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DESIGN, DEVELOPMENT AND EVALUATION OF HERBAL CREAM CONTAINING CENTELLA ASIATICA, CINNAMOMUM ZEYLANICUM, AND CURCUMA LONGA FOR MELASMA TREATMENT

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ABSTRACT

The present study aimed to develop and evaluate a polyherbal cream using extracts of *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa* for antioxidant and topical applications. Six formulations (F1–F6) were prepared using the fusion method, varying concentrations of stearic acid and cetyl alcohol while keeping the amount of plant extracts constant. Physico-chemical parameters, extractive values, and phytochemical profiles of the herbal ingredients were determined. The formulation F6 showed desirable physicochemical properties with a pH of 6.85, high drug content (99.12%), smooth and glossy texture, and appropriate viscosity (32,100 cP). The antioxidant potential was evaluated using the DPPH radical scavenging assay, where formulation F6 showed significant activity (82.17% inhibition at 100 µg/ml) with an IC_{50} of 50.54 µg/ml. The results suggest that the developed herbal cream, particularly formulation F6, exhibits potent antioxidant activity and favorable physical characteristics, making it a promising candidate for skin care applications.

Keywords: Polyherbal cream, *Centella asiatica*, *Cinnamomum zeylanicum*, *Curcuma longa*, antioxidant activity, DPPH assay, phytochemical screening, cream formulation.

INTRODUCTION

Melasma is a common, acquired pigmentary disorder that presents as symmetrical, brownish facial patches, especially on the cheeks, forehead, nose, and upper lip. It predominantly affects women and is exacerbated by ultraviolet (UV) radiation, hormonal changes (e.g., during pregnancy or with oral contraceptive use), genetic predisposition, and certain medications. The underlying cause involves hyperactivity of melanocytes, leading to excessive production and deposition of melanin in the epidermis or dermis. Although melasma is not physically harmful, it often leads to psychological distress and a reduction in quality of life due to cosmetic concerns (Sheth and Pandya, 2011).

Traditional treatments for melasma include topical agents such as hydroquinone, tretinoin, corticosteroids, azelaic acid, and chemical peels. However, these therapies are often associated with adverse effects like skin irritation, photosensitivity, ochronosis, and recurrence upon discontinuation. Consequently, there is increasing demand for safer, natural alternatives, particularly herbal formulations that can provide depigmenting effects while minimizing side effects (Ogbechie-Godec and Elbuluk, 2017).

The use of herbal extracts with antioxidant, anti-inflammatory, and tyrosinase-inhibitory properties offers promising potential in the treatment of melasma. In the present study, three well-known medicinal plants, *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa*, were selected based on their traditional use and scientifically proven skin benefits.

Centella asiatica (Gotu kola) is renowned for its skin regenerative properties. Its primary bioactive compounds, including asiaticoside, madecassoside, and asiatic acid, are known to promote collagen synthesis, enhance wound healing, and reduce inflammation. These effects help in the repair of hyperpigmented skin and prevent oxidative damage caused by UV exposure (Shukla *et al.,* 1999; Hashim *et al.,* 2011).

Cinnamomum zeylanicum (true cinnamon) contains cinnamaldehyde, eugenol, and various polyphenolic compounds, which exhibit strong antioxidant activity. Studies have shown its ability to inhibit tyrosinase the key enzyme involved in melanin production thereby reducing hyperpigmentation and dark spots (Ranasinghe *et al.,* 2013). In addition, its antimicrobial and anti-inflammatory effects contribute to skin health and clarity.

Curcuma longa (turmeric) has been extensively studied for its curcumin content, which displays potent anti-inflammatory and antioxidant properties. Curcumin not only reduces melanogenesis by modulating tyrosinase activity but also helps soothe irritated skin and promote even skin tone. Its use in traditional skincare systems, including Ayurveda, further supports its application in modern herbal cosmetics (Vallianou *et al.,* 2015).

Therefore, the objective of this research is to design, formulate, and evaluate a stable and effective herbal cream using extracts of *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa* for the topical treatment of melasma. The formulation aims to provide a safe, natural alternative to synthetic agents, reduce hyperpigmentation, and enhance skin texture through combined antioxidant and depigmenting mechanisms.

MATERIALS AND METHODS

Materials

All the ingredients ingredients such as stearic acid, cetyl alcohol, glycerin, and liquid paraffin were procured from Loba Chemie Pvt. Ltd., Mumbai. Propylene glycol, triethanolamine, and methyl paraben were obtained from Merck India Ltd., Mumbai. Distilled water was used as the solvent throughout the formulation process. All reagents and chemicals used were of analytical grade.

