PHYTOCHEMICALS AND MEDICINAL USES OF *CLITORIA TERNATEA*

ABSTRACT

The plant *Clitoria ternatea*, commonly known as 'Butterfly pea,' has a rich history of traditional use in Ayurvedic medicine, where different parts of the plant are utilized to used health concerns like indigestion, constipation, arthritis, skin diseases, liver, and intestinal problems. Beyond its medicinal uses, the flowers of *C. ternatea* have gained popularity worldwide as ornamental flowers and have been traditionally employed as a natural food colorant. This review paper aims to explore recent advancements in the medicinal uses and study of phytochemicals from *C. ternatea* flowers, focusing on their potential biological activities. By examining these developments, the paper seeks to provide valuable insights into the therapeutic potential and diverse applications of *C. ternatea* flowers, opening new avenues for further research in this promising area of study. of phytochemicals from *C. ternatea* flowers. *Clitoria ternatea* flower is a promising candidate for functional food applications owing to its wide range of pharmacotherapeutic properties as well as its safety and effectiveness.

Keywords: *Clitoria ternatea* , Alkaloids, Medicinal Benefits, Metabolites.

INTRODUCTION

Since ancient times, aromatic and medicinal plants have been utilized for therapeutic, religious, cosmetic, nutritional, and beautifying purposes, and mankind of all civilizations and cultures is familiar with their use (Senica *et al.,* 2019; Senkal *et al.,* 2019; Gecer *et al.,* 2020). *Clitoria ternatea* is a perennial climber (2–3 m in height) and is known by its common name as butterfly pea or blue pea flower (Mukherjee *et al.,* 2008).

This plant is widely cultivated for its ornamental value and is also utilized as a species for revegetation purposes. In Southeast Asia, the blue pigment from its

flowers has a traditional use as a natural food colorant (Havananda and Luengwilai, 2019; Oguis *et al.,* 2019). Additionally, it is recognized for its suitability as a cover crop and green manure, possessing the ability to effectively suppress perennial weeds and enrich the soil through nitrogen fixation (Chauhan *et al.,* 2012; Reid and Sinclair, 1980).

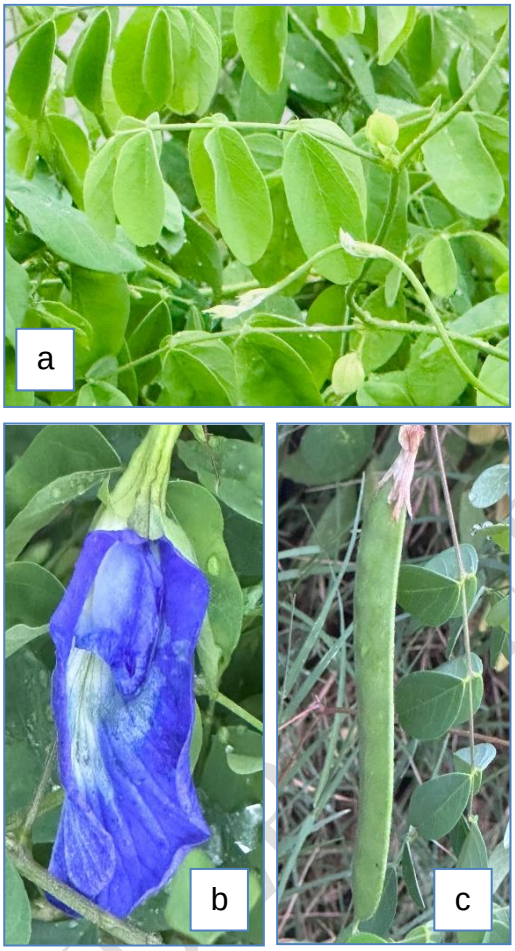

Fig.1 *Clitoria ternatea plant part: a) leaf and vines, b) Flower and c) Pod*

Clitoria ternatea is recognized as a nootropic herb in Ayurvedic medicine (Chauhan *et al.,* 2017). It thrives in regions with full sunlight or partial shade, and its seed germination typically takes around 1-2 weeks, with flowering occurring approximately 4 weeks after germination (Jamil *et al.,* 2018; Nguyen *et al.,* 2011). This plant exhibits several variations with different flower colors, including light blue, dark blue, white, and mauve, each of them measuring 4-5 cm in length (Fig. 1). Compounds reported to be found in the flowers are ternatin anthocyanins and

