



Formulation and Biological Evaluation of a Cinnamon Extract-Loaded Topical Cream: A Green Approach for Anti-Acne Therapy

Dr. Vigneshwaran L.V^{1*}, Rakesh. B², Bhuvaneshwari C³, Dharshan N³, Sathya R³, Thrisha S³

Department of Pharmaceutics, RKP College of Pharmacy, Krishnagiri, Tamilnadu- 635001, India.

*Corresponding Author

Dr. Vigneshwaran L.V

Email:

vigneshwaran85@gmail.com

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Abstract: - Acne vulgaris is a common inflammatory skin disorder associated with microbial infection, excess sebum production, and oxidative stress. Herbal formulations are increasingly preferred due to their safety and therapeutic benefits. The present study aimed to formulate and evaluate a cinnamon extract-loaded cream for enhanced anti-acne efficacy. The cream was prepared by emulsification technique and evaluated for its physicochemical properties, including appearance, pH, viscosity, spreadability and extrudability. The formulation exhibited a smooth and homogeneous texture with good skin compatibility and suitable consistency for topical application. The formulation also demonstrated promising antioxidant and anti-inflammatory activity. Overall, the developed cinnamon extract cream showed desirable characteristics and potential as a safe, effective, and eco-friendly herbal alternative for acne management.

Keywords: Cinnamon extract, cream, Anti-acne, Antioxidant activity.



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1. Introduction

1.1. Cinnamon

Cinnamon (*Cinnamomum zeylanicum* L. and Cinnamon cassia L.), a species of the Lauraceae family, is an evergreen tree of the tropics, which is widely used in medicine, and offers a rich variety of applications worldwide.^[1] The most recognizable species are *Cinnamomum cassia* (L.)J. Presl, *Cinnamomum camphora*, and *Cinnamomum zeylanicum*.^[2] The most useful part of the cinnamon tree is the outer bark which is generally used as a spice and for several natural medicinal applications. The inner bark of the cinnamon tree has more medicinal effects and also contains more essential oil. cinnamon is known to be a very good source of iron, calcium and dietary fibre as well as manganese. There are various nutrients present in cinnamon such as sodium, carbohydrates, sugar, fatty acids, amino acids and so on.^[3] Cinnamaldehyde, cinnamate, cinnamic acid, and many essential oils are among the many resinous chemicals that make up cinnamon. According to Singh et al., the presence

of cinnamaldehyde and the absorption of oxygen are responsible for the spicy flavour and scent. Cinnamon's resinous constituents improve as it matures and darkens in colour. Sangal described a number of cinnamon's physiochemical characteristics. Numerous essential oils have been identified, including trans-cinnamaldehyde, cinnamyl acetate, eugenol, L-borneol, caryophyllene oxide, b-caryophyllene, L-bornyl acetate, E-nerolidol, α -cubebene, α -terpineol, terpinolene, and α -thujene.^[4] Cinnamaldehyde, denoted CA, has already been reported to be one of the most active compounds in cinnamon essential oils, with various biological activities. The reported biological activities of cinnamaldehyde mainly include antibacterial, antifungal, antioxidant, anti-hyperglycaemic, anticancer, and other bioactivities.^[5]

1.2. Cream

Topical medicines that can be applied to the skin are called creams. Creams are described as "viscous liquid or semi-solid emulsions of either the oil-in-water or water-in-oil

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type” dosage forms, with different oil and water consistency levels. Creams can be used for therapeutic or cosmetic objectives, such as cleaning, beautifying, enhancing appearances, or providing protection. These topical preparations are used to deliver the medication to the mucous membrane or the skin’s underlying layer with a localized effect. These treatments are intended to be applied topically to improve the drug’s site-specific distribution into the skin for skin conditions.^[6]

1.2.1. Emulsion

An emulsion is a mixture of two immiscible liquid phases in which one phase is distributed throughout the other. Emulsions are used in a variety of industries, including food, pharmaceutical, agricultural, cosmetics, and petroleum. In essence, an emulsion is made up of a dispersed phase, also known as an internal or discontinuous phase, and a continuous phase, also known as an external phase, where the droplets are dispersed. In addition to water and oil, an emulsion may also contain some solid particles.^[7]

