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# Formulation and evaluation of a polyherbal cream incorporating medicinal plant extracts and essential oils for heel fissures

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**Abstract**
This research work focuses on the formulation and evaluation of a novel polyherbal anti-crack heel cream, prepared using a therapeutic blend of medicinal herbs, natural extracts and essential oils with proven moisturizing and healing properties. Cracked heels, also known as heel fissures, represent a common dermatological problem caused by dryness, excessive pressure and environmental or physical factors. Chemical-based creams often provide temporary relief but may cause irritation or undesirable side effects with long-term use.
Therefore, a herbal approach offers a safe, biocompatible and eco- friendly option for long-term skin care. This formulation was developed using black turmeric (*Curcuma caesia*), vetiver (*Vetiveria zizanioides*), nagkesar (*Mesua ferrea*), aloe vera (*Aloe vera*), green tea extract (*Camellia sinensis*), gond katira (*Astragalus gummifer*), cocoa butter, coconut oil, almond oil, beeswax, and vitamin E. These ingredients were selected for their anti-inflammatory, antioxidant, antimicrobial and emollient properties, which synergistically promote hydration, repair damaged tissue and enhance skin regeneration. The cream was prepared using the water-in-oil emulsification technique and evaluated for various parameters such as organoleptic characteristics, spreadability, washability, pH and irritation. The formulation demonstrated an optimal pH of 6.5, with a yellow color, smooth texture, pleasant aroma and uniform consistency, confirming its compatibility with the skin. It possessed excellent spreadability, easy washability, and no signs of irritation.

**Keywords:** Polyherbal cream, Anti-cracked heel formulation, Natural emollients, Skin regeneration

## 1. Introduction
Creams are soft, semisolid dosage forms that are meant for external use. These are applied not only on the skin but also on other areas such as eyes, nose, vagina or rectum. People use creams for different purposes, such as treating skin problems, protecting the area, or maintaining skin care and hygiene [1]. The active pharmaceutical ingredient (API) in the cream is absorbed through the skin or the mucous membranes, the soft inner linings of certain areas of the body, upon application. This allows the medicine to work only in the area where it is applied, and does not spread throughout the body [2].

**This is a type of water-in-oil (W/O) creams:** They contain tiny droplets of water dispersed in a continuous layer of oil. They are harder to use, but they keep the skin more moisturized because the oil layer slows the leakage of water from the outer layer of the skin [3].

**Fig 1:** Dry and deeply cracked heels

The skin on our feet becomes dry and rough because it does not have oil glands. It depends on numerous sweat glands to keep it moist (Fig. 2). Without proper care, dry skin can get worse and lead to cracks. This problem may be mild at first, but can become severe over time [4]. Lack of moisture and excessive pressure on the skin can cause it to crack (Fig. 1). Some medical skin conditions are also responsible for this. Regular application of creams and being gentle with the feet can prevent it. Older women suffer from it more than younger ones [5].

