

# Design And Evaluation Of A Natural Antioxidant Foot Cream With Healing Potential Using Butterfly Pea Flower Extract

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## ABSTRACT

The demand for natural skincare products is. People are looking for solutions that are good for their skin and the environment. One plant that's getting a lot of attention is *Clitoria ternatea*, also known as butterfly pea. This plant has antioxidants, which help protect the skin from damage. The antioxidants in butterfly pea like anthocyanins, flavonoids and phenolic acids have -inflammatory and antimicrobial properties. These properties make the plant a good candidate for skincare products. This study looks at using butterfly pea extract in a foot cream. The goal is to make a cream that's rich in antioxidants and can help with foot problems like dryness and cracking. The researchers started by extracting the stuff from butterfly pea flowers. They tested ways to extract the antioxidants to get the best results. Then they put the extracted antioxidants into a cream that's gentle on the skin. The researchers tested the cream in ways. They checked if it works as an antioxidant if it can fight off germs and if it can help keep skin hydrated. They also tested the creams stability in conditions to make sure it lasts. The results showed that the butterfly pea cream works as an antioxidant and can help with skin hydration. It also got feedback from people who tested it. Compared to antioxidant foot creams on the market the butterfly pea cream seems to be a good alternative. It's eco-friendly. Uses natural ingredients. This study combines herbal remedies with modern skincare needs. The study provides a foundation for plant-based skincare innovations. It shows that natural ingredients, like butterfly pea can be used to make skincare products. The butterfly pea foot cream is a product that can help people take care of their skin in a natural way.

**Keywords:** Clitoria ternatea, butterfly pea, foot cream, antioxidant activity, anthocyanins, antimicrobial, skin hydration skincare.

## INTRODUCTION

The skin, being the largest organ of the human body, serves as the primary protective barrier against external environmental stressors, including ultraviolet (UV) radiation, atmospheric pollutants, microbial pathogens, and chemical irritants. Continuous exposure to these factors generates reactive oxygen species (ROS), leading to oxidative stress that contributes to premature aging, inflammation, impaired barrier function, and various dermatological disorders [1,2]. Such effects are particularly significant in the feet, where the skin is often subjected to friction, dryness, pressure, and neglect in routine skincare practices, resulting in cracking,

irritation, and compromised skin integrity [3]. Antioxidants play a critical role in neutralizing free radicals and reducing oxidative damage by scavenging ROS and preventing lipid peroxidation, protein oxidation, and cellular membrane disruption [4]. Consequently, the incorporation of natural antioxidant agents into topical skincare products has emerged as an important strategy for skin protection, repair, and hydration [5].

In recent years, growing consumer preference for natural, sustainable, and plant-based cosmetic products has driven extensive research into botanical ingredients with proven therapeutic benefits [6]. Among these, *Clitoria ternatea* L., commonly known

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as butterfly pea, has attracted significant attention due to its rich phytochemical composition, particularly anthocyanins, flavonoids, and phenolic acids [7]. These bioactive compounds possess potent

antioxidant, anti-inflammatory, antimicrobial, and wound-healing properties, making the plant a promising candidate for dermatological and cosmetic applications [8].

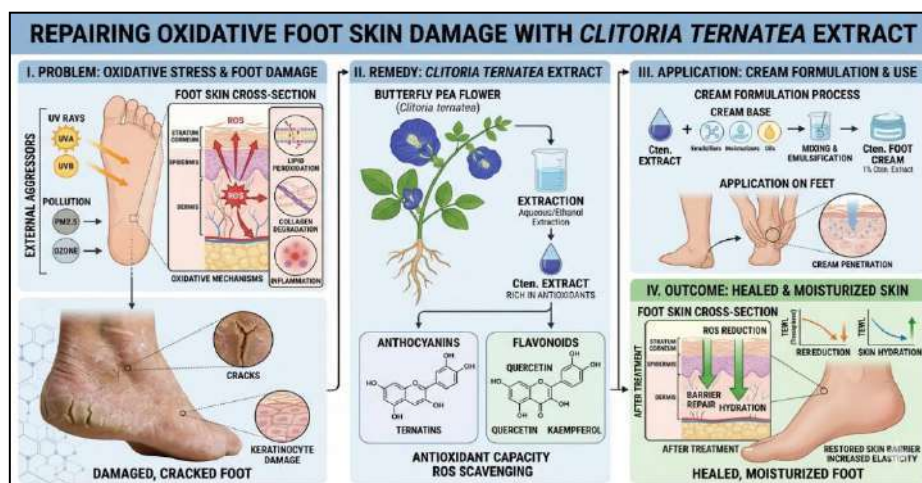


Fig. No. 1 Overview of Design and Evaluation of a Natural Antioxidant Foot Cream.

