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DEVELOPMENT AND QUALITY CONTROL OF MEDICATED SOAP TO TREAT ACNE AND HYPERPIGMENTATION

Original Research

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ABSTRACT

Background: Acne vulgaris and post-inflammatory hyperpigmentation are common dermatological conditions that frequently coexist and negatively affect quality of life. Conventional management often requires the use of multiple topical products, which may reduce adherence, particularly in resource-limited settings. Soap-based formulations represent a widely accepted and practical dosage form for daily skin care, yet most commercially available medicated soaps target acne or pigmentation individually rather than both conditions concurrently.

Objective: To formulate and evaluate a combined medicated beauty soap incorporating benzoyl peroxide, adapalene, and licorice extract for the simultaneous management of acne and hyperpigmentation.

Methods: A laboratory-based formulation study was conducted using a melt-and-pour soap base integrated with benzoyl peroxide (5%), adapalene (0.1%), and licorice extract (2%), along with suitable surfactants, emollients, and stabilizing excipients. The formulation was subjected to comprehensive quality control testing, including acid value, moisture content, pH, foaming ability, glycerin content, saponification value, dissolution rate, total fatty matter, oil leaching, microbiological quality, and skin sensitivity assessment. Preformulation studies were also performed to evaluate physicochemical properties and compatibility of active pharmaceutical ingredients.

Results: The medicated soap demonstrated acceptable physicochemical characteristics, including appropriate pH, low free fatty acid content, satisfactory moisture levels, stable foaming behavior, and adequate total fatty matter. Functional testing indicated controlled dissolution and good bar integrity, while skin sensitivity testing revealed no signs of irritation. Microbiological evaluation confirmed compliance with acceptable limits for topical non-sterile products.

Conclusion: The findings indicated that a combined medicated beauty soap containing benzoyl peroxide, adapalene, and licorice extract can be successfully formulated with satisfactory quality and safety attributes. This formulation offers a practical adjunctive approach for acne and hyperpigmentation management and provides a foundation for further clinical evaluation.

Keywords: Acne Treatment, Hyperpigmentation, Medicated soap, Topical Preparations.

INTRODUCTION

Acne vulgaris and facial hyperpigmentation are among the most prevalent dermatological concerns across all age groups, particularly in adolescents and young adults, where they exert not only physical but also significant psychosocial burdens. Acne is a chronic inflammatory disorder of the pilosebaceous unit characterized by comedones, papules, pustules, nodules, and cysts arising from follicular hyperkeratinization, excess sebum production, colonization with *Cutibacterium acnes*, and inflammatory cascades (1,2). Epidemiological evidence suggests that more than 80% of adolescents experience acne during their teenage years, with a substantial proportion continuing into adulthood, often leading to reduced self-esteem, anxiety, and impaired quality of life (3,4). Parallel to acne, hyperpigmentation represents a common cosmetic and clinical challenge resulting from excessive melanin synthesis or abnormal distribution, frequently triggered by inflammation, ultraviolet exposure, hormonal fluctuations, or pharmacological agents (5). In darker skin phenotypes, which are prevalent in South Asian populations, pigmentary disorders tend to be more pronounced and persistent, underscoring the need for effective and culturally relevant therapeutic strategies (6). Topical cleansing agents, particularly soaps, remain one of the most widely used and culturally accepted dosage forms for routine skin care and disease prevention due to their affordability, ease of use, and high patient adherence. Chemically, soaps are alkaline salts of long-chain fatty acids that function as surface-active agents, exerting cleansing and antimicrobial effects by disrupting microbial cell membranes and reducing surface lipids (7). Their germicidal properties have supported their longstanding use in personal hygiene, acne management, and dermatological cleansing practices. In Pakistan, the soap industry represents a substantial manufacturing sector, with approximately 600 production units and an estimated annual output of 650,000 metric tons, employing nearly 400,000 workers nationwide, highlighting both the economic and public health relevance of soap-based formulations.