various flavanol glycosides of kaempferol, quercetin and myricetin (Mukherjee *et al.,* 2008; Kazuma *et al.,* 2003). The leaves of *Clitoria ternatea* are pinnate, composed of 5-7 leaflets, and have an elliptic-oblong shape with lengths ranging from 2.5 to 5.0 cm and widths from 2.0 to 3.2 cm. The plant produces flat, linear, and beaked seed pods, which have a length range of 5-7 cm and are edible when tender. The seeds are oval-shaped and have a blackish or yellowish-brown color, with lengths varying from 4.5 to 7.0 mm and widths from 3 to 4 mm. *Clitoria ternatea* has a taproot system with numerous slender lateral roots (Kosai *et al.,* 2015; Mukherjee *et al.,* 2008).

Table 1: Names of *Clitoria ternatea* (Butterfly Pea) in Different Regions and Languages

Region	Language	Name
Bengal	Bengali	Aparajita
India	Hindi	Kajroti
Brazil	Brazilian Portuguese	Cunha
Portugal	Portuguese	Cunhã, Fula Criqua
China	Chinese	Lan Hu Die
Indonesia	Indonesian	Bunga Biru, Tembang Telang
Malaysia	Malaysian	Bunga Telang
Spain	Spanish	Clitoria Azul
Thailand	Thai	Dangchan
Vietnam	Vietnamese	Chi Dậu Biếc
Turkey	Turkish	Mavi Kelebek Sarmaşığı

(Kosai *et al.,* 2015; Subramanian and Prathyusha 2011; Mukherjee *et al.,* 2008).

MORPHOLOGY

The taxonomical classification of *Clitoria ternatea* species

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Subclass : Rosids
Order : Fabales
Family : Fabaceae

Subfamily : Papilionoideae
Genus : ***Clitoria***
Species : ***ternatea*** (Linnaeus)

Table 2: Nutritional Analysis of *C. ternatea* Flowers

Nutrient	Percentage	Concentration (mg/g)
Protein	0.32%	-
Fiber	2.1%	-
Carbohydrate	2.2%	-
Fat	2.5%	-
Moisture	92.4%	-
Calcium	-	3.09 mg/g
Magnesium	-	2.23 mg/g
Potassium	-	1.25 mg/g
Zinc	-	0.59 mg/g
Sodium	-	0.14 mg/g
Iron	-	0.14 mg/g

Neda *et al.,* (2013)

Table 3: Bioactive Compounds Identified in *Clitoria ternatea* Flowers

Compound Type	Identified Compounds	References
Anthocyanins	Ternatins A1, A2, B1, B2, D1, D2, and others	Mukherjee *et al.,* 2008; Terahara *et al.,* 1998
	(15 (poly) acylated delphinidin glucosides)	
Flavanols	Kaempferol, Quercetin, and Myricetin glycosides	Mukherjee *et al.,* 2008; Kazuma *et al.,* 2003
	(With variations in substitutions at R1, R2, R3, and R4)	
Lipophilic Compounds	Fatty Acids (Palmitic Acid, Stearic Acid, Linoleic Acid, etc.)	Shen *et al.,* 2016
	Phytosterols (Campesterol, Stigmasterol, β-sitosterol, etc.)	

	Tocols (α-tocopherol and γ-tocopherol)	
Others	Mome Inositol, Pentanal, Cyclohexen, etc.	Neda *et al.,* 2013
	6″-Malonylastragalin, Phenylalanine, Coumaroyl Sucrose, etc.	Zakaria *et al.,* 2018
	Tryptophan, Coumaroyl Glucose, etc.	

Distribution:

Clitoria ternatea, commonly known as the *C. ternatea* plant, has a widespread distribution across various regions. It can be found in numerous tropical Asian countries such as India, the Philippines, Bangladesh, Bhutan, Nepal, Sri Lanka, and the Maldives. Additionally, it is also present in regions of South and Central America, the Caribbean, as well as Madagascar. Moreover, the plant is observed in parts of the Middle East, including Saudi Arabia, Yemen, Iran, and Iraq, along with China Taiwan, Indonesia, Malaysia, Singapore, Cambodia, Laos, Myanmar, Thailand, and Vietnam. The wide distribution of *C. ternatea* highlights its adaptability to diverse climatic conditions in these regions (Sivaranjan and Balachandran, 1994; Ambasta, 1988).

