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Formulation and evaluation of herbal anti-tanning cream containing *Curcuma longa* extract

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Abstract

Skin tanning caused by prolonged exposure to ultraviolet (UV) radiation is a common dermatological concern. Conventional anti-tanning products often contain synthetic chemicals that may cause skin irritation and other adverse effects. Therefore, the present study aimed to formulate and evaluate a herbal anti-tanning cream using natural ingredients such as turmeric extract, coffee extract, aloe vera gel, rose extract, cocoa butter, coconut oil, beeswax, glycerine, vitamin E, and methyl paraben. The cream was prepared using an oil-in-water (O/W) emulsification technique. Four formulations (F1–F4) were developed by varying the concentrations of herbal extracts. The prepared creams were evaluated for physicochemical parameters including appearance, pH, homogeneity, spreadability, washability, viscosity, skin irritation, and stability. Among all formulations, F3 exhibited optimum characteristics with a pH of 5.8, good spreadability (6.8 g-cm/sec), excellent homogeneity, and no signs of irritation. Stability studies revealed that the formulation remained stable without phase separation or significant changes in color or odor. The results indicate that the developed herbal anti-tanning cream is safe, stable, and effective for cosmetic applications and may serve as a natural alternative to synthetic anti-tanning products.

Keywords: Herbal Cosmetics; Anti-Tanning Cream; Turmeric Extract; Aloe Vera; Cosmetic Formulation; Skin Care

1. Introduction

The skin is the largest and one of the most important organs of the human body, functioning as a protective barrier between the internal tissues and the external environment. In addition to protection, the skin performs several essential physiological roles, including regulation of body temperature, sensory perception, immune defense, and synthesis of vitamin D. Maintaining healthy skin is therefore essential for overall well-being and protection against environmental damage.

Structurally, the skin consists of three primary layers: the epidermis, dermis, and hypodermis. The epidermis forms the outermost layer and serves as the first line of defense against physical, chemical, and microbial factors present in the environment. Within this layer are melanocytes, specialized cells responsible for the production of melanin, the pigment that determines skin color. Melanin also plays an important role in protecting the skin by absorbing and dispersing harmful ultraviolet (UV) radiation. However, excessive production of melanin can lead to increased skin pigmentation, commonly observed as tanning or hyperpigmentation.

Among the various environmental factors affecting skin health, ultraviolet radiation is considered one of the most significant contributors to skin damage and tanning. The UV radiation reaching the Earth's surface mainly consists of UVA and UVB rays. UVA radiation penetrates deeper into the skin layers and is associated with immediate tanning as

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well as premature skin aging, whereas UVB radiation primarily affects the outer layers of the skin and is responsible for sunburn and delayed pigmentation. Continuous exposure to these radiations may lead to several dermatological issues such as uneven skin tone, loss of elasticity, wrinkle formation, and increased risk of certain skin disorders.

To minimize these effects, topical cosmetic products such as anti-tanning creams are widely used. These formulations are designed to reduce the appearance of tanning, control excessive pigmentation, and improve the overall appearance of the skin. Anti-tanning preparations may function through different mechanisms, such as reducing melanin formation by inhibiting enzymes involved in pigment production, providing antioxidant protection against oxidative stress, and maintaining adequate hydration of the skin.

Many commercially available cosmetic products contain synthetic chemical agents such as hydroquinone, corticosteroids, and other depigmenting compounds. Although these substances may provide rapid results, prolonged or excessive use may cause adverse reactions including skin irritation, allergic responses, and long-term skin damage. Growing awareness of these potential risks has increased consumer interest in cosmetic products formulated with natural ingredients.

Herbal cosmetics are increasingly preferred because of their safety and natural origin. Plant-derived ingredients contain a variety of bioactive compounds such as flavonoids, phenolic substances, vitamins, and essential oils that exhibit antioxidant, anti-inflammatory, and protective properties. These phytochemicals can support skin health, reduce oxidative damage, and help improve overall skin appearance.

Environmental stressors such as ultraviolet radiation, pollution, and other external factors can lead to the formation of free radicals in skin cells. These unstable molecules may damage cellular components, accelerate the aging process, and stimulate excessive melanin synthesis. Natural ingredients with antioxidant properties are capable of neutralizing free radicals, thereby protecting the skin from oxidative stress and minimizing tanning effects.

Turmeric (*Curcuma longa*) is a well-known medicinal plant traditionally used in various systems of medicine, particularly in Ayurveda. Its major active component, curcumin, has been reported to possess antioxidant, anti-inflammatory, and antimicrobial activities. In addition, curcumin may contribute to the reduction of skin pigmentation by influencing the processes involved in melanin production. Coffee extract is another natural ingredient that contains caffeine and polyphenolic compounds, which provide antioxidant benefits and may assist in protecting the skin from UV-induced damage.

