



Research Article

FROM WASTE TO WONDER: HERBAL-BASED FACE SERUM

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ABSTRACT

The herbal face serum was formulated using fruit waste-derived bio-active ingredients such as avocado peel powder, avocado seed powder, and custard apple peel powder, along with eco-certified herbal excipients. The formulation was designed to provide skin nourishment, hydration, and protection while supporting sustainable and environmentally friendly cosmetic practices. The utilization of agricultural by-products promotes waste reduction and supports the concept of green and zero-waste cosmetics. The prepared face serum was evaluated for organoleptic characteristics, pH, texture, spreadability, stability, and microbial safety. The results demonstrated that the serum possessed a smooth and non-greasy texture, acceptable pH compatible with skin conditions, good stability under various storage conditions, and no evidence of irritation or microbial contamination. As the formulation is intended only for skin care and beautification without therapeutic claims, it is classified as a herbal cosmetic under the Drugs and Cosmetics Act, 1940. This study highlights the potential of fruit waste materials as safe, effective, and economical ingredients for sustainable herbal face serum formulations.

Keywords: Eco-friendly, Bio actives, Face conditions, Herbal cosmetics, Zero-waste.

INTRODUCTION

The skin is the largest organ of the human body, with a vital protective, sensory, and regulatory function. The skin stands as the first line of defence between the internal organs and the external environment, defending the body against mechanical injuries, infectious agents, UV radiation, and toxic chemicals. Beyond protection, it is particularly important for thermoregulation, water balance, and the synthesis of many essential biomolecules such as Vitamin-D. Structural complexity defines it is a three-layered organ with three major layers, the epidermis, dermis, and hypodermis, each having specialized physiological functions. The epidermis is the outermost layer, composed mainly of keratinocytes, which are constantly renewed. This is further subdivided into sub layers; the stratum corneum provides a tough, compact layer of dead cells embedded in lipid layers. It reduces trans epidermal water loss and resists the entry of foreign particles. The melanocytes in the epidermis produce melanin, accounting for skin pigmentation and photo protection, while Langerhans cells are involved in immune defence. Beneath this lies the

dermis, a thick connective tissue matrix containing bundles of collagen and elastin fibers that gives its tensile strength and elasticity. The dermis is also home to blood vessels, nerve endings, sebaceous and sweat glands, and hair follicles. The deepest layer, hypodermis or subcutaneous tissue is made up of adipose cells, which cushion the underlying structures and insulate the body.

Rationale for making herbal cosmetics

Herbal face serum is a concentrated cosmetic formulation prepared using natural plant extracts, herbal oils, and bioactive compounds. It is lightweight in nature and easily penetrates into the deeper layers of the skin to provide effective nourishment and hydration. Herbal serums help improve skin texture, maintain moisture balance, and protect the skin from environmental damage. These serums are free from harsh synthetic chemicals, making them gentle and suitable for all skin types. Regular use of herbal face serum enhances skin glow, reduces dryness, and supports overall skin health. The use of herbal ingredients also promotes eco-friendly, safe, and sustainable cosmetic products.

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Need for herbal cosmetics (Mishra *et al.*, 2018)

The need for herbal cosmetics arises from multiple factors such as health, safety, sustainability, and consumer awareness. Over the years, there has been growing concern about the adverse effects caused by the prolonged use of synthetic cosmetic products. Chemical-based cosmetics may provide quick results, but they can also lead to skin sensitivity, dryness, rashes, or even systemic toxicity with long-term use. In contrast, herbal cosmetics offer a safer and more balanced approach.

Herbal cosmetics are formulated using naturally derived ingredients that are compatible with the human body. They are rich in vitamins, antioxidants, and essential oils that help in maintaining skin vitality. The bioactive compounds present in herbs and botanical extracts support the skin's natural repair mechanisms, enhance collagen formation, and protect against free radical damage. Unlike synthetic agents that temporarily mask imperfections, herbal ingredients nourish the skin and help maintain long-term health and natural glow. Additionally, today's consumers are becoming more conscious about transparency, sustainability, and purity in cosmetic products. The growing preference for cruelty-free, biodegradable, and non-toxic formulations has accelerated the demand for herbal alternatives. The herbal cosmetic sector not only meets these demands but also bridges traditional wisdom with modern cosmetic science. Another key factor driving the use of herbal cosmetics is environmental protection. The production and disposal of synthetic ingredients often involve chemical processes that may release harmful by-products into the environment. Herbal cosmetics, being eco-friendly and biodegradable, contribute to environmental sustainability while ensuring skin safety and effectiveness.

