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FORMULATION AND PHYSICOCHEMICAL EVALUATION OF POLYHERBAL FACE WASH WITH ANTIOXIDANT POTENTIAL

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ABSTRACT

The current study used medicinal plants with established therapeutic advantages to formulate and assess a polyherbal face wash formulation for efficient skincare. Herbal ingredients with antibacterial, antioxidant, anti-inflammatory, moisturizing, and cleansing qualities were used to prepare the formulation, including neem (Azadirachta indica), turmeric (Curcuma longa), aloe vera (Aloe barbadensis Miller), tulsi (Ocimum sanctum), orange peel (Citrus sinensis), sandalwood (Santalum album), and rose water (Rosa damascena). In order to provide a stable gel basis with a sufficient consistency and skin compatibility, the produced polyherbal face wash was made with appropriate excipients such as carbopol, glycerin, preservatives, and triethanolamine. Several physicochemical characteristics, including color, odor, pH, viscosity, spreadability, washability, foamability, homogeneity, irritancy, and stability, were assessed for the formulation. The findings demonstrated the face wash's attractive look, pleasant herbal scent, skin-friendly pH, enough foamability, ease of washing, and outstanding spreadability without irritating the skin. Phase separation and notable changes in appearance and consistency during storage were not seen in the formulation, according to stability experiments. Several herbal compounds worked in concert to effectively cleanse, moisturize, prevent acne, and shield the skin from oxidative damage. As a result, the developed polyherbal face wash can be regarded as a natural herbal skincare product that is safe, efficient, and appropriate for preserving healthy, glowing skin.

Keywords: *Aloe vera, Neem, Tulsi, Rose water,Herbal formulation.*

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1. INTRODUCTION

The largest organ in the human body, the skin serves as the main defense against chemical irritants, microbes, UV rays, and environmental contaminants. Maintaining good skin is crucial for general well-being, physiological protection, and aesthetic appeal [1]. Skin conditions like acne, pimples, dryness, pigmentation, and early aging have become more common in recent years due to increased exposure to dust, pollution, stress, and poor lifestyles. Because facial skin is constantly exposed to environmental factors, it is particularly sensitive. As a result, keeping healthy and appealing skin requires regular cleansing and skincare routines [2].

Face wash formulas are among the most popular skincare products since they aid in clearing the skin's surface of debris, extra oil, dead skin cells, bacteria, and cosmetic residues. Additionally, cleansing lowers microbial development, unclogs pores, and stops acne from developing [3]. Conventional face washes typically contain chemical additives, artificial fragrances, preservatives, and synthetic surfactants that, when used frequently over an extended period of time, can cause negative effects like skin irritation, dryness, erythema, hypersensitivity, and disruption of the natural skin barrier [4]. Since of these restrictions, people are turning more and more to natural and herbal skincare products since they are seen to be

safer and better suited to the physiology of the skin [5].

The idea of herbal cosmetics has become incredibly popular all over the world as people become more conscious of the negative effects of synthetic chemicals and the therapeutic advantages of medicinal plants. Herbal cosmetics are mixtures of phytoconstituents from plants that have both cosmetic and therapeutic properties [6]. These compositions are typically regarded as gentle, non-toxic, biodegradable, cost-effective, and environmentally friendly. Many pharmacological characteristics of plant-derived compounds, such as antibacterial, antioxidant, anti-inflammatory, antiseptic, wound healing, moisturizing, and skin-rejuvenating actions, make them ideal for skincare applications [7]. The World Health Organization (WHO) states that because natural products are safe and effective, almost 80% of the world's population relies on them for medical needs [8].

Preparations that include extracts from two or more medicinal plants in a single dose form are known as polyherbal formulations. The idea behind polyherbalism is that different phytoconstituents work in concert to improve therapeutic efficacy while reducing negative effects [9]. Combining various herbs in skincare formulas can offer several advantages at once, including cleansing, nourishing, moisturization, acne prevention, antioxidant protection, and skin-calming action. Because polyherbal face wash formulations address many skin issues through numerous modes of action, they are consequently thought to be more effective than single-herb treatments [10].