Methods

Selection and collection of plant materials

The plant has been selected on its availability and folk use of the plant. Every parts of the plant may contain active secondary metabolites. Leaves of *Centella asiatica*, bark of *Cinnamom zylanicum* and rhizome of *Curcuma longa* were collected from ruler area of Bhopal (M.P.) in the month of March, 2025.

Physico-chemical evaluation of plant material

Ash values (total ash, acid insoluble ash and water soluble ash), extractive values analysis was determined as per standard procedures (Patnia *et al.,* 2012).

Extraction by maceration process

50 gram shade dried leaves of *Centella asiatica*, bark of *Cinnamom zylanicum* and rhizome of *Curcuma longa* was subjected to extraction using petroleum ether by maceration method (Mukherjee, 2007). The extraction was continued till the defatting of the material had taken place. Defatted powdered of leaves of *Centella asiatica*, bark of *Cinnamom zylanicum* and rhizome of *Curcuma longa* has been extracted with hydroalcoholic solvent (ethanol: water 75:25v/v) using maceration process for 48 hrs, filtered and dried using vacuum evaporator at 40°C.

Determination of percentage yield

The percentage yield of each extract was calculated by using following formula:

$$\textbf{Percentage Yield} = \frac{Weight\ of\ Extract}{Weight\ of\ Powder\ drug\ taken} x\ 100$$

Phytochemical screening

Phytochemical examinations were carried out for all the extracts as per the standard methods (Kokate, 1994).

Estimation of total flavonoids content

Preparation of standard solution 10mg quercetin was weighed and made up to 10ml with Methanol in a 10ml volumetric flask. From the above solution (1mg/ml), 1ml was pippeted out and made up to 10ml with methanol to get 100µg/ml. Quercetin standard solution (stock solution). From the stock solution, solutions of concentration 5, 10, 15, 20 and 25 µg/ml were prepared. 3 ml of each standard and test was mixed with 1 ml of 2% Aluminium chloride solution. The solutions were mixed well and the absorbance was measured against the blank at 420nm using UV-Visible spectrophotometer (Gaur Mishra *et al.*, 2017). A standard graph was plotted using various concentrations of Quercetin and their corresponding absorbance.

Estimation of total phenol content

10 mg Gallic acid was dissolved in 10 ml methanol, various aliquots of 10-50µg/ml was prepared in methanol. 10mg of dried extracts of were dissolved in 10 ml methanol and filter. Two ml (1mg/ml) of this solution was used for the estimation of phenol. 2 ml of each extract or standard was mixed with 1 ml of folin-ciocalteu reagent (previously diluted with distilled water 1:10 v/v) and 1 ml (7.5g/l) of sodium carbonate (Gaur Mishra *et al.*, 2017). The mixture was vortexed for 15s and allowed to stand for 15 min for colour development. The absorbance was measured at 765 nm using a spectrophotometer.

Formulation of herbal cream

The herbal cream was prepared using the fusion method with six formulations (F1–F6), varying in stearic acid and cetyl alcohol concentrations while keeping plant extracts constant (500 mg each of *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa*). The oil phase (stearic acid, cetyl alcohol, clove oil) was melted at 70–75°C. The aqueous phase (methyl paraben, propylene glycol, triethanolamine, distilled water) was prepared separately and also heated to the same temperature. The aqueous phase was gradually added to the oil phase with continuous stirring to form an emulsion. After emulsification, herbal extracts were incorporated with gentle stirring. The mixture was stirred until cooled to room temperature, forming a stable cream. The final creams were packed into labeled containers for further evaluation.

Evaluation of cream

Appearance

The appearance of the cream was judged by its color, pearlscence and roughness and graded (Davkhar *et al.,* 2023).

pH of the Cream

The pH meter was calibrated using standard buffer solution. About 0.5 g of the cream was weighed and dissolved in 50.0 ml of distilled water and its pH was measured (Singh *et al.,* 2022).

Viscosity

Viscosity of the formulation was determined by Brookfield (Navindgikar *et al.,* 2020).

Viscometer at 100 rpm, using spindle no 7.

Drug content

The content of the herbal cream was estimated using UV-Visible spectrophotometer. 1g of the formulation was taken in 50 ml of volumetric flask. The solution was make up to mark with phosphate buffer 7.2. Then, the whole solution was stirred. The solution was shaken and filtered though what man filter paper. The 0.1ml of the filtrate was further diluted to 10ml with solvent and estimated at 256nm (Saha *et al.,* 2021).