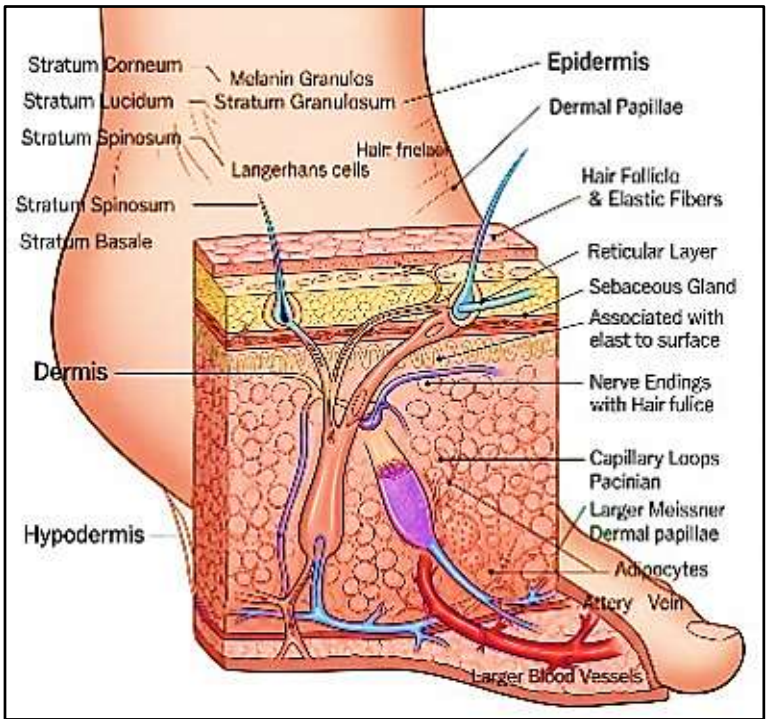


**Fig 2:** Anatomy of heel skin

Cracked heels usually cause dryness, skin irritation, and swelling, which makes the heels crack and feel painful. Long-term use of steroidal or non-steroidal medications may show unwanted and harmful reactions.

Recent studies showed that black turmeric (*Curcuma caesia*) has strong anti-inflammatory properties. It specifically targets the COX-2 enzyme to reduce pain and inflammation, without affecting COX-1, that makes it safer for long-term use. In preclinical trials, black turmeric was found to have strong anti-inflammatory effects. It also prevented protein damage more effectively than other medications like diclofenac [6].

**Common causes and risk factors of cracked heels are [7]:** (Fig. 3)**:**

- Lack of moisture (dry skin)
- Skin conditions like eczema, psoriasis, or athlete's foot
- Aging (skin loses elasticity and moisture)
- Vitamin deficiencies (like lack of vitamin E, zinc, or omega-3)
- Walking barefoot
- Standing without rest for many hours
- Diabetes or thyroid issues (which can cause dry skin)
- Cool and dry climate


**Fig 3:** Common risk factors of cracked heels

**The following crude drugs were used for the preparation of crack heel cream**

**1. Black Turmeric**

- **Synonym:** Kali Haldi (Hindi), Black Zedoary, Nalla Pasupu (Telugu)
- **Biological source:** It is obtained from the rhizomes of *Curcuma caesia* Roxb. (Fig. 4), which belongs to the Zingiberaceae family [8].

**Taxonomic Classification**

- **Kingdom:** Plantae
- **Phylum:** Tracheophyta
- **Class:** Liliopsida
- **Order:** Zingiberales
- **Genus:** *Curcuma*
- **Species:** *Caesia*
- **Morphology:** It is a unique medicinal herb known for its bluish-black rhizomes [9].

**Chemical constituents:** Curcumin, α-Pinene, β-Pinene, Sabinene, Caryophyllene, Camphor.

**Geographical source:** In India it is particularly found in Odisha, West Bengal, Chhattisgarh, Assam, North-East India and also found in some parts of Thailand, Indonesia and Nepal.

**Uses:** It reduces inflammation and irritation, acts as a natural remedy that is safer than standard chemical treatments for inflammation, provides relief from discomfort in cracked heels, enhances the skin's natural healing process [10].

**Fig 4:** Freshly harvested Black Turmeric

**2. Vetiver**

- **Synonym:** Khus (Hindi), Vetiver (English)
- **Biological Source:** It is obtained from the roots of *Vetiveria zizanioides (Linn.)* Nash (Fig. 5), which belongs to the Poaceae family.

**Taxonomic Classification**

- **Kingdom:** Plantae
- **Phylum:** Tracheophyta
- **Class:** Liliopsida
- **Order:** Poales
- **Genus:** *Vetiveria*
- **Species:** *zizanioides*

**Morphology:** It is a perennial, tall, tufted grass known for its long, fibrous, and aromatic roots that grow deep into the soil [11].

