IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
e ISSN-0976-593X Volume **10** | Issue 2 | July, 2015 | 158-162
DOI: 10.15740/HAS/IJPS/10.2/158-162
Visit us - *www.researchjournal.co.in*

A REVIEW

Immunomodulatory and antioxidative properties of *Clitoria ternatea*

■ **SNEHA KSHIRSAGAR, ANUP SINGH THAKUR AND JYOSTANA KSHIRSAGAR**

SUMMARY

The immune system is a remarkably versatile defense system that has evolved to protect animals from invading pathogenic micro-organisms and to eliminate disease. Immunostimulation is required when host defense mechanism has to be activated under the conditions of impaired immune response or when a selective immunosuppression is desired in situations like autoimmune disorders. ROS is also involved to regulate immune system and significantly affect immunomodulation. Allophatic drugs as immunomodulators show various side effects but situation is differ for medicinal immunmodulators. *Clitoria ternatea*, vigorous, strongly persistent, herbaceous perennial legume, show significant immunomodulatory activity and antioxidative properties and can be used commercial with no side effect to replace Allophatic drugs.

Key Words : *Immunomodulatory, Antioxidative, Clitoria ternatea*

How to cite this article : Kshirsagar, Sneha, Thakur, Anup Singh and Kshirsagar, Jyostana (2015). Immunomodulatory and antioxidative properties of *Clitoria ternatea*. *Internat. J. Plant Sci.,* **10** (2): 158-162.

Article chronicle : Received : 10.02.2015; **Accepted :** 28.06.2015

The immune system is a remarkably versatile defense system that has evolved to protect animals from invading pathogenic micro-organisms and to eliminate disease. It is able to generate an enormous variety of cells and molecules capable of specifically recognizing and eliminating an apparently limitless variety of foreign invaders (Diallo *et al.*, 1999). It provides a sensitive indicator of overall animal health and can quickly respond against different environmental exposures. Immunostimulation is required when host defense mechanism has to be activated under the conditions of impaired immune response or when a selective immunosuppression is desired in situations like autoimmune disorders. Immune system is vulnerable to the free radical-induced oxidative stress. The cellular and humoral components of the immune system are particularly sensitive to increased levels of reactive oxygen species, which may cause premature immune-senescence (Joharapurkar *et al.*, 2004). It is essential to counteract this oxidative stress and there by enhance the immunity of body system.

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
ANUP SINGH THAKUR, S.P. College of Agricultural Biotechnology, Kharawate Dahiwali, Chiplun, RATNAGIRI (M.S.) INDIA

Address of the Co-authors:
SNEHA KSHIRSAGAR, Regional Agricultural Rice Research Station, Karjat, RAIGAD (M.S.) INDIA

JYOSTANA KSHIRSAGAR, College of Agriculture, Sangulwadi, Vaibhavwadi, SINDHUDURG (M.S.) INDIA

One link between ROS and immune system is a phenomenon known as respiratory burst. This is a process where phagocytic immune cells, such as neutrophils or macrophages, generate potent oxidant bactericidal agents, hypochlorous acid, $O_2^{-\cdot}$, H_2O_2 and OH^- to kill or destroy foreign molecules (Knight, 2000). Macrophages also release ROS as signaling messengers to other immune cells (Knight, 2000). It is possible that enhanced levels of ROS can lead to immune cell deregulation and result in apoptosis. Furthermore, Kobayashi *et al*. (1995) has proposed B-cells, and possibly NK cells and peripheral T cells, contain a superoxide generating system identical to that in phagocytes. Although the rate of O_2^- generation is much lower than in phagocytic cells, the capability is present for these immune cells to generate ROS. Reports have indicated that certain chemical exposures can result in the alteration of secondary messengers, such as free radicals or ROS, and these alterations have been linked to the induction of apoptosis in immune cells (Kobayashi *et al*., 1995). Free radicals influence gene expression, regulate cellular responses to cytokines, as well as proliferative events of a cell.

