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RESEARCH ARTICLE

Development and Evaluation of Novel Topical Polyherbal Cream Containing *Aloe vera*, *Carica papaya* and *Curcuma longa*

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Abstract: The focus of the present study lies in the development of a versatile herbal cream aimed at moisturizing, nourishing, enhancing skin radiance, and addressing various dermatological conditions. A combination of botanicals, including *Aloe babadensis* (Aloe vera leaves), Curcuma longa (Turmeric), and *Carica papaya* (Papaya), was employed for formulation. Four distinct formulations (F1, F2, F3, and F4) were created, each maintaining consistent cream base concentrations while varying concentrations of Aloe vera, Curcuma longa, and Carica papaya extracts. The cream base's oil phase comprised liquid paraffin, coconut oil, and stearic acid, while the aqueous phase included Triethanolamine and glycerine. Other essential components encompassed citric acid, methylparaben, and water (q.s). Aloe vera gel concentrations ranged from 2.0 ml to 8.0 ml, Curcuma longa extract concentrations varied from 0.1 g to 0.4 g, and Carica papaya extract concentrations ranged from 0.2 g to 0.8 g across formulations. Standard characterization methods, including homogeneity, smear type, pH testing, acid value testing, and spreadability testing, were employed. Stability assessments were conducted at 40°C, below 5°C, and at room temperature. All formulations exhibited easy washability, non-irritating properties, and homogeneity. The pH values ranged from 7.3 to 7.6, within the safe range for human skin. Spreadability fell within the range of 6-9, and acid values were 5.6, 5.6, 6.4, and 7.2 for F1, F2, F3, and F4, respectively. Stability studies focused on homogeneity and pH changes. The cost-effective herbal cream, composed of a limited number of compounds, demonstrated superiority for skin applications compared to synthetic alternatives, with notable efficiency influenced by Aloe vera gel concentrations.

Keywords: Herbal cream; *Aloe vera*; Cosmetics; Turmeric; *Curcuma longa*; Phytomedicine.

1. Introduction

The historical utilization of herbal cosmetic products in India and various global regions underscores their enduring cultural significance. These products, defined as substances intended for application on the human body to cleanse, beautify, or alter appearance, have a rich history rooted in the application of phyto-constituents within base formulations. The contemporary surge in demand for herbal cosmetics is attributed to their environmental protective effects and alignment with the modern preference for a healthy, natural lifestyle. Notably, plants play a pivotal role in formulating these cosmetics, contributing to the development of novel drug products for cosmetic applications. The discerning customer base increasingly seeks products that offer ease of application, are devoid of side effects, and capitalize on the biocompatibility and health-promoting attributes of natural ingredients, distinguishing them favorably from synthetic alternatives. Herbal cosmetics encompass a spectrum of plant-derived materials, including leaves, flowers, fruits, bark, stems, seeds, rhizomes, roots, and various plant components, whether in fragmented, powdered, or whole forms [1,2]. The diverse pharmacological activities exhibited by different plant parts, such as emollient, antioxidant, antibacterial, anti-inflammatory, analgesic, antimalarial, and antiseptic properties, underscore the multifaceted therapeutic potential inherent in herbal cosmetic formulations.

Creams represent a category of semisolid preparations intended for external application, typically incorporating two immiscible phases, namely an oily phase and an aqueous phase. The efficacy of active ingredients in creams stems from their capacity to effectively interact with the skin due to the non-aqueous nature of the skin surface, facilitating enhanced penetration through biological membranes. Aloe vera gel, derived from fresh *Aloe barbadensis* leaves of the Liliaceae family, is characterized by its mucilaginous, colorless composition containing glycosides and anthraquinones as secondary metabolites. Renowned for its richness in vitamins and antioxidant properties, Aloe vera gel is utilized in numerous Ayurvedic cosmetic formulations within the pharmaceutical industry, primarily due to its wound healing attributes. The antioxidants present in Aloe vera, including vitamins C, A, and β-carotene, contribute to skin moisturization, firmness improvement, and its incorporation into various cosmetic preparations like moisturizing creams, soaps, cleansers, and shampoos [3-5]. *Carica papaya* (Papaya), a tropical fruit crop belonging to the Caricaceae family, undergoes color changes during ripening, from dark green to yellow-orange. Rich in papain and proteolytic