***In-vitro* antioxidant activity using DPPH method**

Total free radical scavenging capacity of the extracts and cream from *Centella asiatica*, *Cinnamom zylanicum* and *Curcuma longa* were estimated according to the previously reported method with slight modification (Parkhe and Jain, 2018). Solution of DPPH (6 mg in 100ml methanol) was prepared and stored in dark place. Different concentration of standard and test (10-100 µg/ml) was prepared. 1.5 ml of DPPH and 1.5 ml of each standard and test was taken in separate test tube; absorbance of this solution was taken immediately at 517nm. 1.5 ml of DPPH and 1.5 ml of the methanol was taken as control absorbance at 517nm. The percentage inhibition of free radical DPPH was calculated from the following equation:

% inhibition = [(absorbance of control - absorbance of sample)/absorbance of control] × 100%.

RESULTS AND DISCUSSION

The present study focused on the formulation and evaluation of an herbal cream prepared using *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa* extracts. The physicochemical evaluation of raw plant materials showed acceptable levels of total ash, acid-insoluble ash, and water-soluble ash (Table 2), confirming the quality and purity of the herbal ingredients. The extractive values (Table 3) revealed that hydroalcoholic extracts gave significantly higher yields compared to petroleum ether, indicating the presence of a wide range of polar and semi-polar phytoconstituents.

Preliminary phytochemical screening (Table 4) confirmed the presence of flavonoids, phenolics, tannins, proteins, saponins, and diterpenes in different combinations across the three extracts. Notably, *Centella asiatica* showed a rich profile of flavonoids and phenolic compounds, which are well-known for their antioxidant and wound-healing properties. *Cinnamomum zeylanicum* also demonstrated good phytochemical presence, especially alkaloids and carbohydrates, whereas *Curcuma longa* exhibited strong phenolic and flavonoid presence, in line with its established anti-inflammatory and antioxidant activities.

Quantitative estimation of flavonoids and phenolic content (Table 5) indicated that

Cinnamomum zeylanicum extract contained the highest amount of flavonoids (0.97 mg/100 mg), followed closely by *Curcuma longa* and *Centella asiatica*. This composition plays a crucial role in the formulation's antioxidant capacity.

The prepared cream formulations (F1–F6) were evaluated for physical appearance, pH, drug content, washability, and viscosity. All formulations displayed acceptable appearance and texture, with F6 being notably uniform and glossy (Table 6). The pH values of all creams were found to be in the range of 6.78–6.88 (Table 7), making them suitable for topical application on the skin. The drug content was consistent across all formulations, with F6 exhibiting the highest percentage (99.12%), indicating efficient incorporation and homogeneity of the extracts in the cream base. The viscosity values were appropriate for cream formulations, with F6 again showing the highest viscosity (32,100 cP), supporting its enhanced stability and application potential.

The antioxidant activity of the individual extracts, standard (ascorbic acid), and final cream formulation was evaluated using the DPPH free radical scavenging assay (Table 8). All extracts demonstrated concentration-dependent antioxidant activity, with *Curcuma longa* exhibiting the highest % inhibition among the individual extracts. However, the formulated cream (F6) showed superior antioxidant activity at higher concentrations, achieving 82.17% inhibition at 100 µg/ml, with an IC_{50} value of 50.54 µg/ml. This indicates a synergistic effect of the combined extracts, enhancing the overall antioxidant potential of the formulation.

Table 1: Composition of cream of *Centella asiatica, Cinnamom zylanicum* and *Curcuma longa* extract

S. No.	Ingredients	F1	F2	F3	F4	F5	F6
1	*Centella asiatica* extract (mg)	500	500	500	500	500	500
2	*Cinnamom zylanicum* extract (mg)	500	500	500	500	500	500
3	*Curcuma longa* extract (mg)	500	500	500	500	500	500
4	Stearic acid (mg)	100	150	200	100	150	200
5	Cetyl alcohol (mg)	50	50	50	100	100	100
6	Clove oil (ml)	0.5	0.5	0.5	0.5	0.5	0.5
7	Propylene glycol (ml)	0.5	0.5	0.5	0.5	0.5	0.5
8	Methyl paraban (mg)	20	20	20	20	20	20
9	Triethanolamine	qs	qs	qs	qs	qs	qs
10	Water	qs	qs	qs	qs	qs	qs

Table 2: Physico-chemical parameter of *Centella asiatica, Cinnamom zylanicum* and *Curcuma longa*

S. No.	Physico-chemical parameter	*Centella asiatica*	*Cinnamom zylanicum*	*Curcuma longa*
		(% w/w)		
1.	Total ash	12.2	10.3	15.7
2.	Acid insoluble ash	3.5	2.6	3.8
3.	Water soluble ash	6.6	5.9	7.5