During the past decade, traditional systems of medicine have become increasingly important in view of their safety. Current estimates suggest that, in many developing countries, a large proportion of the population relies heavily on traditional practitioners and medicinal plants to meet primary health care needs. Although modern medicine may be available in these countries, herbal medicines (phyto-medicines) have often maintained popularity for historical and cultural reasons (Mecdad *et al.,* 2011).

Clitoria ternatea, common names including butterfly-pea, blue-pea, and cordofan-pea, is a plant species belonging to the Fabaceae family. Origin and geographic distribution *Clitoria ternatea* is pantropical (20 -N-24 -S). Its true origin is obscured by extensive cultivation or naturalization in the humid lowland tropics of Asia, Africa, the Pacific Islands, and the Americas (Staples, 2000). *Clitoria ternatea* white-flower and blue flower varieties (Anonymous, 2001) found in Indo-China, Philippines and Madagascar, since the flowers of the plant resemble a conch shell; it is commonly called "Shankpushpi" (Kulkarni *et al*., 1988).

Medicinally important phyto-constituents :

Concentration of primary metabolites of *Clitoria ternatea* as root contain sugar 102±0.59 milligram per gram dry weight, starch 42±0.35 milligram per gram dry weight, protein 21±0.49 milligram per gram dry weight, phenol 43±0.13 milligram per gram dry weight and protein 41±0.14 milligram per gram dry weight. Its stem contain sugar 112±0.30 milligram per gram dry weight, starch 53±0.47 milligram per gram dry weight, protein 39±0.13 milligram per gram dry weight, phenol 37±0.56 milligram per gram dry weight, and protein 18±0.35 milligram per gram dry weight while leaf contain sugar 120±0.35 milligram per gram dry weight, starch 26±0.40 milligram per gram dry weight, protein 58±0.48 milligram per gram dry weight, phenol 18±0.35 milligram per gram dry weight, and protein 16±0.40 milligram per gram dry weight (Shekhawat and Vijayvergia, 2010).

Ethanol extract of *Clitoria ternatea* showed presence of terpenoid, flavonoid, tannin and steroid which may act as antioxidant principals (Rai Kiranmai, 2010). The major phytoconstituents found in *Clitoria ternatea* are the pentacyclic triterpenoids such as taraxerol and taraxerone. Phytochemical screening of the roots showed presence of ternatins, alkaloids, flavonoids, saponins, tannins, carbohydrates, proteins, resins, starch, taraxerol and taraxerone (Trease and Evans, 1983). Leaves contain 3 monoglucoside, 3-rutinoside, 3-neohisperidoside, 3- o- rhamnosyl Glycoside, kaempferol- 3- o-rhamnosyl, aparajitin, beta-sitosterol, and essential oil. Flower contains delphinidin-3, 5-diglucoside, delphinidin-3ß- glucoside, and malvidin- 3ß - glucoside, kaemphferol, p-coumaric acid Rootcontains ß- carotene, stigmast- 4- ene- 3, 6, diene, taraxerol and teraxerone, starch, tannins and resins (Anonymous, 2005).

Therapeutic value :

Clitoria ternatea L. (Family: Fabaceae) a perennial twinge herb. The roots have a sharp bitter taste and have cooling, laxative, diuretic, anti-helmintic, anti-inflammatory properties; they are useful in severe bronchitis, asthma and hectic fever. The fatty acid content of *C. ternatea* seeds includes palmitic, stearic, oleic, linoleic, and linolenic acids (Debnath and Chakravarti, 1975; Husain and Devi, 1998; Joshi *et al.*, 1981). The seeds also contain water-soluble mucilage, delphinidin 3, 3', 5'-triglucoside useful as a food dye (Macedo and Xavier-Filho, 1992) beta-sitosterol (Sinha, 1960). *C. ternatea* possesses number of pharmacological activities such as nootropic, anxiolytic, antidepressant, anticonvulsant (Jain *et al.,* 2003), sedative (Kulkarni *et*

al., 1988), antipyretic, anti-inflamatory and analgesic activities (Parimaladevi *et al.,* 2003). It enhances the memory and increases acetylcholine content and acetyl cholinesterase activity in rats (Rai *et al.,* 2001; Rai *et al.,* 2002). The study for evaluation of ethanol extract of *Clitoria ternatea* root on clonidine and haloperidol showed induction of catalepsy in mice. Chauhan *et al.* (2012) showed that the oral administration of ethanolic extract of *Clitoria ternatea* of dose 30mg/kg of rat failed to show any significant effect in both animal models of anxiety.

