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A Review on Formulation and Evaluation of a Clitoria Ternatea Based Anti Oxidant Gel for The Management of Eczema

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ABSTRACT
Eczema (atopic dermatitis) is a chronic inflammatory skin disease characterized by erythema, itching, and recurrent flare-ups, often associated with oxidative stress and immune dysregulation. Excessive production of reactive oxygen species (ROS) contributes to lipid peroxidation, inflammation, and skin barrier dysfunction, aggravating disease severity. To address these challenges, the present study focuses on the **formulation and evaluation of a Clitoria ternatea-based antioxidant gel** for the management of eczema. *Clitoria ternatea* (Butterfly pea), belonging to the Fabaceae family, is a medicinal plant traditionally used for its wound-healing, anti-inflammatory, and antioxidant properties, mainly attributed to its bioactive compounds such as anthocyanins, flavonoids, and triterpenoids. The ethanolic flower extract of *C. ternatea* was incorporated into a Carbopol-based gel formulation to enhance topical delivery, stability, and patient compliance. The prepared gels were evaluated for physicochemical parameters, including pH, viscosity, spreadability, homogeneity, and stability, showing satisfactory characteristics suitable for topical application. The literature supports strong antioxidant and antimicrobial activities of *C. ternatea* extract, indicating its potential to mitigate oxidative stress and microbial colonization in eczematous skin. Overall, this study highlights *Clitoria ternatea* as a promising natural therapeutic candidate for developing antioxidant-rich topical gels aimed at effective, safe, and sustainable eczema management.

Keywords: *Clitoria ternatea*, antioxidant gel, eczema, oxidative stress, herbal formulation, topical therapy

I. INTRODUCTION

Eczema is one of the most common inflammatory skin disorders encountered in dermatological practice, representing a diverse group of chronic or recurrent conditions characterized by erythema, vesiculation, and intense pruritus. The term "eczema" originates from the Greek word *ekzein*, meaning "to boil over" or "break out," reflecting the inflamed, blistering appearance typically observed in the affected areas of skin.Historical documentation of eczema-like diseases dates back to ancient Egyptian texts, particularly the *Ebers Papyrus*, written more than 3000 years ago, which described various inflammatory skin conditions resembling eczema.[1] Around 400 BC, Hippocrates contributed to early theories regarding the pathophysiology and treatment of such disorders, laying the foundation for the medical understanding of inflammatory dermatoses.[2] The term "eczema" was officially coined in 1817 to describe fluid-filled, blistering rashes similar to those caused by sunburn, though its definition has since broadened to include multiple chronic inflammatory skin diseases with variable etiologies and presentations.[3,4]

The terms "eczema" and "dermatitis" are often used interchangeably to describe polymorphic inflammatory reactions of the skin, especially in their acute stages when characterized by erythema, oozing, vesiculation, and pruritus.[5] However, there has been a longstanding debate over their precise usage. Atopic dermatitis (AD) or atopic eczema is one of the most studied forms of eczema and exemplifies this terminological ambiguity. Historically, "atopic eczema" was more frequently used until the late 1970s, after which the term "atopic dermatitis" gained prominence in medical literature and clinical diagnosis, continuing to increase in usage until 2015. The use of "eczema" tends to describe clinical manifestations and visible symptoms such as childhood eczema, flexural eczema, infantile eczema, dyshidrotic eczema, and nummular eczema, whereas "dermatitis" is more often applied to disease nomenclature such as contact dermatitis or seborrheic dermatitis.[6] Despite its terminological complexity, eczema remains a major dermatological concern affecting millions worldwide, often linked to genetic, immunological, and environmental factors that contribute to chronic skin barrier dysfunction and inflammation.

Oxidative stress plays a crucial role in the pathogenesis and progression of eczema. The overproduction of reactive oxygen species (ROS) and free radicals results in oxidative damage to lipids, proteins, and nucleic acids, contributing to inflammation, apoptosis, and disruption of skin homeostasis. Oxidative metabolism is vital for cell survival, yet it also produces reactive intermediates that can damage cellular structures when not balanced by sufficient antioxidant defenses.[7] When excessive ROS are generated, they can overwhelm protective enzymatic systems such as superoxide dismutase, catalase, and peroxidase, leading to lipid peroxidation, protein oxidation, and cellular injury.[8,9] This oxidative imbalance not only affects biological systems but also plays a major role in the degradation of foods, causing rancidity, loss of nutritional value, and textural changes due to lipid oxidation.[10,11] It has been estimated that up to half of the world's fruit and vegetable crops are lost postharvest due to oxidative spoilage and deteriorative reactions.[12]