Goodness of herbal and floral residues

Herbal face serums are formulated using plant-derived bioactive compounds that provide antioxidant, anti-inflammatory, antimicrobial, and skin-protective effects. Ingredients such as lavender oil, tulsi, and marigold are widely used due to their rich phytochemical composition, including flavonoids, carotenoids, essential oils, and polysaccharides. Lavender oil exhibits soothing, antimicrobial, and preservative properties, while tulsi acts as a natural tonic for skin health with antioxidant and anti-aging benefits. Marigold supports skin regeneration, UV protection, hydration, and barrier repair. The incorporation of these herbal ingredients in face serums enhances skin hydration, reduces oxidative stress, prevents premature aging, and promotes sustainable, eco-friendly cosmetic formulations.

Face serum

The human skin is the largest and most polyvalent organ of the body, acting as a barrier against aggressions from the environment while maintaining internal homeostasis. However, with advancing age and exposure to external stressors like ultraviolet radiation, pollution, chemical cosmetics, and oxidative stress, skin changes become

evident, such as the appearance of fine lines and wrinkles, dehydration, irregularities in skin tone, and loss of skin elasticity. Such changes are primarily due to degradation of collagen and elastin fibers, a decrease in the cell renewal rate, and weakened antioxidant defence. These factors have raised scientific and commercial interest in the formulation of anti-aging skin care products to potentially restore vitality, firmness, and brightness to the skin. Herbal face serums have gained immense popularity in the present scenario, where natural and sustainable beauty products are in high demand. These formulations make use of multiple herbal excipients rich in vitamins, antioxidants, essential fatty acids, phytonutrients for nourishing and protecting the skin naturally, thereby rejuvenating it. Plant based extracts incorporating aloe vera, green tea, avocado, rose are commonly used because they have been proven effective against signs of aging. These botanicals provide various synergistic actions: hydrating the skin, increasing collagen synthesis, neutralising free radicals, elasticity, which helps to delay wrinkle formation and fine lines. A well-formulated herbal serum generally contains natural humectants, emollients, and stabilisers in a blended form. Natural humectants such as honey, glycerin, and aloe vera help to retain moisture, maintain skin suppleness, and avoid trans epidermal water loss. Emollient ingredients such as cold-pressed oils (e.g., jojoba, almond, argon, or avocado oils) and herbal butters soften and smother the skin texture while fortifying the epidermal lipid barrier. Inclusion of herbal actives such as polyphenols, flavonoids, carotenoids, vitamins A, C and ensures strong antioxidant protection against oxidative stress, the number one cause of skin premature aging. In modern design of herbal formulations, safe and eco-certified preservatives are an integral component that ensures product stability along with microbiological safety. Artificial preservatives like parabens and formaldehyde-releasing agents, while effective, have drawbacks such as irritation and possible long-term health risks. Hence the alternatives geogard ultra, leucidal liquid have become increasingly popular. Besides efficacy, eco-sustainability and biocompatibility stand out as key guide points in herbal serum formulation. Plant-based excipients, biodegradable packaging, and renewable ingredients point to global trends in green chemistry and clean beauty. Such a formulation will not only protect the skin but also have less environmental impact, therefore offering a comprehensive approach to skin care. The formulation of a multi-herbal excipient face serum, with eco-certified preservatives, represents a harmonious blend of traditional herbal wisdom and modern cosmetic science. This is a safe, effective, and sustainable solution in anti-aging skincare to promote natural radiance, health, and environmental responsibility.

Advantages (Pandey, *et al* 2013)

Face serums are lightweight and absorb quickly into the skin. They deliver highly concentrated active ingredients directly to the skin. Help in deep hydration without making the skin greasy. Improve skin texture and smoothness. Reduce signs of aging such as fine lines and wrinkles. Enhance skin brightness and glow. Help in treating specific skin concerns like acne, pigmentation, and dullness.

Disadvantages (Pandey *et al*, 2013)

Face serums may cause skin irritation or allergy in sensitive individuals. Some serums are expensive due to high concentration of active ingredients. Incorrect or excessive use can lead to breakouts or redness. Results may take time and regular use to become visible. Certain serums may increase skin sensitivity to sunlight. Not all serums are suitable for all skin types. Over-layering with other products may cause product incompatibility. Improper storage can reduce the stability and effectiveness of the serum. Short shelf life compared to creams in some formulations.

MATERIALS AND METHODS**Face serum****Aloe Vera gel (Fox *et al*, 2014)**

Role: Moisturizing, skin soothing, hydrating base.

Glycerin

Role: Moisture retention, smoothness.

Castor oil

Role: Gloss-enhancer, viscosity modifier.

Rose petals powder and Rose water

Role: Fragrance, antioxidant, cooling agent.

Xanthan gum (Gandhi A, *et al*, 2009)

Role: Gelling and viscosity-enhancing agent.

Rosemary oil (Braga, A, *et al*, 2020)

Role: Preservative booster, antioxidant, aroma.

Lavender oil (Braga, A, *et al*, 2020)

Role: Aroma, soothing agent.

