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DEVELOPMENT OF FACE PACK FORMULATION CONTAINING COFFEE BEAN POWDER, CHICORY AND LEMONGRASS OIL

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ABSTRACT

The increasing demand for herbal cosmetic products has led to the development of skincare formulations based on natural plant-derived ingredients. The present study aimed to formulate and evaluate a herbal face pack containing coffee bean powder (*Coffea arabica*), chicory (*Cichorium intybus*), and lemongrass oil (*Cymbopogon citratus*). Coffee powder provides exfoliating and antioxidant properties due to its caffeine and chlorogenic acid content, while chicory contributes anti-inflammatory and detoxifying effects. Lemongrass oil possesses antimicrobial and refreshing characteristics beneficial for acne-prone skin. The formulation also included bentonite clay and sandalwood powder to enhance detoxification and skin soothing effects. The prepared formulation was evaluated for organoleptic properties, spreadability, stability, and consistency. The optimized formulation showed a smooth texture, pleasant aroma, good spreadability, and stable characteristics. The results indicate that the developed herbal face pack formulation possesses promising cosmetic potential for skin cleansing, rejuvenation, and acne management.

KEYWORDS: Herbal cosmetics, Coffee bean powder, Chicory, Lemongrass oil, Face pack formulation.

1. INTRODUCTION

Skin is the largest organ of the human body and serves as the primary protective barrier against environmental stressors, pathogenic microorganisms, ultraviolet radiation, and chemical pollutants. It performs several essential physiological functions including thermoregulation, sensory perception, immune defense, and prevention of excessive water loss. However, constant exposure to environmental pollutants, oxidative stress, UV radiation, and lifestyle factors can lead to various skin disorders such as acne, premature aging, hyperpigmentation, inflammation, and loss of skin elasticity. These factors stimulate the generation of reactive oxygen species (ROS), which damage cellular structures, proteins, lipids, and DNA, ultimately accelerating skin aging and deterioration of skin health.[1]

In recent years, there has been a significant shift toward herbal and natural cosmetic formulations due to increasing awareness regarding the adverse effects associated with synthetic cosmetic ingredients. Herbal cosmetics are formulated using plant-derived materials such as extracts, powders, essential oils, and clays that provide therapeutic benefits to the skin with minimal side effects. Natural products are generally considered safer, biodegradable, and environmentally friendly compared to synthetic cosmetic ingredients. As a result, herbal face packs have gained considerable popularity as skincare formulations because they provide cleansing, detoxifying, moisturizing, and rejuvenating effects on the skin.[2]

Herbal face packs are topical cosmetic preparations applied to the face to improve skin texture, tone, and appearance. These formulations typically contain natural ingredients such as plant powders, mineral clays, herbal extracts, essential oils, and moisturizing agents. The application of face packs helps remove dead skin cells, unclog pores, absorb excess sebum, improve blood circulation, and promote skin rejuvenation. Moreover, herbal face packs often possess antioxidant, antimicrobial, and anti-inflammatory properties that help in preventing acne, reducing skin irritation, and maintaining overall skin health.[3]

The present study focuses on the development of a herbal face pack formulation containing coffee bean powder (*Coffea arabica*), chicory (*Cichorium intybus*), and lemongrass oil (*Cymbopogon citratus*). These ingredients were selected based on their well-documented pharmacological and dermatological properties.

Coffee bean powder (*Coffea arabica*) is widely recognized for its antioxidant and exfoliating properties. Coffee beans contain various bioactive compounds such as caffeine, chlorogenic acid, polyphenols, tannins, proteins, and fixed oils. Among these, caffeine and chlorogenic acid play an important role in neutralizing reactive oxygen species and protecting the skin from oxidative damage. Caffeine also promotes microcirculation in the skin, which may help reduce puffiness, improve skin texture, and stimulate collagen production. Additionally, the granular structure of coffee powder acts as a natural exfoliating agent that helps remove dead skin cells and impurities from the skin surface, thereby improving skin smoothness and brightness.[4]

