IJPSR (2012), Vol. 3, Issue 02 **(Review Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 01 October, 2011; received in revised form 08 January, 2012; accepted 22 January, 2012

PHARMACOGNOSTICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW ON *CLITORIA TERNATEA* FOR ANTIASTHMATIC ACTIVITY

Neelmani Chauhan*, Sourabh Rajvaidhya and B. K. Dubey

Department of Pharmacognosy, T.I.T. College of Pharmacy, Bhopal- 462 021, Madhya Pradesh, India

Keywords:
Clitoria ternatea,
Leguminoseae,
Hemicrania
Helminthiasis
Pitta vicerormegaly

Correspondence to Author:

Neelmani Chauhan

Department of Pharmacognosy, T.I.T. College of Pharmacy, Anand Nagar, Bhopal- 462 021, Madhya Pradesh, India

ABSTRACT

In recent times, focus on plant research has increased all over the world and a large body of evidence has collected to show immense potential of medicinal plants used in various traditional systems. Use of plant based drugs and chemicals for curing various ailments and personal adornment is as old as human civilization *Clitoria ternatea* is used for curing various diseases and symptoms. *Clitoria ternatea* is diuretic and laxative, a decoction is given as a demulcent in the irritation of the bladder and urethra. It is useful in ophthalmopathy, bronchitis, asthma tubercular glands, hemicrania, burning sensation, starngury, helminthiasis, inflammation, vitiated condition of pitta vicerormegaly and fever.

INTRODUCTION: *Clitoria ternatea* (Family- Leguminoceae, previously known as Papillioneceae), a perennial twining herb, stems terete, more or less pubscent. Leaves imperipinnate, petioles 2-2.5 cm long; stipules 4 mm long, linear, acute. Leaflets 5-7, subcoriaceous, 2.5-5 by 2-3.2 cm, elliptic-oblong, obtuse or caute; stipules filiform. Flowers- axillary, solitary, standard bright or blue or sometimes white, with an orange centre; seed- 6-10, yellowish brown, smooth. Two types- white variety and blue flowered variety; widely distributed throughout Bangladesh, used as ornamental plant [1].

Distribution: Originated from tropical Asia and later was distributed widely in South and Central America, East and West Indies, China and India, where it has become naturalized. Native to the island of Ternate in the *Molluca archipelago*, this species is now widely grown as ornamental, fodder or medicinal plant. It is found commonly as an escape in hedges and thickets throughout India to an altitude of 15cm and in 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. The plant is also suitable as a green manure and cover crop. Besides suppressing many perennial weeds, it enriches the soil by fixing nitrogen [8]. *Clitoria ternatea* is now widely distributed throughout the humid, low land tropics, occurring both naturally and in cultivations [1].

Clitoria ternatea is now widely distributed throughout the humid, lowland tropics occurring both naturally and in cultivations [1]

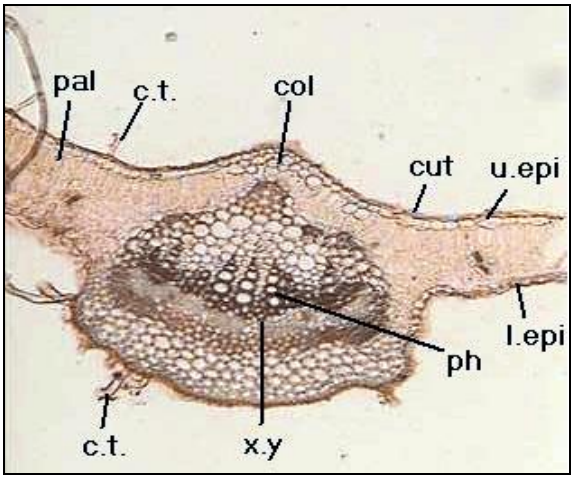
Cultivation: *Clitoria ternatea* is a deep-rooted, tall slender, climbing legume with five leaflets and a deep blue flower. It is well adapted to a variety of soil types (pH 5.5-8.9) including calcareous soils. It is surviving in both the extended rainfall regions and prolonged periods of drought. Propagation is done through seed. It exhibits excellent re-growth after cutting or grazing within short period and produce high yields also [6]. *Clitoria ternatea L.* is well adapted to heavy cracking clay soils in northern Australia [8].