**Chemical Constituents:** Vetiverol, Vetivone, Khusimol, α-Vetivone, β-Vetivone, Terpenoids, and Sesquiterpenes.

**Geographical Source:** Particularly in India and Southeast Asia [12].

**Uses:** It heals deep cracks and rough skin on the feet, gives a cool and fresh feeling to the tired feet, moisturize the dry skin and keeps it hydrated, reduces the itching and burning sensation on the skin [14].

**Fig 5:** Aromatic vetiver roots

**3. Nagkesar Powder**

**Synonyms:** Nagkesar (Hindi) Ceylon Ironwood, Cobra's Saffron (English).

**Biological Source:** Nagkesar (Fig. 6) is obtained from the dried stamens of *Mesua ferrea Linn*, a tree belonging to the Calophyllaceae family [14].

**Taxonomic Classification**

- **Kingdom:** Plantae
- **Phylum:** Tracheophyta
- **Class:** Magnoliopsida
- **Order:** Malpighiales
- **Genus:** *Mesua*
- **Species:** *ferrea*

**Morphology:** It is a medium to large evergreen tree known for its fragrant white flowers with bright yellow stamens, which are dried and ground to prepare Nagkesar powder.

**Chemical Constituents:** It contains essential oils with major components like α-pinene and β-caryophyllene. It also includes mesuol, ferulic acid, xanthones, tannins, flavonoids, and coumarins [15, 16].

**Geographical Source:** Usually found in Assam, West Bengal, Kerala, Odisha, and other parts of Northeast and South India. Also grown in Sri Lanka and some parts of Southeast Asia [17].

**Uses:** It reduces swelling and gives quick relief to cracked heels, improves blood circulation which supports in healing process of the skin, acts as a natural skin tightener, clears dark patches and improves overall skin tone [18, 19].

**Fig 6:** Nagkesar buds with golden flower

**4. Gond Katira**

**Synonyms:** Gond Katira (Hindi), Tragacanth Gum, Goat's Thorn Gum (English)

**Biological Source:** Gond Katira (Fig. 7) is obtained from the dried gum of the *Astragalus gummifer* plant which belongs to the Fabaceae family.

**Taxonomic Classification**

- **Kingdom:** Plantae
- **Phylum:** Tracheophyta
- **Class:** Magnoliopsida
- **Order:** Fabales

- **Genus:** *Astragalus*
- **Species:** *gummifer*

**Morphology:** It is a natural, dried, translucent gum obtained from the stems and branches of *Astragalus* species, appearing as irregular, brittle flakes that swell into a jelly-like mass when soaked in water.

**Chemical Constituents:** It contains polysaccharides (mainly tragacanthin, and bassorin, along with galacturonic acid, arabinose, rhamnose, and xylose. It also contains trace minerals like calcium and magnesium.

**Geographical Source:** Mainly found in Iran, Turkey, Afghanistan, and in some parts of northern India.

**Uses:** It keeps the skin soft, reduces the redness and swelling in the cracked skin and forms a cool and soft gel when mixed with water [20].

**Fig 7:** Translucent crystals of Gond Katira

**5. Aloe Vera Gel**
**Synonyms:** Kumari (Hindi).

**Biological source:** It is obtained from the leaves of *Aloe* (Fig. 8), which belongs to the Liliaceae family.

**Taxonomic Classification**
- **Kingdom:** Plantae
- **Phylum:** Tracheophyta
- **Class:** Liliopsida
- **Order:** Asparagales
- **Genus:** *Aloe*
- **Species:** *vera*

**Morphology:** It is a perennial, succulent plant with thick, fleshy, green leaves containing a clear gel-like pulp, widely known for its soothing and healing properties.

**Chemical constituents:** Vitamins (A, B1, B2, B4, B6, B12), Enzymes (amylase, catalase, lipase).

**Geographical source:** In India it is commonly found in Rajasthan, Gujarat, Tamil Nadu, Maharashtra, Kerala and it is also cultivated in some parts Africa and Mexico.