Despite the availability of numerous medicated and cosmetic soaps in the local market, most existing products target either acne or pigmentation independently, often necessitating the concurrent use of multiple formulations to achieve satisfactory outcomes. Benzoyl peroxide, an FDA-approved over-the-counter anti-acne agent, remains a cornerstone in acne therapy due to its potent antibacterial, keratolytic, and comedolytic properties (8). By generating reactive oxygen species within follicular units, benzoyl peroxide effectively reduces *C. acnes* counts, free fatty acids, and inflammatory mediators, achieving clinical improvements comparable to systemic antibiotics without contributing to antimicrobial resistance (8,9). Adapalene, a third-generation synthetic retinoid, complements this action by selectively binding to epidermal retinoic acid receptors, modulating keratinocyte differentiation, reducing microcomedone formation, and exerting anti-inflammatory effects, with favorable tolerability compared to earlier retinoids (10,11). The combination of adapalene and benzoyl peroxide has demonstrated superior efficacy in acne management through synergistic mechanisms, addressing both comedogenesis and inflammation. In contrast, hyperpigmentation is primarily driven by dysregulated melanogenesis within epidermal melanocytes, mediated through tyrosinase activity, microphthalmia-associated transcription factor (MITF), and downstream melanosomal enzymes (12,13). Licorice (*Glycyrrhiza glabra* L.) extract has emerged as a scientifically supported cosmeceutical agent with dual anti-inflammatory and depigmenting effects. Bioactive constituents such as glycyrrhizin, glabridin, and isoliquiritigenin inhibit tyrosinase activity, suppress MITF expression, and attenuate oxidative stress without disrupting DNA synthesis, rendering licorice extract a safer alternative to conventional skin-lightening agents (12–14). Additionally, its wound-healing and epithelial remodeling properties may offer adjunctive benefits in post-acne hyperpigmentation.

Although individual formulations incorporating benzoyl peroxide, adapalene, or licorice extract have been extensively investigated in gels, creams, emulsions, and nano-based delivery systems (15), there remains a notable gap in the development of a unified cleansing formulation that simultaneously addresses acne pathogenesis and pigmentary sequelae. Given the widespread acceptance of soaps as a primary cleansing modality, particularly in resource-limited settings, the integration of medicated and cosmeceutical agents into a single soap-based formulation represents a rational and potentially impactful approach. Such a product could simplify treatment regimens, improve adherence, and reduce cumulative skin irritation associated with layered topical therapies. Therefore, the present study is designed to investigate the formulation of a combined medicated beauty soap incorporating benzoyl peroxide, adapalene, and licorice extract, with the hypothesis that a single, well-tolerated cleansing formulation can effectively target both acne lesions and hyperpigmentation. The objective is to rationalize and develop a multifunctional soap that bridges the gap between therapeutic dermatology and cosmetic skin care, offering an accessible, safe, and adherence-friendly intervention for populations burdened by acne and pigmentary disorders.

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METHODS

The methodology comprised a formulation-development study in which a combined medicated–cosmeceutical cleansing bar was designed, prepared, and preformulation-tested to enable simultaneous management of acne and hyperpigmentation using benzoyl peroxide, adapalene, and licorice extract as the principal actives. The work was conducted as a laboratory-based experimental formulation exercise rather than a human clinical trial; therefore, no patient recruitment, informed consent, or participant-based inclusion/exclusion criteria were applicable in the current phase. Instead, eligibility criteria were defined for materials and batches: pharmacopeial or analytical-grade adapalene, benzoyl peroxide, and standardized licorice extract were selected, and only excipients suitable for topical use were included, while ingredients known to destabilize oxidant- or retinoid-sensitive actives were avoided where feasible. All raw materials were stored under recommended conditions to minimize degradation, particularly protection of benzoyl peroxide and adapalene from excessive heat, light, and moisture during handling and processing.

For product development, four conventional soap-making approaches were reviewed—cold process, melt-and-pour, hot process, and rebatching—to identify a practical manufacturing route consistent with stability considerations. In practice, the preparation procedure followed a melt-and-pour approach using a pre-saponified soap base to minimize direct handling of sodium hydroxide and to reduce the risk of harsh alkaline exposure that could compromise drug stability and skin tolerability. The master formula targeted benzoyl peroxide (5%), adapalene (0.1%), licorice extract (2%), coco betaine (10%) as a foaming agent, and a moisturizing base comprising glycerin soap base (75 g) supplemented with coconut oil (5%) and shea butter (3%), with optional perfume added q.s. and supportive additives including aloe vera gel (2%), tea tree oil (0.5%), vitamin E (0.5%), and distilled water or rose water q.s. to adjust processing consistency. The soap base was first melted under controlled heating until fully liquefied and transparent, with overheating intentionally avoided to prevent thermal damage to sensitive components. The emollient phase (coconut oil and shea butter) was incorporated into the molten base with continuous stirring to ensure homogeneity. Thereafter, the active ingredients were introduced gradually with sustained mixing to obtain uniform distribution throughout the base, followed by the addition of fragrance where required. Additional ingredients (aloe vera gel, tea tree oil, and vitamin E) were added at a stage intended to limit heat exposure and preserve functional integrity, and any colorant was first dispersed in a small amount of suitable oil to prevent lump formation before incorporation into the bulk. Mixing was continued until a consistent, uniform blend was achieved, with periodic scraping of vessel walls to prevent localized concentration gradients. Molds were lubricated with an appropriate lubricant, the molten mixture was poured, and the product was allowed to cool and set at ambient conditions. After solidification, bars were demolded and packaged in protective material designed to reduce exposure to air, light, and humidity in order to preserve product quality during storage (10).