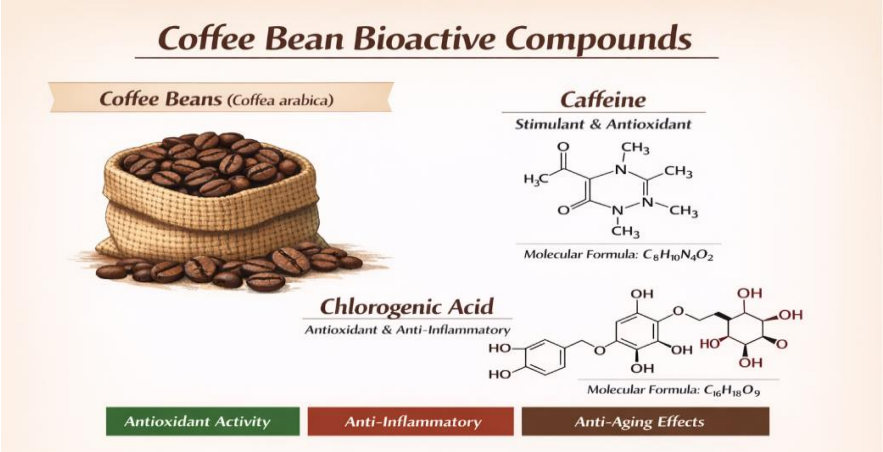


Figure 1. Chemical structure and composition of coffee bean bioactive compounds Chicory (*Cichorium intybus*) is a medicinal plant belonging to the family Asteraceae and is widely used in traditional medicine for its anti-inflammatory, antioxidant, and detoxifying properties. Chicory root contains bioactive constituents such as inulin, coumarins, flavonoids, sesquiterpene lactones, and phenolic compounds. These compounds exhibit strong antioxidant activity, which helps protect the skin from oxidative stress and environmental damage. Inulin, a natural prebiotic fiber present in chicory, also contributes to skin hydration and improves skin barrier function. Additionally, chicory extracts have been reported to stimulate collagen synthesis and improve skin elasticity, which may help reduce the appearance of wrinkles and signs of aging.[5]

Lemongrass oil (*Cymbopogon citratus*) is an essential oil widely used in cosmetic and dermatological formulations due to its antimicrobial, antioxidant, and anti-inflammatory properties. The oil contains several biologically active compounds including citral (a mixture of geranial and neral), geraniol, citronellal, and limonene. Citral is the major active component responsible for the antimicrobial activity of lemongrass oil against various

pathogenic microorganisms, including acne-causing bacteria such as *Staphylococcus aureus* and *Cutibacterium acnes*. Furthermore, lemongrass oil possesses a refreshing fragrance and exhibits skin-toning properties that help tighten pores and reduce excess oil production on the skin surface.[6]

The combination of coffee bean powder, chicory extract, and lemongrass oil in a single formulation may produce synergistic effects that enhance the overall efficacy of the face pack. Coffee powder provides mechanical exfoliation and antioxidant protection, chicory contributes anti-inflammatory and detoxifying properties, and lemongrass oil offers antimicrobial and skin-toning effects. Together, these ingredients may improve skin texture, promote detoxification, prevent microbial growth, and enhance overall skin rejuvenation.

Therefore, the objective of the present study was to develop and evaluate a herbal face pack formulation containing coffee bean powder, chicory, and lemongrass oil using natural ingredients. The formulation aims to provide multiple dermatological benefits including exfoliation, detoxification, antimicrobial protection, and improvement of skin appearance while minimizing the use of synthetic cosmetic ingredients.

Figure 2. Botanical images of the herbal ingredients used in the formulation.

2. OBJECTIVES

The present study was designed with the following objectives:

1. **To develop** a herbal face pack formulation using natural ingredients including coffee bean powder (*Coffea arabica*), chicory (*Cichorium intybus*), and lemongrass oil (*Cymbopogon citratus*).

