

Formulation And Evaluation Of Colour Changing Glycerine Soap Using Butterfly Pea Flower Extract For Pediatric Use

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ABSTRACT

The present study aimed to formulate and evaluate a colour changing herbal glycerine soap using Butterfly Pea Flower (*Clitoria ternatea*) extract for pediatric use. The increasing demand for natural and skin-friendly cosmetic products has encouraged the development of herbal formulations free from harsh synthetic chemicals. Butterfly Pea Flower is rich in anthocyanins, flavonoids, and phenolic compounds that exhibit antioxidant, antimicrobial, and anti-inflammatory properties, making it a promising ingredient for pediatric skincare formulations. Three different formulations (F1, F2, and F3) were prepared using varying concentrations of Butterfly Pea Flower extract, aloe vera gel, coconut oil, glycerin, rose oil, and vitamin E in a glycerine soap base. The soap formulations were evaluated for physicochemical and organoleptic parameters including appearance, color, odor, pH, washability, rancidity, skin irritation, and loss on drying (LOD). Preliminary phytochemical screening confirmed the presence of bioactive constituents such as flavonoids, alkaloids, terpenoids, proteins, resins, carbohydrates, and antioxidants in the herbal extract. The formulated soaps exhibited satisfactory characteristics with pleasant odor, smooth texture, good homogeneity, and acceptable pH suitable for delicate pediatric skin. No irritation or rancidity was observed in any formulation. Among the prepared formulations, F2 showed optimum stability and desirable physicochemical properties. Stability studies carried out for three months under accelerated conditions demonstrated no significant changes in appearance, pH, odor, or hardness, confirming the stability of the formulation. The study concluded that the formulated colour changing herbal glycerine soap was safe, mild, stable, and effective for pediatric skincare. The incorporation of Butterfly Pea Flower extract and other herbal ingredients provided moisturizing, antioxidant, soothing, and cleansing benefits, making the formulation a promising natural alternative for infant and child skincare applications.

Keywords: Butterfly Pea Flower, *Clitoria ternatea*, Herbal Soap, Glycerine Soap, Pediatric Skincare, Antioxidant, Herbal Cosmetics, Colour Changing Soap.

INTRODUCTION

The skin is the largest and one of the most vital organs of the human body, functioning as the primary protective barrier against environmental pollutants, microorganisms, ultraviolet radiation, and physical injuries. It also plays an important role in maintaining body temperature, preventing water loss, and providing sensory perception [1,2]. Structurally, the skin is composed of three major layers namely the epidermis, dermis, and hypodermis. Depending on its texture and physiological characteristics, skin can be classified into different types such as normal, dry, oily, combination, sensitive, and baby skin. Among these, baby skin is highly delicate, thin, and sensitive, making it more prone to irritation, dryness, and microbial infections. Therefore, the selection of safe

and mild skincare products is especially important for pediatric use [3].

Soap is one of the most commonly used cleansing agents for maintaining skin hygiene. However, conventional soaps available in the market often contain synthetic detergents, artificial fragrances, preservatives, and harsh chemicals that may damage the natural skin barrier and cause irritation, especially in infants and children. In recent years, there has been increasing interest in herbal and natural skincare formulations due to their safety, biocompatibility, and eco-friendly nature. Herbal soaps are prepared using plant-derived oils, natural colorants, herbal extracts, and essential oils, which provide therapeutic and cosmetic benefits without causing harmful side effects. These soaps are biodegradable,

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environmentally friendly, and suitable for sensitive skin types [4,5].

Among various medicinal plants, *Clitoria ternatea* L., commonly known as Butterfly Pea Flower, has gained considerable attention because of its medicinal, nutritional, and cosmetic applications. It belongs to the family Fabaceae and is widely cultivated in countries such as India, Thailand, Malaysia, Indonesia, and Vietnam. The flower is rich in bioactive phytoconstituents including anthocyanins (ternatins), flavonoids, alkaloids, saponins, and phenolic compounds. Anthocyanins are natural pigments responsible for the characteristic blue color of the flower and exhibit pH-sensitive color-changing properties. These compounds also possess strong antioxidant activity that helps protect the skin from oxidative stress and free radical damage. In addition, Butterfly Pea Flower exhibits anti-inflammatory, antimicrobial, neuroprotective, and antidiabetic properties, making it a promising ingredient for herbal cosmetic formulations [6].

The incorporation of Butterfly Pea Flower extract into glycerine soap offers several advantages for pediatric skincare. Glycerine soap is known for its mild cleansing action, moisturizing effect, and ability to retain skin hydration. The addition of Butterfly Pea Flower extract not only enhances the antioxidant and antimicrobial potential of the soap but also imparts an attractive natural color-changing property due to the presence of anthocyanins. This color transformation occurs in response to changes in pH and can provide an innovative and appealing feature for children, thereby improving user acceptance and encouraging healthy hygiene practices [7].

The present study focuses on the formulation and evaluation of a color-changing glycerine soap using Butterfly Pea Flower extract for pediatric use. The objective of this research is to develop a mild, safe, and skin-friendly herbal soap suitable for delicate baby skin while utilizing the therapeutic benefits of natural ingredients. The formulated soap was evaluated for various physicochemical parameters such as pH, foam stability, hardness, appearance, and skin compatibility to ensure its suitability, safety, and effectiveness for pediatric application.