Antioxidants act as defensive agents that neutralize ROS and minimize oxidative stress by scavenging free radicals and decomposing peroxides. The measurement of antioxidant activity is therefore essential for understanding and quantifying the protective effects of both natural and synthetic antioxidants. Methods for assessing antioxidant potential generally fall into two categories: those measuring food preservation efficacy and those evaluating biological or therapeutic activity. In food systems, antioxidant activity is evaluated for its capacity to prevent oxidative spoilage, while in biological systems, the emphasis is on reducing oxidative damage to cells and tissues.[13] In human physiology, oxidative stress develops from an imbalance between ROS and the antioxidant defense network, which includes enzymatic components like superoxide dismutase, catalase, and glutathione peroxidase, as well as non-enzymatic antioxidants such as vitamin E, uric acid, and serum albumin.[14,15] These endogenous mechanisms, together with dietary antioxidants, form a critical barrier against oxidative injury and inflammatory damage.

Various analytical methods have been developed to assess antioxidant activity, particularly concerning lipid oxidation, which plays a major role in both biological and food systems. It is important to distinguish between measuring antioxidant "activity" (the mechanism and rate of free radical scavenging) and quantifying antioxidant "concentration" (the amount present in a sample), as antioxidants can exhibit pro-oxidant behavior at high concentrations. [16,17] Mechanistic aspects of antioxidant activity include free radical scavenging, catalytic decomposition of peroxides, and inhibition of pro-oxidant enzymes. Parameters such as reaction kinetics, medium selectivity (aqueous vs. lipid phase), concentration-effectiveness ratio, and synergistic interactions with other antioxidants determine the overall efficacy of the compound. Thin-layer chromatography (TLC) and other rapid screening methods are often used to identify the presence and class of antioxidants, such as phenolics or flavonoids, within plant extracts.[18] However, in vitro findings must always be validated under in vivo conditions, as factors such as absorption, metabolism, and excretion significantly influence antioxidant efficacy within living organisms.[19]

In recent decades, increasing attention has been given to the use of herbal medicines and plant-derived antioxidants in managing oxidative stress–related diseases such as eczema. Among these natural agents, *Clitoria ternatea* has emerged as a plant of great pharmacological and therapeutic interest. Commonly known as Butterfly pea, *C. ternatea* is a perennial twining legume belonging to the Fabaceae family and Papilionaceae sub-family, widely distributed in tropical Asia and other warm regions such as South and Central America, China, and India, where it has naturalized extensively.[20] The genus *Clitoria* comprises about 60 species, mostly confined to tropical climates, with *C. ternatea* being the most studied for its medicinal potential. The plant is characterized by its striking blue papilionaceous flowers, infundibular calyx with persistent bracteoles, and distinctive stalked ovaries.[21,22]

Ethnobotanical records highlight the plant's use in traditional medicine for enhancing fertility, reducing menstrual discharge, treating gonorrhea, and stimulating sexual vigor.Fantz documented medicinal and commercial applications of 23 *Clitoria* species, citing their antihelmintic, diuretic, and refrigerant activities. In Indian Ayurveda, *C. ternatea* is widely recognized under names such as Aparajit (Hindi), Aparajita (Bengali), and Kokkattan (Tamil).[23] It also appears in Sanskrit literature under names such as Aparajita, Girikarnu, Asphota, and Vishnukranta, and is known in English as Butterfly Pea or Winged Leaved Clitoria.[24]

Agronomically, *C. ternatea* serves as a valuable multipurpose forage legume due to its high palatability and ability to thrive under diverse tropical conditions.[25] The plant was first reported on Ternate Island in the Moluccas and is now cultivated throughout India and the tropics as an ornamental, medicinal, and fodder crop.[26,27] Its roots improve soil fertility through nitrogen fixation and suppress perennial weeds, making it useful as a green manure and cover crop.[28] Despite its widespread adaptation, no superior grazing cultivars have yet been developed.[29,30]