Clitoria ternatea is reported to be a good "Medhya" (toning the brain) drug mainly used in the treatment of "Masasika" roga (mental illness), but it is also said to be useful in hectic fever, severe bronchitis, asthma and remedy for snakebite (Chopra *et al.,* 1982). The root with a few tortuous branches, cylindrical, 1-5mm in thickness, a few places show cracks due to presence of lenticels, colour light brown, fracture fibrous, taste bitter.

Immunomodulation effect :

Clitoria ternatea seed and root alcoholic extracts showed profound immunosupressive activity in male albino rat model. The antioxidant and anti-inflammatory activities of plant may be playing major role in immuno-inhibition. The immunomodulatory activity might be attributed to the presence of flavonoid and phenolic compounds (Daisy *et al.,* 2004).

In the study immunostimulatory activities of aqueous extracts of *Clitoria ternatea* leaf and flower were evaluated by oral administration of aqueous extract of *Clitoria ternatea* to alloxan-induced diabetic rats for duration of 60 days which significantly decreased the serum glucose and cholesterol levels. The total white blood cells, red blood cells, T-lymphocytes and B-lymphocytes were significantly increased in treated animals, while monocytes and eosinophils showed an opposite trend. These results further indicated that these plant extracts have immunomodulatory effects that strengthen the immune system (Daisy *et al.,* 2004).

Anthocyanin ternatin D1 isolated from petals of *C. ternatea* showed *in vitro* platelets aggregation inhibitory activity in rabbits. It is due to significant inhibition of collagen and ADP-induced aggregation of platelets (Honda *et al.,* 1991).

Antioxidative properties :

Oxidative stress is among the major causative factor of many chronic and degenerative diseases (Vadlapudi, 2010). In concern to anti-oxidative studies, CT petals have been recognized to possess anti-oxidant activity (Kankonen *et al.,* 1999; Shan, 2005; Hinneburg *et al.,* 2006). Extracts of *Clitoria ternatea* flowers are used in Thailand as a component of cosmetics and the chemical composition of the flowers suggested that these may have anti-oxidant activity. Aqueous extracts were shown to have stronger anti-oxidant activity than ethanol extracts (Kamkaen and Wilkinson, 2009). The antioxidant potential of aqueous leaf extracts of *Clitoria ternatea* were evaluated by determining the levels of enzymatic and non-enzymatic antioxidants. *In vitro* antioxidant capacity was also determined using different assays such as Ferric reducing power assay (FRAP), Reducing activity assay, diphenypicrylhydrazyl (DPPH) assay and hydroxyl radical scavenging activity. The results were found to be comparable with standard antioxidants such as butylated hydroxyl toluene (BHT), ascorbic acid and rutin. This study showed that CT has significant antioxidative properties (Rao *et al.,* 2009).

Several workers reported its medicinal value such as anti-imflammatory (Parimaladevi *et al.,* 2003), anti-oxidant (Chauhan *et al*., 2012), immunomodulatory, hypoprotective (Solanki and Jain, 2011). It has more than 130 mg of GAE/g of phenols content. It has high anti-oxidative properties as it have 90 per cent scavenging effect in DPPH assay and >1000 µmol/g FRAP value (Kruawan and Kangsadalampai, 2006). It has purgative, diuretic, laxative properties (Chauhan *et al*., 2012).

Ramaswamy *et al.* (2011) showed that *Clitoria ternatea* demonstrated dose dependant increase in the percentage antioxidant activity for all concentrations tested. The extract at a concentration of 5µg/ml showed a percentage inhibition of 18.96±2.02 and for 250 µg/ml it was 89.0±1.64.