1.3. Acne

Acne vulgaris has a long-term impact on the pilosebaceous unit. It is a complex disorder that usually first appears in adolescence but often persists into maturity. Asia has a somewhat lower prevalence of 19.4% compared to an estimated 20% worldwide. Acne primarily affects people in India between the ages of 18 and 25, and it is much more common in women (81.7%).^[9] Increased sebum production, keratinocyte shedding, bacterial development, and inflammation are the main causes of acne. By triggering certain inflammatory mediators, the anaerobic pathogen *Propionibacterium acnes* (*P. acnes*) makes a substantial contribution to the pathogenesis of acne.^[10]

1.3.1. Symptoms

Signs and symptoms of acne differ based on how severe your problem is:

- Whiteheads, or clogged pores.
- Blackheads, which are open, clogged pores that turn brown when exposed to air.
- Tiny red, sensitive lumps (papules).
- Pustules, or pimples, are papules with pus at their tips.
- Nodules are large, painful lumps that are solid beneath the skin’s surface.
- Cystic lesions, which are painful, pus-filled lumps beneath the skin’s surface.^[11]

1.3.2. Impact of Acne on Mental Health

The results of the current study showed that acne vulgaris has a negative impact on patients psychological health and

that all psychiatric symptoms, such as somatization, obsession, sensitivity, depression, anxiety, hostility, phobia, paranoid ideation, and psychoticism, are correlated with the skin condition. On the other hand, compared to controls, people with acne scored higher on every SCL-90 item.^[8]

1.3.3. Mechanism of Cinnamon Extract in Treatment of Acne

- Reducing sebum production
- Killing acne causing bacteria
- Reducing inflammation^[12]

2. Materials and Methods

2.1. Materials

Active Ingredient was collected from local market. Isopropyl myristate-BRM Chemicals, ethanol-Bio liqua research pvt.ltd; stearyl alcohol, cetyl alcohol, Tween 80, glycerine and methyl paraben was collected from Department of pharmaceutics, RKP College of Pharmacy, Krishnagiri.

2.2. Pharmacognostical Profile of Active Ingredient – Cinnamon



Fig 1: Cinnamon

Synonym: Cinnamon bark, Kalmi – Dalchini, Ceylon cinnamon

Scientific name: *Cinnamomum zeylanicum* (*Cinnamomum verum*)

Family: Lauraceae

Chemical constituents: cinnamaldehyde, eugenol, cinnamic acid, tannins, flavonoids, and other polyphenols

Uses: antimicrobial, antioxidant, anti-inflammatory, and antifungal activities

2.3. Formulation of Cinnamom Extract-Loaded Cream

Table 1: Formulation of cinnamon extract-loaded cream

Ingredients	Quantity	Uses
Stearyl alcohol	5g	Stiffening agent / Emollient
Cetyl alcohol	2.5g	Thickener, emulsifying, agent
Isopropyl myristate	2.5ml	Emollient / Penetration enhancer
Glycerine	2.5ml	Humectant
Tween 80	1ml	Surfactant
Methyl paraben	0.07g	Preservative
Cinnamon extract	0.5%	Active ingredient
Distilled water	33ml	Vehicle/solvent

2.4. Procedure for Preparation of Cream

- Accurately weigh and prepare oil phase (10%stearyl alcohol,5%acetyl alcohol and 5% isopropyl myristate) and aqueous phase (90%water,5%glycerin and 1%tween 80, 0.07% methyl paraben).
- Separately heat at 70°C with constant stirring until all components are uniformly mixed.
- The oil phase was then gradually added to the aqueous phase with continuous stirring using a overhead stirrer for 20 minutes to form a uniform emulsion.
- The prepared cream was allowed to cool to room temperature, and 0.5% cinnamon extract was added with continuous stirring to obtain a homogeneous cream formulation.



Fig 2: Cinnamon extract-loaded cream

3. Evaluation

3.1. Appearance

Appearance is evaluated by visual and physical examination.

3.2. pH

The pH of the sample was determined using pH meter.