**Uses:** It helps in healing sunburn and wounds, reducing skin irritation, and also provides anti-inflammatory properties [21, -23].

**Fig 8:** Pure green aloe gel with leaf background

**6. Coconut Oil**
**Synonyms:** Nariyal ka tel (Hindi), Cocos oil, Copra oil.

**Biological Source:** It is obtained from the dried endosperm of the fruit of *Cocos nucifera*, which belongs to Arecaceae family [24].

**Chemical Constituents:** It mainly contains medium-chain fatty acids: Lauric acid, Caprylic acid, Capric acid, Myristic acid, Palmitic acid, Glycerides, Vitamin E and Polyphenols [25].

**Uses of coconut oil (Fig. 9) in cracked heel creams:** Deep moisturization**,** softens skin**,** reduces inflammation**,** improves texture**,** nourishes skin [26].


**Fig 9:** Pure coconut oil with fresh coconut

**7. Beeswax**
Beeswax **(**Fig. 10) is a natural ingredient commonly used in skin care products. The wax in the cracked heel cream prevents the skin from drying out and helps in maintaining the softness. It also forms a protective layer on the skin, which prevent further cracking of dry and damaged heels.

**Synonyms:** Cera alba (purified white beeswax), Cera flava (yellow beeswax), Bee wax.

**Uses:** In crack healing cream it acts as a thickening agent, protective barrier and a natural moisturiser [27].

**Fig 10:** Beeswax block with natural honeycomb

### 8. Almond Oil

Almond oil **(**Fig. 11) is known for its softening and moisturizing properties. It penetrates deep into the skin, making it softer and less dry. It has a very light texture, so it does not feel heavy or sticky on the skin, especially in hot weather. Almond oil is rich in essential fatty acids such as oleic acid and linoleic acid, which deeply moisturize dry and rough skin [28].

**Fig 11:** Fresh almond oil with raw almonds

### 9. Vitamin E

Vitamin E **(**Fig. 12), also known as tocopherol, is safe, effective, and suitable for all skin types. It shows good compatibility with other ingredients commonly found in creams, such as beeswax, aloe vera, and almond oil [29].

**Uses:** It acts as an antioxidant, moisturizes the dry skin, reduces the inflammation, improves skin texture and also prevents rancidity [30].

**Fig 12:** Vitamin E softgel capsules

### 10. Green Tea Extract

Green tea extract **(**Fig. 13) is rich in polyphenols and has strong antioxidant and moisturizing properties. Some studies show that using a cream containing 6% green tea extract for 15 to 30 days can increase skin moisture and elasticity, making the skin softer and smoother. It improves overall skin texture and moisture, making it beneficial for treating cracked heels [31].

**Biological Source:** Green tea extract is obtained from *Camellia sinensis* leaves and belongs to the Theaceae Family.
**Uses:** Improves skin elasticity, reduces skin roughness, repairs damaged skin, soothes irritation and rich in antioxidants [32].


**Fig 13:** Green tea in raw and extracted form

### 11. Cocoa Butter

Cocoa butter **(**Fig. 14) is one of the main ingredients used in making cracked heels cream. It is a natural fat that remains solid at room temperature, but melts quickly when applied to the skin. This property makes it an excellent carrier for active ingredients, allowing them to be effectively absorbed into the skin. Its smooth, creamy texture provides deep moisture and enhances the overall feel of the cream [33].

**Biological Source:** Cocoa butter is obtained from the *Theobroma cacao* seed, which belongs to the Malvaceae family.

**Uses of cocoa butter in cracked heel creams:** Improves skin elasticity, forms a protective barrier**,** reduces flakiness and dryness and promotes skin healing [34].