The vibrant blue petals of *C. ternatea* are especially rich in ternatins, a class of polyacylated anthocyanins known for their strong free radical scavenging activity and protective effects against oxidative stress-induced cellular damage [7,9]. Previous studies have demonstrated that butterfly pea extracts can protect keratinocytes against hydrogen peroxide-induced cytotoxicity and UV-mediated mitochondrial DNA damage, supporting their potential in topical skin formulations [10]. Additionally, topical applications of *C. ternatea* extract have shown promising results in improving collagen preservation, reducing matrix metalloproteinase activity, and promoting skin regeneration [11,12].

Despite its established pharmacological and antioxidant potential, the application of *C. ternatea* in targeted foot care formulations remains relatively underexplored. Therefore, the present study focuses on the formulation and evaluation of an antioxidant healing foot cream incorporating butterfly pea flower extract to provide hydration, nourishment, and protection against oxidative stress-induced skin damage. This work aims to bridge the gap between traditional herbal medicine and modern sustainable skincare product development.

## MATERIALS AND METHODOLOGY

### Materials

The materials used in the formulation and evaluation of the natural antioxidant foot cream included butterfly pea flower extract (Butterfly pea flower) as the principal active ingredient, selected for its antioxidant and healing properties. Aloe vera gel (Aloe vera) was incorporated for its soothing, moisturizing, and wound-healing effects on dry and cracked foot skin, while neem extract (Neem) was added for its antimicrobial and anti-inflammatory properties. The excipients used in the formulation, namely beeswax, liquid paraffin, borax, and methyl paraben, were procured from Research-Lab Fine Chem. Pvt. Ltd., Mumbai, India. Beeswax was used as a stiffening agent, liquid paraffin as an emollient, borax as an emulsifying agent, and methyl paraben as a preservative to improve the stability and shelf life of the cream. All the materials used were of pharmaceutical grade.

## EXPERIMENTAL METHOD

### Extraction of Butterfly Pea Flower Extract

The extraction of bioactive constituents from butterfly pea flowers (Butterfly pea flower) was carried out using the hot water extraction method, which is considered a simple, economical, and efficient technique for the isolation of hydrophilic phytoconstituents, particularly anthocyanins, flavonoids, and phenolic compounds. The use of water as a solvent at elevated temperatures enhances

the solubilization and diffusion of these compounds, thereby improving extraction yield while maintaining the natural and non-toxic nature of the extract.

Fresh butterfly pea flowers were initially washed thoroughly with purified water to remove adhering dust, dirt, and other extraneous matter. The cleaned flowers were then air-dried under shade at room temperature until complete removal of moisture was achieved. The dried floral material was subsequently coarsely powdered using a mortar and pestle to increase the surface area for efficient extraction.

A measured quantity of the powdered plant material (10–50 g) was transferred into a clean beaker, and distilled water was added in a 1:10 (w/v) ratio. The mixture was subjected to heating at 70–90°C using a hot plate or water bath and maintained at this temperature range for 30–60 min with intermittent stirring to ensure uniform extraction of the phytoconstituents. Care was taken to avoid excessive heating in order to minimize degradation of thermolabile compounds.

After completion of the extraction process, the mixture was allowed to cool to room temperature and subsequently filtered through Whatman filter paper to separate the liquid extract from the residual plant material. The obtained filtrate was then concentrated using a rotary vacuum evaporator to remove excess water and obtain a concentrated extract. In the absence of a rotary evaporator, the extract may be gently concentrated by controlled heating at low temperature to preserve the stability of the bioactive compounds.

The concentrated extract was transferred into sterile amber-colored glass bottles to protect it from light-induced degradation and oxidative damage. The prepared extract was stored at 4°C for short-term use, while long-term storage was carried out under frozen conditions until further formulation studies [13].

### **Preparation of Antioxidant Healing Foot Cream**

The antioxidant healing foot cream was made using a standard oil-in-water (O/W) emulsion method. To make the oil phase, liquid paraffin and beeswax were carefully weighed and put into a clean beaker. The beaker was then heated to 70–75°C until the wax and paraffin were completely melted, which made a clear

and homogeneous phase. At the same time, the aqueous phase was made by mixing borax and methyl paraben in a separate beaker with the right amount of distilled water and then heating it to the same temperature range (70–75°C) to keep the two phases compatible while they were emulsifying.