2. **To evaluate** the physicochemical and organoleptic properties of the developed formulation, including appearance, aroma, texture, consistency, and spreadability.
3. **To investigate** the potential skincare benefits of the formulation such as exfoliating activity, detoxifying effect, and antimicrobial properties.
4. **To formulate** a stable and effective herbal cosmetic product using plant-based ingredients that may contribute to improved skin health and rejuvenation.

3. MATERIALS AND METHODS

3.1 MATERIALS

The herbal ingredients used for the preparation of the face pack formulation were selected based on their reported dermatological, antioxidant, antimicrobial, and skin-rejuvenating properties. Herbal cosmetics are widely preferred because plant-derived ingredients are generally biocompatible, biodegradable, and associated with fewer adverse effects compared to synthetic cosmetic compounds. Therefore, natural materials such as plant powders, essential oils, mineral clays, and botanical extracts are commonly incorporated into cosmetic formulations for their multifunctional benefits on the skin.[7]

Coffee bean powder (*Coffea arabica*) was selected as one of the primary ingredients due to its strong antioxidant and exfoliating properties. Coffee beans contain bioactive constituents such as caffeine, chlorogenic acid, polyphenols, and tannins, which have been reported to exhibit antioxidant, anti-inflammatory, and photoprotective effects. Caffeine present in coffee stimulates blood circulation in the skin and may contribute to improved skin tone and reduction of puffiness. Furthermore, the granular texture of coffee powder acts as a natural exfoliating agent that helps remove dead skin cells, unclog pores, and promote smoother and brighter skin appearance.[8]

Chicory powder (*Cichorium intybus*) was incorporated into the formulation due to its anti-inflammatory and detoxifying properties. Chicory contains several phytochemical constituents including inulin, flavonoids, phenolic acids, and coumarins that exhibit antioxidant and anti-inflammatory activity. These bioactive compounds can help protect the skin from oxidative stress and environmental damage caused by free radicals. In addition, inulin present in chicory acts as a natural humectant that helps maintain skin hydration and improves skin barrier function. Recent studies have also reported that chicory extracts may stimulate collagen synthesis and improve skin elasticity, thereby contributing to anti-aging effects.[9]

Lemongrass oil (*Cymbopogon citratus*) was included in the formulation because of its well-documented antimicrobial and antioxidant properties. Lemongrass essential oil contains several active constituents such as citral (geranial and neral), geraniol, citronellal, and limonene. Among these compounds, citral is considered the major active component responsible for the antimicrobial activity of lemongrass oil against a wide range of microorganisms including acne-causing bacteria such as *Staphylococcus aureus* and *Cutibacterium acnes*. Additionally, lemongrass oil possesses a pleasant citrus fragrance and exhibits skin-toning properties that help tighten pores and regulate sebum production, making it suitable for cosmetic formulations intended for oily and acne-prone skin.[10]

Bentonite clay (montmorillonite clay) was incorporated into the formulation as a detoxifying and oil-absorbing agent. Bentonite clay is a naturally occurring mineral clay composed primarily of hydrated aluminum silicates. Due to its high adsorption capacity and large surface area, bentonite clay can absorb toxins, impurities, and excess oils from the skin. It is widely used in cosmetic masks and face packs for deep cleansing and detoxification purposes. Additionally, bentonite clay exhibits mild antimicrobial and anti-inflammatory properties that may help reduce acne and skin irritation.[11]

Sandalwood powder (*Santalum album*) was used in the formulation due to its cooling, soothing, and antimicrobial properties. Sandalwood has been traditionally used in Ayurvedic and herbal cosmetic preparations for the treatment of skin inflammation, acne, and pigmentation disorders. The presence of bioactive compounds such as santalols contributes to its anti-inflammatory and antioxidant effects. Sandalwood also provides a calming fragrance and helps improve overall skin complexion and texture.[12]

Rose water was used as the vehicle in the formulation to provide appropriate consistency and enhance skin toning effects. Rose water possesses mild astringent, anti-inflammatory, and antioxidant properties that help soothe irritated skin and maintain skin hydration. Aloe vera gel (*Aloe barbadensis*) was incorporated as a moisturizing and skin-conditioning agent because it contains polysaccharides, vitamins, enzymes, and amino acids that help promote wound healing, hydration, and skin regeneration.[13]

All the ingredients used in the formulation were of cosmetic or pharmaceutical grade and were procured from local herbal suppliers. The materials were stored in airtight containers

under dry and cool conditions until further use in the preparation of the face pack formulation.