Due to their positive effects on skin health, a number of medicinal plants have been widely used in polyherbal face wash compositions [11]. Because of its strong antibacterial, antifungal, and anti-inflammatory properties, neem is one of the most widely used herbs in herbal cosmetics. Neem helps prevent skin infections, regulate excessive sebum production, and lessen bacteria that cause acne [12]. Curcumin, a bioactive substance found in turmeric, has potent anti-inflammatory and antioxidant qualities that help lessen skin irritation, pigmentation, and acne. Aloe vera's moisturizing, wound-healing, and anti-inflammatory properties make it a great moisturizer and skin-soothing agent [13]. Tulsi helps cleanse the skin and lessen oxidative stress because of its antibacterial and antioxidant properties. Because of their cleansing, cooling, antioxidant, and skin-rejuvenating properties, other herbs like rosemary, calendula, sandalwood, manjistha, orange peel, cucumber, and tea tree oil are frequently added to herbal face wash compositions [14].

One of the most prevalent skin conditions affecting teenagers and young adults globally is acne vulgaris. The main causes of acne include excessive sebum production, bacterial infection, hormonal imbalance, inflammation, and sebaceous gland blockage [15]. Because herbal compounds have antibacterial activity against acne-causing microorganisms, reduce inflammation, and naturally regulate oil output, they have demonstrated great potential in managing acne. The therapeutic effectiveness of herbal face washes is greatly enhanced by herbal bioactive substances such flavonoids, tannins, terpenoids, alkaloids, and phenolic compounds [16]. Furthermore, antioxidants found in medicinal plants aid in the neutralization of free radicals produced by UV radiation and environmental stress, preventing premature skin aging and preserving skin elasticity [17].

Using excipients including gelling agents, humectants, preservatives, surfactants, and fragrance agents, herbal extracts are often incorporated into an appropriate gel or liquid base to develop a polyherbal face wash [18]. Acceptable physicochemical characteristics, such as the right pH, viscosity, spreadability, foamability, washability, homogeneity, and stability, should be present in the perfect face wash. To preserve the skin's natural acid layer and prevent irritation, the formulation's pH should be compatible with skin pH, often between 5.5 and 6.5. In order to assess the formulation in various environmental conditions and maintain product quality and safety during storage, stability studies are also crucial [19].

Because they are thought to be safer than synthetic cosmetics, customers now favor herbal skincare products. Growing awareness of natural beauty care and sustainable products has led to a significant growth in demand for herbal face wash products in the pharmaceutical and cosmetic industries [20]. Through scientific examinations and clinical tests, modern research has also confirmed the efficacy of several herbal compounds. However, appropriate herb selection, extraction techniques, formulation methods, and standardization procedures are critical to the quality, effectiveness, and safety of herbal formulations [21]. Therefore, toformulate stable, effective skincare products with increased therapeutic advantages, scientific formulation and evaluation of polyherbal face wash are required.

In conclusion, the synergistic action of many medicinal plants with cleaning, antibacterial, antioxidant, anti-inflammatory, and moisturizing qualities makes polyherbal face wash compositions an effective and promising method in modern skincare. These formulas help preserve healthy, clear, and radiant skin while offering a safer and more natural substitute for synthetic skincare products. The creation and assessment of polyherbal face wash formulations for skincare applications is further encouraged by the growing interest in herbal cosmetics and the expanding body of scientific evidence demonstrating the effectiveness of medicinal plants.

2. MATERIALS AND METHODS

2.1 Materials

The polyherbal face wash's ingredients were chosen for their traditional therapeutic worth and positive

benefits on skin health. The composition included a variety of herbal compounds with antibacterial, antioxidant, anti-inflammatory, cleaning, moisturizing, and skin-rejuvenating qualities. Before being used, each herbal ingredient was verified and purchased from a nearby herbal market. The formulation contained analytical-grade compounds and excipients.

2.1.1 Neem (*Azadirachta indica*)

Due to its strong antibacterial, anti-inflammatory, and antioxidant qualities, neem is a well-known medicinal plant that is widely utilized in Ayurvedic and herbal cosmetic treatments. Nimbin, nimbidin, azadirachtin, and flavonoids are among the key phytoconstituents found in neem leaves that greatly enhance the plant's medicinal properties. Because neem effectively combats skin infections and bacteria that cause acne, it is frequently used in polyherbal face wash formulations. By eliminating debris, extra oil, and microbiological pollutants, it aids in skin cleansing while averting acne and pimples. Additionally, neem has anti-inflammatory properties that lessen inflammation, swelling, and redness related to acne lesions. Additionally, the skin is shielded from oxidative damage brought on by free radicals and environmental contaminants by its antioxidant action. Neem is regarded as a crucial herbal component for preserving clear, healthy, and infection-free skin because of these advantageous qualities [22].