Traditional uses:

Root was used for the treatment of ascetics, enlargement of the abdominal viscera, sore throat and skin diseases. They were also used as purgative, but because, they cause griping and tenderness, they were not recommended. Root was administered with honey and ghee as a general tonic to children for improving mental faculties, muscular strength and complexion tonics. Seeds and leaves were widely used as a brain tonic and to promote memory and intelligence. Juice and flowers were used as an antidote for snake bite. Seeds were used in swollen joints; crushed seeds are taken with cold or boiled water for urinary problems. (Morris et al.,1999), (Ragupathy *et al.,* 2009), (Nadkarni, 1976), (Mukherjee *et al.,* 2007),

Plant parts used:

Leaves, seeds, bark, fruits, sprouts and stems were used medicinal. (Alok et al.,2015), (Deka et al.,2013)

Fig:2 Traditional uses of *Clitoria ternatea*

Chemical constituents:

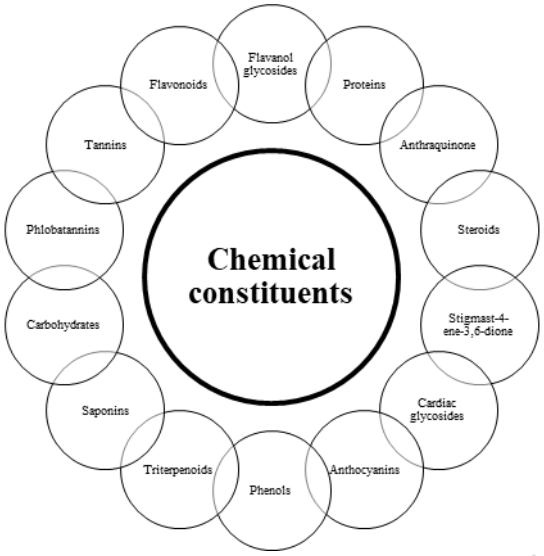

Fig: 3 Chemical constituents of *Clitoria ternatea*

Butterfly pea (*Clitoria ternatea*) contains a wide range of chemical compounds, each contributing to its therapeutic benefits. The plant's chemical composition includes tannins, phlobatannins, carbohydrates, saponins, triterpenoids, phenols, flavonoids, flavanol glycosides, proteins, alkaloids, anthraquinones, anthocyanins, cardiac glycosides, Stigmast-4-ene-3,6-dione, volatile oils, and steroids. These diverse chemical constituents play a significant role in the medicinal properties of Butterfly pea. Here is a list of the principal chemical components found in this plant. (Kelemu *et al.,* 2004), (Husain *et al.,* 1998)

Pharmacological actions of butterfly pea

Butterfly pea includes a variety of chemicals with therapeutic effects. These include alkaloids, flavonoids, and glycosides. Alkaloids are chemicals that can stimulate or depress the central nervous system. Flavonoids are plant chemicals with antioxidant and anti-inflammatory effects. Glycosides are substances that can be broken down into sugar and a non-sugar component. The non-sugar component of Butterfly pea glycosides possesses anti-cancer effects.

Anticancer Activity:

Butterfly pea (*Clitoria ternatea*) is well-known for its potent anticancer effects. In vitro studies have shown significant dose-dependent cytotoxic activity of

Clitoria ternatea extracts. The petroleum ether extract achieved a 100% reduction in cell count at 500 µg/ml, while the ethanolic extract exhibited an 80% reduction at the same concentration. Moreover, the water extract demonstrated significant effects against MCF-7 breast cancer cells, with an IC50 value of 175.35 µg/ml. (Shyam and Bhat, 2011)

In vivo experiments using the methanol extract of *Clitoria ternatea* in DLA-bearing mice exhibited promising results. The treatment increased survival time and decreased tumor volume, indicating potential therapeutic benefits against cancer. These findings underscore the potential of *Clitoria ternatea* as a valuable natural source for developing anticancer agents. (Jacob L and Latha, 2012)

Antimicrobial effect:

Clitoria ternatea extracts have demonstrated inhibitory effects against a variety of pathogens, including bacteria, fungi, and viruses. The methanol extracts from both the leaf and root exhibited the most potent antimicrobial activity, with MIC (Minimum Inhibitory Concentration) values ranging from 0.3 mg/ml to 100.00 mg/ml against various bacterial, yeast, and fungal species. Among the tested organic solvent extracts (petroleum ether, ethyl acetate, and methanol), the methanol extract proved to be the most effective. (Kamilla *et al.,* 2009)

Anti-inflammatory antipyretic and analgesic effects:

The ethanol extract of *Clitoria ternatea* root (ECTR) showed antihistaminic activity by inhibiting clonidine-induced catalepsy in mice, but it did not exhibit the same effect against haloperidol-induced catalepsy. In contrast, the methanol extract of *Clitoria ternatea* root with blue flowers (MECTR) demonstrated anti-pyretic potential. It effectively reduced normal body temperature and yeast-induced pyrexia in rats, comparable to the effects of paracetamol. (Taur and Patil,2011), (Parimaladevi *et al.,* 2004)

Antiparasitic and insecticidal effects:

Clitoria ternatea's ethanolic extract (100mg/ml) induced paralysis in Indian earthworms (*Pheretima posthuma*) within 15-20 minutes and led to their death within 28-30 minutes. Among the various extracts, the methanol extract of *Clitoria*

ternatea roots exhibited the most potent anthelmintic activity. Both the aqueous and ethanolic extracts of *Clitoria ternatea* leaves demonstrated significant anthelmintic activity against Eisenia foetida, with the ethanolic extract showing higher efficacy. Furthermore, the seed extract of *Clitoria ternatea* displayed promising mosquito larvicidal activity against *Aedes aegypti*, *Culex quinquefasciatus*, and *Anopheles stephensi*. (Nirmal *et al.,* 2008), (Salhan *et al.,* 2011), (Mathew *et al.,* 2009)

Antioxidant Activity:

Clitoria ternatea flower petal extract (CTE) demonstrated potent antioxidant activity and protected erythrocytes against oxidative damage. *Clitoria ternatea* leaf extracts showed significant antioxidant effects and reduced DNA damage. Aqueous extracts exhibited stronger antioxidant activity compared to ethanol extracts. Methanolic extract of *Clitoria ternatea* leaf showed antioxidant properties and a hepatoprotective effect in mice against paracetamol-induced liver toxicity. (Jayakar *et al.,* 2011), (Phrueksanan *et al.,* 2014)

Neuroprotective Activity:

Clitoria ternatea has been found to have neuroprotective qualities, which may be linked to its antioxidant and anti-inflammatory capabilities. It has showed promise in preventing neurodegenerative disorders and increasing cognitive function.

Anthelmintic activity:

The ethanolic extract of *Clitoria ternatea* (CT) leaves exhibited anthelmintic activity at 100 mg/ml. However, in another study, anthelmintic activity was observed with the methanolic extract of CT leaves at 10 mg/ml and 25 mg/ml, while no such activity was found with the ethanolic extract at the same concentrations.

Medicinal properties

Butterfly pea has a wide range of medicinal applications due to its diverse pharmacological properties. Here are some of the notable medicinal applications of Butterfly pea:

Diuretic and anti-urolithiasis effect:

The alcoholic extract derived from *Clitoria ternatea* leaves exhibited robust inhibitory potency against the formation of calcium oxalate crystals, which is comparable to the effect of the proprietary drug Cystone used for dissolving kidney stones. Notably, the extract showed a higher percentage of inhibition of calcium oxalate crystallization in vitro compared to Cystone.

Central nervous effect:

Clitoria ternatea extracts have shown promising memory-enhancing and cognitive effects, including significant anxiolytic, antidepressant, and CNS-depressant activities. The extracts increased acetylcholine content in the hippocampus, leading to improved learning and memory. Additionally, they enhanced passive avoidance learning and retention by increasing dendritic intersections and branching in amygdaloid neurons. The extracts also exhibited anti-amnesic effects, boosted acetylcholine content, and increased acetylcholinesterase activity in the brain. Overall, *Clitoria ternatea* extracts demonstrated nootropic, anxiolytic, antidepressant, anticonvulsant, and antistress activities, making them promising candidates for cognitive enhancement and neuroprotective interventions.