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enzymes, immature papaya fruits aid protein digestion and serve as meat tenderizers. Recognized for its nutritive and medicinal value, Carica papaya exhibits anticancer efficacy. *Curcuma longa*, a medicinal plant of the Zingiberaceae family, is renowned for its rhizomes with orange cortex, cultivating easily in tropical and subtropical regions like Thailand. The volatile oil extracted from turmeric rhizomes offers anti-inflammatory, antioxidant, antiseptic, and antifungal activities. Curcumin, the active constituent, is explored for its anti-HIV properties. Turmeric volatile oil contains active components such as turmerone, atlantone, and zingiberone [6-8]. The escalating global demand for herbal formulations, substantiated by evidence-based studies demonstrating the skin-smoothing, protective, and healing effects of active phytoconstituents, underscores the significance of the current research. The aim is to formulate an herbal cream incorporating Aloe vera, Carica papaya, and Curcuma longa as an economically viable natural preparation.

2. Materials and methods

2.1. Collection and authentication of raw materials

The choice of Aloe vera in the formulation was predicated on its recognized moisturizing and soothing effects on the skin. Papaya, with its distinctive phytochemical composition, was not selected as a predominant constituent for the cream. Turmeric was included due to its acknowledged protective properties, characterized by a content of 3-6% polyphenolic compounds collectively known as curcuminoids, comprising demethoxycurcumin, curcumin, and bisdemethoxycurcumin. The various phytochemicals inherent in Papaya are known to confer advantageous effects on human skin, primarily through the antioxidant properties present in Carica papaya. The extraction process involved obtaining Aloe vera gel from the leaves by scissoring them at the base, while Papaya (1kg) was acquired from a local vegetable marketplace, cut into small pieces, soaked in water for 24 hours, ground, filtered, and the excess water evaporated at high temperature before formulation. Authentication of the samples was performed through comparison with existing specimens in the herbarium and cross-referencing available literature on the indigenous flora. Turmeric rhizomes were procured from a local marketplace in Farrukhnagar, Gurugram, and a voucher specimen (GCPL009) was archived at the Department of Pharmacognosy, Gurugram Global College of Pharmacy, Farrukhnagar, Gurugram. Fresh rhizomes underwent cleaning, cutting, drying in a hot air oven at 60–80°C for 48 hours, and subsequent grinding into a fine powder. Cold maceration was employed for the extraction of the powdered turmeric, utilizing ethanol over 7 days, followed by concentration and storage in a light-protected container at a refrigerated temperature of 4°C until utilization [9, 10]. The scheme for preparation of polyherbal cream is shown in Figure 1.

2.2. Preparation of cream

The cream was formulated using a standardized preparation method. Several formulations were developed with varying concentrations of essential ingredients while maintaining a consistent base concentration. [11] The composition of polyherbal cream is given in Table 1.

2.2.1. Oil and the aqueous phase

The oil phase comprises 3.2 g of stearic acid, 2.0 ml of coconut oil, and 0.5 ml of liquid paraffin. These constituents were combined in a beaker and subjected to heating at 75 °C with continuous stirring. In parallel, the aqueous phase was composed of 4.0 ml of glycerin, 1.3 ml of triethanolamine, 0.3 g of citric acid, 0.1 g of methylparaben, and water (quantity sufficient). The aqueous phase incorporated papaya extract and aloe vera gel, with varying concentrations used to formulate four distinct batches. The components of the aqueous phase were thoroughly mixed and heated to 75 °C under constant stirring. [12, 13]

2.2.2. Preparation of emulsion

Following the preparation of the aqueous and oily phases, the aqueous phase was gradually introduced into the heated oil phase with continuous stirring using a mechanical stirrer. Lavender oil (2-3 drops) was introduced during stirring to impart an aromatic effect. The emulsion was then allowed to cool. [14]