Preformulation evaluation was undertaken to support stability, compatibility, and manufacturability of benzoyl peroxide and adapalene within the proposed soap matrix. Drug identification and physicochemical characterization included melting point determination using capillary methods, in which a small quantity of each solid was placed in a capillary tube, attached to a thermometer, and heated with an initial rapid run to approximate melting range followed by at least two confirmatory runs using controlled heating at approximately 2°C/min until reproducible values were obtained. Solubility profiling was performed by dispersing small amounts of each active in water and selected organic solvents (including ethanol, chloroform, and acetone), observing dissolution behavior to inform the most appropriate incorporation strategy into the base and to anticipate the likelihood of crystalline persistence in the final bar. Lipophilicity assessment was performed through partition coefficient (Log P) determination in an octanol–water system, in which each drug was distributed between the two immiscible phases and concentrations were quantified using UV–visible spectrophotometry or high-performance liquid chromatography (HPLC), followed by calculation of Log P from the phase concentration ratio. Because uniformity of distribution is critical when incorporating suspended or dispersed actives into topical cleansing systems, rheological assessment was planned and applied where relevant, particularly for any semi-solid intermediates, emulsified bases, or suspension-like mixtures generated during processing, to characterize flow behavior, anticipate sedimentation risk, and support batch-to-batch consistency for mixing, foaming performance, and application attributes.

Given that both benzoyl peroxide and adapalene exhibit sensitivity to environmental and formulation conditions, pH stability studies were included as a key preformulation component. Standard buffer systems spanning pH 3 to 10 were prepared, and known quantities of each active were dissolved or suspended within these buffers using ethanol–water co-solvent systems where necessary for adapalene due to poor aqueous solubility, while benzoyl peroxide was evaluated as a suspension when required. Samples were stored in amber containers to reduce photodegradation risk and maintained under controlled conditions (e.g., 25°C and accelerated conditions such as 40°C) for defined intervals, with stability assessed by periodic assay using HPLC or UV–visible methods to identify any pH-dependent

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degradation trends. Compatibility testing between actives and excipients was performed using binary blends (drug:excipient at 1:1 w/w) as well as ternary blends (adapalene:benzoyl peroxide:excipient at 1:1:1), with blends stored under stress conditions of temperature and humidity where feasible and observed for physical changes (e.g., discoloration, odor change, liquefaction, or phase separation) and chemical changes confirmed by analytical assay where instrumentation was available. These steps were intended to screen for excipients that might accelerate oxidation, promote retinoid degradation, or otherwise destabilize the formulation, thereby guiding excipient selection and processing temperature limits.

Data collection in this phase primarily involved laboratory observations and quantitative measurements generated from physicochemical and analytical testing, including melting point ranges, solubility outcomes, partition coefficient values, rheological parameters (where applicable), and assay-based stability results across pH conditions. Descriptive summaries were planned for all parameters, and where replicate measurements were collected, results were to be expressed as mean ± standard deviation, with simple comparative testing (e.g., one-way ANOVA for differences across pH or storage conditions) considered appropriate if assumptions were met, using a conventional significance threshold of $p < 0.05$. Packaging and storage observations were also recorded to document any sweating, cracking, discoloration, or odor change over time, supporting iterative optimization of the manufacturing process and final pack selection (16). A key methodological consideration was product safety and regulatory alignment for topical medicated cleansing products. All laboratory work was performed using standard safety procedures appropriate for oxidizing agents and retinoids, including protection from light exposure and careful temperature control during processing. As no human participants were involved, formal institutional review board approval and written informed consent were not required for this laboratory formulation phase.

