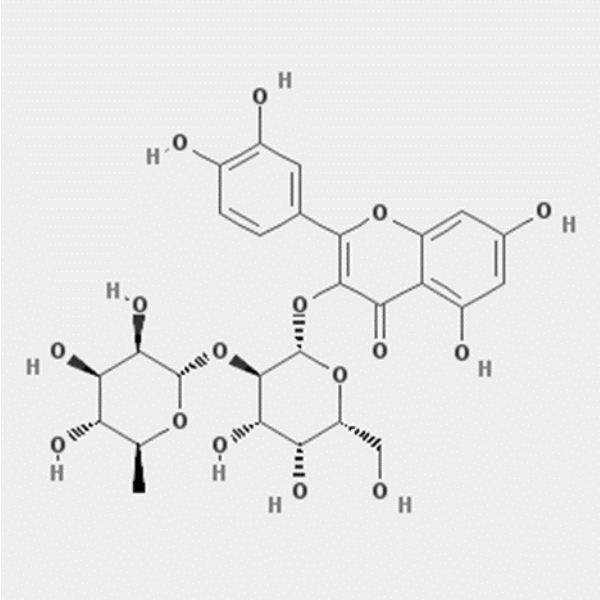
Flowers- The plant bears solitary, axillary, papilionaceous flowers, white or bright blue in colour with yellow or orange center. The pods are 5–10 cm long, flat, nearly straight, sharply beaked and 6–11 seeded.

Phytochemicals in *Clitoria ternatea:*

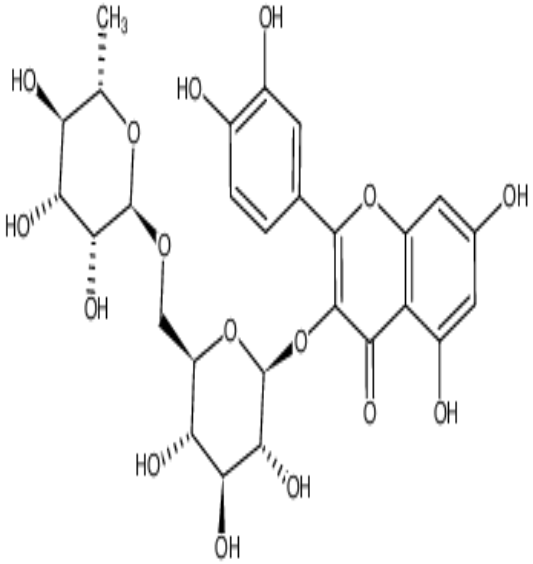
Kaempferol was isolated and identified from the flowers of *C. ternatea* and various phytochemicals also detected in this plant such as kaempferol, kaempferol-3-neohesperidoside, kaempferol-3-rutinoside, kaempferol-3-glucoside, quercetin, Quercetin-3-neohesperidoside, Quercetin-3-rutinoside, Quercetin-3-glucoside, myricetin-3-neohesperidoside, myricetin-3-rutinoside and myricetin-3-glucoside (Gupta G K et al.,2010, Pendbhaje N S et al., 2011).