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 [1].

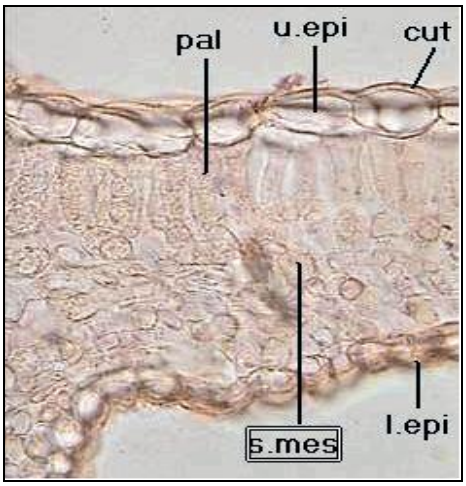
Morphological Description: *Clitoria ternatea* has twining fine stems, 0.5-3 m long. The leaves are pinnate, with 5-7 elliptic to lanceolate leaflets, 3-5 cm long and shortly pubescent underneath. Flowers are solitary, deep blue to blue mauve; very short pedicellate and 4-5 cm long. Pods are flat, linear, beaked, 6-12 cm long, 0.7-1.2 mm wide and slightly pubescent with upto 10 seeds. The seeds are olive, brown or black in color, often mottled, 4.5-7 mm long and 3-4 mm wide [9]. 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 [18, 19]. Cortex is composed of 10- 12 layers of thin-walled almost polygonal or tangentially elongated cells, packed with mostly compound starch grains. [18, 20] All the ray cells are fully packed with starch grains and few contain calcium oxalate crystals [1].

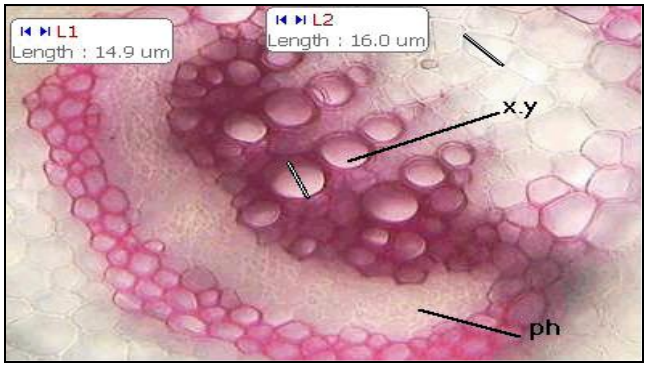
Microscopic Characters: Root - Shows 10-20 or more layers of rectangular, thin-walled, tangentially elongated exfoliating cork cells; secondary cortex consists of 10-12 rows of large, polygonal, thin walled cells filled with starch grains, a few cells contain prismatic crystals of calcium oxalate in this region; single or groups of 2-10 lignified cortical fibers, distributed in the lower half of the cortex; secondary phloem consists of usual elements; phloem fibers 2-8 in groups, a few solitary fibers also present, very long, thin-walled with narrow lumen and pointed tips; secondary xylem consists of usual elements; vessels pitted with oblong, bordered pits and have short conical tail at one end, mostly occur 2 or 3 in groups; 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 compound having 2-6 components, single grains measuring 3-13 µ in dia., found in secondary cortex, phloem and xylem parenchyma. Powder - Yellowish-brown; shows simple and compound starch grains, measuring 3-13µ in dia., vessels with oblong bordered pits and fragments of fibers [7].