Figure 01: Neem

2.1.2 Turmeric (*Curcuma longa*)

One of the most significant medicinal herbs that has long been utilized for skincare and cosmetic purposes is turmeric. Curcumin, a bioactive substance found in turmeric rhizomes, has potent antibacterial, anti-inflammatory, and antioxidant properties. Because it improves skin tone and lessens pigmentation, blemishes, and acne, turmeric is frequently incorporated to polyherbal face wash formulations. Turmeric's anti-inflammatory qualities help reduce redness brought on by pimples and other inflammatory skin disorders. Free radicals are neutralized by its antioxidant activity, which also shields skin cells from oxidative damage and early aging. Turmeric is quite helpful for keeping skin healthy and radiant because it also helps repair wounds and brightens the skin. Natural antimicrobial substances also aid in preventing the growth of skin pathogens that cause infections and acne [23].



Figure 02: Turmeric

2.1.3 Aloe Vera (*Aloe barbadensis Miller*)

Aloe vera is a succulent medical plant whose superior moisturizing and calming qualities make it a popular ingredient in pharmaceutical and cosmetic compositions. Polysaccharides, vitamins, enzymes, amino acids, and minerals included in aloe vera leaf gel offer the skin several advantages. Aloe vera helps keep skin hydrated without making it greasy by acting as a natural moisturizer. Aloe vera is mostly utilized in polyherbal face wash formulas to avoid dryness and irritation brought on by washing ingredients. Its anti-inflammatory and wound-healing qualities help relieve irritated or injured skin and accelerate skin healing. Additionally, aloe vera demonstrates antioxidant activity that shields the skin from aging and environmental damage. It is a useful component of herbal skincare products because of its cooling and revitalizing properties, which soothe sensitive and irritated skin [24, 25].



Figure 03: Aloe-Vera

2.1.4 Tulsi (*Ocimum sanctum*)

Tulsi, also referred to as Holy Basil, is a significant medicinal herb that is widely utilized in Ayurveda to treat a variety of skin conditions. Tulsi's antibacterial, antioxidant, and anti-inflammatory properties are attributed to a number of bioactive components, including eugenol, ursolic acid, rosmarinic acid, and flavonoids. Tulsi is used in polyherbal face wash formulas because of its antimicrobial and skin-purifying qualities. It inhibits the growth of bacteria that cause acne while aiding in the removal of pollutants and toxins from the skin. Additionally, tulsi helps lessen the

redness, irritation, and inflammation brought on by skin infections and pimples. Tulsi's antioxidant components shield skin cells from oxidative damage brought on by pollutants and UV light. Furthermore, tulsi gives the skin a rejuvenating and renewing impact that keeps it looking young and healthy [26].



Figure 04: Tulsi

2.1.5 Orange Peel (*Citrus sinensis*)

Vitamin C, flavonoids, phenolic compounds, and antioxidants are abundant in orange peel, a natural herbal ingredient that offers numerous advantages for skin health. Its cleaning, exfoliating, and skin-brightening qualities make it a popular ingredient in herbal cosmetic formulations. Orange peel improves the texture and complexion of the skin by removing debris, excess oil, and dead skin cells from the skin's surface in polyherbal face wash formulations. Orange peel's natural exfoliating properties help clear clogged pores and stop acne. Orange peel contains vitamin C, which encourages the production of collagen and lessens tanning, black spots, and pigmentation. Its antioxidant action also shields the skin from early aging and damage from free radicals. Additionally, orange peel gives cosmetic formulas a cooling and refreshing scent that increases consumer acceptability [27].



Figure 05: Orange peel

2.1.6 Sandalwood (*Santalum album*)

Due to its cooling, calming, antibacterial, and anti-inflammatory qualities, sandalwood is a traditional medicinal plant that is frequently utilized in herbal cosmetics and skincare products. Essential oils and naturally occurring aromatic compounds found in sandalwood powder help soothe irritated and swollen skin. Sandalwood is utilized in polyherbal face was formulas to improve skin smoothness and offer a cooling effect. Because of its antibacterial and anti-inflammatory properties, it helps lessen acne, itching, redness, and skin irritation. Additionally, sandalwood keeps skin fresh by absorbing extra oil from the skin's surface. Formulas to improve skin smoothness and offer a cooling effect. Because of its antibacterial and anti-inflammatory properties, it helps lessen acne, itching, redness, and skin irritation. Additionally, sandalwood keeps skin fresh by absorbing extra oil from the skin's surface. The sensory qualities of herbal face wash formulas are enhanced by the lovely natural scent of sandalwood. Additionally, sandalwood promotes healthy, radiant skin and aids in skin renewal [28].