Medicinally, *C. ternatea* exhibits multiple pharmacological properties, supported by both traditional and modern scientific evidence. The flower extract is used to treat skin conditions, including eczema and wounds, due to its potent antioxidant and anti-inflammatory constituents.[31] The roots have been used for asthma, inflammation, leprosy, leucoderma, pulmonary tuberculosis, and ophthalmic disorders, and act as laxative, diuretic, and aphrodisiac agents.[32] Seeds possess cathartic properties and are beneficial in colic, dropsy, and visceral enlargement.[33] Roots, stems, and flowers are also traditionally used in India to treat snakebites and scorpion stings, reflecting the plant's broad therapeutic range. Extensive research over the past few decades confirms that *C. ternatea* possesses significant antioxidant, anti-inflammatory, and wound-healing activities, which justify its use in topical formulations such as gels for the management of eczema and related oxidative skin conditions.[34]

II. LITERATURE REVIEW

Setyo Nurwaini et al..,2024 *Clitoria ternatea* L. (Telang flower) is valued for its antioxidant properties and potential in topical formulations. Gel formulations offer convenient application and stability of active compounds. Studies incorporating Telang flower extract into Carbopol gels (0.5%, 1%, 2%) showed that the 2% Carbopol gel had optimal physical properties—pH 5.82, viscosity 2,666 cP, spreadability 4.33 cm, and stickiness 2.2 s. DPPH assay revealed strong antioxidant activity with an IC_{50} of 97.72 ppm, indicating that Carbopol concentration affects gel properties without reducing bioactivity. These findings support the use of Telang flower gels as effective natural antioxidant skincare formulations.[35]

Wahyu Setiyaningsih et al..,2024 *Clitoria ternatea* L. (Telang or butterfly pea) flowers are rich in antioxidants that help neutralize free radicals, providing notable anti-aging benefits in cosmetics. Butterfly pea extract, obtained via 70% ethanol maceration, has been successfully incorporated into peel-off gel masks using gelling and film-forming polymers such as PVA and HPMC. Quality evaluations—including pH, viscosity, spreadability, stickiness, drying time, and user preference—demonstrate that polymer concentrations significantly influence the mask's physical properties and performance. Optimizing these polymer levels ensures effective mask functionality while preserving the antioxidant activity of the flower extract.[36]

Sayukta Pahurkar et al..,2023 The global importance of natural medicines has grown due to their therapeutic potential and lower side effects compared to allopathic drugs. *Clitoria ternatea* L. (Fabaceae) has attracted attention for its antimicrobial, antioxidant, and skin-protective properties. Recent studies have formulated herbal gels using methanolic leaf extracts of *C. ternatea* with Carbopol 940, propylene glycol, parabens, glycerine, and water. The gels were evaluated for color, homogeneity, pH, viscosity, and spreadability, ensuring quality and stability. Antimicrobial testing via the agar diffusion method showed enhanced activity, highlighting *C. ternatea* gel formulations as safe, effective, and patient-friendly topical agents for managing microbial infections and promoting skin health.[37]

Zaidan, U.H et al..,2022 Natural antioxidants from *Clitoria ternatea* (butterfly pea) have gained attention for combating oxidative stress, with anthocyanins being the primary bioactive compounds. However, anthocyanins are highly sensitive to temperature, light, pH, and storage, making optimization of extraction and formulation crucial. A recent study examined the effect of sugar on anthocyanin stability and antioxidant capacity in jelly formulations made from dried flowers, comparing extract (E), jelly with sugar (JWS), and jelly without sugar (JWOS) over 11 weeks at 25°C and 4°C. Anthocyanin content decreased in all samples, with the extract showing better stability (56.27 µg/mL to 7.19 µg/mL after 14 days) than the jellies, likely due to processing degradation. In contrast, jelly formulations maintained higher and more stable antioxidant activity. Degradation accelerated at 25°C, affecting color and nutritional value. These results highlight the importance of proper storage and formulation to preserve the functional and aesthetic properties of *C. ternatea* anthocyanins.[38]

Ethel Jeyaseela Jeyarajet al..,2022*Clitoria ternatea* (butterfly pea) is a traditional medicinal herb valued for its vibrant anthocyanin pigments and bioactive properties, including antioxidant, antibacterial, and cytoprotective activities. A recent study developed an efficient method to purify anthocyanin-rich fractions using column chromatography, with Amberlite XAD-16 resin yielding the highest anthocyanin-to-phenolic ratio. LC–MS analysis identified 11 ternatin anthocyanins, confirming chemical diversity. The fraction showed strong antioxidant activity (DPPH IC_{50} = 0.86 ± 0.07 mg/mL), though lower intracellular activity in RAW 264.7 macrophages suggested limited bioavailability. It exhibited significant antibacterial effects against *Bacillus cereus*, *B. subtilis*, and *E. coli*, outperforming crude extracts, but was more cytotoxic to HEK-293 cells, indicating the need for dose optimization. These findings highlight the potential of anthocyanin-rich fractions as natural antioxidants and antibacterial agents for functional foods or nutraceuticals, while further studies are needed to improve safety and stability.[39]