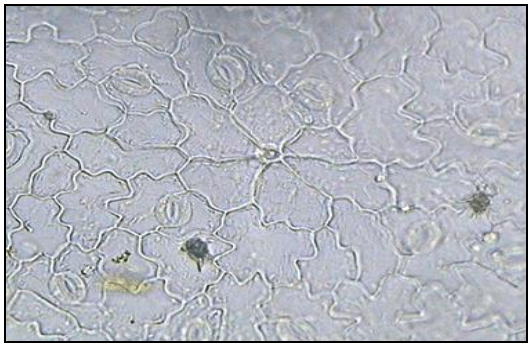
TRANSVERSE SECTION OF *CLITORIA TERNATEA* LEAVES
(Pal.-Palisade, **c.t**. - Covering trichome, **cut**- cuticle, **u, epi**- upper epidermis, **l.epi**- lower epidermis, **s.mes-** spongy mesophyll)



TRANSVERSE SECTION OF *CLITORIA TERNATEA* LEAVES THOUGH LAMINA

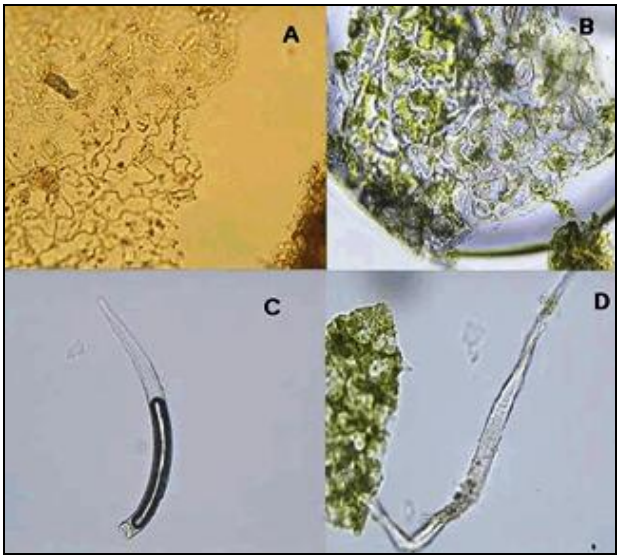


TRANSVERSE SECTION OF *CLITORIA TERNATEA* LEAVES SHOWING VASCULAR BUNDLE
(x.y. - xylem, **ph**- phloem **cr. -** crystal, **col-** collenchymas, **l.epi-** lower epidermis)



STOMATA OF *CLITORIA TERNATEA* LEAVES

Powder Characters: The powder is green in color and contains paracytic stomata, covering trichomes, fibers, wavy epidermal cells, covering trichomes and presence of starch grain in epidermal cell [3].



Identity, Purity and Strength [7]:

- Foreign matter- Not more than 2 per cent
- Total Ash - Not more than 5 per cent
- Acid-insoluble ash - Not more than 2 per cent
- Alcohol-soluble extractive - Not less than 5 per cent
- Water-soluble extractive - Not less than 8 per cent

Phytoconstituents:
Primary metabolites:

	Root	Stem	Leaf
Sugar	102±0.59	112±0.30	120±0.35
Starch	42±0.35	53±0.47	26±0.40
Protein	21±0.49	39±0.13	58±0.48
Phenol	43±0.13	37±0.56	18±0.35
Lipid	41±0.14	18±0.35	16±0.40

Chemical constituent: Ethanol extract of *Clitoria ternatea* shows presence of terpenoid, flavonoid, tannin and steroid which may act as antioxidant principal [18]. The major phytoconstituents found in *Clitoria ternatea* are the pentacyclic triterpenoids such as taraxerol and taraxerone. Phytochemical screening of the roots shows the presence of ternatins, alkaloids, flavonoids, saponins, tannins, carbohydrates, proteins, resins, starch, taraxerol and taraxerone [3].

A wide range of secondary metabolites including triterpenoids, flavones glycosides, anthocyanins and steroids has been isolated from *Clitoria ternatea* Linn. Four kaempferol glycosides I, II, III and IV were isolated from the leaves of *Clitoria ternatea* L. Kaempferol-3-glucoside (I), kaempferol- 3- rutinoside (II) and kaempferol-3- neohesperidoside (III) were identified by Ultra Violet, Protein Magnetic Resonance and Mass Spectrometry. (IV), C33H40O19, mp: 198, was characterized as Kaempferol-3- orhamnosyl glucoside from spectral data and was named clitorin [1].