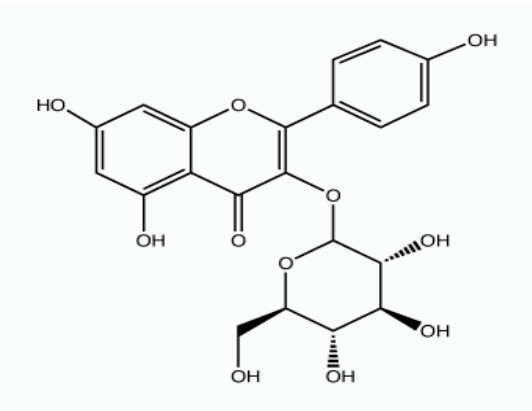
Kaempferol-3-neohesperidoside



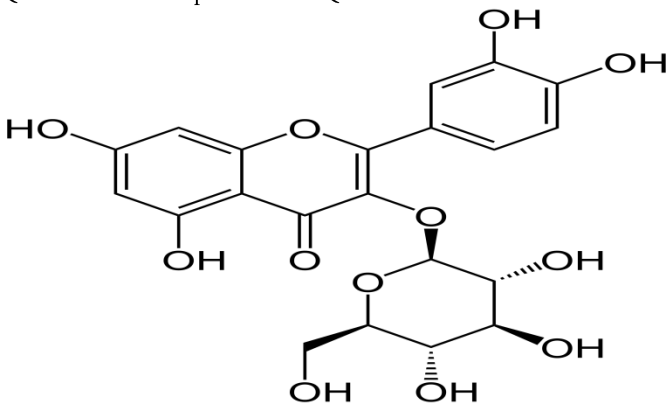
Kaempferol-3-rutinoside

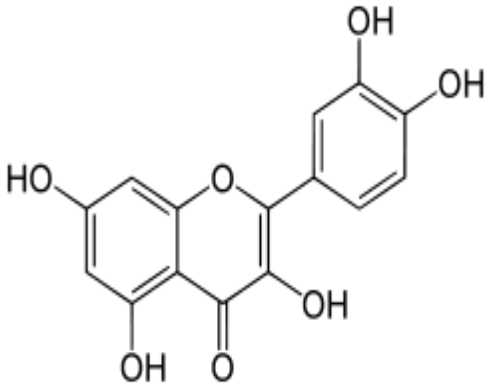


Quercetin-3-neohesperidoside

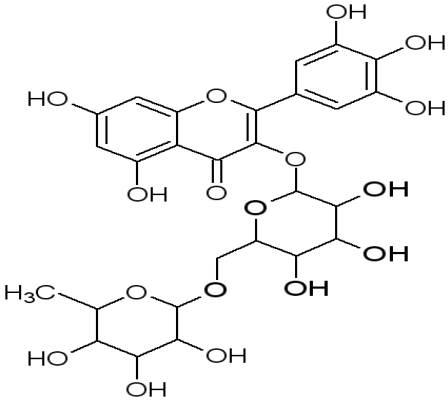


Quercetin-3-rutinoside



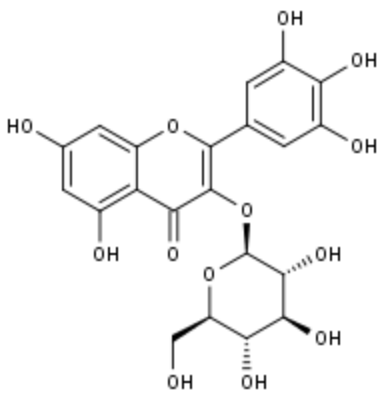


Kaempferol-3-glucoside



Quercetin

Quercetin-3-glucoside Myricetin-3-neohesperidoside

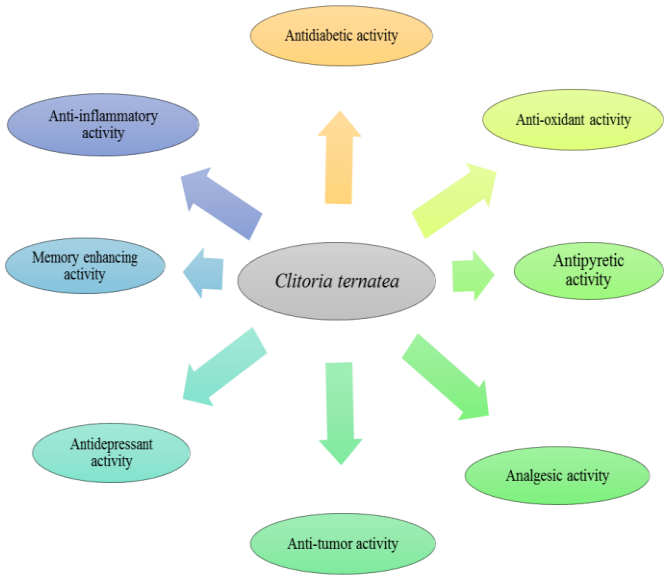


Myricetin-3-glucoside

Pharmacological activity:

Clitoria ternatea Linn root possesses significant antidiabetic activity, anti-oxidant activities, anti-inflammatory activity and neuroprotective activity has been proven by *Clitoria ternatea Linn.* extract in in-vitro study. Plant have been used for the treatment of diseases all over the world before the advent of modern clinical drugs and are known to contain substances that can be used for therapeutic purposes or as precursors for the synthesis of useful drugs .

Flow chart on pharmacological activity of *Clitoria ternatea*



Antidiabetic activity:

The insulin (short-acting soluble human insulin) at dose level of 4 IU/kg showed 80.98% reduction in plasma glucose after 24h (570.5 ±9.12 mg/dl at 0 h to 108.53 ±8.50 mg/dl; $p < 0.001$). *Clitoria ternatea* aqueous extract has reduced elevated blood glucose level to 66.0% dose level of 200 mg/kg, p.o. after 24 h (541.25±14.26 mg/dl at 0 h to 184.0 ±7.87 mg/dl; $p < 0.001$), while comparing with the blood glucose at 0 h. Oral administration of rutin also significantly reduced 50.19% blood glucose level after 24 h (528 ±10.61 mg/dl at 0 h to 263 ± 6.78 mg/dl; $p < 0.001$). The 66.0% reduction in blood glucose level exhibited by *Clitoria ternatea* aqueous extract at 200 mg/kg *p.o.* at 24 h seemed to distribute into chloroform and *n*-butanol soluble fractions in 55.23 and 46.14% respectively (Verma P R et al., 2013).