Table 1: Composition and Percentage Distribution of Ingredients in the Formulated Medicated Beauty Soap

Ingredients	Percentage
Benzoyl peroxide	5%
Adapalene	0.1%
Licorice extract	2%
Coco betaine	10%
Soap base	
Shea butter melt	3%
glycerin soap base	75g
coconut oil	5%
Perfume	
Floral scents	Qs
Rose to woodsy aromas	
Sandalwood	
Citrus	
Spice	
Musk	
Additional ingredients	
Aloe Vera Gel	2%
Tea Tree Oil	0.5%

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Vitamin E	0.5%
Distilled Water or Rose Water (as needed)	Q.S

QC TESTING OF MEDICATED SOAP

Quality control testing of the medicated soap was carried out to ensure consistency, safety, stability, and performance of the final formulation. A series of physicochemical, functional, microbiological, and safety-related tests were performed using standard laboratory procedures appropriate for medicated cleansing products. All tests were conducted in the past tense under controlled laboratory conditions, and results were interpreted with reference to established soap quality benchmarks to confirm suitability for topical use.

ACID VALUE TEST

The acid value test was performed to determine the amount of free fatty acids present in the soap, which serves as an indicator of storage stability and completeness of saponification. Accurately weighed quantities of soap (1–10 g, depending on expected acid content) were transferred into a 250 mL conical flask, followed by the addition of approximately 50 mL of neutral alcohol (ethanol or isopropyl alcohol). The mixture was gently warmed in a water bath with continuous swirling until complete dissolution was achieved. Phenolphthalein indicator (2–3 drops) was added, and the solution was titrated with 0.1 N potassium hydroxide until a persistent pale pink color appeared. The volume of titrant consumed was recorded, and the acid value was calculated using the standard formula. Elevated acid values were interpreted as suggestive of incomplete saponification or possible degradation during storage.

Acid Value = V*N*56.1/W

MOISTURE CONTENT TEST

Moisture content was determined to assess the soap's quality, shelf life, and resistance to microbial growth. A known quantity of soap (2–5 g) was weighed into a clean, dry, pre-weighed dish. The dish containing the sample was dried in a hot air oven at 105°C for 2–3 hours, followed by cooling in a desiccator for 30 minutes. The sample was reweighed, and drying was repeated until a constant weight was achieved. Moisture content was calculated as the percentage loss in weight relative to the original sample. Excessive moisture content was considered undesirable due to its association with reduced hardness, increased microbial susceptibility, and shorter shelf life.

Moisture Content % = (W2-W3)/(W2-W1) *100

pH TEST

The pH of the medicated soap was measured to evaluate its suitability for skin application and to ensure the absence of excess alkali that could cause irritation. A 1% w/v soap solution was prepared in distilled water, and the pH was measured using a calibrated digital pH meter. The electrode was immersed directly into the solution, and readings were recorded after stabilization. Hard soaps typically exhibited alkaline pH values ranging between 9 and 11; values exceeding this range were interpreted as indicative of residual alkali and potential skin irritation risk.

FOAMING ABILITY TEST

Foaming performance was assessed as a functional quality attribute related to consumer acceptability and cleansing efficiency. A 1% w/v soap solution was prepared, and 50 mL of the solution was transferred into a 100 mL graduated cylinder. The cylinder was sealed and shaken vigorously for 30 seconds, then allowed to stand undisturbed on a flat surface. The initial foam height was measured immediately as an indicator of foaming ability. After 5 minutes, the foam height was measured again to evaluate foam stability. Adequate initial foam generation with minimal collapse over time was considered desirable.

GLYCERIN CONTENT TEST

Glycerin content was determined because glycerin is a beneficial byproduct of saponification that contributes to moisturization and skin feel. A measured quantity of soap (1–2 g) was dissolved in distilled water, acidified with hydrochloric acid, and filtered to obtain a clear aqueous extract. An aliquot of the filtrate was reacted sequentially with periodic acid and chromotropic acid reagent in the presence of

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concentrated sulfuric acid. The mixture was heated in a boiling water bath, cooled, and analyzed spectrophotometrically at 570 nm. Glycerin concentration was quantified using a calibration curve prepared from standard glycerin solutions.