The seeds contain nucleoprotein with its amino-acid sequence similar to insulin, delphinidin-3,3,5-triglucoside, essential amino-acids, pentosan, watersoluble mucilage, adenosine, an anthoxanthin glucoside, greenish yellow fixed oil, a phenol glycoside, 3, 5, 7, 4-tetrahydroxy-flavone-3-rhamoglycoside, an alkaloid, ethyl D-galactopyranoside, p-hydroxycinnamic acid polypeptide, a highly basic protein-finotin, a bitter acid resin, tannic acid, 6% ash and a toxic alkaloid [8, 28]. Seeds contain sitosterol, ß-sitosterol, and hexacosanol and anthocyanin glucoside.

It also contains anti-fungal proteins and has been shown to be homologous to plant defensins.Aabgeena *et al.* reported a lectin present in the seeds of *Clitoria ternatea* agglutinated trypsin-treated human B erythrocytes. Since the purified lectin was found to be potential tool for cancer studies so an attempt was made for the alternate high yielding purification method for *Clitoria ternatea* lectin designated CTL, present in the seeds of this member of leguminosae family.

Another study demonstrated that minor delphinidin glycosides, eight anthocyanins (ternatins C1, C2, C3, C4, C5 and D3 and preternatins A3 and C4) were isolated from the young *Clitoria ternatea* flowers.

Recent study showed that malonylated flavonol glycosides were isolated from the petals of *Clitoria ternatea* with different petal colors using LC/MS/MS. It was also reported that five new anthocyanins, ternatins A3, B3, B4, B2 and D2 were isolated from *Clitoria ternatea* flowers [1]. Kaempferol-3-glucoside, kaempferol-3-robinobioside-7-rhamnoside, quercetin and quercetin 3-glucoside. Six ternatins A1, A2, B1, B2, D1 and D2 in *Clitoria ternatea* flowers were isolated by reversed phase High Performance Liquid Chromatography and their structures were partly characterized as highly acylated delphinidin derivatives. *Clitoria ternatea* was powdered and evaluated quantitatively for the analysis of total soluble sugars, protein, phenol, starch, carbohydrate and lipid [1].

Leaves: Leaves contain 3 monoglucoside, 3-rutinoside, 3-neohisperidoside, 3- o- rhamnosyl Glycoside, kaempferol- 3- o-rhamnosyl, aparajitin, beta-sitosterol, and essential oil [5].

Flower: Flower contains delphinidin-3, 5-diglucoside, delphinidin-3ß- glucoside, and malvidin- 3ß - glucoside, kaemphferol, p-coumaric acid [5].

Root: Contains ß- carotene, stigmast- 4- ene- 3, 6, diene, taraxerol & teraxerone, starch, tannins & resins [5].

Toxicity: Ethanol extract did not show any sign of toxicity upto 2000mg/kg dose [18].

Pharmacology:

Roots:

- The powder of its roots or seeds, combined with sunthi of fennel is recommended in ascites, with hot water. Being sharp in attribute, it breaks down the accumulations of dosas and malas [2].
- It works well as febrifuge especially in gout. In glandular swellings like cervical adenitis, the root powder or juice is valuable [2].
- The root bark is diuretic and laxative; a decoction is given as a demulcent in the irritation of the bladder and urethra [2, 9, 4].
- Root juice is given in cold milk to remove the phlegm in chronic bronchitis.
- The decoction of its roots alleviates the burning sensation in the vagina, effectively [4].
- In habitual abortion, the roots of white variety, mashed in milk are given orally to avert the abortion and stabilize the foetus [2].
- Used as general tonic for improving mental faculties, muscular strength, in epilepsy [2].
- Root juice is recommended in hemicranias [2].
- It has a sharp bitter taste and cooling, laxative, diuretic, antihelmintic, anti-inflammatory properties; they are useful in severe bronchitis, asthma and hectic fever [2, 6].
- The roots have a sharp bitter taste and cooling, laxative, diuretic, antihelmintic, anti-inflammatory properties; they are useful in severe bronchitis, asthma and hectic fever [2, 6].