Martyna Zagórska-Dziok etal..,2021 In recent years, natural bioactive ingredients from medicinal plants have gained significant attention for dermatological and cosmetic use. Ayurvedic plant extracts, rich in phytochemicals and antioxidants, have shown strong potential in promoting skin health and treating disorders. Comparative studies revealed that extracts from three Ayurvedic plants exhibited high antioxidant activity, with 76% and 88% inhibition in DPPH and ABTS assays, respectively. They also reduced intracellular ROS and enhanced superoxide dismutase (SOD) activity by 60%, reinforcing cellular antioxidant defense.Beyond antioxidant effects, the extracts showed over 70% inhibition of lipoxygenase and 40% inhibition of collagenase, indicating notable anti-inflammatory and anti-aging potential. Cytoprotective effects on keratinocytes and fibroblasts further support their skin-protective role. HPLC–ESI–MS/MS analysis confirmed diverse bioactive compounds, with *Epilobium angustifolium* L. displaying the strongest therapeutic potential for skincare formulations and treatment of skin disorders.[40]

Nurjamalina Fasihah Jaafar et al..,2020*Clitoria ternatea*, known for its medicinal and nutritional benefits, is rich in phenolic, flavonoid, and anthocyanin compounds, contributing to its strong antioxidant potential. Extraction methods critically influence the concentration and activity of these bioactives. A recent study optimized flower extraction using Response Surface Methodology (RSM) to evaluate ethanol concentration, extraction time, and temperature on total phenolic content (TPC) and DPPH radical-scavenging activity. Optimal conditions—37% ethanol, 90 minutes, 45°C—yielded a TPC of 41.17 ± 0.5 mg GAE/g, DPPH scavenging activity of 63.53 ± 0.95%, total flavonoid content of 187.05 ± 3.18 mg quercetin/g, and total anthocyanin content of 28.60 ± 0.04 mg/L. These results confirm that RSM effectively maximizes extraction efficiency, and that *C. ternatea* is a potent natural antioxidant source suitable for nutraceutical, cosmetic, and pharmaceutical applications.[41]

N Kamkaen et al..,2009*Clitoria ternatea* (butterfly pea) is widely used in Thailand for cosmetic purposes due to its rich phytochemical content and strong antioxidant potential. Studies show that aqueous flower extracts exhibit higher free radical scavenging activity than ethanol extracts, with IC_{50} values of 1 mg/mL and 4 mg/mL, respectively—indicating greater efficacy of water-soluble compounds. When formulated into an eye gel, the extractsmaintained antioxidant activity, though slightly lower than a commercial anti-wrinkle cream. With a total phenolic content of 1.9 mg/g (as gallic acid equivalents), these phenolics are key contributors to the extract's antioxidant effects. Overall, *C. ternatea* extracts serve as promising natural antioxidants for protecting skin from oxidative stress and premature aging.[42]

III. AIM AND OBJECTIVE

AIM

To review the formulate and evaluate a **topical antioxidant gel containing** *Clitoria ternatea* **flower extract** for the management of eczema and improve skin barrier function.

OBJECTIVE

The objectives of the present study are to investigate the disease profile of eczema, emphasizing its etiology, pathophysiology, and the role of oxidative stress in disease progression; to explore the phytochemical composition of *Clitoria ternatea* flowers with a focus on bioactive constituents such as flavonoids, anthocyanins, and triterpenoids that contribute to its therapeutic potential; and to extract and standardize the flower extract of *Clitoria ternatea* using suitable solvent extraction methods to ensure maximum recovery of

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antioxidant compounds for effective formulation development.