REFERENCES

Anonymous (2001). *The wealth of India-A dictionary of Indian raw materials and industrial products,* Vol 2: Cl-Cy, Council of Scientific and Industrial Research, New Delhi, pp. 71-73.

Anonymous (2005). *Wealth of India,* Vol. II, New Delhi: Council of Scientific and Industrial Research pp. 233-234.

Anonymous (2009). (Fabaceae) in alloxan-induced diabetes in Rats. *Tropical J. Pharmac. Res.,* **8**(5): 393-398.

Chauhan, N., Rajvaidhya, S. and Dubey, B.K. (2012). Pharmacognostical, phytochemical and pharmacological review on *Clitoria ternatea* for antiasthmatic activity. *IJPSR*, **3**(2) : 398-404.

Chopra, R.N., Chopra, I.C., Handa, K.L. and Kapur, L.D. (1982). *Indigenous drugs of India*. Academic Publishers, Calcutta, India, 476 pp.

Daisy, P., Priya, N.N. and Rajathi, M. (2004a). Immunomodulatory activity of *Eugenia jambolana*, *Clitoria ternatea* and *Phyllanthus emblica* on alloxan-induced diabetic rats. *J. Experimental Zoology*, India, **7** (2) : 269-278.

Debnath, N.B. and Chakravarti, D. (1975). Fatty acids of *Clitoria ternatea* seed oils. *J. Institution Chemists* India, **47** : 253-255.

Diallo, D., Hveem, B., Mahmoud, M.A., Betge, G., Paulsen, B.S. and Maiga, A. (1999). An ethnobotanical survey of herbal drugs of Gourma district, Mali. *Pharma. Biol.,* **37** : 80-91.

Hinneburg, I., Dorman, H.J.D. and Hiltunen, R. (2006). Antioxidant activities of extracts from selected culinary herbs and species. *Food Chem.*, **97**(1): 122-129.

Honda, T., Saito, N., Kusano, T., Ishisone, H., Funayama, N., Kubota, T. and Araogi, S. (1991). Isolation of anthocyanins (Ternatin A1, A2, B1, B2, D1 and D2) from *Clitoria ternatea cv.* (DOUBLE BLUE) having blood platelet aggregation-inhibiting and vascular smooth muscle relaxing activities. *Japan Kokai Tokyo Koho,* 7.

Husain, S. and Devi, K.S. (1998). Fatty acid composition of three plant species: *Cliitorea ternatea*, *Mandulea suberosa* and *Ruta chalapensis*. *J. Oil Technologists Assoc. India*, **30** : 162-164.

Jain, N.N., Ohal, C.C. and Shroff, S.K. (2003). *Clitoria ternatea* and the CNS. *Pharmac. Biochem. Behav*., **75** (3) : 529-536.

Joharapurkar, A.A., Wanjari, M.M., Dixit, P.V. and Zambad, S.P. (2004). Pyrogallol; A novel tool for screening immunomodulators. *Indian. J. Pharmaco.*, **36** (6) : 355-359.

Joshi, S.S., Shrivastava, R.K. and Shrivastava, D.K. (1981). Chemical examination of *Clitoria ternatea* seeds. *J. American Oil & Chemical Soc.*, **58** (6) : 714-715.

Kamkaen, N. and Wilkinson, J.M. (2009). The antioxidant activity of *Clitoria ternatea* flower petal extracts and eye gel. *Phytotherapy Res.*, **23**(11) : 1624-1625.

Kankonen, M.P., Hopia, A.I., Vuorela, H.J., Rauha, J.P., Pihlaja, K., Kujala, T.S. and Heinonen, M. (1999). Antioxidant activity of plant extracts containing phenolic compounds. *J. Agril. & Food Chem.*, **47**(10): 3954-3962.

Knight, J.A. (2000). Review: Free radicals, antioxidants, and the immune system. *Ann. Clin. Lab Sci. Spring,* **30**(2) : 145-158.

Kobayashi, T., Vieira, W.D., Potterf, S.B., Sakai, C., Imokawa, G. and Hearing, V.J. (1995). Modulation of melanogenic protein expression during the switch from euto pheomelanogenesis. *J. Cell. Sci.,* **108** (Pt 6) : 2301-2309.