Leaves:

- The juice of its leaves mitigates the toxins [2].
- The fresh leaves juice, combined with ginger juice, effectively controls the excessive sweating [2, 6].
- It is also used to promote the intellect (medhya) [2].
- The infusion of leaves is used for eruptions.
- The juice of the leaves mixed with common salt is applied warm all around the ear-aches, especially when combined with swelling of the neighboring glands [2, 6].

Seeds:

- Seeds roasted and powdered are given in doses of 30-60 grains in cases of ascites and enlargement of abdominal viscera, generally administered with one part of cream of tartar and one part of ginger to one part one *clitoria* seeds in doses of half-one drahm[6].
- Seeds are cathartic and the root diuretic [2].
- Seeds are purgative and aperients [2].
- Seeds are used in swollen joints, dropsy and enlargement of abdominal viscera [6].
- The roots, stem and flower are recommended for the treatment of snakebite and scorpion-sting [2, 6].
- They are also employed in sight weakness, sore throat, mucous disorders, in tumors, affection of skin and in dropsy [6].

Flower: Ethanol extract is used as antidiabetic [4].

Anxiolytic Activities: In study, the effect of alcoholic extract of aerial parts of *Clitoria ternatea* on spatial discrimination in rats followed by oral treatment with alcoholic extract at a dose of 460 mg/kg significantly prolonged the time taken to traverse the maze, which was equivalent to that produced by chlorpromazine [11].

The oral administration of CT (100-400mg/kg) dose dependently increased the time spent in the open arm; the time spent in the lit box and decreased the duration of time spent in the dark box. The oral administration of CT (30mg/kg) failed to show any significant effect in both animal models of anxiety. The animals treated with CT (100mg/kg) showed a significant increase in the inflexion ratio and discrimination index which providesevidence for the species nootropic activity [1].

Cns Depressant Activity Studies: The *Clitoria ternatea* extract was found to possess nootropic, anxiolytic, antidepressant and anti-stress activities [7]. The nootropic drugs facilitate intellectual performance, learning and memory [1, 27].

Anti-Stress Activities of *Clitoria ternatea*: The anti-stress activity of aerial parts was assessed using cold restraint stress (CRS) induced ulcers, lithium-induced head twitches, clonidine-induced hypothermia, sodium nitrite-induced respiratory arrest and haloperidol-induced catalepsy in rat and mice [1].

Effect of *Clitoria ternatea* on general behavior: Ethanol extract of the root of *Clitoria ternatea* shows significant neuropharmacological activity [1].

Immunomodulatory Effects: The plant extracts have immunomodulatory effects that strengthen the immune system [1].

Larvicidal Activities: The methanol extracts of *Clitoria ternatea* seed extract was effective against the larvae of all the three species with LC50 values 65.2, 154.5 and 54.4 ppm, respectively for *A.stephensi*, *A. aegypti* and *C. quinquefascitus*. CT was showing the most promising mosquito larvicidal activity [1].

Proteolytic Activities: The activities of endopeptidases (hemoglobin pH 3.5 and azocasein pH 6.0), carboxypeptidase benzyloxy carbonyl (CBZ-Phe-Ala Ph 5.2), and arylamidases lysophosphatidic acid and a-N-benzoyl-L-arginine P-nitro-analide (LPA 7.0 and BAPA 7.6) were assayed in extracts of cotyledons and axis of resting and germinating seeds of *Clitoria ternatea* but the endopeptidases at pH 3.5 and the arylamidase at 7.0 were high in cotyledons. The activities of carboxypeptidase and the arylamidase increased in cotyledons reaching a maximum at the day 9, while the endopeptidases showed an increase at the day 3 followed by a decrease. In the axial tissue the endopeptidases and carboxypeptidase activities showed an increase until the day 9 followed by a decrease and arylamidase were low. The increase of acidic endopeptidases and carboxypeptidase activities in germinating cotyledons is an indication of their participation in the degradation of the storage proteins [1].

