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A RESEARCH ARTICLE ON CLITORIA TERNATEA – BASED NASAL SPRAY FORMULATION FOR STRESS RELIEF

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ABSTRACT

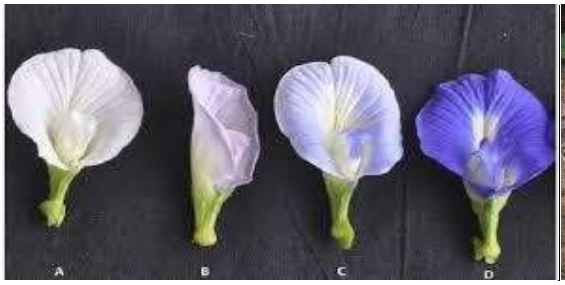
This study presents the development and evaluation of a Clitoria ternatea-based nasal spray formulation aimed at providing rapid, non-invasive stress relief. Clitoria ternatea, known for its adaptogenic and anxiolytic properties, contains bioactive compounds such as flavonoids and anthocyanins that modulate oxidative stress and the hypothalamic-pituitary-adrenal (HPA) axis. Utilizing the intranasal route enhances the bioavailability of these compounds by enabling direct nose-to-brain delivery, bypassing the blood-brain barrier and first-pass metabolism.. These findings support the potential of Clitoria ternatea nasal spray as a fast-acting, plant-based therapeutic option for stress management.

2.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 [1, 2, and 3]. 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 [4]. 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 [5, 6].

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 [7] (Reid and Sinclair, 1980). Clitoria ternatea is recognized as a nootropic herb in Ayurvedic medicine [8]. 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 [9, 10, 11, and 12]. 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 ternate anthocyanins and various flavanol glycosides of kaempferol, quercetin and myricetin [4,13,14]. 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 [15, 4]





[1] [2]

Fig [1][2] is of Clitoria Ternatea Flowers

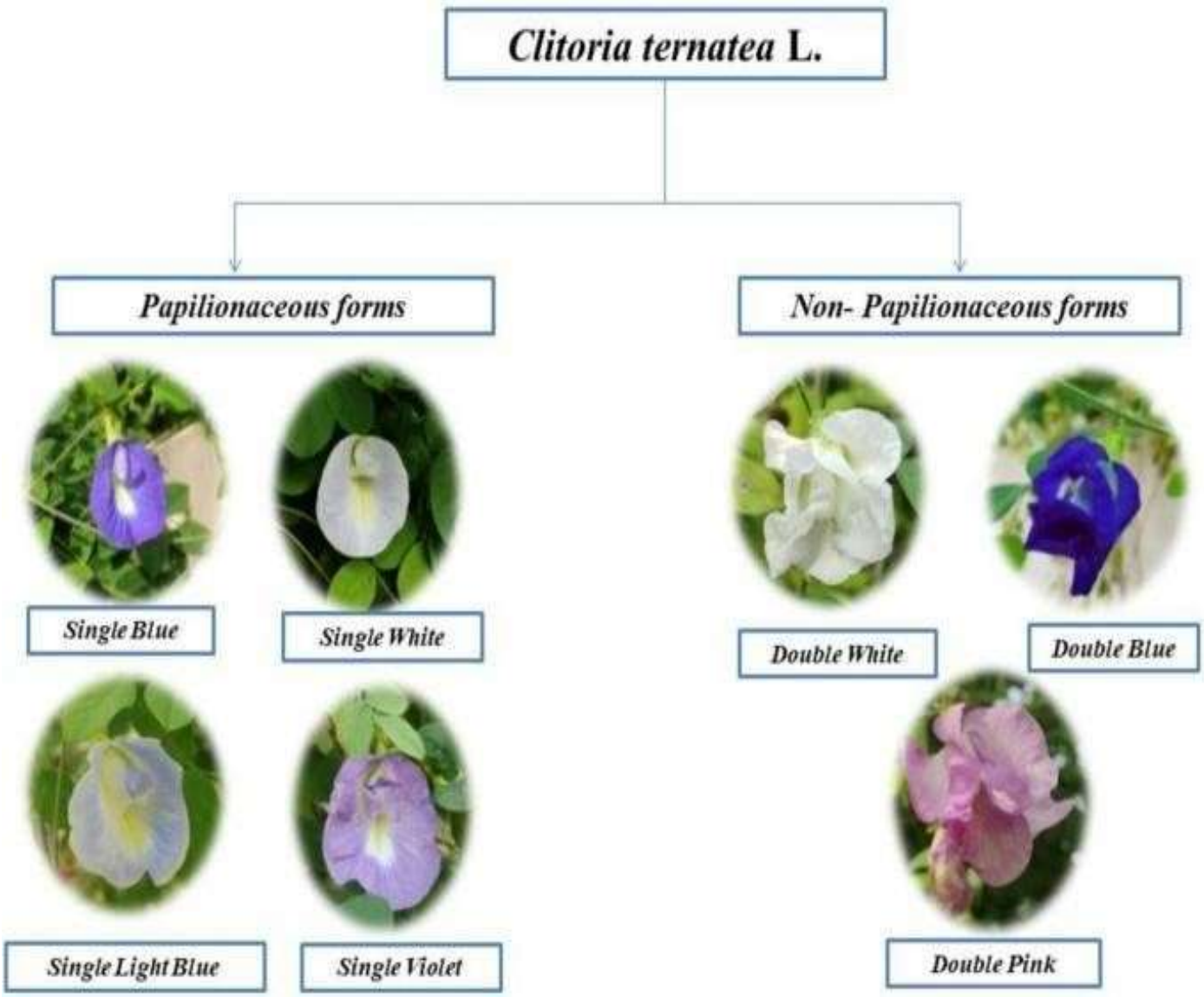
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3. MORPHOLOGY

