



FORMULATION AND EVALUATION OF A POLYHERBAL ANTI-AGING GEL

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ABSTRACT

Skin aging is a complex biological process influenced by intrinsic factors such as genetic predisposition and hormonal changes, as well as extrinsic factors including ultraviolet (UV) radiation, environmental pollution, and lifestyle habits. These factors lead to the formation of reactive oxygen species (ROS), which cause oxidative stress and damage to cellular structures, resulting in visible signs of aging such as wrinkles, fine lines, dryness, and loss of elasticity. The present study aims to formulate and evaluate a polyherbal anti-aging gel containing multiple herbal extracts with antioxidant and skin-protective properties. The formulation includes *Zingiber zerumbet*, *Calendula officinalis*, *Glycyrrhiza glabra* (licorice), *Camellia sinensis* (green tea), and *Aloe vera*. Beetroot extract was incorporated as a natural coloring agent, while methyl paraben was used as a preservative.

Carbopol 940 was employed as a gelling agent, and triethanolamine was used for neutralization and pH adjustment. The prepared gel was evaluated for various physicochemical parameters including pH, viscosity, spreadability, extrudability, and homogeneity. Additionally, UV-visible spectrophotometric analysis and microbiological evaluation were performed.

The results indicated that the formulation exhibited acceptable pH, good viscosity, excellent spreadability, and no microbial growth. The

presence of multiple herbal extracts provided synergistic antioxidant activity, making the formulation effective for anti-aging purposes. Thus, the developed polyherbal gel can be considered a safe, stable, and effective alternative to synthetic anti-aging products.

KEYWORDS

Polyherbal gel, Anti-aging, Antioxidants, Zingiber zerumbet, Herbal cosmetics

1. INTRODUCTION

Skin is the largest organ of the human body and acts as a protective barrier against environmental aggressors such as ultraviolet radiation, pollution, and microorganisms. It plays a vital role in thermoregulation, sensation, and prevention of water loss. However, with advancing age, the skin undergoes structural and functional changes, leading to visible signs of aging.

Skin aging is broadly classified into intrinsic and extrinsic aging. Intrinsic aging is a natural, genetically determined process characterized by thinning of the epidermis and decreased collagen production. Extrinsic aging, also known as photoaging, is caused by external factors such as UV radiation, smoking, and environmental pollutants, leading to deeper wrinkles, pigmentation, and rough skin texture.

A major mechanism responsible for skin aging is oxidative stress caused by reactive oxygen

species (ROS). These free radicals damage cellular components including proteins, lipids, and DNA, resulting in degradation of collagen and elastin fibers.

Herbal products have gained significant attention in cosmetic science due to their natural origin, safety, and therapeutic potential. Polyherbal formulations, which combine multiple plant extracts, provide synergistic effects and enhanced efficacy compared to single-herb formulations.

The present study focuses on the formulation of a polyherbal anti-aging gel containing *Zingiber zerumbet*, calendula, licorice, green tea, and aloe vera. These herbs possess antioxidant, anti-inflammatory, moisturizing, and skin-protective properties.

2. LITERATURE REVIEW

Numerous studies have demonstrated the role of oxidative stress in skin aging and the importance of antioxidants in preventing cellular damage. Herbal extracts are rich sources of antioxidants and have been widely used in dermatological and cosmetic formulations.

Zingiber zerumbet contains zerumbone, a bioactive compound with strong antioxidant and anti-inflammatory properties. It has been reported to reduce oxidative stress and prevent premature aging.

Green tea (*Camellia sinensis*) is rich in polyphenols such as epigallocatechin gallate (EGCG), which protect the skin from UV-induced damage and improve elasticity.

Licorice (*Glycyrrhiza glabra*) contains glabridin, which exhibits skin-brightening and anti-inflammatory effects. It helps reduce hyperpigmentation and enhances skin tone.

Calendula (*Calendula officinalis*) is known for its wound-healing and soothing properties. It promotes tissue regeneration and reduces inflammation.

Aloe vera is widely used for its moisturizing and healing properties. It enhances collagen synthesis and improves skin hydration.

Polyherbal formulations offer synergistic effects, improving overall efficacy and reducing side effects. Carbopol-based gels are widely used in

topical formulations due to their stability, transparency, and ease of application.