Antihelmintic Activities: There are so many studies which have been reported on antihelmintic activity of *Clitoria ternatea*. It was indicated that crude alcoholic extract of CT and its ethyl acetate and methanol fractions significantly demonstrated paralysis and also caused death of worms especially at higher concentration of 50 mg/ml, as compared to standard reference piperazine citrate. Inhibitory effect of CT leaves on free-living nematodes was evaluated using aqueous and methanol extract. In another study, flowers, leaves, stems and roots of CT were evaluated for antihelmintic activity on adult Indian earthworms *Pheretima posthuma.* Methanol extract of root is most potent and required very less time to paralysis and death of worms as compared to other extracts. The potency increases from flowers, leaves, stems to roots [1, 20].

Diuretic Activity: The powdered form of dried whole root and ethanol extract were evaluated for diuretic activity and only single I.V. dose of extract produce moderate increase in urinary excretion of Na, K and decrease in Cl but no change in urine volume. Also, an appreciable effect was seen on oral dosing [1].

Anti-microbial Activities: The methanolic extracts of the leaves and root of *Clitoria ternatea* were tested for their antibacterial activity against different pathogenic drug resistant Gram-positive and Gram-negative clinical isolates and minimum inhibitory concentration

was determined by agar dilution technique followed by estimation of zone of inhibition against the selected strains by disc diffusion technique and comparison was done with reference to the standard antibiotic ciprofloxacin. The leaf was found to possess powerful antibacterial activity against *E. coli* and *V. cholera*, known for causing dysentery, and *S. aureus*, causative agent of fever. The leaf extract showed stronger antibacterial activity than root extract. Both extracts were shown to be bactericidal in their mode of action. Quercetin may contribute to the activity of leaf extract.

In another study, it was reported that crude extract from seeds of CT showed maximum zone of inhibition (22±0.5 mm) against *E. coli* at 0.75 mg concentration and minimum with *M. flavus* of (14±1 mm) and the callus extract showed maximum zones of inhibition (16±2mm) against *S. typhi* while the lowest with *E. coli* and *S. aureus* (12±1 mm and 12±0.9mm) respectively. Alcoholic and Aqueous extracts from in vitro raised calli were tested for antibacterial activity by agar well diffusion method against Gram-negative bacteria. Antibacterial activity was shown against *Salmonella* spp. and *Shigella dysenteriae*; organisms causing enteric fever. In addition, the methanol crude extracts showed anti-bacterial activity against *K. pneumonia* and *P. aeruginosa* [1].

Conclusion: *Clitoria ternatea* belonging to family Fabaceae is an indigenous herb which was chosen for further study of anti-asthmatic activity as folk claims shows that they posses treatment for chronic bronchitis and asthma. The scanty availability of information on this plant facilitates the study on it since ages various part of this part is being used for their medicinal use.

REFERENCES:

1. Gupta Girish Kumar, Chahal Jagbir, Bhatia Manisha, *Clitoria ternatea* (L.): Old and new aspects, Journal of Pharmacy Research, 2010, 3(11), 2610-2614
2. Kirtikar KR, Basu, BD. Indian Medicinal Plants; Publisher: Bishen Singh, Mahandra Pal Singh; Dehradun, India. 1980; 1: 802-803
3. Trease G.E. and Evans W.C., Pharmacognosy. 12th edition, Bailliere, Tindall, East Bourne., 1983, 17-32.
4. Orient Longman, 'Indian medicinal plants, vol 2, 129
5. Anonymous. The Wealth of India, Vol. II, New Delhi: Council of Scientific and Industrial Research: 2005, 233-234.
6. Nadkarni AK, Indian Materia Madica, 3rd ed, Vol-I, Popular Prakashan, Bombay, 1992, 354.
7. Taur D.J., Taware S.B., Patil R.N., Patil R.Y., Kharya M.D, Pharmacognostical and Preliminary Phytochemical Evaluation of *Clitoria ternatea* leaves, Pharmacognosy Journal,Vol 2, Issue 9, May, 2010 Page 260-265
8. Anonymous, the Ayurvedic Pharmacopoeia of India, Part-I, Vol. II. Controller of Publications, New Delhli, 1980, 10-11.
9. Babu Uma, Kesani Prabhakar, Sadayappan Rajendran, Phytochemical Analysis and antimicrobial activity of *Clitorea ternatea* linn. Against extended spectrum beta lactamase producing energic and urinary pathogens, Journal of Pharmaceutical and Clinical Research, Vol.2 Issue 4, October-December 2009, 94-96
10. Rajathi M, Daisy P., Hypoglycemic Effects of *Clitoria ternatea* Linn.
11. (Fabaceae) in Alloxan-induced Diabetes in Rats, Tropical Journal of Pharmaceutical Research, October 2009; 8 (5): 393-398
12. Rahman AKM Shahidur, Arslan Iqbal, Saha Rama, Talukder Nirupama, Khaleque Sma, Ali Husne Ara, Bioactivity guided cytotoxic activity of *Clitorea ternatea* utilizing brine shrimp letha liya bio assay, Bangladesh Journal of Physiology and Pharmacology,18-21.
13. Upwar Nitinkumar, Patel Roshan, Waseem Naheed, Mahobia NK, Evaluation of antidiarrhoeal activity of the root of *Clitorea ternatea* linn., International Journal of Pharmaceutical Sciences Review and Research,131-133.
14. Daisy P, Santosh Kanakappan, Rajathi M., Antihyperglycemic and antihyperlipidemic effects of *Clitoria ternatea* Linn. in alloxan-induced diabetic rats, African Journal of Microbiology Research, 287-291
15. Shekhawat Neha, Vijayvergia Rekha, Comparative study of primary metabolites in different plant parts of *Clitoria ternatea* (L.), *Guazuma ulmifolia* (Lam.) & *Madhuca indica* (Gmel., J. Chem. Pharm 2010, 2(2): 168-171
16. Pandeya Krishna, Tiwari Kavindra Nath, Singh Jayanti, Verma Jay Prakash, Dubey Satya Deo, In vitro propagation of *Clitoria ternatea* L.: A rare medicinal plant, Journal of Medicinal Plants Research Vol. 4(8), pp. 664-668, 18 April, 2010
17. Khelemu S., Cardona C. and Segura G., Antimicrobial and Anti Insectisidal properties of isolates seeds of tropical forage legume *Clitoria ternatea*, Centro Internacional De Agricultura Tropical (CIAT)
18. Rai Kiranmai S., Neurogenic Potential of Clitoria ternatea Aqueous Root Extract–A Basis for Enhancing Learning and Memory, World Academy of Science, Engineering and Technology 70 2010,237-240
19. R. Shanmugasundram., Velusamy Kalpana Devi, Pious Soris Tresina, Arumugam Maruthupandian, Veerabahu Ramasamy Mohan, hepatoprotective activity of ethanol extract of *Clitoria ternatea* L. and *Cassia angustofolia* vahl leafs against ccl4 induced liver toxicity in rats, International research journal of pharmacy, 2010, 201-205
20. Gupta Girish Kumar, Chahal Jagbir, Bhatia Manisha, *Clitoria ternatea* (L.): Old and new aspects, Journal of Pharmacy Research, 2010, 3(11), 2610-2614
21. Nahar Kamrun, Rahman Ashikur, Parvin Most. Nazma, Sarwar Shammy, Evaluation of Anthelmintic Activity of Aqueous Leaf Extract of *Clitoria ternatea* Linn. Stamford Journal of Pharmaceutical Sciences 46-48
22. Shekhawat Neha, Vijayvergia Rekha, Comparative study of primary metabolites in different plant parts of *Clitoria ternatea* (L.), *Guazuma ulmifolia* (Lam.) & *Madhuca indica* (Gmel., Journal of Chemical and Pharmaceutical Research2010, 2(2): 168-171