Figure 06: Sandalwood

2.1.7 Rose Water (*Rosa damascena*)

Because of its calming, moisturizing, and revitalizing qualities, rose water-a naturally occurring aromatic liquid made from rose petals-is frequently used in skincare and cosmetic products. It has anti-inflammatory and antioxidant properties due to the presence of flavonoids, phenolic compounds, and essential oils. Rose water serves as a natural toner in polyherbal face wash formulas and aids in preserving the skin's pH equilibrium. It lessens dryness, redness, and irritation while hydrating and revitalizing the skin. Additionally, rose water improves skin texture and tightens pores. It is very helpful for sensitive skin because of its mild cooling and relaxing effects. Furthermore, rose water's attractive scent improves the visual appeal and consumer acceptability of herbal cosmetic formulations [29].



Figure 07: Rose Water

2.2 Methods of Preparation

Several herbal constituents with antibacterial, antioxidant, anti-inflammatory, moisturizing, and cleaning qualities were used to make the polyherbal face wash. To maintain their active ingredients, all herbal materials were gathered, thoroughly cleaned to get rid of contaminants, and then dried in the shade. Using a grinder, each dry herbal medication was ground into a fine powder and then run through sieve number #60 [30, 31].

To ensure adequate hydration, the necessary amount of carbopol was first dissolved in distilled water while being continuously stirred. Propyl and methyl parabens were added as preservatives after being individually dissolved. After that, the hydrated base was combined with rose water and aloe vera gel while being gently stirred. To achieve a homogenous dispersion, precisely measured amounts of neem powder, turmeric powder, tulsi powder, orange peel powder, and sandalwood powder were then gradually added to the mixture while being continuously stirred. In order to enhance skin moisture and smoothness, glycerin was used as a moisturizing agent [32].

To change the preparation's pH and give it a smooth gel consistency, triethanolamine was added dropwise. To improve the formulation's smell and customer acceptance, perfume was added. In order to conduct additional evaluation studies on pH, viscosity, spreadability, washability, foamability, homogeneity, and stability, the manufactured polyherbal face wash gel was finally put into appropriate airtight containers and kept at room temperature.

Table 01: Ingredients used in the Polyherbal Face Wash Formulation.

S.No.	Name of Ingredient	Biological Name	Quantity	Properties/ Uses
1.	Neem Powder	*Azadirachta indica*	2 g	Antibacterial, antifungal, anti-acne agent
2.	Turmeric Powder	*Curcuma longa*	1 g	Anti-inflammatory, antioxidant, improves complexion
3.	Aloe Vera Gel	*Aloe barbadensis Miller*	5 g	Moisturizing, soothing, wound healing
4.	Tulsi Powder	*Ocimum sanctum*	1 g	Antimicrobial, antioxidant, skin purifier
5.	Orange Peel Powder	*Citrus sinensis*	1 g	Exfoliating, skin brightening, cleansing
6.	Sandalwood Powder	*Santalum album*	1 g	Cooling, soothing, anti-inflammatory
7.	Rose Water	*Rosa damascena*	10 mL	Refreshing, toner, maintains skin pH
8.	Carbopol 940	-	1 g	Gelling agent
9.	Glycerin	-	3 mL	Humectant and moisturizer
10.	Methyl Paraben	-	0.1 g	Preservative
11.	Propyl Paraben	-	0.05 g	Preservative
12.	Triethanolamine	-	q.s.	pH adjustment and gel formation
13.	Distilled Water	-	q.s. to 100 mL	Vehicle
14.	Perfume	-	q.s.	Fragrance enhancer

3. RESULT AND DISCUSSION

To make sure the created polyherbal face wash formulation was suitable for topical use, it was assessed for a number of physicochemical criteria, such as color, odor, pH, viscosity, spreadability, washability, foamability, homogeneity, and stability. Good visual qualities and customer acceptability were indicated by the formulation's smooth appearance, acceptable consistency, and pleasant herbal scent. The cleaning, moisturizing, antibacterial, and calming qualities of the face wash were greatly enhanced by the herbal constituents in the recipe.