Kruawan, K. and Kangsadalampai, K. (2006). Antioxidant activity, phenolic compound contents and antimutagenic activity of some water extract of herbs Thai. *J. Pharm. Sci.,* **30** : 28-35.

Kulkarni, C., Pattanshetty, J.R. and Amruthraj, G. (1988). Effects of alcoholic extracts of *Clitoria ternatea* Linn on centralnervous system in rodents. *Indian J. Exp. Biol.,* **26** (12) : 957-960.

Macedo, M.L.R. and Xavier-Filho, J. (1992). Purification and partial characterization of trypsin inhibitors from seeds of *Clitoria ternatea*. *J. Sci. Food & Agric.,* **58** (1) : 55-58.

Mecdad, A.A., Ahmed, M.H., Manal, E.A., ElHalwagy, Mostafa, M.M. and Afify (2011). Study on oxidative stress biomarkers and immunomodulatory effects of pesticides in pesticide-sprayers. *Egyptian J. Forensic Sci.,* **1** (2) : 93-98.

Parimala Devi, B., Boominathan, R. and Mandal, S.C. (2003). Anti-inflammatory, analgesic and antipyretic properties of *Clitoria ternatea* root. *Fitoterapia,* **74** (4) : 345-349.

Rai Kiranmai, S. (2010). Neurogenic potential of *Clitoria ternatea* aqueous root extract–A basis for enhancing learning and memory, *World Acad. Sci., Engg. & Technol.,* **70** : 237-240.

Rai, K.S., Murthy, K.D. and Karanth, K.S. (2001). *Clitoria ternatea* Linn root extract treatment during growth spurt period enhances learning andmemory in rats. *Indian J Physiol. Pharmac*., **45** (3) : 305-313.

Rai, K.S., Murthy, K.D. and Karanth, K.S. (2002). *Clitoria ternatea* root extract enhances acetylcholine content in rat hippocampus. *Fitoterapia*, **73** (7-8) : 685-689.

Ramaswamy, K.S., Palmer, M.L., Van der Meulen J.H., Renoux, A., Kostrominova, T.Y., Michele, D.E. and Faulkner, J.A. (2011). Lateral transmission of force is impaired in skeletal muscles of dystrophic mice and very old rats. *J. Physiol.,* **589** (Pt 5) : 1195-1208.

Rao, D.B., Kiran, C.R., Madhavi, Y., Rao, P.K. and Rao, T.R. (2009). Evaluation of antioxidant potential of a *Clitoria ternatea* L. and *Eclipta prostrate* L. Indian *J. Biochem. & Biophys.*, **46** : 247-252.

Shan, B., Cai, Y.Z., Sun, M. and Corke, H. (2005). Antioxidant capacity of 26 spice extracts and characterization of their phenolic constituents. *J. Agril. & Food Chem.*, **53**(20) : 7749-7759.

Shekhawat, Neha and Vijayvergia, Rekha (2010). Comparative study of primary metabolites in different plant parts of *Clitoria ternatea* L., *Guazuma ulmifolia* Lam. and *Madhuca indica* Gmel. *J. Chem. Pharm.*, **2**(2) : 168-171.

Sinha, A. (1960). β-Sitosterol from the seeds of *Clitoria ternatea*. *Curr. Sci.*, **29** : 180- 181.

Solanki, Y.B., and Jain S.M. (2011). Hepato-protective effects of *Clitoria ternatea* and *Vigna mungo* against acetaminophen and carbon tetrachloride-induced hepatotoxicity in rats. *J. Pharmacol. & Toxicol.*, **6** (1) : 30-48.

Trease, G.E. and Evans, W.C. (1983). *Textbook of Pharmacognosy*. (12th Ed.). Balliese Tindall and Company Publisher, London. pp. 343-383.

Vadlapudi, V. and Naidu, K.C. (2010). *In vitro* bioautography of different Indian medicinal plants. *Drug Invention Today*, **2**(1) : 53-56.