23. Jain Reshma A., Shukla Sangita H., Saluja Ajay K., In-Vitro Evaluation of *Clitoria Ternatea* Stem Extract for Antioxidant Property, IJPSR (2010), Vol. 1, Issue 12, 88-94
24. Subramanian M.S., Prathyusha P., Pharmaco-Phytochemical Characterization of *Clitoria ternatea* Linn. International Journal of PharmTech Research, Vol. 3, No.1, pp 606-612,
25. B. Shyam kumar. Bhat K.Ishwar, *In-Vitro* Cytotoxic Activity Studies of *Clitoria Ternatea* Linn Flower Extracts, International Journal of Pharmaceutical Sciences Review and Research, Volume 6, Issue 2, January – February 2011;120-121
26. Taur Dnyaneshwar J, Patil Ravindra Y, Antihistaminic activity of *Clitoria ternatea* L., Journal of Basic and Clinical Pharmacy,roots,41-43
27. Mukherjee Pulok K., Kumar Venkatesan, Kumar Satheesh, Heinrich Micheal, The Ayurvedic medicine Clitoria ternatea—From traditional use to scientific assessment , Journal of Ethnopharmacology,Volume 120, Issue 3, 8 December 2008, Pages 291-301
28. Selvamaleeswaran Ponnusamy, Wesely Ebenezer Gnanaraj, Johnson Marimuthu Antonisamy, Velusamy Selvakumar and Jeyakumar Nelson, The effect of leaves extracts of *Clitoria ternatea* Linn against the fish pathogens, Asian Pacific Journal of Tropical Medicine, Volume 3, Issue 9, September 2010, Pages 723-726
29. Kogawa Koichiro , Kazuma Kohei, Kato Naoki, Noda Naonobu, Suzuki Masahiko, Biosynthesis of malonylated flavonoid glycosides on the basis of malonyltransferase activity in the petals of *Clitoria ternatea*, Journal of Plant Physiology ,Volume 164, Issue 7, 26 July 2007, Pages 886-894
30. Kohei Kazuma, Naonobu Noda and Masahiko Suzuki, Malonylated flavonol glycosides from the petals of *Clitoria ternatea*, phytochemistry, Volume 62, Issue 2, January 2003, Pages 229-237
31. Jain Neeti N., Ohal C. C., Shroff S. K., Bhutada R. H., Somani R. S., Kasture V. S., Kasture S. B., *Clitoria ternatea* and the CNS , Pharmacology Biochemistry and Behavior, Volume 75, Issue 3, June 2003, Pages 529-536
32. Parimaladevi B., Boominathan R., Mandal Subhash C., Evaluation of antipyretic potential of *Clitoria ternatea* L. extract in rats, Phytomedicine, Volume 11, Issue 4, 2004, Pages 323-326
33. Norihiko Terahara, Norio Saito, Toshio Honda, Kenjiro Toki and Yutaka Osajima, Acylated anthocyanins of *Clitoria ternatea* flowers and their acyl moieties, Phytochemistry Volume 29, Issue 3, 1990, Pages 949-953
34. Devi B. Parimala, Boominathan R., Mandal Subhash C., Anti-inflammatory, analgesic and antipyretic properties of *Clitoria ternatea* root, Fitoterapia, Volume 74, Issue 4, June 2003, Pages 345-349
35. Rai K.S., Murthy K.D., Karanth K.S., Nalini K., Rao M.S., Srinivasan K.K., *Clitoria ternatea* root extract enhances acetylcholine content in rat hippocampus , Fitoterapia, Volume 73, Issues 7-8, December 2002, Pages 685-689
36. Segenet Kelemu, César Cardona and Gustavo Segura, Antimicrobial and insecticidal protein isolated from seeds of *Clitoria ternatea* , a tropical forage legume , Biochemistry, Volume, December 2004, Pages 867-873
37. Singh Jayanti, Tiwari Kavindra Nath. High-frequency in vitro multiplication system for commercial propagation of pharmaceutically important *Clitoria ternatea* L.—A valuable medicinal plant ,Products Volume, November 2010, Pages 534-538
38. Kazuma Kohei, Noda Naonobu, Suzuki Masahiko, Flavonoid composition related to petal color in different lines of *Clitoria ternatea*, Phytochemistry, Volume 64, Issue 6, November 2003, Pages 1133-1139

****