Experimental:

Materials:

The materials used in the formulation of colour changing glycerine soap using Butterfly Pea Flower extract for pediatric use were selected based on their safety, skin compatibility, moisturizing ability, and therapeutic benefits. All ingredients used in the study were of cosmetic or analytical grade.

Methods:

Preparation of Butterfly Pea Flower Extract

Fresh flowers of *Clitoria ternatea* (Butterfly Pea Flower) were collected and washed thoroughly with clean water to remove dust and impurities. About 100 mL of distilled water was taken in a beaker and heated to boiling temperature. The cleaned flowers were added to the boiling water and heated for 10–15 minutes to extract the natural blue pigment and phytoconstituents present in the flowers. After extraction, the solution was allowed to cool to room temperature and then filtered using filter paper to remove solid residues. The obtained filtrate containing Butterfly Pea Flower extract was collected and stored in a clean, airtight container for further use in soap formulation [8].

Preparation of Herbal Glycerine Soap

Approximately 50 g of glycerine soap base was cut into small pieces to facilitate easy melting. The soap base was then melted using a double boiler method with continuous stirring to obtain a uniform molten mixture. Care was taken to avoid overheating in order to preserve the transparency and quality of the soap base. After complete melting, the herbal ingredients were added gradually with continuous stirring. About 5 mL of Butterfly Pea Flower extract was incorporated as a natural colorant and antioxidant agent. Subsequently, 5 mL of aloe vera gel extract was added to provide moisturizing and soothing effects to the skin. To improve nourishment, cleansing ability, and skin hydration, 10 mL of coconut oil was mixed into the formulation. In addition, 5 mL of glycerin was added to enhance softness and moisture retention properties of the soap.

Further, Vitamin E capsules were cut open and their contents were added as an antioxidant and skin nourishing agent. Approximately 2–3 mL of rose oil

was incorporated to provide a mild and pleasant fragrance suitable for pediatric use. The entire mixture was stirred continuously until a homogeneous and uniform solution was obtained, while minimizing bubble formation to maintain a smooth appearance. The prepared liquid soap mixture was then carefully poured into clean and dry soap molds and kept undisturbed at room temperature for proper setting.

The soap was allowed to cool and solidify completely for several hours. After complete hardening, the soap bars were gently removed from the molds. Finally, the prepared herbal glycerine soap bars were wrapped in butter paper or aluminum foil and stored in a cool and dry place until further evaluation studies were carried out [9].

Table 1: Formulation Composition of Colour Changing Herbal Glycerine Soap

Sr. No.	Ingredients	F1	F2	F3	Uses
1	Soap Base	50 g	45 g	53 g	Base material
2	Butterfly Pea Flower Extract	5 mL	4 mL	7 mL	Antioxidant, antimicrobial activity
3	Aloe Vera Gel Extract	5 mL	4 mL	8 mL	Anti-inflammatory activity, moisturizer
4	Rose Oil	9.5 mL	10 mL	8 mL	Fragrance
5	Glycerin	5 mL	6 mL	4 mL	Moisturizer and hydration
6	Coconut Oil	10 mL	8 mL	11 mL	Nourishment and skin hydration
7	Vitamin E	2 capsules	3 capsules	2 capsules	Antioxidant
	Total	50 ml	50 ml	50 ml	

EVALUTION OF HERBAL BABY SOAP [10]

1. Physical Appearance

The prepared soap was visually examined for: Colour, Shape, Texture, Transparency

2. pH Determination

Dissolve 1 g of soap in 10 mL distilled water. Measure pH using a pH meter or pH paper.

3. Foam Height Test

Dissolve 1 g soap in 50 mL distilled water in a measuring cylinder. Shake vigorously for 1 minute. Measure foam height immediately.

4. Foam Retention / Stability Test

After foam height measurement, allow the cylinder to stand for 5 minutes. Measure remaining foam height.

5. Hardness Test

Soap hardness was checked manually by pressing with fingers. Hardness tester may also be used if available.

6. Moisture Content

Weigh a small quantity of soap Dry in hot air oven at 105°C until constant weight obtained.

7. Total Fatty Matter (TFM)

Determined by standard analytical method.

8. Skin Irritation Test

Apply small amount of soap solution on skin. Observe for redness, itching, or irritation for 24 hours.

9. Cleansing Ability

Soap was applied on skin and washed with water. Cleansing effect and ease of washing were observed.

10. Spreadability / Texture

Texture and smoothness were checked manually.

RESULT AND DISCUSSION

Evaluation of Antioxidant-Rich Herbal Baby Soap

Three different formulations (F1, F2, and F3) of colour changing herbal glycerine soap were prepared using varying concentrations of herbal ingredients. The prepared formulations were evaluated for various physicochemical and organoleptic parameters such as appearance, color, odor, homogeneity, irritation, washability, pH, loss on drying (LOD), and rancidity. The formulations showed satisfactory characteristics suitable for pediatric use.