3. MATERIALS AND METHODS

The polyherbal anti-aging gel was prepared by initially extracting active constituents from selected plant materials followed by formulation of the gel base. The plant materials including *Zingiber zerumbet* rhizome, calendula flowers, licorice roots, and green tea leaves were collected, washed thoroughly with distilled water, and dried under shade at room temperature to preserve heat-sensitive constituents. The dried materials were then coarsely powdered to increase the surface area for extraction. The powdered materials were subjected to maceration using ethanol or hydroalcoholic solvent for a period of 24 to 48 hours with occasional stirring to facilitate extraction of phytoconstituents. The extract was filtered using muslin cloth or filter paper, and the filtrate was concentrated by evaporation to obtain a semi-solid extract, which was stored in airtight containers.

For gel preparation, Carbopol 940 was dispersed in distilled water with continuous stirring and allowed to hydrate for 24 hours. The prepared polyherbal extracts were then incorporated into the hydrated gel base with continuous stirring to ensure uniform distribution. Aloe vera gel was added to provide moisturizing properties, followed by the addition of beetroot extract as a natural coloring agent. Methyl paraben was dissolved in warm water and added as a preservative to prevent microbial contamination. Finally, triethanolamine was added dropwise to neutralize the formulation and adjust the pH, resulting in the formation of a smooth, homogeneous gel. The prepared gel was stored in suitable containers for further evaluation.

1. Zingiber zerumbet (Rhizome)



Zingiber zerumbet, commonly known as shampoo ginger, belongs to the family Zingiberaceae. In the present study, the **rhizome (underground stem)** was used due to its high concentration of bioactive compounds, particularly **zerumbone**, a sesquiterpene known for its potent antioxidant, anti-inflammatory, and anti-proliferative activities. Zerumbone plays a crucial role in scavenging reactive oxygen species (ROS), thereby preventing oxidative stress-induced cellular damage. Additionally, it inhibits collagenase and elastase enzymes responsible for degradation of collagen and elastin, which are essential for maintaining skin elasticity. Hence, the rhizome extract contributes significantly to anti-aging activity by preserving skin structure and reducing wrinkle formation.

2. Calendula officinalis (Calendula Extract)



Calendula officinalis is widely used in dermatological preparations due to its **anti-inflammatory, wound healing, and antimicrobial properties**. It contains flavonoids, triterpenoids, and carotenoids, which help in reducing skin irritation and promoting tissue regeneration. Calendula also enhances epithelialization and accelerates wound healing, making it beneficial for damaged or aging skin. Its soothing effect helps reduce redness and inflammation, thereby improving overall skin texture and appearance.

3. Glycyrrhiza glabra (Licorice Extract)



Glycyrrhiza glabra, commonly known as licorice, is a well-known herbal drug used for its **skin-lightening and anti-inflammatory properties**. The active constituent **glabridin** inhibits tyrosinase enzyme, thereby reducing melanin synthesis and pigmentation. It also exhibits antioxidant properties, protecting the skin from UV-induced damage. Licorice extract further helps in soothing irritated skin and reducing redness, making it suitable for anti-aging

formulations aimed at improving skin tone and complexion.

Camellia sinensis (Green Tea Extract)



Camellia sinensis (green tea) is rich in **polyphenols, especially catechins such as epigallocatechin gallate (EGCG)**, which are powerful antioxidants. These compounds neutralize free radicals and protect the skin from oxidative stress caused by UV radiation and environmental pollutants. Green tea also exhibits anti-inflammatory and photoprotective properties, helping to reduce skin damage and delay the aging process. It further contributes to improving skin elasticity and reducing wrinkle formation.

5. Aloe vera (Aloe Gel)



Aloe vera is a natural moisturizer widely used in cosmetic formulations. It contains polysaccharides, vitamins, enzymes, and amino acids that contribute to its **hydrating, soothing, and healing properties**. Aloe vera enhances skin hydration by retaining moisture and promotes

collagen synthesis, thereby improving skin elasticity and reducing fine lines. It also exhibits anti-inflammatory and antimicrobial properties, making it suitable for sensitive and aging skin.