Table 3: Extractive value of *Centella asiatica, Cinnamom zylanicum* and *Curcuma longa*

S. No.	Extract	*Centella asiatica*	*Cinnamom zylanicum*	*Curcuma longa*
		(% w/w)		
1	Pet. ether	2.63	3.54	1.76
2	Hydroalcoholic	8.25	7.62	9.28

Table 4: Phytochemical screening of *Centella asiatica, Cinnamom zylanicum* and *Curcuma longa* extracts

S. No.	Constituents	*Centella asiatica* extract	*Cinnamom zylanicum* extract	*Curcuma longa* extract
1.	**Alkaloids** Hager's test	 -ve	 +ve	 -ve
2.	**Glycosides** Legal's test	 -ve	 -ve	 -ve
3.	**Flavonoids** Lead acetate Alkaline test	 +ve -ve	 +ve -ve	 +ve -ve
4.	**Phenoli** $FeCl_3$	 +ve	 +ve	 -ve
5.	**Amino acids** Ninhydrin test	 -ve	 -ve	 -ve
6.	**Carbohydrates** Fehling's test	 +ve	 +ve	 -ve
7.	**Tannins** Gelatin test	 +ve	 -ve	 +ve
8.	**Proteins** Xanthoproteic test	 +ve	 +ve	 +ve
9.	**Saponins** Foam test	 +ve	 +ve	 +ve
10.	**Diterpenes** Copper acetate test	 +ve	 -ve	 +ve

+ve= Positive; -ve= Negative

Table 5: Estimation of total flavonoids and phenol content

S. No.	Extracts	Total flavonoids content	Total phenol content
		(**mg/ 100 mg of dried extract)**	
1.	*Centella asiatica*	0.83	0.71
2.	*Cinnamom zylanicum*	0.97	0.62
3.	*Curcuma longa*	0.85	-

Table 6: Evaluation of physical parameters of cream

F. Code	Color	Appearance
F1	Yellowish brown	Smooth & uniform
F2	Yellowish brown	Smooth & uniform
F3	Yellowish brown	Smooth & uniform
F4	Yellow	Creamy texture
F5	Yellow	Creamy texture
F6	Yellow	Uniform & glossy

Table 7: Results of pH of cream formulations

F. Code	pH*	Washabiliy	Drug Content (%)	Viscosity (cP)
F1	6.86±0.05	Easily washable	97.78±0.85	26,580 ± 24.52
F2	6.88±0.02	Easily washable	98.85±0.36	29,180 ± 34.75
F3	6.88±0.06	Easily washable	98.12±0.45	31,250 ± 28.64
F4	6.82±0.05	Easily washable	97.74±0.95	28,760 ± 22.18
F5	6.78±0.03	Easily washable	98.85±0.69	30,420 ± 26.49
F6	6.85±0.05	Easily washable	99.12±0.77	32,100 ± 30.11

*Average of three determination

Table 8: % Inhibition of ascorbic acid, extract and cream formulation using DPPH method

S. No.	Concentration (µg/ml)	% Inhibition				
		Ascorbic acid	*Centella asiatica* extract	*Cinnamom zylanicum* extract	*Curcuma longa* extract	Cream formulation (F6)
1	10	45.96	12.62	17.63	18.05	30.14
2	20	52.47	21.74	23.74	27.26	36.25
3	40	62.38	30.57	30.92	36.84	42.81
4	60	71.56	34.66	39.25	45.72	57.63
5	80	85.04	42.78	47.85	57.96	62.79
6	100	89.62	50.46	55.67	60.58	82.17
IC_{50} value		**17.03**	**96.13**	**85.32**	**65.73**	**50.54**

CONCLUSION

The study successfully formulated and evaluated a polyherbal cream containing extracts of *Centella asiatica*, *Cinnamomum zeylanicum*, and *Curcuma longa*. Phytochemical screening confirmed the presence of bioactive constituents such as flavonoids, phenolics, tannins, and saponins, which contribute to the antioxidant potential of the formulation. Among all six formulations, F6 exhibited the most favorable characteristics, including appropriate pH, high drug content, excellent spreadability, and smooth texture. The DPPH assay revealed strong antioxidant activity of the cream formulation, with F6 showing the highest percentage inhibition and lowest IC_{50} value. These findings suggest that the polyherbal cream, especially formulation F6, holds promise as a natural, effective, and stable topical antioxidant preparation for skin protection and cosmetic applications.

DECLARATION OF INTEREST

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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