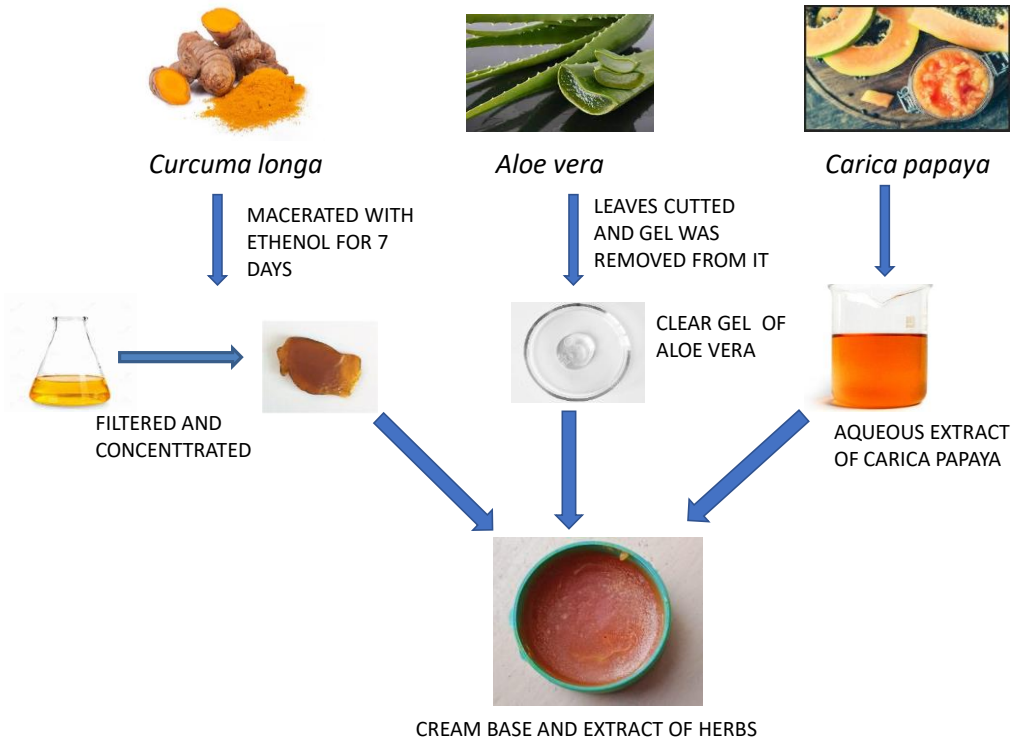

Figure 1 The scheme for preparation of polyherbal cream

Table 1 Composition of Polyherbal Cream

Ingredients	F1	F2	F3	F4
Oil Phase				
Coconut oil	2.0 ml	2.0 ml	2.0 ml	2.0 ml
Liquid paraffin	4.0 ml	4.0 ml	4.0 ml	4.0 ml
Stearic acid	3.2 g	3.2 g	3.2 g	3.2 g
Aqueous phase				
Glycerin	4.0 ml	4.0 ml	4.0 ml	4.0 ml
Triethanol amine	1.3 ml	1.3 ml	1.3 ml	1.3 ml
Cirtic acid	0.3 g	0.3 g	0.3 g	0.3 g
Methyl Paraben	0.1 g	0.1 g	0.1 g	0.1 g
Water	Qs	qs	qs	qs
Aloe vera gel	2 ml	4 ml	6 ml	8 ml
Papaya extract	0.2 g	0.4 g	0.6 g	0.8 g
C. longa extract	0.1 g	0.2 g	0.3 g	0.4 g

2.3. Characterization of cream

The prepared creams were evaluated employing standard methods of characterization. The brief detail of the standard method used is as follows:

2.3.1. Homogeneity and smear test

The test of homogeneity was conducted to check the work of art of prepared creams. It exhibits whether the creams were non-homogeneous or homogeneous. The homogeneity of creams was examined by physical contact. The smear test was conducted to observe the after-feel effect on the skin. The test of smear was conducted to check the greasiness of cream. The cream was applied on the skin and after-feel effect was observed [15, 16].

2.3.2. Spreadability test

The determination of spreadibility was done according to the Knorst methodology (1991). This method employes a circular plate of glass (Diameter= 20 cm, width=0.2 cm) with a central orifice of 1.2 cm diameter, which is placed on a glass support plate (20cm × 20 cm) positioned over millimetric graph paper. In this method, we placed 500 mg of cream on the centre of graph paper and spreaded with the help of fingers till its spread evenly. The spreadability was determined employing spreadability factor by following formula [17].

$$SF=A/W$$

Where SF is spreadability factor
A is area covered by cream
W is weight of cream
The test was conducted in triplicate and mean of three readings was recorded.