Materials Used in Face Pack Formulation.

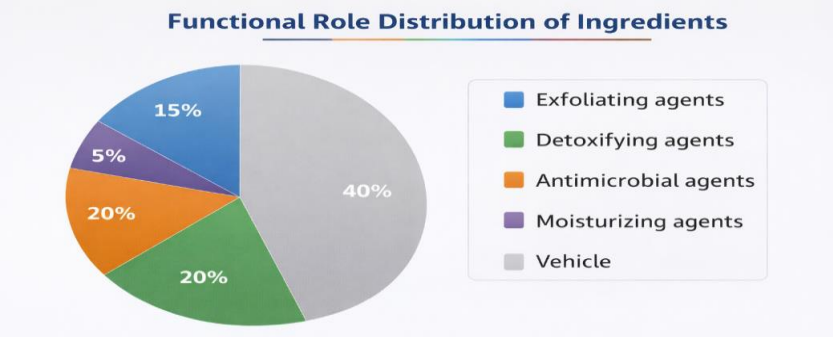
Ingredient	Scientific Name	Function
Coffee bean powder	*Coffea arabica*	Exfoliant, antioxidant
Chicory powder	*Cichorium intybus*	Anti-inflammatory agent
Lemongrass oil	*Cymbopogon citratus*	Antimicrobial, fragrance
Bentonite clay	Montmorillonite clay	Detoxifying agent
Sandalwood powder	*Santalum album*	Cooling and soothing agent
Rose water	—	Vehicle
Aloe vera gel	*Aloe barbadensis*	Moisturizing agent

These ingredients were selected based on their reported abilities to promote skin rejuvenation, detoxification, exfoliation, antimicrobial protection, and improvement of skin texture and appearance.

4. Formulation of Herbal Face Pack

The herbal face pack was formulated using natural plant-derived ingredients selected for their exfoliating, detoxifying, antimicrobial, and skin-rejuvenating properties. The formulation consisted primarily of coffee bean powder, chicory powder, lemongrass oil, bentonite clay, sandalwood powder, rose water, and aloe vera gel. Each ingredient was incorporated based on its functional role in improving the efficacy and stability of the final cosmetic product.

Coffee bean powder and chicory powder were included as major active ingredients due to their antioxidant and anti-inflammatory activities. Coffee powder acts as a natural exfoliant that helps remove dead skin cells and improve skin circulation, while chicory provides antioxidant protection and supports skin hydration due to its inulin content. Bentonite clay was incorporated as a detoxifying agent because of its high adsorption capacity, which helps absorb excess oil, toxins, and impurities from the skin. Sandalwood powder was added for its soothing, cooling, and antimicrobial properties, which help calm irritated skin and improve skin tone.



Graph 1. Functional role distribution of ingredients.

Lemongrass oil was incorporated in small quantities to provide antimicrobial protection and a pleasant fragrance to the formulation. Rose water served as the vehicle to achieve the desired consistency of the face pack, while aloe vera gel was included as a moisturizing and skin-conditioning agent that helps maintain skin hydration and improve skin texture.