Diabetes Control:

Clitoria ternatea extracts exhibited noteworthy antidiabetic effects in diabetic rats. Methanol, water, petroleum ether, and chloroform extracts were able to reduce blood glucose levels. The aqueous extracts of leaves and flowers showed improvements in glucose and insulin levels while reducing enzyme activity. The alcoholic root extract demonstrated preventive effects against diabetic complications in the brain and pancreas. Moreover, *Clitoria ternatea* extract showed inhibition of advanced glycation end product (AGE) formation and displayed strong antioxidant properties, indicating its potential as a therapeutic intervention for diabetic complications.

Wound healing effect:

Clitoria ternatea seed and root extracts have demonstrated remarkable wound healing activity in various models, including excision, incision, and dead-

space models, whether administered orally or applied topically. These extracts exerted their effects on all phases of wound healing: the inflammatory, proliferative, and remodeling phases. Moreover, the standardized leaf extract exhibited inhibitory activity against enzymes involved in skin wound healing, such as hyaluronidase and matrix metalloproteinase-1 (MMP-1). The presence of the bioactive compound taraxerol in the extract and ethyl acetate fraction is believed to contribute to its wound healing potential. Overall, *Clitoria ternatea* extracts hold promise as natural agents for promoting effective wound healing. (Solanki *et al.,* 2012)

CONCLUSION

In conclusion, *Clitoria ternatea*, commonly known as Butterfly pea, holds immense medicinal potential and has been utilized since ancient times for various therapeutic purposes. Its traditional use in Ayurvedic medicine for treating health concerns such as indigestion, arthritis, and skin diseases has been well-documented. Furthermore, the flowers of *C. ternatea* have gained global popularity as ornamental flowers and natural food colorants. The plant has demonstrated significant effects in wound healing, memory enhancement, antidiabetic activity, and antimicrobial properties. Additionally, its antioxidant, neuroprotective, and anthelmintic activities have been well-documented. The various bioactive compounds identified in *C. ternatea*, such as anthocyanins, flavonols, and lipophilic compounds, contribute to its therapeutic benefits and add to its value as a natural remedy. Moreover, its adaptability to different climates and wide distribution across various regions make it a promising candidate for functional food applications. The micropropagation techniques discussed in this review offer valuable tools for mass-producing homogeneous and disease-free plantlets, contributing to the conservation and commercial production of *Clitoria ternatea*.

Reference:

1. Alok S, Gupta N, Kumar A and Malik A. An update on Ayurvedic herb vishnukanta (*Clitoria ternatea* Linn.): A review. International Journal of Life Sciences and Review (IJLSR) 2015; 1(1): 1-9.
2. Al-Snafi, Ali Esmail. "Pharmacological importance of Clitoria ternatea–A review." *IOSR Journal of Pharmacy* 6.3 (2016): 68-83.
3. Anonymous. Indian Medicinal Plants, Vol. 2. Orient Longman, Madras 1995: 129–132.
4. Chauhan N, Rajvaidhya S and Dubey BK. Antihistaminic effect of roots of *Clitorea ternarea* Linn. IJPSR 2012; 3(4): 1076-1079.
5. Chauhan NS, Singh NK, Gupta JK et al (2017) A Review on *Clitoria ternatea* (Linn.): Chemistry and Pharmacology. Medicinal Plants and its Therapeutic Uses. OMICS Group eBooks, CA, USA. ISBN: 1632780747
6. Deka M, Medhi AK, Kalita JC, Sarma KK and Deka L. Proximate analysis of primary metabolites in different parts of *Clitoria ternatea* L. A comparative study. International Archive of Applied Sciences and Technology 2013;4(3): 62-67.
7. Gecer MK, Kan T, Gundogdu M et al (2020) Physicochemical characteristics of wild and cultivated apricots (Prunus armeniaca L.) from Aras valley in Turkey. Genet Resour Crop Eviron 67:935–945. https://doi.org/10.1007/s10722-020-00893-9
8. Husain S and Devi KS. Fatty acid composition of three plant species: *Clitorea ternatea, Mandulea suberosa* and *Ruta chalapensis*. Journal of the Oil Technologists Association of India 1998; 30: 162-164.
9. Jacob L and Latha MS. Anticancer activity of *Clitoria ternatea* Linn. against Dalton's lymphoma. International Journal of Pharmacognosy and Phytochemical Research 2012; 4(4); 207-212.
10. Jamil N, Zairi MNM, Nasim NAIM et al (2018) Influences of environmental conditions to phytoconstituents in *Clitoria ternatea* (butterfly pea flower): a review. J Sci Technol 10:208–228

11. Jamil, N. & Pa'ee, F., 2018. Antimicrobial activity from leaf, flower, stem, and root of *Clitoria ternatea* - A review. In *AIP Conference Proceedings*. pp. 1–6.