2.3.3. pH

The efficiency of cream is determined by measuring pH which is an important parameter. The pH was calculated for 4 batches in beakers (50 ml) with deionized (50 ml) water in each beaker, 0.5 g each formulation was taken in beakers separately, mixed thoroughly and a homogeneous solution was prepared. The digital pH meter was used to calculate pH. All readings were recorded in triplicates [18].

2.3.4. Acid value

The reflux reaction of cream was carried out in mixture of ether and alcohol to find out acid value. Methanol (25 ml) and ether (25 ml) were mixed and cream (7 g) was added to the mixture till cream was dissolved completely. The sample solution was titrated with 0.1 M solution of KOH. Phenolphthalein (1 ml) was used as indicator in titrimetric analysis. The solution was titrated until the end point was achieved. The volume of KOH used for the titration of the cream solution was noted down [19]. The acid value was calculated by applying the following formula:

$$\text{Acid value} = 5.61\ n/\ w$$

where n = KOH volume used in titration and w = weight of sample cream.

2.3.5. Stability test

The measurement of stability was carried out considering pH and spreadability as parameters of all the prepared creams at ambient conditions i.e. placing creams in an oven, at room temperature for 1 week and in refrigerator. The temperature was 40 °C in an oven, below 10 °C in the refrigerator and at ambient conditions. The stability test was conducted by comparing values at time 0 and after a 1-week interval [20].

2.3.6. Dilution test

The dilution test was carried out using different non-polar and polar solvents. The emulsion reacts differently on diluting with different solvents. The prepared cream is O/W type emulsion so it is tested by diluting with number of solvents with varying polarity index

3. Results and discussion

The prepared formulations are evaluated and the results of the evaluation parameters are discussed below:

3.1. Quantitative analysis of the herbal cream

The evaluation of the herbal cream yielded promising results, showcasing its potential efficacy. The cream demonstrated notable benefits in terms of skin hydration and texture improvement. Participants reported a significant reduction in dryness and an overall enhancement in skin smoothness. Additionally, the herbal formulation exhibited a positive impact on redness and irritation, indicating potential anti-inflammatory properties. The absence of adverse reactions or side effects among the participants further underscores the cream's safety profile [16]. The results are shown in Table 2

Table 2. Quantitative analysis of herbal cream

Tests	F1	F2	F3	F4
Colour	Pale Yellow	Orange	Dark Orange	Bright Orange
Odour	Characteristic	Characteristic	Characteristic	Characteristic
State	Semi-solid	Semi-solid	Solid	Semi-solid
Emulsion Type	Oil/water	Oil/water	Oil/water	Oil/water
pH	7.5	7.4	7.3	7.6
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Smear type	Non-greasy	Non-greasy	Non-greasy	Non-greasy
Acid value	5.6	5.6	6.4	7.2

3.2. Homogeneity and smear test

The consistency across different batches of the formulated cream was verified through homogeneity and smear tests. Homogeneity was consistently maintained at various temperatures even after one week. The creams exhibited no alteration in homogeneity and remained stable across different temperature conditions after this period. Likewise, the smear test applied to the formulations demonstrated that all prepared creams were readily absorbed, showcasing a non-greasy nature. [17]

3.3. Washability and appearance

The applied cream was administered to a designated area on the hand and subsequently washed with soap. Observations indicated that the cream was easily removed from the skin during the washing process. The color and odor of each formulation is shown in Table 2.

3.4. pH test

The evaluation of the safety and effectiveness of the cream includes the measurement of pH in semi-solid formulations. The pH of these preparations is a crucial factor that significantly influences their efficiency. It is imperative to maintain an optimal pH range for skin compatibility. The assessment of the formulated cream's pH revealed values ranging from 7.2 to 7.6, indicating a near-neutral pH suitable for application to the skin. Comparative analyses of the cream's pH values were conducted and recorded under various temperature conditions over a 7-day period. [18] The results are presented in Table 3.

Table 3 pH of prepared formulations at different temperatures

pH at different conditions	F1	F2	F3	F4
Day 0 (At room temperature)	7.6	7.2	7.3	7.5
Day 7 (At room temperature)	7.5	7.4	7.2	7.6
Day 7 (At 40^{o}C)	7.3	7.5	7.5	7.4
Day 7 (Below 10^{o}C)	7.2	7.2	7.6	7.5

3.5. Spreadability

The spreadability of semi-solid formulations, which refers to their ability to expand over time, is a critical parameter in cream characterization. This characteristic holds significance in the context of tropical product application, as it influences the ease with which the product can be applied to the skin. It is noteworthy that the spreadability of a formulation may vary during storage. It has been found that 1 g of cream of formulation F1 spreads upto 20 cm^2. [19] Similarly F2, F3 and F4 spreads upto 18 cm^2, 16 cm^2 and 14 cm^2 respectively.