Anti-oxidant activity:

The methanol extract of *Clitoria ternatea* flower petal was found to demonstrate the most active free radical scavenging, followed by chloroform and petroleum ether extracts (Mukhopadhyay et al., 2012). *Clitoria ternatea* extract possesses antioxidant properties and could serve as free radical scavengers. It suggests that *Clitoria ternatea* extract under investigation can protect hemolysis, membrane lipid and protein oxidation of erythrocytes due to its scavenging activity against free radicals. Many epidemiological studies demonstrate that phytochemicals have been shown to possess significant antioxidant activity in various in vitro models (Malireddy et al., 2012). Oral administration of *Clitoria ternatea* extract in streptozotocin-induced diabetic rats has been shown to be effective in reducing lipid peroxidation and preventing cellular glutathione depletion in the brain tissue (Talpate et al., 2013).

Antipyretic activity:

Rats were divided into five groups and each group has six rats. A thermister probe was inserted 3–4 cm deep into the rectum and fastened to the tail by adhesive tape. The temperature was measured on a thermometer. The normal body temperature of each rat was measured at predetermined intervals and recorded. The rats were trained to remain quiet in a restraint cage. After measuring the basal rectal temperature, animals were given a subcutaneous injection of 10 ml/kg of 15% w/v yeast suspended in 0.5% w/v methylcellulose solution. Rats were then returned to their housing cages. After 19 h of yeast injection, the animals were treated with the test compound (methanol extract of *C. ternatea* roots), and their rectal temperatures recorded. The extract showed a significant antipyretic activity by causing a reduction in yeast-induced fever. (Parimaladevi et al, 2003.)

Analgesic activity:

Animals were divided into five groups containing six animals each. The first group was given Tween 80, the second and third group was given 200 and 400 mg/kg of the extract, respectively, and the fourth group was given aspirin 150 mg/kg. Immediately after administering acetic acid, the numbers of writhing were counted up to 15 min.

The methanol extract of *C. ternatea* roots markedly reduced the number of writhing at both tested doses by 50.1 and 63.8% compared to the reduction of 70.9% induced by 150 mg/kg of aspirin. (Parimaladevi et al, 2003.)

Anti-tumor activity:

The tumor volume, packed cell volume and viable cell count were found to be significantly increased and nonviable cell count was significantly low in DLA (Dalton's lymphoma) control animals when compared with normal control animals. Administration of methanol extract of *Clitoria ternatea* (MECT) at the dose of 100 and 200 mg/kg significantly decreased the tumor volume, packed cell volume and viable cell count. Non-viable cell count was higher in MECT treated animals when compared with DLA control animals. MECT has a remarkable capacity to inhibit the growth of solid tumor induced by DLA cell line in experimental animals (M.S. Latha et al., 2013).

Anti-depressant activity:

The extracts of *C. ternatea* significantly decreased the locomotor activity as shown by the results of the open field and hole cross tests. The locomotor activity lowering effect was evident at the observation at 30 min and continued up to observation period 120 min. Both hole cross and open field tests showed that the anti depressing activity of the extracts was evident against the test animals at the doses of 200 & 400 mg/kg body weight. Maximum depressant effect was observed from 60 min to 120 min observation period. From the result this is observed that, *Clitoria ternatea* has CNS depressant activity by using both open field & hole cross tests, which is comparable to the reference drug Diazepam at doses of 1 mg/kg. (Shammy Sarwar et al., 2014).

Memory enhancing activity:

The effect of *C. ternatea* aqueous root extract on learning and memory in rat pups (7 days old) was observed using open field behavior test, spontaneous alternation test, rewarded alternation test and passive avoidance test. The oral administration of *C. ternatea* roots extract at different doses significantly enhanced memory in rats (Rai et al., 2000a). *C. ternatea* aqueous root extract for learning and memory improvement using open field behavior test, passive avoidance test and, spatial learning test (T-maze test) in neonatal rat pups (7 days old). Neonatal rat pups were incubated during growth spurt period at the dose of 50 and 100mg/kg of aqueous root extract for 30 days (Rai et al., 2001).