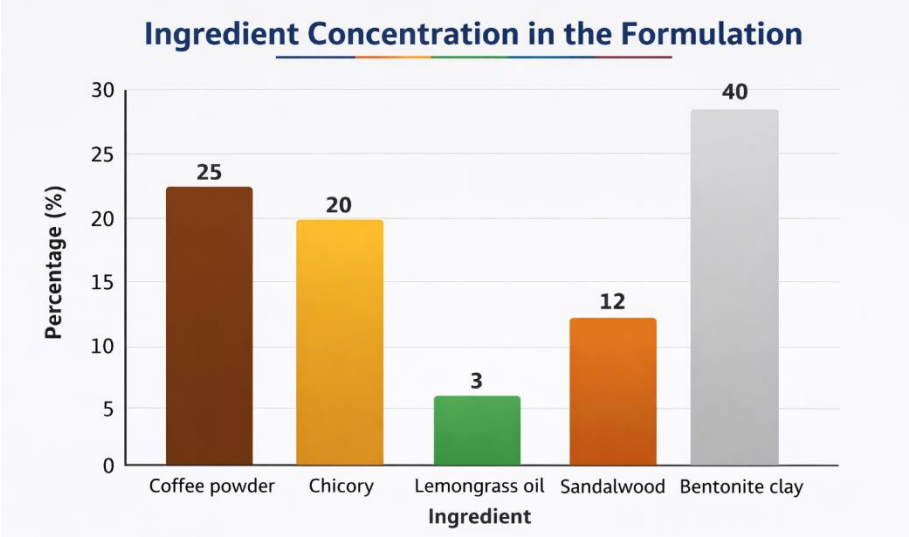
The quantities of the ingredients were selected based on preliminary trials to achieve optimal consistency, spreadability, and stability of the formulation. The formulation composition is shown in Table 1.

Table 1: Formulation Composition of Herbal Face Pack.

Sr No	Ingredient	Quantity Given	Quantity Taken	Role
1	Coffee bean powder	2 g	2 g	Emollient
2	Chicory powder	4 g	4 g	Emollient
3	Lemongrass oil	Q.S	Q.S	Emulsifying / fragrance
4	Sandalwood powder	2 g	2 g	Emollient
5	Bentonite clay	2 g	2 g	Detoxifying agent
6	Rose water	Q.S	Q.S	Vehicle
7	Aloe vera gel	Q.S	Q.S	Preservative

Table 2: Ingredient Concentration.

Ingredient	Concentration (%)
Coffee bean powder	10
Chicory powder	5
Lemongrass oil	1
Sandalwood powder	2
Bentonite clay	10
Water	q.s to 100



Graph 2. Ingredient concentration in the formulation.

The concentration of each ingredient was optimized to maintain the stability, consistency, and therapeutic effectiveness of the formulation. Coffee powder and bentonite clay were used in relatively higher concentrations to enhance exfoliating and detoxifying effects. Chicory powder was incorporated at moderate concentration to provide antioxidant and anti-inflammatory activity. Lemongrass oil was used in a low concentration due to its high potency and strong fragrance. Sandalwood powder was included to enhance soothing and skin-conditioning properties.

Such balanced formulation helps achieve appropriate viscosity, smooth texture, and good spreadability, which are essential characteristics of cosmetic face pack products. Additionally, the use of natural ingredients improves the safety profile of the formulation and reduces the risk of adverse skin reactions compared to synthetic cosmetic preparations.[14,15]

5. Method of Preparation

The herbal face pack formulation was prepared using the conventional **powder blending method**, which is widely used in the preparation of herbal cosmetic masks and topical formulations. This method ensures uniform mixing of powdered herbal ingredients and allows the formation of a smooth paste suitable for topical application on the skin.

Initially, all powdered ingredients including coffee bean powder (*Coffea arabica*), chicory powder (*Cichorium intybus*), sandalwood powder (*Santalum album*), and bentonite clay were accurately weighed using a digital weighing balance to ensure precise quantities according to

the formulation design. Accurate measurement of ingredients is essential to maintain uniformity, consistency, and reproducibility of the formulation.

The weighed powdered ingredients were transferred into a clean and dry mixing bowl and blended thoroughly using a spatula. Proper mixing of the dry ingredients is important to ensure homogeneity and uniform distribution of the active components throughout the formulation.

After obtaining a uniform powder mixture, lemongrass essential oil (*Cymbopogon citratus*) was added to the mixture in a small quantity (approximately 1–2 drops). Lemongrass oil was incorporated carefully to ensure even distribution within the formulation while preventing excessive concentration that could potentially cause skin irritation.