Then, while stirring with a mechanical stirrer, the hot oil phase was slowly added to the water phase. The temperature was kept between 70 and 75 degrees Celsius to help the emulsification process. The mixture was stirred constantly and allowed to cool slowly to about 40°C, which made a stable emulsion system. At this point, the active ingredients were added with gentle stirring to make sure they were evenly mixed and to keep thermolabile phytoconstituents from breaking down. These ingredients included butterfly pea flower extract (Butterfly pea flower), aloe vera gel (Aloe vera), and neem extract (Neem).

Then, more methyl paraben (if needed for preservation) and fragrance (rose water, q.s.) were added to the mix at a lower temperature of 30–35°C. The mixture was then stirred constantly until it became a smooth, even cream. The final formulation was then put into sterile, airtight containers and kept at room temperature for more testing [14].

### **Evaluation of Antioxidant Healing Foot Cream**

The prepared antioxidant healing foot cream was evaluated for various physicochemical and performance parameters to ensure its quality, stability, safety, and user acceptability. The formulation was initially assessed for its organoleptic properties, including colour, odour, and texture, by visual and tactile examination to confirm uniformity and aesthetic acceptability. The pH of the cream was determined using a calibrated digital pH meter after dispersing the formulation in distilled water, ensuring that it remained within the physiological skin range (4.5–6.5) to prevent irritation and maintain skin compatibility [15]. The viscosity of the formulation was measured using a Brookfield viscometer under controlled conditions, as it plays a crucial role in determining the flow behavior, consistency, and overall stability of the cream.

Furthermore, spreadability was evaluated using the parallel plate method by measuring the time required

for two glass slides to separate under a specified load, which indicates the ease of application and uniform distribution over the skin surface. The moisturizing efficacy of the cream was assessed based on its ability to enhance skin hydration and reduce trans-epidermal water loss, attributed to the presence of emollients and humectants that improve skin barrier function. The skin irritation test was performed by applying the formulation to a small area of skin and observing for any signs of erythema, edema or adverse reactions, thereby confirming its dermatological safety.

In addition, washability of the cream was evaluated by determining the ease with which it could be removed with water after application, reflecting its user-friendliness and practicality. Finally, greasiness was assessed through tactile evaluation after topical application to ensure that the formulation provided adequate moisturization without leaving an undesirable oily residue, thereby enhancing patient compliance and cosmetic acceptability.

## RESULTS AND DISCUSSION

The prepared antioxidant healing foot cream was evaluated for various physicochemical and performance parameters to ensure its quality, stability, safety, and user acceptability.



**Fig. No. 2 Spreadability Measurement**

The formulation was initially assessed for its organoleptic properties, including colour, odour, and texture, by visual and tactile examination to confirm uniformity and aesthetic acceptability. The pH of the cream was determined using a calibrated digital pH meter after dispersing the formulation in distilled water, ensuring that it remained within the physiological skin range (4.5–6.5) to prevent irritation and maintain skin compatibility. The viscosity of the formulation was measured using a Brookfield viscometer under controlled conditions, as it plays a

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**Fig. No. 3 Viscosity Measurement**

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**Fig. No. 4 pH Measurement.**

The results obtained for the three formulations (F1, F2, and F3) demonstrated acceptable physicochemical and performance characteristics. In terms of organoleptic properties, F1 exhibited a whitish appearance, F2 showed a faint blue colour, and F3 appeared greenish, while all formulations possessed a pleasant odour and smooth texture, indicating good uniformity. The pH values were found to be 7.12 for F1, 8.0 for F2, and 6.65 for F3, suggesting that F3 was closest to the physiological skin pH range.

The viscosity values were recorded as 11278 cps (F1), 13581 cps (F2), and 12333 cps (F3), indicating appropriate consistency for topical application.



**Fig. No. 5 F-3 Batch of Cream.**

The spreadability of the formulations was found to be 4.16 cm/s for F1, 3.57 cm/s for F2, and 2.5 cm/s for F3, suggesting that F1 exhibited superior spreadability compared to the other formulations. All formulations showed efficient moisturizing efficacy, indicating their ability to enhance skin hydration. The skin irritation study revealed that all formulations were non-irritant, confirming their safety for topical use. Additionally, all formulations were easily washable, demonstrating good user convenience, and were found to be non-greasy, indicating better cosmetic acceptability. Overall, among the tested formulations, F3 showed better compatibility in terms of pH, while F1 demonstrated superior spreadability, and all formulations were found to be stable, safe, and suitable for topical application.

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