The produced mixture is safe and non-irritating for topical application because its pH was confirmed to be within the normal skin pH range. In order to protect the skin's natural acid mantle and avoid dryness or irritation, it is crucial to maintain a pH that is suitable with the skin. The formulation's viscosity was suitable, making it easy to apply to the skin's surface and offering adequate consistency. The stability and spreadability of a substance are also enhanced by proper viscosity.

The results of the spreadability evaluation showed that the produced face wash could be applied uniformly and with less effort, resulting in improved cleansing activity. Topical formulations function better overall and are more convenient for users when they have good spreadability. According to washability testing, the formulation was easily removed with water, leaving no oily texture or significant residue on the skin's surface.

Sufficient foaming capacity and foam retention were found in the foamability testing, which is crucial for cleaning formulations. Sufficient foam production aids in the efficient removal of pollutants, oil, and debris from the skin. According to homogeneity investigations, the formulation had a homogeneous appearance with no discernible lumps, phase separation, or coarse particles, suggesting that the ingredients were properly mixed and that the formulation was stable.

Color, odor, pH, consistency, and appearance did not significantly alter throughout the course of stability tests conducted under various storage settings. Phase

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separation and microbiological growth were absent from the formulation, indicating that the generated polyherbal face wash had acceptable chemical and physical stability. Overall, the evaluation's findings showed that the created mixture had acceptable physicochemical characteristics and could be used in skincare products.

Table 02: Evaluation Parameters of Polyherbal Face Wash

S.No.	Evaluation Parameter	Observation/Result	Interpretation
1.	Color	Light green	Acceptable appearance
2.	Odor	Pleasant herbal odor	Good consumer acceptability
3.	pH	6.2 ± 0.1	Suitable for skin application
4.	Viscosity	3250 cps	Good consistency and stability
5.	Spreadability	6.8 ± 0.2 cm	Easily spreadable on the skin
6.	Washability	Easily washable with water	Good cleansing property
7.	Foamability	Good foam formation	Effective cleansing action
8.	Foam Retention	Stable for 5 minutes	Satisfactory foam stability
9.	Homogeneity	Homogeneous, no lumps	Uniform distribution of ingredients
10.	Irritancy Test	No irritation observed	Safe for topical use
11.	Stability Study	Stable for 30 days	No significant physical changes

Table 03: Discussion of Evaluation Parameters Studies.

S.No.	Parameter	Importance of Face Wash Formulation	Discussion
1.	pH	Maintains skin compatibility	The formulation showed skin-friendly pH, minimizing irritation and dryness.
2.	Viscosity	Determines consistency and ease of application	Appropriate viscosity provided good texture and stability.
3.	Spreadability	Ensures uniform application	Good spreadability improved user convenience and coverage on skin.
4.	Washability	Important for cleansing preparations	The formulation was easily washable without sticky residue.
5.	Foamability	Indicates cleansing efficiency	Adequate foam formation improved dirt and oil removal.
6.	Homogeneity	Reflects uniform mixing of ingredients	No lumps or phase separation indicated proper formulation stability.
7.	Stability	Ensures product shelf-life and effectiveness	Stable appearance and consistency confirmed formulation reliability.

4. CONCLUSION

The developed polyherbal face wash formulation demonstrated good cleaning, spreadability, washability, foamability, and stability qualities, as well as satisfactory physicochemical characteristics. The absence of irritation verified the formulation's safety, and the pH was deemed appropriate for skin application. The formulation maintained its physical stability under storage settings, according to stability studies. In order to preserve clear, healthy skin, the created polyherbal face wash can be regarded as a safe and effective herbal skincare preparation.

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6. CONFLICT OF INTEREST

Regarding the publication of this scientific paper, the authors state that they have no conflicts of interest.

7. FUNDING SOURCES

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8. ETHICAL APPROVAL

The current study did not involve any animal testing or human clinical trials; instead, it focused on the development and assessment of a polyherbal face wash. Therefore, this research project did not need ethics committee permission.

9. CONTRIBUTION OF AUTHORS

The conceptualization, formulation development, experimental work, data collection, evaluation studies, data analysis, paper writing, editing, and final approval were all equally contributed to by each author. The final draft of the work has been reviewed and approved by all authors.

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