Subsequently, rose water and aloe vera gel were gradually added to the powder mixture while continuously stirring the formulation. The addition of the liquid phase was performed slowly to obtain a smooth and lump-free paste. Continuous stirring was carried out until a homogeneous and uniform consistency suitable for facial application was achieved.

The final formulation exhibited a smooth texture with good spreadability and pleasant aroma. The prepared herbal face pack was then transferred into sterile airtight containers and stored at room temperature until further evaluation. Proper storage conditions were maintained to prevent contamination, moisture absorption, and degradation of the active components present in the formulation.[16]

Figure 3. Flow diagram of herbal face pack formulation

6. Evaluation of Formulation

Organoleptic Evaluation

The prepared herbal face pack formulation was subjected to preliminary evaluation to assess its quality, stability, and suitability for cosmetic application. Evaluation of topical cosmetic formulations is essential to ensure that the product possesses acceptable physical characteristics, stability, and user compliance. In the present study, the formulation was evaluated using **organoleptic parameters**, which involve sensory assessment of the formulation's physical appearance, odor, texture, and consistency.

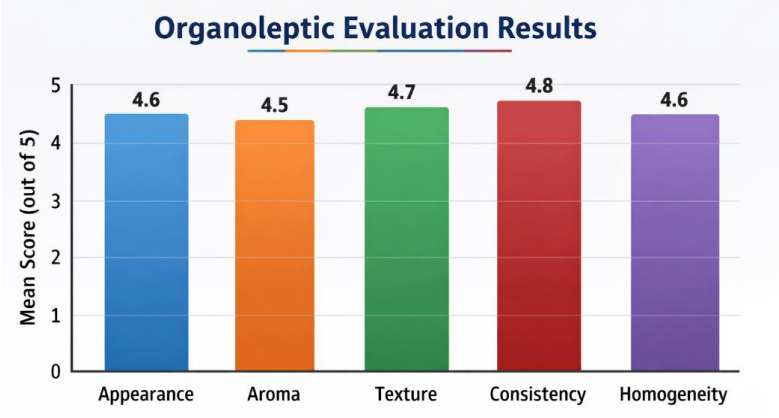
Organoleptic evaluation is an important step in cosmetic product development because it provides information about the aesthetic acceptability of the formulation. Parameters such as appearance, aroma, texture, consistency, and homogeneity play a significant role in determining the consumer acceptance of herbal cosmetic products. The evaluation was carried out visually and manually by examining the prepared formulation under normal laboratory conditions.

The prepared face pack formulation was inspected for its color and overall appearance to ensure that the ingredients were uniformly distributed throughout the mixture. The odor or aroma of the formulation was evaluated to determine whether the fragrance of the essential oil and herbal ingredients was pleasant and acceptable. Texture and consistency were examined by applying a small quantity of the formulation on the skin to observe smoothness and ease of spreading. Homogeneity of the formulation was evaluated by visual inspection to ensure the absence of lumps or coarse particles.

The results of organoleptic evaluation are presented in Table 3.

Table 3: Organoleptic Evaluation of Herbal Face Pack.

Parameter	Observation
Appearance	Light brown herbal paste
Aroma	Pleasant fragrance of lemongrass and coffee
Texture	Smooth
Consistency	Spreadable
Homogeneity	Good



Graph 3. Organoleptic evaluation results.

The results indicated that the prepared formulation exhibited acceptable cosmetic characteristics suitable for topical application. The light brown color of the formulation was attributed to the presence of coffee powder and bentonite clay. The pleasant aroma resulted from the combined fragrance of lemongrass oil and natural herbal ingredients. The formulation showed a smooth texture and good spreadability, which are desirable properties for facial mask preparations.