Other natural ingredients such as aloe vera and vitamin E further enhance the benefits of topical cosmetic formulations. Aloe vera is widely recognized for its soothing, moisturizing, and healing properties, making it beneficial for skin exposed to sunlight. Vitamin E acts as a lipid-soluble antioxidant that helps protect cell membranes from oxidative damage while supporting skin softness and elasticity. When incorporated together in a topical formulation, these ingredients may act synergistically to provide improved skin protection and cosmetic benefits.

Considering these advantages, the development of a herbal anti-tanning cream using turmeric extract along with other natural components represents a promising approach for producing a safe and effective cosmetic formulation. Such a preparation may help reduce tanning, protect the skin against environmental stress factors, and contribute to maintaining healthy and radiant skin.

Objective of the study

- To develop a herbal anti-tanning cream using turmeric extract and other natural ingredients suitable for topical application.
- To prepare different formulations of the cream by varying the concentration of herbal components.
- To evaluate the prepared formulations for physicochemical characteristics such as pH, homogeneity, spreadability, viscosity, and washability.
- To examine the safety of the developed formulation through skin irritation testing.
- To assess the stability of the prepared cream under different storage conditions.

2. Material and methods

2.1. Materials

The materials used for the preparation of the herbal anti-tanning cream were selected based on their cosmetic benefits, safety, and compatibility with skin.

Table 1 Ingredients used in herbal anti tanning cream

Sr. No	Common name	Botanical name	Family	Part used	Advantage	Disadvantage	Objective
1	Turmeric	<i>Curcuma longa</i>	Zingiberaceae	Rhizome	Antioxidant, anti-inflammatory and anti-pigmentation properties; reduces melanin synthesis	May stain skin/clothing; possible irritation in sensitive skin	Reduce tanning and improve complexion
2	Coffee	<i>Coffea arabica</i>	Rubiaceae	Seeds (Beans)	Antioxidant; improves blood circulation	Possible mild irritation at high concentration	Provide antioxidant protection and reduce pigmentation
3	Aloe Vera	<i>Aloe barbadensis</i>	Asphodelaceae	Leaf gel	Soothing, moisturizing, anti-inflammatory; supports wound healing	Rare allergic reactions; high water content may affect stability	Moisturize and soothe sun-exposed skin
4	Rose	<i>Rosa damascena</i>	Rosaceae	Flower petals	Mild astringent and soothing effect; pleasant fragrance	Fragrance components may cause sensitivity	Provide soothing effect and natural fragrance
5	Cocoa Butter	<i>Theobroma cacao</i>	Malvaceae	Seeds (Cocoa beans)	Excellent emollient; softens skin; improves cream texture	Heavy texture may clog pores in acne-prone skin	Enhance consistency and moisturization
6	Coconut Oil	<i>Cocos nucifera</i>	Arecaceae	Kernel (Oil)	Strong moisturizing effect	May be comedogenic for oily skin	Improve hydration and spreadability
7	Beeswax	<i>Apis mellifera</i>	Apidae	Honeycomb wax	Natural thickener and stabilizer; forms protective barrier	Excess may make cream too thick; rare allergies	Provide semi-solid consistency and stability
8	Glycerine	<i>Glycerol</i>	—	—	Humectant that attracts moisture and improves skin softness	Excess use may cause stickiness	Maintain skin hydration

9	Vitamin E	<i>Tocopherol</i>	—	—	Lipid-soluble antioxidant; protects skin from oxidative damage	High concentration may irritate sensitive skin	Improve antioxidant protection and formulation stability
10	Methyl Paraben	<i>Methyl parahydroxybenzoate</i>	—	—	Preservative	Possible sensitivity	Extend shelf life and prevent contamination

2.2. Method of Preparation

The herbal anti-tanning cream was formulated using an oil-in-water (O/W) emulsification technique, which is commonly applied in the preparation of topical creams.

2.2.1. Step 1: Preparation of the Oil Phase

Measured quantities of cocoa butter, coconut oil, and beeswax were taken and heated together at approximately 70°C until all the ingredients melted completely and formed a uniform oily mixture.

2.2.2. Step 2: Preparation of the Aqueous Phase

In a separate container, aloe vera gel, glycerine, rose extract, and methyl paraben were dissolved in distilled water. The mixture was then heated to the same temperature as the oil phase to maintain uniformity during emulsification.

2.2.3. Step 3: Formation of the Emulsion

The aqueous phase was gradually incorporated into the oil phase while continuously stirring the mixture. This process was continued until a smooth and stable emulsion was obtained.

2.2.4. Step 4: Incorporation of Herbal Ingredients

Once the emulsion cooled slightly, turmeric extract, coffee extract, and vitamin E were added to the mixture and blended thoroughly to ensure uniform distribution of the active components.