3.1 The taxonomical classification

kingdom	plantea
division	magnoliophyta
class	magnoliopsida
subclass	rosids
order	fabales
family	fabaceae
genus	clitoria
species	Ternatea [Linnaeus]

3.2 Classification of clitoria ternatea l.

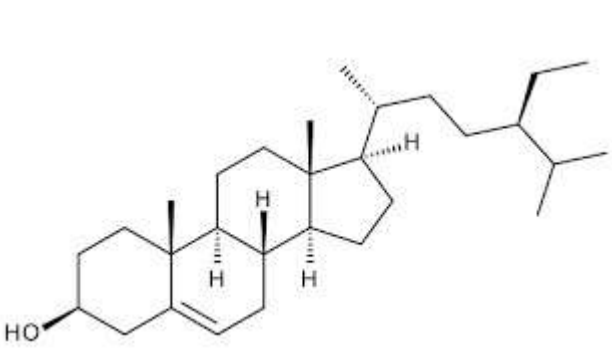


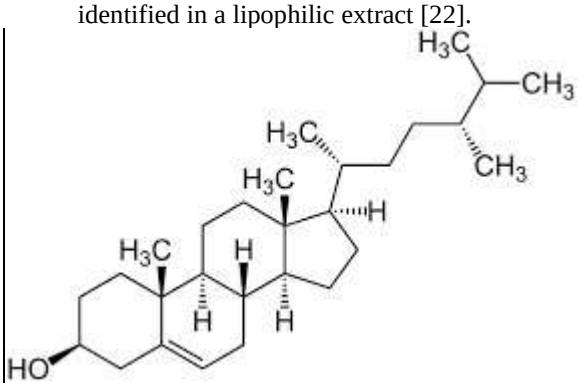
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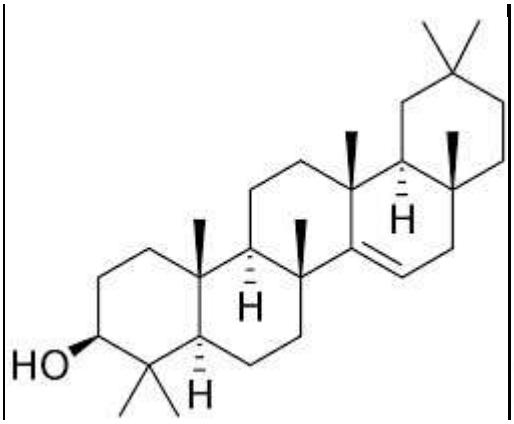
4. PHYTOCHEMICAL COMPOSITION