3.3. Viscosity

The viscosity of the sample was determined by Ostwald viscometer.

3.4. Spreadability

The two clean glass slide of standard dimensions were selected. 100 gm was placed upon the upper slide and cream between two slides is pressed uniformly to form a thin layer. The two slides in position were then fixed to a stand (at angle 45°) without any disturbance and in such a way that only the lower slide was held firmly by the clamp allowing the upper slide to travel a distance of 7.5 cm under the direction of weight which was noted. The weight was removed and excess of cream adhering to the slide was scrapped off. The experiment was repeated and mean time taken for three such determinations were calculated. Spreadability was calculated by using the following

formula: $S = m \times l/t$

where, S= spread ability, m-weight tied to upper slides (20 g),l- length of the glass slide (7.5 cm),t time taken in sec.

3.5. Extrudability

The cream was filled into a clean collapsible tube and sealed properly. A known weight was placed on the tube to apply pressure. The amount of cream extruded from the tube was collected and measured. Extrudability was determined based on the ease and quantity of cream expelled.

3.6. Invitro antioxidant activity by DPPH assay and FRAP assay

A frequently used method for assessing how well antioxidants work to eliminate free radicals involves the DPPH test. During this procedure, a steady free radical

known as DPPH is combined with a plant extract, and the resulting colour change is monitored. A more significant change in colour indicates stronger antioxidant capabilities. (Baliyan S. et al., 2022).

The FRAP assay evaluates antioxidant capacity by measuring the ability of a sample to reduce ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}). When Fe^{3+} -TPTZ is reduced to Fe^{2+} -TPTZ, a blue-coloured complex is formed, which is measured spectrophotometrically. The intensity of the blue color indicates the antioxidant power of the sample. Results are expressed as Fe^{2+} equivalents or as FRAP values based on a standard calibration curve.

3.7. In-vitro Anti-Inflammatory Activity – Egg Albumin Denaturation method

The albumin (egg white) denaturation assay evaluates the ability of a compound to prevent protein denaturation under stress conditions such as heat or pH changes. Protein denaturation leads to loss of structure and function and is associated with inflammation. Substances with anti-inflammatory properties can stabilize proteins and inhibit denaturation. The percentage inhibition is measured spectrophotometrically to determine anti-inflammatory activity.^[13,14,15,16]

4. Results and Discussion

S.No	Parameters	Results
01	Appearance	Smooth, homogeneous, and creamy in texture, light brown to pale cream Color.
02	pH	5.6
03	Viscosity	Smooth consistency
04	Spreadability	19 g·cm/sec
05	Extrudability	Easy extrusion

Invitro antioxidant activity

Cream exhibited good in vitro antioxidant activity with 60% DPPH inhibition and an IC_{50} of 21.68 mg/ml, along with dose-dependent activity in the FRAP assay (1.36 OD at 100 mg/ml).

Invitro anti-inflammatory activity

Cream exhibited significant in vitro anti-inflammatory activity by the albumin denaturation method, showing 33% inhibition at 50 mg/ml with a low IC_{50} value of 8.14 mg/ml, indicating moderate activity compared to diclofenac sodium (IC_{50} 121.29 mg/ml).

5. Discussion

The developed cream exhibited smooth, homogeneous appearance with skin-compatible pH, suitable viscosity, extrudability and good spreadability, confirming its appropriateness for topical application.

In vitro antioxidant studies (DPPH and FRAP) demonstrated significant free radical scavenging activity, while the albumin denaturation assay confirmed notable anti-inflammatory potential in a dose-dependent manner.

6. Conclusion

The present study successfully formulated a cinnamon extract-loaded cream using a green approach for enhanced anti-acne efficacy. The optimized formulation exhibited desirable physicochemical properties, good spreadability, suitable viscosity, and skin-compatible pH.

In vitro antioxidant (DPPH and FRAP) and anti-inflammatory studies confirmed significant biological activity, indicating its potential in reducing oxidative stress and inflammation associated with acne. Overall, the developed cream demonstrates promising therapeutic potential as a safe and effective herbal topical formulation for acne management.

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