IV. MATERIALSANDMETHODS

DISEASE PROFILE

1. Definition
Eczema, also known as *Atopic Dermatitis (AD)*, is a chronic, relapsing, inflammatory skin disorder characterized by intense pruritus, erythema, and dryness of the skin. It is commonly associated with a personal or family history of atopy, including asthma and allergic rhinitis. The condition often begins in infancy but may persist or develop later in life.[43]

2. Epidemiology
Atopic dermatitis affects approximately 10–20% of children and about 10% of adults globally. The prevalence is higher in industrialized and urban populations due to environmental and lifestyle factors. The disease imposes a major psychosocial and economic burden on patients and families due to its chronic and relapsing nature.[44]

Figure: Eczema on skin

3. Etiology
Eczema results from a multifactorial interplay of genetic, immunological, and environmental influences.

- **Genetic factors:** Mutations in the filaggrin (FLG) gene disrupt epidermal barrier function, leading to increased transepidermal water loss and enhanced allergen penetration.
- **Immune dysregulation:** The disease is characterized by a predominance of Th2-type immune responses and elevated levels of cytokines such as IL-4 and IL-13, which drive inflammation and IgE production.
- **Environmental factors:** Climate, pollutants, allergens, and irritants such as detergents and fragrances contribute to disease flares.
- **Microbial factors:** Skin colonization by *Staphylococcus aureus* worsens inflammation and induces further barrier dysfunction
- **Psychological stress:** Emotional stress and anxiety can exacerbate itching and flares. [45]

4. Pathophysiology
Atopic dermatitis is driven by epidermal barrier dysfunction and immune system dysregulation. The defective skin barrier allows entry of allergens and microbes, triggering Th2-mediated inflammation. This leads to increased production of IL-4, IL-5, and IL-13, promoting IgE synthesis and chronic inflammation. Repetitive scratching further damages the barrier, creating an "itch–scratch cycle" that perpetuates the disease. Colonization with *S. aureus* aggravates inflammation by releasing toxins that act as superantigens.[46]

5. Clinical Features
The hallmark feature is intense pruritus, often worse at night
Skin lesions vary depending on disease stage:

- **Acute:** Erythematous papules and vesicles with oozing and crusting.
- **Subacute:** Scaling and excoriations.
- **Chronic:** Lichenified plaques and pigmentation changes.

The distribution changes with age—facial and extensor involvement in infants, flexural surfaces in children, and hand, neck, or generalized lesions in adults. Associated features include xerosis, infraorbital folds, and susceptibility to secondary bacterial or viral infections. Chronic itching may lead to sleep disturbance and psychological stress.

6. Diagnosis

Diagnosis is primarily clinical, based on morphology, distribution, and chronicity of lesions. The **Hanifin and Rajka criteria** remain a standard for research and clinical use. Supporting findings include elevated serum IgE and eosinophilia. Differential diagnoses include contact dermatitis, seborrheic dermatitis, psoriasis, and scabies.[47]

7. Complications

Common complications include secondary bacterial infection, eczema herpeticum, and lichenification due to chronic scratching. Persistent pruritus causes sleep disturbance, anxiety, and depression, significantly impairing quality of life.[48]

8. Treatment

Management is individualized based on disease severity and includes general care, topical therapy, and systemic options.

- **General measures:** Avoiding triggers, maintaining hydration, and using emollients are essential to restore the skin barrier.
- **Topical therapy:** Topical corticosteroids are first-line agents, while calcineurin inhibitors serve as steroid-sparing alternatives. Newer agents like topical PDE-4 inhibitors and JAK inhibitors are promising.
- **Systemic therapy:** For severe or refractory cases, systemic corticosteroids, cyclosporine, methotrexate, or biologics such as dupilumab are used.
- **Phototherapy:** Narrow-band UVB is effective in chronic or widespread eczema.
- **Supportive therapy:** Antihistamines may relieve itching, and antibiotics are used for secondary infections. [49]

PLANT PROFILE:

Clitoria ternatea is also known as blue pea or butterfly pea flower. [50]

A perennial herbaceous creeping plant, the butterfly pea (*Clitoria ternatea L.*) is a member of the Fabaceae family. [51]

SYNONYMS:

Clitoria ternatea–first named by Breyne, butterfly pea[52], Aparajita[53] , Shankhpushpi[54] , bluepea and cordofan-pea[55] is its common name.

Figure no: 01

Figure no: 02

Figure no: 03

Figure no: 04

Figure no 01 - *Clitoria ternatea* Figure no :02 - bud of *Clitoria ternatea*

Figure no 03 - seed pods of *Clitoria ternatea* Figure no 04 – seeds of *Clitoria ternatea*

OTHER NAME:
English: Butterfly pea, Tamil: sangupoo or kokkattan, Hindi:Aparajit , Bengali: Aparajita
BIOLOGICAL SOURCE:
The dried or fresh portions of the plant *Clitoria ternatea*, which is in the Fabaceae family, are used to make *Clitoria ternatea*.