6. Beetroot Extract (Natural Coloring Agent)



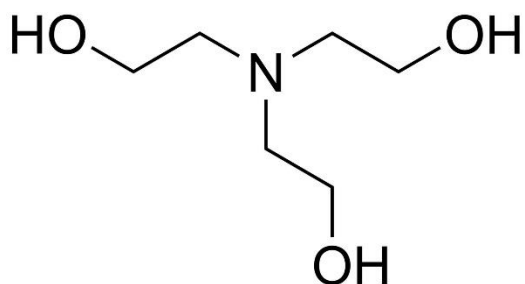
Beetroot extract was incorporated as a **natural coloring agent** due to the presence of **betalains**, which impart a characteristic red color to the formulation. In addition to its coloring property, beetroot also possesses mild antioxidant activity. However, betalains are sensitive to environmental factors such as pH, light, and oxygen, which may lead to gradual fading of color over time. Despite this, the extract does not affect the stability or efficacy of the formulation.

7. Carbopol 940 (Gelling Agent)



Carbopol 940 is a high molecular weight cross-linked polymer of acrylic acid used as a **gelling agent**. It swells in water and forms a viscous colloidal dispersion. Upon neutralization with a base such as triethanolamine, it forms a clear and stable gel. Carbopol provides desired viscosity, consistency, and stability to the formulation, ensuring proper application and retention on the skin surface.

8. Triethanolamine (Neutralizing Agent)



Triethanolamine (TEA) is used as a **neutralizing agent** in gel formulations. It neutralizes the acidic Carbopol dispersion and converts it into a gel by increasing viscosity. Additionally, it helps in adjusting the pH of the formulation to a skin-compatible range. Proper neutralization is essential for achieving the desired consistency and stability of the gel.

9. Methyl Paraben (Preservative)



Methyl paraben is widely used as a **preservative** in cosmetic and pharmaceutical formulations. It prevents microbial growth by inhibiting bacteria and fungi, thereby enhancing the shelf life of the product. It is effective at low concentrations and ensures the safety and stability of the formulation during storage.

10. Distilled Water



Distilled water acts as a **vehicle and solvent** for the formulation. It facilitates uniform dispersion of all ingredients and ensures homogeneity of the gel. Being free from impurities and ions, it prevents unwanted chemical reactions and maintains the stability of the formulation.

3.2 Method of Preparation

The polyherbal anti-aging gel was prepared by initially extracting the active constituents from selected plant materials followed by formulation of the gel base. The plant materials including *Zingiber zerumbet* rhizome, calendula flowers, licorice roots, and green tea leaves were collected and thoroughly washed with distilled water to remove dust and impurities. The cleaned materials were then dried under shade at room temperature for several days to prevent degradation of heat-sensitive constituents. After complete drying, the plant materials were coarsely powdered using a grinder to increase the surface area for efficient extraction.

The powdered materials were subjected to extraction using a suitable solvent such as ethanol or a hydroalcoholic mixture by the maceration method. The powders were soaked in the solvent and kept for 24–48 hours with occasional stirring to facilitate the release of active phytoconstituents into the solvent. After the extraction period, the mixture was filtered using muslin cloth or Whatman filter paper to separate the liquid extract from the solid residues. The obtained filtrate was then concentrated by allowing the solvent to evaporate at room temperature or by using a water

bath at controlled temperature, resulting in a semi-solid concentrated extract. The prepared extracts were stored in airtight containers for further use.

For the preparation of the gel, an accurately weighed quantity of Carbopol 940 was dispersed slowly in distilled water with continuous stirring to avoid lump formation, and the dispersion was allowed to stand for approximately 24 hours to ensure complete hydration and swelling of the polymer. The previously prepared polyherbal extracts were then mixed together and incorporated gradually into the hydrated Carbopol base with continuous stirring to ensure uniform distribution of active ingredients. Aloe vera gel was added to the formulation and mixed thoroughly to impart moisturizing and soothing properties. Subsequently, beetroot extract was added dropwise as a natural coloring agent, and the mixture was stirred until a uniform light reddish color was obtained.

Methyl paraben, used as a preservative, was dissolved in a small quantity of warm distilled water and added to the formulation with continuous stirring to prevent microbial contamination and enhance shelf life. Finally, triethanolamine was added dropwise to the formulation with constant stirring, which resulted in neutralization of Carbopol and formation of a smooth, thick gel. The pH of the formulation was adjusted to a skin-friendly range of approximately 5.8 to 6.2. The final product was mixed thoroughly until a homogeneous, lump-free gel was obtained and then transferred into suitable containers for further evaluation.