**Fig 14:** Pure cocoa butter with roasted cocoa

## 2. Materials and methods

### 2.1. Materials

All the crude drugs were purchased from the local market of Aminabad, Lucknow, Uttar Pradesh. Listed crude drugs (Table 1) were authenticated with the reference no. IU/PHAR/HRB/25/10 by Dr. Mohd. Arif (Associate Professor, Department of Pharmacy, Integral University Lucknow). Vitamin E Capsules were purchased, which were marketed by Procter & Gamble Health Ltd. (P&G Health) India.

**Table 1:** List of ingredients used in heel cream

| S. No. | Ingredient | Form | Quantity |
|---|---|---|---|
| 1. | Black Turmeric | Powder | 2 g |
| 2. | Vetiver essential oil | Liquid | 0.5 ml |
| 3. | Nagkesar powder | Powder | 1.5 g |
| 4. | Aloe vera gel | Gel | 40 g |
| 5. | Green Tea extract | Liquid extract | 2 ml |
| 6. | Cocoa butter | Solid butter | 10 g |
| 7. | Gond katira | Gel | 7 g |
| 8. | Coconut oil | Liquid oil | 1 ml |
| 9. | Beeswax | Solid | 10 g |
| 10. | Almond oil | Liquid | 25 ml |
| 11. | Vitamin E | Liquid | 1 ml |

### 2.2. Method for the extraction of Green Tea by Hot Infusion

Hot tea infusion was prepared by adding purified water at 90 °C to 1.5 g of green tea and brewed for 25-30 minutes, then the prepared tea was filtered through filter paper, after that it was lyophilized (freeze-dried) and stored. The pH of the extracted aqueous solution was found to be less than 5.0 [35].

### 2.3. Methods for preparing 100 g Crack-Heel Cream [36]

**Step-1 Preparation of oil phase**

10 g of cocoa butter, 10 g of yellow beeswax, and 25 ml of almond oil were taken in the clean beaker. The mixture (Fig. 15) was heated in a water bath at 70-75 °C until it became a clear and uniform liquid then it was stirred gently to combine.

**Fig 15:** Oil phase mixture

**Step-2 Preparation of aqueous phase**

In the second beaker, 40 g of pure aloe vera gel was taken, and 7 g of swollen Gond Katira gel was added. After that, 2 ml of green tea extract and 1.5 g of Nagkesar powder were added. The mixture (Fig. 16) was slightly warmed to 40-45 °C and mixed thoroughly to form a uniform mixture.

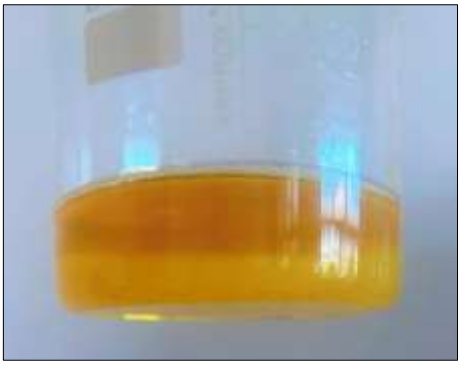

**Fig 16:** Aqueous phase mixture

**Step-3 Combine the oil and aqueous phases (Emulsification)**

With constant stirring, the aqueous phase was gradually introduced to the oil phase (Fig. 17). After creating a smooth cream in a blender, the mixture was allowed to cool.

**Fig 17:** Combining oil phase into aqueous phase

**Step-4 Add active ingredients and preservatives**
After the cooling step, 2 g of black turmeric extract, 0.5 ml of vetiver essential oil, 1 ml of coconut oil, and 1 ml of vitamin E were added. The mixture was stirred slowly to prevent the formation of air bubbles.