12. Jamil, N. et al., 2018. Influences of Environmental Conditions to Phytoconstituents in *Clitoria ternatea* (Butterfly Pea Flower) – A Review. *Journal of Science and Technology*, 10(2), pp.208–228.

13. Jayakar B and Suresh B. Hepatoprotective potential of *Clitoria ternatea* leaf extract against paracetamol induced damage in mice. Molecules 2011; 16: 10134-10145.

14. Kamilla L, Mnsor SM, Ramanathan S and Sasidharan S. Antimicrobial activity of *Clitoria ternatea* (L.) extracts. Pharmacologyonline 2009; 1: 731-738.

15. Kazuma K, Noda N and Suzuki M. Flavonoid composition related to petal color in different lines of *Clitoria ternatea*. Phytochemistry 2003; 64(6):1133-1139.. https://doi.org/10.1074/jbc.m111.229922

16. Kazuma K, Noda N and Suzuki M. Malonylated flavonol glycosides from the petals of *Clitoria ternatea*. Phytochemistry 2003; 62(2):229-237.

17. Kelemu S, Cardona C and Segura G. Antimicrobial and insecticidal protein isolated from seeds of *Clitoria ternatea*, a tropical forage legume. Plant Biochemistry and Physiology 2004; 42: 867-873

18. Kosai P, Sirisidthi K, Jiraungkoorskul K, Jiraungkoorskul W (2015) Review on ethnomedicinal uses of memory boosting herb, butterfly pea, Clitoria ternatea. J Nat Remedies 71–76. https:// doi. org/ 10. 18311/ jnr/ 2015/ 480

19. Mathew N, Anitha MG, Bala TS, Sivakumar SM, Narmadha R and Kalyanasundaram M. Larvicidal activity of *Saraca indica, Nyctanthes arbortristis*, and *Clitoria ternatea* extracts against three mosquito vector species. Parasitol Res 2009; 104(5):1017-1025.

20. Morris JB. Legume genetic resources with novel value added industrial and pharmaceutical use. In: Janick J. (Ed.), Perspectives on new crops and new uses. ASHS Press, Alexandria, VA, USA, 1999: 196–201.

21. Mukherjee PK, Kumar V, Kumar NS et al (2008) The Ayurvedic medicine Clitoria ternatea-From traditional use to scientific assessment. J Ethnopharmacol 120:291–301. https://doi.org/10. 1016/j.jep.2008.09.009
22. Nadkarni KM. Indian materia medica. Popular Publication, Bombay 1976: 354-355. 52-Mukherjee PK, Kumar V, Mal M and Houghton PJ. Acetylcholinesterase inhibitors from plants. Phytomedicine 2007; 14(4): 289-300.
23. Nair V, Bang WY, Schreckinger E et al (2015) Protective role of ternatin anthocyanins and quercetin glycosides from butterfly pea (*Clitoria ternatea* Leguminosae) blue flower petals against lipopolysaccharide (LPS)-induced inflammation in macrophage cells. J Agric Food Chem 63:6355–6365. https://doi.org/10. 1021/acs.jafc.5b00928
24. Neda GD, Rabeta MS and Ong MT. Chemical composition and anti-proliferative properties of flowers of *Clitoria ternatea*. International Food Research Journal 2013; 20(3): 1229-1234.
25. Neda GD, Rabeta MS, Ong MT (2013) Chemical composition and anti-proliferative properties of flowers of Clitoria ternatea. Int Food Res J 20:1229–1234
26. Nguyen GKT, Zhang S, Nguyen NTK et al (2011) Discovery and characterization of novel cyclotides originated from chimeric precursors consisting of albumin-1 chain a and cyclotide domains in the Fabaceae family. J Biol Chem 286:24275– 24278
27. Nirmal SA, Bhalke RD, Jadhav RS and Tambe VD. Anthelmintic activity of *Clitoria ternatea*. Pharmacologyonline 2008; 1: 114-119.,
28. Oguis GK, Gilding EK, Jackson MA et al (2019) Butterfly pea (Clitoria ternatea), a cyclotide-bearing plant with applications in agriculture and medicine. Front Plant Sci 10:645. https://doi.org/ 10.3389/fpls.2019.00645
29. Parimaladevi B, Boominathan R and Mandal SC. Evaluation of antipyretic potential of *Clitoria ternatea* L. extract in rats. Phytomedicine 2004;11(4):323-326.