4. EVALUATION OF GEL

4.1 Organoleptic Properties

The gel was visually examined for color, odor, appearance, and texture.
Result: Smooth, homogeneous, light reddish gel with pleasant herbal odor.

4.2 pH Determination

The pH was measured using a digital pH meter.
Result: 5.8–6.2 (skin compatible)

4.3 Viscosity

Measured using a viscometer.
Result: Good consistency suitable for topical application.

4.4 Spreadability

Measured using glass slide method.
Result: Excellent spreadability indicating easy application.

4.5 Extrudability

Tested using collapsible tube method.
Result: Good extrudability.

4.6 Homogeneity

Checked visually.
Result: No lumps, uniform gel.

4.7 UV Analysis

Performed using UV spectrophotometer.
Result: Presence of active compounds confirmed.

4.8 Microbiological Evaluation

The microbiological evaluation of the formulated polyherbal anti-aging gel was carried out to ensure its safety and absence of microbial contamination. The test was performed using the agar plate method under aseptic conditions. The nutrient agar medium was prepared by accurately weighing and dissolving beef extract, peptone, sodium chloride, and agar in distilled water. The mixture was heated with continuous stirring until a clear solution was obtained, ensuring complete dissolution of all components.

The prepared medium was then sterilized by autoclaving at 121°C for 15–20 minutes to eliminate any microbial contaminants. After sterilization, the molten agar medium was allowed to cool to approximately 40–45°C and was aseptically poured into sterile petri plates inside a laminar airflow cabinet to prevent contamination from the external environment. The plates were left undisturbed at room temperature until the agar solidified, forming a firm gel-like surface suitable for microbial growth testing.

Once the agar medium had completely solidified, a small quantity of the prepared gel formulation was taken and carefully applied onto the surface of the agar plates using a sterile loop or spreader. The sample was evenly spread over the surface to ensure proper contact and uniform distribution. The inoculated plates were then placed in an incubator and maintained at 37°C for a period of 24 to 48 hours.

After the incubation period, the plates were carefully observed for the presence of any microbial growth such as bacterial colonies or fungal growth. The absence of visible colonies indicated that the formulation was free from microbial contamination. The results confirmed that the polyherbal gel was microbiologically safe, and the preservative system, particularly methyl paraben, was effective in preventing microbial growth.

4.9 Stability Study

Formulation stored under different conditions.

Result: No significant changes observed.

5. RESULTS

Parameter	Observation
Color	Light reddish
pH	5.8–6.2
Viscosity	Good
Spreadability	Excellent
Microbial Test	No growth
Stability	Stable

6. DISCUSSION

The results obtained from the evaluation studies indicate that the formulated polyherbal gel possesses desirable physicochemical and microbiological properties. The pH of the formulation was within the acceptable range, ensuring that it is non-irritant and suitable for topical application. The viscosity and spreadability of the gel were found to be optimal,

providing ease of application and uniform distribution over the skin surface. The combination of multiple herbal extracts contributed to synergistic antioxidant activity, which plays a crucial role in preventing oxidative stress-induced skin damage. Green tea and *Zingiber zerumbet* extracts act as potent antioxidants, while aloe vera enhances hydration and improves skin elasticity. Licorice contributes to skin brightening, and calendula provides anti-inflammatory effects. The absence of microbial growth confirms the effectiveness of the preservative system, particularly methyl paraben. Overall, the formulation demonstrated good stability, safety, and effectiveness as an anti-aging product.

7. MECHANISM OF ACTION

The herbal extracts act by neutralizing free radicals and reducing oxidative stress. This prevents collagen degradation and improves skin elasticity. Aloe vera hydrates the skin, while other extracts provide antioxidant and anti-inflammatory effects.

8. CONCLUSION

The polyherbal anti-aging gel was successfully formulated and evaluated. The formulation showed good stability, safety, and effectiveness. It can be considered a promising alternative to synthetic anti-aging products.

Further studies such as clinical trials and long-term stability testing are recommended.

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