GEOGRAPHICAL SOURCES:
In India, *Clitoria ternatea* is frequently observed growing untamed in bushes and hedges, even at elevations of up to 15 cm. It grows naturally in the Andaman Islands as well. States such as Punjab, Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, and Karnataka can grow this plant as a fodder crop.

TAXONOMY:

Kingdom	Plantae
Subkingdom	Tracheobionta (vascular plants)
Division	Spermatophyta (seed plants)
Class	Magnoliophyta (flowering plants)
Subclass	Magnoliopsida (dicotyledons)
Order	Rosidae
Family	Fabales
Subfamily	Fabaceae (Leguminosae)
Genus	*Clitoria*
Species	*Clitoria ternatea* L.

CHEMICAL CONSTITUENTS:
Clitoria ternatea has excellent nutritional value due to the presence of primary metabolites throughout the plant. The leaves contain 30% crude protein and 14% crude fibre.[56]
Plant seeds have 20% carbohydrates, 7% lipids, and 3% total ash. These primary metabolites play crucial roles as precursors or pharmacologically active metabolites in medicinal drugs. *C.ternatea* contains fatty acids such as stearic, linolenic, palmitic, and oleic acid.[57]
Many studies have focused on bioactive compounds and crude plant extracts, emphasising their potential to replace synthetic antioxidants with natural and effective alternatives. [58]
All parts of the plant—flower, root, stem, seeds, bark, and leaves—are known to produce bioactive compounds. According to studies, *Clitoria ternatea* contains significant phytochemicals as taraxerone and taraxerol.[59]
Phytochemical analysis of different parts of *Clitoria ternatea* revealed the presence of a variety of compounds, including tannins, resins, steroids, flavonoids, saponins, triterpenoids, anthocyanins, xanthenes, and others.[60]

MECHANISMS OF ACTION
Clitoria ternatea (butterfly pea) is traditionally known for its wound-healing and anti-inflammatory properties and has recently gained attention for its potential in dermatological formulations, particularly for managing eczema (atopic dermatitis). The pathophysiology of eczema involves oxidative stress, inflammation, and microbial infection. The bioactive compounds in *C. ternatea*, mainly anthocyanins (ternatins) and flavonoids, target these pathological mechanisms effectively.
The plant's extract exhibits strong antioxidant activity, neutralizing free radicals and reducing reactive oxygen species (ROS)-mediated damage to keratinocytes and fibroblasts in inflamed skin[61]. Its anti-inflammatory effects are mediated by suppression of the nuclear transcription factor NF-κB, inducible nitric oxide synthase (iNOS), and cyclo-oxygenase-2 (COX-2) pathways[62]. These actions reduce the release of pro-inflammatory cytokines such as TNF-α and IL-1β, which are elevated in eczematous skin.
Additionally, *C. ternatea* extract shows membrane-stabilizing and anti-allergic activities, attributed to its flavonoid content that inhibits mast cell degranulation and histamine release[63]. This is crucial for mitigating itching and erythema associated with eczema. Its antimicrobial properties notably against *Staphylococcus aureus* and *Pseudomonas aeruginosa*—help prevent secondary skin infections, a common complication in chronic eczema. [64]

USES:
Root was used to alleviate ascetics, abdominal visceral hypertrophy, sore throats, and skin conditions. They were also employed as a purgative, but were not recommended because to the griping and discomfort they caused.Root was administered with honey and ghee as a general tonic to children to improve their mental faculties. Muscular strength and complexion tonics. Roots were also utilised for epilepsy and insanity. Seeds and leaves were traditionally used as brain tonics to improve memory and intelligence. The juice and petals were used as an antidote for snake bite. Seeds can treat inflamed joints, and crushed seeds can be given with cold or hot water for urinary issues. [65-72]

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PLANT EXTRACT:

Extraction

Dried petals of *C. ternatea* are pulverized and subjected to **maceration or Soxhlet extraction** using ethanol (70–90%) or hydroalcoholic solvents for 6–8 hours. [73] Some studies also use **ultrasound-assisted extraction** to enhance anthocyanin yield. [74] The filtrate is concentrated under reduced pressure using a rotary evaporator, and the crude extract is dried and standardized based on **total anthocyanin content**using the pH differential method. [75]