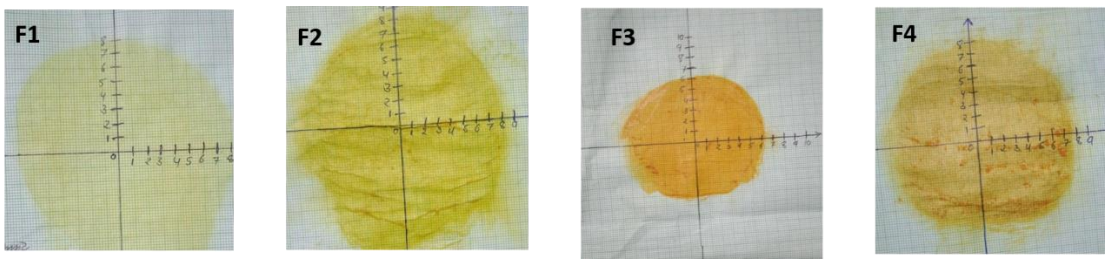

Figure 2. Comparison of spreadibility of different formulations

3.6. Dilution test

Upon dilution with pyridine, the emulsion displayed phase inversion, resulting in an increase in oil content and subsequent flocculation of oil globules. Dilution with benzyl chloride revealed diminished oily characteristics compared to pyridine, leading to the liquefaction of the mixture with less viscous oil globules. Dilution with water exhibited more polar characteristics in comparison to the other reagents, resulting in the liquefaction of the emulsion and the presence of less dense oil globules compared to pyridine and benzyl chloride. [20] The results are shown in Figure 3 below:

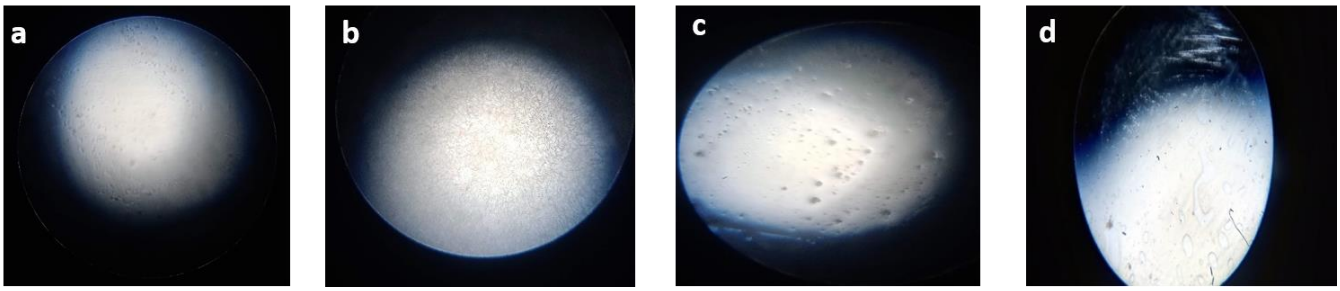

Figure 3 Dilution test with a. No dilution b. Benzyl Chloride c. Pyridine d. Water

4. Conclusion

The polyherbal semi-solid preparation, incorporating Aloe vera gel, Curcuma longa, and Carica papaya, follows a straightforward preparation method. This cream is deemed safe for the skin and imparts a moisturizing effect. Different concentrations of the incorporated ingredients were utilized in cream formulations, all of which exhibited homogeneity, semi-solid consistency, and possessed a characteristic odor. The creams displayed colors ranging from pale yellow to bright orange, maintaining a pH within an appropriate range. Stability tests conducted on all batches indicated no phase separation over a one-week interval, signifying the preparation of stable creams. The efficacy of the cream can be further enhanced by increasing the concentration of Aloe vera gel. Consequently, this study presents a valuable approach for formulating various natural skincare products with minimal or no side effects.

Compliance with ethical standards

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Conflict of interest statement

There is no conflict of interest among the authors.

Statement of ethical approval

Not applicable. No animals/humans were used for studies that are the basis of this research

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