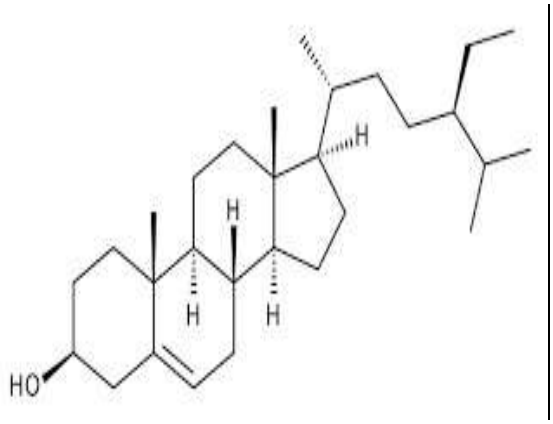
The benefits of C. ternatea have been recognized since ancient times, believed to be a natural cure for many diseases, and also used as a natural food additive. Besides the phytochemical compounds, the nutritional composition of C. ternatea flowers has been identified and reported by Neda et al. [16]. The percentage of fat, carbohydrate, fiber, and protein are, respectively, 2.5, 2.2, 2.1, and 0.32%, while the moisture content is 92.4%. The flowers were also identified as being rich in 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), and iron (0.14 mg/g) [17]. Various phenolic compounds contained in the plant are responsible for the beneficial effects, especially the petals of the flower. C. ternatea contains many bioactive compounds, such as alkaloids, tannins, glycosides, resins, steroids, saponins, flavonoids, and phenols [18]. Another study also stated that malonylated flavonol glycosides were isolated from the flower petals [19].

The phenolics compounds found in the flowers of C. ternatea are mainly ternatinan thocyanins and various flavanol glycosides of kaempferol, rutin, quercetin, and myricetin, which are isolated in a hydrophilic extract. Meanwhile, some fatty acids (palmitic acid, stearic acids, petroselinic acid, linoleic acid, arachidic acid, behenic acid, and phytanic acid), various phytosterols (Figure 1) such as campestrerol, stigmasterol, β-sitosterol, and sitostanol, and tocols such as α-tocopherol and γ-tocopherol are also identified in a lipophilic extract [22].









5. AYURVEDIC PROPERTIES AND USES

Clitoria is pungent in the post digestive effect, has cold potency, bitter in taste, and possesses light dry and sharp attributes. In Ayurveda „Sankhapushpi" is one of the formulations which consists of the seeds and roots of C. ternatea, is used as a „nerve tonic", alternative and laxative. It has been used for the treatment of various neurological disorders as an active ingredient in „Medhya Rasayana". By various group of persons it is considered as medicine which is useful in skin diseases, eye and throat infections also in urinary disorders, ulcers and antidote activity

6. PHARMACOLOGICAL ACTIVITY

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.

6.1 Anticancer Activity

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

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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 . 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 [23].

6.2 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 [24].

6.3 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 haloperidolinduced 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 [24, 25].

6.4 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 [26, 27, and 28]

6.5 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 [29, 30].

6.6 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.

6.7 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.

6.8 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.

6.9 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.

6.10 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.

6.11 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 roots 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.

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6.12 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 [31-33].