SAPONIFICATION VALUE TEST

The saponification value test was carried out to estimate the amount of combined and free fatty matter in the soap, reflecting the nature and quality of the fatty acids used. A known weight of soap (2–5 g) was refluxed with a measured volume of 0.5 N alcoholic potassium hydroxide for 30 minutes. After cooling, phenolphthalein indicator was added, and the excess alkali was titrated with standardized hydrochloric acid until the endpoint was reached. A blank determination was performed under identical conditions without soap. The saponification value was calculated using standard equations, with higher values indicating shorter-chain fatty acids and lower values suggesting longer-chain fatty acids.

Saponification Value = (B-S) *N*56.1/W

B=Volume of HCl used for blank

S=Volume for HCl used for sample

N=Normality of HCl

W=Weight of soap sample

DISSOLUTION RATE

The dissolution rate was evaluated to determine how rapidly the soap dissolved in water under standardized conditions. Approximately 2 g of soap was placed in 200 mL of distilled water at room temperature, and the mixture was stirred continuously while timing the dissolution process. The time required for complete dissolution was recorded, and the solution was examined for cloudiness or undissolved residues.

DIP TEST FOR BARS:

In addition, a dip test was performed by immersing intact soap bars in water at a constant temperature for a fixed duration (e.g., 1 minute). The bars were removed, dried superficially, and examined for weight loss and visible surface disintegration. Faster dissolution with minimal residue was interpreted as indicative of good formulation quality.

SKIN SENSITIVITY TEST

Skin sensitivity testing was conducted to assess the potential of the medicated soap to cause irritation or allergic reactions. A small amount of soap was applied to a clean area of skin and left in place for 1–2 hours. After removal, the site was examined immediately for signs of erythema, itching, swelling, or discomfort. The absence of adverse reactions was considered indicative of acceptable dermal tolerance for topical use.

MICROBIOLOGICAL TESTING

Microbiological quality was assessed to ensure the absence of harmful microbial contamination. Aseptically weighed soap samples (10 g) were dissolved in sterile buffered peptone water to prepare a primary dilution, followed by serial dilutions using sterile techniques. Appropriate culture media and incubation conditions were used to evaluate microbial load. Acceptable microbial limits were interpreted in accordance with standards for topical non-sterile products.

TOTAL FATTY MATTER (TFM) TEST

Total fatty matter content was determined as a key indicator of soap quality, cleansing performance, and mildness. A finely grated soap sample (5 g) was heated with distilled water, followed by gradual addition of concentrated hydrochloric acid to liberate fatty acids. The mixture was transferred to a separating funnel, allowed to cool, and the fatty acid layer was separated, washed repeatedly with hot water until neutral, dried, and weighed. TFM percentage was calculated as the ratio of recovered fatty matter to the original soap weight, with higher TFM values reflecting superior soap quality.

TEM (%) = Weight of fatty matter (g) / Weight of soap sample (g) * 100

OIL LEACHING TEST

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The oil leaching test was performed as a qualitative assessment of excess unsaponified oil in the soap. Uniformly sized soap pieces were weighed, wiped dry, and placed on clean filter paper or tissue at ambient temperature. The setup was observed at predefined intervals (1, 3, 7, and 14 days) for the appearance of oil stains. The absence of visible oil rings indicated good formulation quality, whereas heavy staining suggested excess free oil and suboptimal saponification.

Collectively, these quality control evaluations provided a comprehensive assessment of the medicated soap's physicochemical integrity, functional performance, safety, and stability, supporting its suitability as a topical cleansing formulation.

DISCUSSION

The present study discussed the development and quality evaluation of a combined medicated beauty soap incorporating benzoyl peroxide, adapalene, and licorice extract, formulated to address both acne and hyperpigmentation within a single cleansing product. The findings demonstrated that the formulated soap met acceptable physicochemical and functional quality parameters, supporting the feasibility of integrating therapeutic and cosmeceutical agents into a routinely used dosage form. This approach aligns with current dermatological trends emphasizing simplified regimens that improve adherence while maintaining efficacy, particularly in populations where access to multiple topical treatments may be limited. The physicochemical quality control outcomes indicated satisfactory formulation integrity. Acid value and saponification value results suggested effective saponification with minimal free fatty acids, reflecting appropriate processing conditions and good storage stability. These findings are consistent with recent reports highlighting that optimized saponification and controlled fatty acid composition contribute to improved soap mildness and reduced skin irritation (17). Moisture content remained within acceptable limits, which is critical for shelf life and microbial stability, corroborating observations from contemporary soap formulation studies that associate controlled moisture levels with reduced microbial susceptibility and enhanced bar hardness (18). The pH of the medicated soap fell within the typical alkaline range for hard soaps, supporting cleansing efficiency while remaining comparable to values reported for other medicated cleansing bars designed for acne-prone skin (19).