Phytochemical Class	Test Name	Procedure	Positive Observation	Inference
Carbohydrates	Benedict's Test	Take 2 mL of extract and add 2 mL of Benedict's reagent. Heat in a boiling water bath for 5 minutes.	Formation of green, yellow, or brick-red precipitate	Presence of reducing sugars
Flavonoids	Alkali Test	Add few drops of sodium hydroxide solution to the extract followed by dilute acid.	Intense yellow color that becomes colorless after adding acid	Presence of flavonoids
Terpenoids / Steroids	Salkowski Test	Mix 2 mL of extract with 2 mL of chloroform and carefully add concentrated sulfuric acid along the side of the test tube.	Reddish-brown coloration at the interface	Presence of terpenoids/steroids
Proteins	Millon's Test	Add 2 mL of Millon's reagent to 2 mL of extract and heat gently.	White precipitate turning red on heating	Presence of proteins
Antioxidants	DPPH Test	Mix extract with DPPH solution and incubate.	Purple color decreases or becomes yellowish	Presence of antioxidant activity
Resins	Stainy Test	Dissolve extract in acetic anhydride and carefully add concentrated sulfuric acid.	Violet or blue coloration	Presence of resins
Alkaloids	Dragendorff's Test	Add few drops of Dragendorff's reagent to the acidic extract solution.	Orange or reddish-brown precipitate	Presence of alkaloids

Table 2: Preliminary Phytochemical Screening of Herbal Extracts

Parameters	F1	F2	F3
Appearance	Solid bar	Solid bar	Solid bar
Color	Light Purple	Light Purple	Light Purple
Odor	Pleasant	Pleasant	Pleasant
Homogeneity	Good	Good	Good
Consistency	Smooth	Smooth	Smooth
Texture	Soft and uniform	Soft and uniform	Soft and uniform

Table 3: Organoleptic Characteristics of Prepared Herbal Soap

Sr. No.	Parameters	F1	F2	F3
1	Washability	Good	Good	Good
2	pH	5.5	5.4	5.5
3	Rancidity	No rancidity	No rancidity	No rancidity
4	Viscosity (cP)	15.1	17.8	19.5
5	Loss on Drying (LOD %)	0.60	0.45	0.50
6	Skin Irritation	No	No	No

Table 4: Evaluation Parameters of Prepared Colour Changing Glycerine Soap

The prepared formulations exhibited acceptable physicochemical and organoleptic properties. The color intensity increased with increasing concentration of Butterfly Pea Flower extract due to the presence of anthocyanins. All formulations showed good homogeneity, pleasant odor, smooth texture, and satisfactory washability. The pH values were found to be within the suitable range for pediatric skin, indicating mildness and skin compatibility. No irritation or rancidity was observed in any formulation, confirming the stability and safety of the herbal soap. Preliminary phytochemical screening confirmed the presence of important bioactive compounds such as flavonoids, alkaloids,

terpenoids, proteins, and antioxidants, which may contribute to the therapeutic and protective effects of the formulated soap.

Stability Study:

The stability of the formulated herbal soap was evaluated over a period of three months under ICH guidelines at $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ / $75 \pm 5\%$ RH. The formulations were stored properly, and samples were analyzed at 0 months (initial) and 3 months for appearance, pH and viscosity to assess any physicochemical changes.

Sr. No.	Parameters	F2 (0 Month)	F2 (3 Month)	Results
1	Appearance	Light purple colour	Light purple colour	Stable colour
2	pH	5.55 ± 0.1	5.54 ± 0.2	Within acceptable limits
3	Hardness	Good	Good	No significant change
4	Odor	Pleasant	Pleasant	Stable fragrance
5	Rancidity	Absent	Absent	No rancidity observed

Table 5: Stability Study of Optimized Formulation (F2)

The F2 formulation retained its clarity and blue colour throughout the three-month stability study, indicating the absence of significant degradation or precipitation. A slight variation in pH was observed during the study period; however, the pH remained within the acceptable range suitable for pediatric skin and did not affect the overall stability of the formulation. No noticeable changes in appearance, odor, texture, or washability were observed during storage. Furthermore, no signs of rancidity or phase separation were detected, confirming the physical and chemical stability of the formulation. These findings indicate that the F2 batch remained stable under storage conditions for three months and maintained its suitability for topical pediatric application.

CONCLUSION

From the present study, it can be concluded that the formulated colour changing herbal glycerine soap using Butterfly Pea Flower extract was found to be safe, mild, effective, and suitable for delicate pediatric skin. The incorporation of natural ingredients such as Butterfly Pea Flower extract, aloe vera gel, coconut oil, glycerin, and vitamin E contributed significant moisturizing, antioxidant, soothing, and cleansing properties to the formulation. The prepared soap exhibited satisfactory physicochemical characteristics including appropriate pH, good washability, absence of rancidity, and non-irritant nature, indicating good skin compatibility and stability. Furthermore, the use of herbal and natural ingredients in place of harsh synthetic chemicals minimized the chances of skin irritation, dryness, and adverse reactions. Therefore, the formulated herbal glycerine soap can be considered a promising and skin-friendly alternative for pediatric skincare applications.

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