7. METHOD AND MATERIALS

7.1 Procedure

1. Fresh clitoria flower – 1 cup (or 2 tablespoons dried flower)Distilled water – 1 cup Non-iodized salt – ¼ tsp (optional, for isotonic solution)Baking soda – a pinch (optional, helps reduce irritation) Clean nasal spray bottle (sterilized).
2. Wash the clitoria flowers throughly.From 250 gm clitoria flowers of was distillate in the amount of about 0.2 ml, which was slightly water-soluble and viscous.
3. Boil them in 1 cup of distilled water for 10– 15 minutes.
4. Let the mixture cool down.
5. Strain it through a fine cloth or filter to remove all plant particles.
6. Add ¼ tsp non-iodized salt and a pinch of baking soda for a gentle, saline effect. Pour the cooled, filtered solution into a clean nasal spray bottle.
7. Store in the refrigerator and use within 5–7 days. An intranasal delivery system from the distillate clitoria in an aqueous solution used in the form of nasal spray.
8. Use 1–2 sprays in each nostril as needed.
9. Shake well before each use.]34]

SR.NO	INGRIDENT	QUANTITY	ROLE OF INGRIDIENTS
1	Clitoria ternatea	0.3ml	Anti stress effects
2	Sodium benzoate	0.015ml	preservative
3	Saline	0.097ml	Nasal congestion
4	Eucalyptus oil	0.45ml	Nasal congestion
5	glycerine	3.4ml	humectants

8. STEPS ARE FOLLOWS

Step 1: dry and weight the flowers of clitoria ternatea



Step2: boil them and extract the etract from the flower



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Step3: keep it for cooling



Step 4: filter it with filter paper or fine cloth



Step 5: fill the mixture in a clean container



9. Evolution Parameter:

Sr.no.	Evaluation Parameter	result
1.	Visual Appearance, Clarity	Satisfactory ,clear
2.	pH	6.5
3.	sterility	Sterile and free from microorganisum
4.	stability	stable
5.	viscocity	

RESULT

This study demonstrates that a nasal spray formulated from Clitoria ternatea extract may be a promising intervention for stress reduction. The observed reduction in both subjective stress scores and physiological stress markers suggests that Clitoria ternatea exerts anxiolytic effects, potentially through its flavonoid content and modulation of neurotransmitter systems (e.g., GABA ergic or serotonergic pathways).

The nasal delivery route likely enhances the extract's central activity by bypassing first-pass metabolism and enabling more direct access to the central nervous system via the olfactory route.

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This aligns with prior research suggesting intranasal delivery as a viable route for neuroactive herbal compounds.
The botanical's antioxidant and anti-inflammatory properties may also contribute to its stressrelieving effects by mitigating neuro inflammation, a known factor in chronic stress.
While our results are encouraging, further research is warranted. Future studies should aim to:

1] Explore long-term safety and efficacy.
2] Investigate the molecular mechanisms of action, particularly its effects on the HPA axis and neurochemical pathways.
3] Conduct large-scale, randomized controlled trials across diverse populations.

CONCLUSION

The present study highlights the potential of a Clitoria ternatea-based nasal spray as a novel, noninvasive therapeutic approach for stress relief. Our findings indicate that this formulation not only reduces perceived stress but also positively influences physiological markers associated with the stress response, including salivary cortisol levels and heart rate variability. These results suggest that the extract's bioactive compounds may have central nervous system activity, potentially mediated by antioxidant, anti-inflammatory, and neurotransmitter-modulating mechanisms.

The intranasal route offers a practical advantage for delivering herbal neuro therapeutics, ensuring faster onset of action and improved bioavailability. Given the growing demand for natural, nonsedating alternatives to conventional anxiolytics, this formulation represents a promising candidate for future development in integrative medicine.

Clitoria ternatea nasal spray demonstrates potential as an accessible, safe, and effective stressreducing intervention. With further validation, it may serve as an important addition to complementary therapies for stress-related conditions, enhancing mental health care through botanical science and novel drug delivery systems.

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