Anti-inflammatory activity:

The *C. ternatea* extract reduced the intensity of peritoneal inflammation by 35.9 and 55.1% as observed in the reduction of Evan blue dye leakage induced by acetic acid in rats compared with that of diclofenac as the standard drug. A methanolic extract of *C. ternatea* roots was reported to have significant anti-inflammatory activity using carrageenin-induced rat paw oedema and acetic acid-induced vascular permeability models in rats (Parimaladevi et al., 2003).

Conclusion:

Based on the above findings it can be concluded that, *C. ternatea* plant has dual significance firstly, it's a promising future food and secondly it has some potentially active constituents for future pharmaceutical study. It is used in the treatment of a number of ailments including body-aches, infections, and urogenital disorder and psychotropic effect in Ayurveda system of medicine. The plant has been scientifically studied for various pharmacological activities including antioxidant, analgesic, antidepressant, hypoglycemic and found to possess all these properties. Thus as demonstrated by results *C. ternatea* need to be elaborated an extensive experimental studies to prove its potency in cure of various diseases.

References:

1. B. Parimala Devi, R. Boominathan, Subhash C. Mandal, 2003. Anti-inflammatory, analgesic and antipyretic properties of *Clitoria ternatea* root, Fitoterapia 74, 345–349.
2. Govindarajan, R., Vijayakumar, M., Pushpangadan, P., 2005. Antioxidant approach to disease management and the role of Rasayana herbs of Ayurveda. Journal of Ethnopharmacology 99, 165–178.
3. Gupta GK, Chahal J, Bhatia M., 2010. *Clitoria ternatea (L.)*: Old and new aspects. J Pharm Res ; 3: 2610-2614.
4. Lijy Jacob,M.S. Latha, 2013. Anticancer Activity of *Clitoria ternatea Linn.* Against Dalton's Lymphoma, International Journal of Pharmacognosy and Phytochemical Research 2012-13; 4(4); 207-212.
5. Malireddy S., Kotha S.R., Secor J.D., Gurney T.O., Abbott J.L., Maulik G., 2012. Phytochemical antioxidants modulate mammalian cellular epigenome: implications in health and disease. Antioxidants and Redox Signaling 17, 327–339.
6. Mukherjee, P.K., 2002. Quality Control of Herbal Drugs — An Approach to Evaluation of Botanicals. Business Horizons, New Delhi, India, pp. 604–608.
7. Mukherjee, P.K., Kumar, V., Mal, M., Houghton, P.J., 2007a. Acetyl cholinesterase inhibitors from plants. Phytomedicine 14, 289–300.
8. Mukhopadhyay R., Bhattacharya S., Biswas M., 2012. In vitro free radical scavenging activity of *Clitorea ternatea* leaf extracts. Journal of Advanced Pharmaceutical Research 2, 206–209.

9. Pendbhaje NS, Sudheendra G, Pathan SM, Musmade DS., 2011. Ethnopharmacology, pharmacogosy and phytochemical profile of *Clitorea ternatea Linn*: an overview. Pharmacologyonline 3: 166-175.
10. Rai K.S., Rao M.S., Karanth K.S., Murthy K.D., 2000a. *Clitoria ternatea* enhances learning and memory — an experimental study on rats. International Congress on Frontiers in Pharmacology and Therapeutics in 21st Century, vol. 32, New Delhi, India, Abstracts. Indian Journal of Pharmacology, 150.
11. Rai K.S., Murthy K.D., Karanth K.S., Rao M.S., 2001. *Clitoria ternatea* Linn. root extract treatment during growth spurt period enhances learning and memory in rats. Indian Journal of Physiology and Pharmacology 45, 305–313.
12. Shammy Sarwar, Md. Rashidur Rahman, Kamrun Nahar, Muhammad Ashikur Rahman., 2014.Analgesic and Neuropharmacological Activities of Methanolic Leaf Extract of *Clitoria ternatea Linn.* Journal of Pharmacognosy and Phytochemistry ; 2 (5): 110-114.
13. Talpate, K.A., Bhosale, U.A., Zambare, M.R., Somani, R., 2013. Antihyperglycemic and antioxidant activity of Clitorea ternatea Linn. on streptozotocin-induced diabetic rats. Ayu 34, 433–439.
14. Verma P. R., Itankar P. R., Arora S.K., 2013. Evaluation of antidiabetic antihyperlipidemic and pancreatic regeneration, potential of aerial parts of *Clitoria ternatea*, Rev Bras Farmacogn 23: 819-829.

Cite this article as:

Mukesh Kumar Yadav, Santosh Kumar Singh, J S Tripathi. Ethnopharmacological activity of *Clitoria ternatea* with special reference to Neuroprotective and Antidiabetic effect. Asian Journal of Complementary and Alternative Medicine, 03(09), 2015, 14-18.