Geogard ultra (Ruhil, S., *et al*, 2020)

Role: Broad-spectrum preservation.

Neem leaf powder (Dhakad, A.K, *et al*, 2019)

Role: Antimicrobial, skin purifying agent.

Preparation of herbal extract (Kaur *et al*, 2019)**Aloe vera gel extract (Khandelwal *et al*, 2019)**

Fresh Aloe Vera leaves were washed thoroughly, outer rind removed, and the inner mucilaginous gel collected aseptically. The gel was homogenized and filtered through muslin cloth. The filtrate was dried at 40–45 °C or lyophilized to obtain a concentrated extract and stored at 4°C until use.

Table 1. List of Ingredients.

Ingredients	Quantity
Aloevera gel	18 ml
Glycerin	2ml
Xanthangum	0.15gr
Vitamin-E oil	0.30ml
Neem oil	0.30 ml
Rosemary oil	0.06ml
Lavender oil	0.06ml
Geogard	0.30ml
Citric acid	0.8 ml

Avocado peel extract

Fresh avocado peels were washed, shade-dried, and powdered. The powder was extracted using ethanol or hydroalcohol (1:10 w/v) by maceration for 48–72 hr with intermittent shaking. The extract was filtered and concentrated under reduced pressure using a rotary evaporator, then dried and stored in airtight containers for further study.

MATERIALS AND METHODOS**Preparation of face serum**

Every plant powder with distilled water at a 1: 10 w/v ration. Heated at 60-70 C for 30-45 minutes cooled and filtered with muslin cloth Whatman 0.1-micron filter paper. Stored the extracts at 40 C until use.

Preparation of fermented Rice water

Soaked rice in distilled water for 24 hours. Collected the soaked water and fermented it for 48 hours. Filtered and stored under refrigeration.

Preparation of Aqueous phase

Combined aloe gel, glycerin, honey, rose water, fermented rice water, and herbal extracts. Sprinkle xanthan gum slowly, with continuous stirring for uniform hydration.

Preparation of oil phase

Heat coconut oil, castor oil, shea butter all together at 60°C. Vitamin E, Rorefrse Mary oil, and lavender oil were then added to the cold mixture.

Serum formation

The oil phase was slowly added into the aqueous phase under continuous stirring. Homogenised the mixture until it achieved a smooth consistency, like a serum. Allowed the mixture to rest for deaeration. Addition of preservative and pH adjustment. Incorporated geogard ultra after cooling.

Checked pH and, if necessary, adjusted to 5.0 -5.5 with suitable pH modifiers. Filtration, packaging, and storage. The serum was filtered through sterile muslin cloth. Filled into sterilised amber glass bottles. Stored at room temperature for further evaluation.



Figure 1. Processing of Raw materials (a) Extraction (b) Filtration (c) Washing (d)Drying.

Table 2. Phytochemical tests results (Kokate, C.K *et al*, 2018)

S. No	Chemical tests	Aloe vera	Avacado	Mari gold
1	Alkaloids	✓	✓	✓
	Mayers test			
2	Dragondroff test	✓	✓	✓
	Carbohydrates			
3	Molisch test	✓	✓	✓
	Iodine test			
5	Proteins	✓	✓	✓
	Biuret test			
6	Phenols	✓	✓	✓
	Ferric chloride test			
7	Flavanoids	✓	✓	✓
	Shinoda test			
8	Alkaline test	✓	✓	✓



Figure 2. Various tests on the prepared formulation (a) Presence of Vitamin A (b) Presence of Alkaloids (c) Microbial test (d) Absorption test (e) Grittiness test (f) Patch test.

Table 3. Evaluation test (Mukherjee *et.al*, 2019).

Parameters	Observation/ Results
Color	Brownish orange
Odour	Characteristic
Homogeneity	No lumps
pH	5.5
Microbial growth	No growth
Patch test	No irritation
Spreadability	Good
Grittiness	No grittiness

This study focused on formulating herbal cosmetic product - face serum, using common plant-based ingredients processed differently. Variations in formulation and processing produced products with distinct textures, stability, and therapeutic functions. The use of antioxidant-rich botanicals and fruit peel powders highlights sustainability, cost-effectiveness, and versatility. Overall, the results demonstrate that a single set of herbal ingredients can be transformed into multiple effective, eco-friendly skincare products through systematic formulation design.

CONCLUSION

This study demonstrates the effective use of natural, plant-derived ingredients in developing multiple herbal cosmetic products with distinct functions. Using common raw materials such as fruit peels, aloe vera, glycerin, oils, and vitamins, a face serum, was successfully formulated through different processing methods. Variations in drying, blending, and incorporation techniques significantly influenced product functionality and performance. The results highlight the versatility, sustainability, and therapeutic potential of herbal ingredients. Overall, the project supports eco-friendly, cost-effective cosmetic innovation and promotes value addition to plant-based waste materials.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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