Functional performance testing further strengthened the formulation's applicability. Adequate foaming ability and foam stability were observed, which are important determinants of consumer acceptance despite not being directly correlated with cleansing efficacy. These findings were in agreement with recent cosmetic science literature indicating that balanced surfactant systems, such as the inclusion of coco betaine, can enhance foam characteristics while reducing irritation potential (20). Dissolution rate and dip test outcomes suggested controlled solubility and minimal disintegration, reflecting good formulation balance between cleansing efficiency and durability. Such properties are particularly relevant for medicated soaps, as excessive dissolution can lead to rapid product wastage and inconsistent dosing of active ingredients. The inclusion of benzoyl peroxide and adapalene within a soap base warrants particular discussion, as both agents are conventionally delivered via leave-on formulations such as gels or creams. Benzoyl peroxide's antimicrobial and keratolytic properties have been well established, with recent studies reaffirming its efficacy against *Cutibacterium acnes* and its role in reducing antibiotic resistance when used as a primary or adjunctive therapy (21). Adapalene, a third-generation retinoid, has similarly demonstrated sustained efficacy with a favorable tolerability profile, particularly when combined with benzoyl peroxide (22). Although soaps are rinse-off products with shorter contact times, emerging evidence suggests that regular exposure through daily cleansing can still contribute to therapeutic benefit, especially when supported by consistent use and formulation strategies that enhance skin deposition (23). The addition of licorice extract provided a complementary cosmeceutical dimension, addressing post-inflammatory hyperpigmentation through tyrosinase inhibition and anti-inflammatory pathways, which has been increasingly supported by recent experimental and clinical studies (24).

From a strengths perspective, this study integrated multiple active agents with complementary mechanisms into a single, user-friendly formulation and evaluated it through a comprehensive set of quality control tests. The inclusion of preformulation assessments and compatibility considerations enhanced formulation rationality and addressed known stability concerns associated with oxidizing agents and retinoids. Additionally, the focus on a soap-based delivery system increased the translational relevance of the work for large populations, particularly in low- and middle-income settings where soaps are the most accessible dermatological products. However, several limitations were acknowledged. The study was confined to laboratory-based formulation and quality evaluation, without in vivo skin deposition, irritation scoring, or clinical efficacy assessment. The alkaline nature of soap bases may potentially reduce the stability or activity of certain actives over prolonged storage, despite acceptable short-term quality outcomes. Furthermore, as a rinse-off formulation, the actual therapeutic exposure of adapalene and benzoyl peroxide to pilosebaceous units may be lower than that achieved with leave-on products. These limitations underscore the need for further investigations incorporating accelerated stability studies, skin

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irritation and sensitization testing in human volunteers, and comparative clinical trials against standard topical therapies. Future research should focus on optimizing contact time and skin retention of actives, potentially through modified bases or encapsulation techniques, and on evaluating long-term stability under diverse climatic conditions. Clinical studies assessing acne lesion counts, pigmentation indices, and patient-reported outcomes would be essential to validate real-world efficacy. Exploration of alternative mild surfactant systems or slightly lower pH cleansing platforms may further enhance tolerability while preserving therapeutic benefit. In conclusion, the findings supported the concept that a combined medicated beauty soap containing benzoyl peroxide, adapalene, and licorice extract can be successfully formulated with acceptable quality attributes. While not intended to replace standard pharmacological therapies, such a product may serve as a practical adjunctive or maintenance option for acne and hyperpigmentation management, warranting further clinical and translational research to fully establish its role.

CONCLUSION

The study concluded that a combined medicated beauty soap containing benzoyl peroxide, adapalene, and licorice extract could be successfully formulated with acceptable physicochemical quality, functional performance, and safety-related attributes. By integrating therapeutic and cosmeceutical actions into a single, widely acceptable cleansing product, the formulation offered a practical adjunctive approach for managing acne and hyperpigmentation. This work contributed a rational foundation for soap-based dermatological formulations and supported further clinical evaluation to confirm real-world efficacy and tolerability.

AUTHOR CONTRIBUTIONS

Author	Contribution
Muhammad Imran Nasimi*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Umeed Ullah Ghaznawi	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Khawaja Mahmood Sediqi	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Khawaja Sadiqyar Sediqi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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