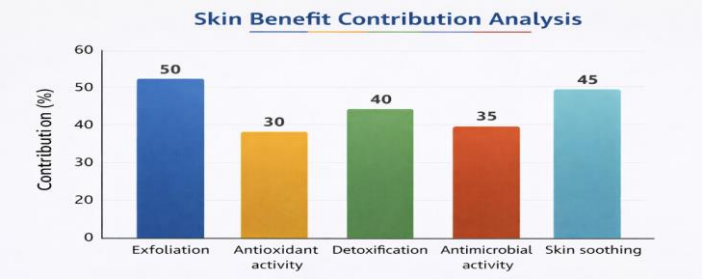
Furthermore, the uniform distribution of ingredients confirmed the homogeneity of the formulation, indicating that the preparation method was effective in producing a stable and aesthetically acceptable herbal cosmetic product. These characteristics suggest that the developed herbal face pack may provide good user acceptability and ease of application in skincare routines.[17]

7. RESULTS AND DISCUSSION

The herbal face pack formulation prepared in the present study exhibited desirable physicochemical and organoleptic properties suitable for topical cosmetic application. The formulation appeared as a light brown, smooth, and homogeneous paste with a pleasant herbal aroma due to the presence of coffee powder and lemongrass oil. The smooth texture

and spreadable consistency indicated proper mixing of ingredients and appropriate formulation design. These properties are essential for ensuring user acceptability and effective application on the skin.

The inclusion of bentonite clay played an important role in enhancing the detoxifying capability of the formulation. Bentonite clay possesses strong adsorptive properties due to its layered mineral structure and large surface area. These characteristics enable it to absorb excess oil, toxins, and impurities from the skin surface, thereby promoting deep cleansing of pores. This property makes bentonite clay a commonly used ingredient in cosmetic face masks designed for oily and acne-prone skin.[18]



Graph 4. Skin benefit contribution analysis.

Coffee bean powder (*Coffea arabica*) contributed significantly to the exfoliating and antioxidant properties of the formulation. The granular structure of coffee powder provides mild mechanical exfoliation that helps remove dead skin cells and unclog pores. Additionally, coffee contains bioactive compounds such as caffeine, chlorogenic acid, and polyphenols, which exhibit antioxidant activity and help neutralize reactive oxygen species responsible for skin aging. These antioxidant effects may contribute to improved skin texture and a brighter complexion.[19]

Chicory powder (*Cichorium intybus*) further enhanced the therapeutic properties of the formulation due to its rich phytochemical composition. Chicory contains inulin, flavonoids, phenolic acids, and coumarins that possess antioxidant and anti-inflammatory properties. These compounds help reduce skin inflammation, support skin detoxification processes, and protect the skin from oxidative damage. Moreover, inulin has been reported to improve skin hydration and barrier function, thereby promoting healthier and more resilient skin.[20]

Lemongrass oil (*Cymbopogon citratus*) served as an antimicrobial and aromatic component in the formulation. The essential oil contains several active constituents, particularly citral,

geraniol, and citronellal, which demonstrate antimicrobial activity against various pathogenic microorganisms. Previous studies have reported that lemongrass oil exhibits inhibitory activity against acne-causing bacteria such as *Staphylococcus aureus* and *Cutibacterium acnes*. Therefore, its incorporation in the formulation may help reduce microbial growth on the skin and prevent acne formation.[21]

The synergistic combination of coffee powder, chicory powder, lemongrass oil, bentonite clay, and sandalwood powder resulted in a multifunctional herbal formulation capable of providing exfoliation, detoxification, antimicrobial protection, and skin soothing effects. The prepared formulation also demonstrated good spreadability and easy washability, which are essential characteristics of cosmetic face packs. The presence of rose water and aloe vera gel contributed to improved hydration, soothing effects, and pleasant sensory characteristics of the formulation.