Formulation Method

Topical gels and creams are the most common formulations developed. In gel formulation, the gelling agent (e.g., Carbopol 940) is dispersed in water, neutralized with triethanolamine to pH 5.5–6.5, and combined with humectants such as glycerin and propylene glycol. The standardized *C. ternatea* extract (1–5 % w/w) is incorporated slowly under continuous stirring until a homogeneous product is obtained. For cream formulations, a conventional oil-in-water (O/W) emulsion method is followed, with the extract added to the aqueous phase after cooling.[76]

EXCIPIENT PROFILE:

Excipient	Role in Formulation
Carbopol 940 / 934	Gelling agent, provides viscosity and texture
HPMC K100M	Alternative polymer for smooth transparent gels
Glycerin / Propylene glycol	Humectant, skin hydration, improves solubility
Triethanolamine (TEA)	Neutralizer to adjust pH 5.5–6.5 (skin-friendly)
Methylparaben + Propylparaben / Phenoxyethanol	Preservatives to inhibit microbial growth
Ascorbic acid / Sodium metabisulfite	Antioxidant stabilizers to protect anthocyanins
Distilled water	Vehicle

EVALUATION

The Physical Appearance of Gel Compositions: Gel compositions were visually assessed for colour, odour, consistency, grittiness, stickiness, and homogeneity.

pH measurement: The pH of the produced gels was measured using a digital pH meter. Before each usage, the pH meter was calibrated using standard buffer solutions at pH 4 and 7.

Viscosity: Viscosity of the prepared gels was measured by a Brookfield viscometer at 100 rpm, using spindle number 6. Viscosities were recorded at room temperature.

Syringeability: To treat severe periodontitis, an injectable method was used to administer a medication directly into the periodontal pocket, providing quick relief. In this view, syringeability of gel compositions was assessed with a 21G needle. [77]

Stability test: The optimized batch's semisolid mucoadhesive dosage form underwent centrifugal, thermal, freeze and thaw, and cooling and heating tests. [77,78]

Spreadability: Dental formulations must be spreadable to ensure patient compliance. A pre-marked circle of 1 cm diameter was used to place approximately 0.5 g of gel on a glass plate, which was then covered by another glass plate. A weight of 100 g was placed on the upper glass plate. The gels increased in diameter as they spread. [78]

Centrifugal test: The formulation's stability was evaluated against centrifugal force after 48 hours of preparation. The formulation was spun at 2000 rpm for 60 minutes using a centrifugal apparatus. Its stability was assessed at various time intervals (5, 15, 30, and 60 minutes).

Thermal test: The formulation's thermal stability was tested after 48 hours of preparation. Three formulation samples were tested at 4°C, 25°C, and 45°C during 24 hours, 1 week, and 1 month.

Freeze And Thaw test: The formulation's stability was tested against temperature changes after 48 hours of preparation. The gel formulation (15 g) was frozen at -8°C for 48 hours, then thawed at 25°C for 48 hours in three cycles.

Homogeneity: Gel compositions were put in a container and visually inspected for homogeneity and aggregates. The gel's appearance was noted. [79]

Grittiness: All produced gel compositions were examined under a microscope for the presence of particles. The gel formulations were observed under a light microscope. If no particle matter is visible under a light microscope, the gel is considered free of grittiness. [79,80]

V. CONCLUSION

Natural resources such as plants have been used since ancient times for their medicinal and therapeutic potential. Clitoria ternatea L. is a well-known medicinal plant rich in phytochemicals such as flavonoids, alkaloids, and anthocyanins, which contribute to its antimicrobial, antioxidant, and anti-inflammatory activities. Incorporating these bioactive constituents into a topical gel formulation enhances their stability, ease of application, and effectiveness in localized therapy.The formulated antimicrobial gel exhibited desirable physicochemical characteristics, including suitable pH, viscosity, spreadability, and consistency—parameters essential for uniform application and optimal skin retention. The gel's formulation ensured adequate drug diffusion and adherence, promoting sustained release of the active phytoconstituents and enhancing antimicrobial efficacy.Based on literature reviews, several studies have reported that the methanolic leaf extract of Clitoria ternatea shows promising antimicrobial activity against various pathogenic microorganisms. These article-based findings support the potential use of Clitoria ternatea-derived gels as effective, safe, and natural alternatives to synthetic antimicrobial formulations. However, further experimental and clinical investigations are recommended to validate these observations and confirm their therapeutic applicability.

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