30. Phrueksanan W, Yibchok-anun S and Adisakwattana S. Protection of *Clitoria ternatea* flower petal extract against free radical-induced hemolysis and oxidative damage in canine erythrocytes. Res Vet Sci 2014;97(2):357-363.
31. Ragupathy S and Newmaster SG. Valorizing the Irulas traditional knowledge of medicinal plants in the Kodiakkarai Reserve Forest, India. Journal of Ethnobiology and Ethnomedicine 2009; 5: 10.
32. Salhan M, Kumar B, Tiwari P, Sharma P, Sandhar HK and Gautam M. Comparative anthelmintic activity of aqueous and ethanolic leaf extracts of *Clitoria ternatea.* Int J Drug Dev & Res 2011; 3 (1):68-69.
33. Senica M, Stampar F, Petkovsek MM (2019) Different extraction processes affect the metabolites in blue honeysuckle (Lonicera caerulea L. subsp. edulis) food products. Turk J Agric For 43:576–585. https://doi.org/10.3906/tar-1907-48
34. Senkal BC, Uskutoglu T, Cesur C et al (2019) Determination of essential oil components, mineral matter, and heavy metal content of Salvia virgata Jacq. grown in culture conditions. Turk J Agric For 43:395–404. https://doi.org/10.3906/tar-1812-84
35. Shen Y, Du L, Zeng H et al (2016) Butterfly pea (Clitoria ternatea) seed and petal extracts decreased Hep-2 carcinoma cell viability. Int J Food Sci Technol 51:1860–1868. https://doi.org/10.1111/ ijfs.13158
36. Shyam kumar B and Ishwar Bhat K. *In-vitro* cytotoxic activity studies of *Clitoria ternatea* Linn flower extracts. International Journal of Pharmaceutical Sciences Review and Research 2011; 6(2): 120-121.
37. Sivaranjan VV, Indira B (1994) Ayurvedic drugs and their plant sources. New Delhi: Oxford & IBH Publishers Pvt ltd, p: 425.
38. Solanki YB and Jain SM. Wound healing activity of *Clitoria ternatea* L, in experimental animal model. Pharmacologia 2012; 3(6): 160-168.

39. Suarna, I. W., & Wijaya, I. M. S. (2021). Butterfly pea (*Clitoria ternatea* L.: Fabaceae) and its morphological variations in Bali. *Journal of Tropical Biodiversity and Biotechnology*, *6*(2), 63013.
40. Subramanian MS, Prathyusha P (2011) Pharmaco-phytochemical characterization of *Clitoria ternatea* Linn. Int J Pharmtech Res Havananda T, Luengwilai K (2019) Variation in floral antioxidant activities and phytochemical properties among butterfly pea (*Clitoria ternatea* L.) germplasm. Genet Resour Crop Eviron 66:645–658. https://doi.org/10.1007/s10722-018-00738-6
41. Taur DJ and Patil RY. Antihistaminic activity of *Clitoria ternatea* L roots. J Basic Clin Pharm 2011; 2(1): 41-44.,
42. Terahara N, Toki K, Saito N, Honda T, Matsui T and Osajima Y. Eight new anthocyanins, ternatins C1-C5 and D3 and preternatins A3 and C4 from young *Clitoria ternatea* flowers. J Nat Prod. 1998; 61(11): 1361-1367.
43. Zakaria NNA, Okello EJ, Howes MJ et al (2018) In vitro protective effects of an aqueous extract of *Clitoria ternatea* L. flower against hydrogen peroxide-induced cytotoxicity and UV-induced mtDNA damage in human keratinocytes. Phytother Res 32:1064–1072. https://doi.org/10.1002/ptr.6045