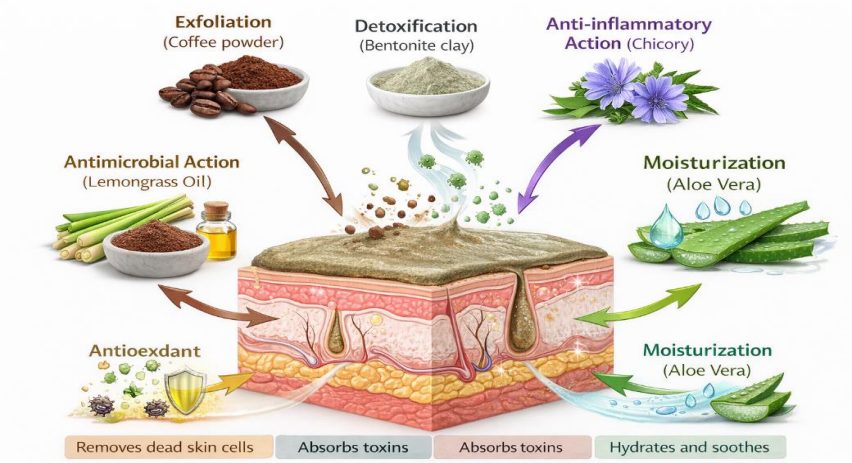


Figure 5. Mechanism of action of herbal face pack on skin.

Overall, the results suggest that the developed herbal face pack formulation possesses promising cosmetic and dermatological benefits. The combination of natural ingredients provides multiple functional properties that can help cleanse the skin, remove impurities, reduce microbial growth, and promote a healthy and rejuvenated complexion.

8. CONCLUSION

The present study successfully developed a herbal face pack formulation containing coffee bean powder (*Coffea arabica*), chicory (*Cichorium intybus*), and lemongrass oil (*Cymbopogon citratus*) using natural plant-based ingredients. The prepared formulation exhibited desirable organoleptic properties including a smooth texture, pleasant aroma, good

spreadability, and homogeneous appearance, indicating its suitability for topical cosmetic application. The formulation also demonstrated acceptable stability and cosmetic characteristics, suggesting that the selected ingredients were compatible and effective in producing a stable herbal cosmetic preparation.

The incorporation of coffee bean powder contributed exfoliating and antioxidant properties, which may help remove dead skin cells and protect the skin from oxidative damage. Chicory powder enhanced the formulation with anti-inflammatory and detoxifying effects due to the presence of bioactive compounds such as flavonoids and inulin. Lemongrass oil provided antimicrobial activity and a refreshing fragrance, which may assist in preventing microbial growth and improving overall skin hygiene. Additionally, supporting ingredients such as bentonite clay, sandalwood powder, rose water, and aloe vera gel contributed detoxifying, soothing, moisturizing, and skin-conditioning effects.

Overall, the synergistic combination of these herbal ingredients resulted in a multifunctional formulation capable of cleansing the skin, absorbing excess oil, removing impurities, and promoting healthier skin appearance. Therefore, the developed herbal face pack formulation shows promising potential as a safe, effective, and natural cosmetic product for skin rejuvenation, detoxification, and acne prevention. Further studies involving physicochemical evaluation, microbiological stability testing, and clinical studies on human volunteers may be conducted to validate its long-term safety and efficacy for commercial cosmetic applications.

9. Future Scope

The present study demonstrated the successful formulation of a herbal face pack containing coffee bean powder, chicory powder, and lemongrass oil with promising cosmetic properties. However, further research can be conducted to enhance the scientific validation and potential commercial application of the developed formulation.

Future studies may focus on conducting detailed **physicochemical evaluations**, including parameters such as pH, viscosity, spreadability, washability, and stability studies under different storage conditions to determine the long-term shelf life of the formulation. In addition, **microbiological studies** can be performed to assess the antimicrobial efficacy of the formulation against various skin pathogens, particularly acne-causing microorganisms.

Clinical studies involving **human volunteers** may also be carried out to evaluate the safety, skin compatibility, and therapeutic effectiveness of the formulation in real-life conditions. Such studies would provide valuable data regarding the product's potential to improve skin texture, reduce acne, and enhance skin hydration.

Furthermore, advanced formulation techniques such as **nanoformulations, herbal extract standardization, and controlled-release systems** may be explored to improve the bioavailability and effectiveness of the active ingredients. The incorporation of additional herbal extracts with complementary dermatological properties may also enhance the overall performance of the formulation.

Therefore, with further scientific validation and clinical evaluation, the developed herbal face pack formulation may have significant potential for **large-scale production and commercialization as a natural cosmetic product** for skin care and dermatological applications.

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