2.2.5. Step 5: Packaging and Storage

The prepared cream was carefully transferred into clean, dry containers and stored at room temperature for further evaluation and stability studies.

2.3. Formulation composition

Table 2 Composition of F1 F2, F3 and F4 (Grams)

S. No.	Ingredients	F1 (g)	F2 (g)	F3 (g)	F4 (g)	Functions
1.	Turmeric Extract	1	1	1.5	2	Skin brightening /Anti-tanning agent
2.	Coffee Extract	1	1.5	1.5	2	Antioxidant
3.	AloeVera Gel	5	6	7	8	Moisturizer /Skin soothing
4.	Rose Extract	1	1	1	1	Cooling agent/ Skin toner
5.	Cocoa Butter	5	5	6	6	Emollient/ Moisturizing base
6.	Coconut Oil	5	6	6	7	Skin conditioning agent
7.	Beeswax	3	3	4	4	Thickening agent/ Emulsifier
8.	Glycerine	4	4	5	5	Humectant
9.	Vitamin E	0.5	0.5	0.5	0.5	Antioxidant /Skin protection
10.	Methyl paraben	0.2	0.2	0.2	0.2	Preservative

2.4. Evaluation of Formulation

2.4.1. Physical Evaluation

The prepared cream was examined for color, odor, texture, and homogeneity.

2.4.2. pH Determination

One gram of cream was dissolved in 100 ml distilled water and the pH was measured using a digital pH meter.

2.4.3. Spreadability Test

Spreadability was determined using the glass slide method.

Formula:

$$S = M \times L / T$$

Where

- S = Spreadability
- M = Weight tied to upper slide
- L = Length of slide
- T = Time taken to separate slides

2.4.4. Viscosity Measurement

Viscosity was measured using a Brookfield viscometer.

2.4.5. Washability Test

The cream was applied to the skin and washed with water to observe ease of removal.

2.4.6. Skin Irritation Test

A small amount of cream was applied to the skin patch and observed for redness, itching, or irritation for 24 hours.

2.4.7. Stability Studies

The prepared formulations were stored under different temperature conditions such as room temperature, refrigeration, and 40°C to observe changes in color, odor, pH, and phase separation.

3. Results and Discussion

Table 3 Evaluation table

s. no.	Evaluation Parameter	F1	F2	F3	F4
1	Colour	Light yellow	Light yellow	Light yellow	Slightly dark yellow
2	Odour	Pleasant	Pleasant	Pleasant	Strong herbal odour
3	Appearance	Smooth	Smooth	Smooth	Slightly thick
4	Homogeneity	Good	Good	Excellent	Good
5	pH	5.6	5.7	5.8	6.0
6	Spreadability (g·cm/sec)	5.8	6.2	6.8	5.5
7	Washability	Easily washable	Easily washable	Easily washable	Slightly oily residue
8	Skin irritation test	No irritation	No irritation	No irritation	No irritation
9	Stability (30 days)	Stable	Stable	Highly stable	Slightly viscosity change

Among the developed formulations (F1–F4), formulation **F3** demonstrated the most satisfactory performance during the evaluation process. The cream showed a smooth and uniform consistency with good homogeneity and an appealing appearance, without any visible lumps or signs of phase separation. The pH of formulation F3 was measured to be **5.8**, which falls within the normal pH range of human skin and is therefore considered appropriate for topical application.

The formulation also exhibited good spreadability, suggesting that the cream can be easily applied and evenly distributed across the skin surface. Furthermore, it was readily washable and did not produce any signs of irritation during testing. Stability studies indicated that the formulation remained stable throughout the storage period, with no

noticeable changes in color, odor, or texture. Based on these observations and evaluation parameters, formulation F3 was identified as the optimized formulation of the herbal anti-tanning cream

4. Conclusion

The present investigation focused on the development and assessment of a herbal anti-tanning cream prepared using naturally derived ingredients. The formulation was developed in the form of an oil-in-water emulsion, which offers advantages such as a light, non-greasy texture and easy removal from the skin surface. Evaluation of the prepared formulations indicated that the cream possessed acceptable physicochemical characteristics and maintained stability during the storage period.

Among the different formulations prepared, F3 demonstrated the most favorable properties with respect to pH, spreadability, stability, and overall physical appearance. The presence of natural ingredients such as turmeric extract, coffee extract, aloe vera, and vitamin E may contribute antioxidant and protective effects that help reduce tanning and support healthy skin.

Based on these findings, the formulated herbal anti-tanning cream may serve as a safe and cost-effective alternative to synthetic cosmetic preparations. However, additional investigations, including clinical evaluation and microbial studies, would be beneficial to further confirm its safety, effectiveness, and potential for large-scale cosmetic application.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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