**Step-5 Finished Product**
Transferred the formulation into a sterilised cosmetic container (Fig. 18).

**Fig 18:** Cream-filled container

**Step-6 Storage**
The cream was kept in a cool and dry place, protected from direct sunlight and moisture.

**3. Evaluation of cream**

a) **Organoleptic properties:** The physical characteristics of the formulations, including appearance, colour and texture, were evaluated by visual inspection. To check the texture, a small amount of cream was gently pressed between the thumb and index finger. The evaluation focused on consistency and the presence of coarse particles. Additionally, the tactile sensation of the product was examined immediately after application, focusing on parameters such as hardness, roughness, and smoothness.
b) **Spreadability:** This was determined by taking 1 gram of anti-crack cream and placing it on a circular glass plate of 1 cm diameter, another glass plate was placed on top of it and a fixed weight was applied on the upper plate for 5 minutes. It was then observed how evenly the cream was spread, and ensured that there were no lumps or unmixed particles.
c) **Washability:** A small amount of the prepared cream was applied evenly to a specific area of the skin and then exposed to running water for a certain period of time. After that, it was observed how easily the cream washed off from the skin surface, and the results were recorded.
d) **Determination of pH:** A solution of the cream was prepared by weighing 1 g of cream and dissolving it in 10 ml of water. Once the proper solution was prepared, the pH value was determined using pH paper.
e) **Irritancy test:** The prepared cream was applied to the desired area of skin. After an hour, the skin was checked for any irritation, redness, or swelling [37-39].

**4. Results and Discussion**

f) **Organoleptic Properties:** This formulation demonstrated desirable organoleptic properties. The cream was smooth, uniform, and free from coarse particles or phase separation. Upon application, the formulation spread evenly without any lumpiness or greasiness, ensuring good texture and aesthetic appeal. These properties are important because they directly impact patient compliance.
g) **Spreadability:** This test showed that the cream was evenly distributed without any mixed particles. The average spread diameter indicated that the cream had good spreadability, suggesting that it could be easily applied with minimal effort. An ideal topical formulation should have sufficient spreading ability to ensure uniform coverage, which was observed in this study.
h) **Washability**: The formulation was easy to rinse off with running water, providing excellent washability. This not only makes it convenient for users but also ensures that the cream adheres well during application. Good washability is important, as it balances ease of removal with effective performance during use, thereby enhancing the overall user experience and satisfaction with the product.
i) **pH Determination:** These formulations were found to have a pH value of 6.5, which is close to the skin's natural pH. This suggests that the cream is skin-friendly and reduce the risk of irritation or damage to the skin's protective layer. Maintaining a near-neutral pH is especially important for long-term topical use.

The prepared herbal anti-crack heel cream exhibited satisfactory physical properties (Table 2), with a smooth texture and yellow color. The pH value of this formulation was found to be 6.5, which confirms its skin-friendly and non-irritating nature. The cream spread easily, felt non-greasy, and washed off easily with water. A combination of aloe vera, black turmeric, vetiver, saffron, and coconut oil moisturized the skin and provided therapeutic benefits. These natural ingredients work together to moisturize, soothe, and effectively promote skin health. Overall, this formulation was found to be stable, effective and suitable for the management of cracked heels.

**Table 2:** Observation of evaluation parameters for the herbal crack heel cream

| Parameter | Result |
|---|---|
| Colour | Pale yellow |
| Smell | Characteristic |
| Texture | Smooth |
| Irritancy | No |
| Washability | Washable |
| Emulsion Type | O/W |
| pH | 6.5 |
| Spreadability | Spreadable |
| Phase seperation | No phase seperation |

**5. Conclusion**
The prepared polyherbal anti-crack heel cream showed smooth texture, uniform consistency, good spreadability, easy washability, skin-friendly pH, suitable viscosity, excellent moisture absorption and no signs of skin irritation. These evaluation results confirm that this cream is safe, stable, and effective in moisturizing, healing, and protecting cracked heels, and is a natural alternative to conventional treatments.

**6. Conflict of interest**
The authors declare no conflicts of interest and agree to the publication of this work.

**7. Author's Contribution**
All the authors are equally contributed in this research work

**8. Funding**
None

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