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Polyherbal Anti-Acne Shower Gel Containing *Berberis aristata, Celastrus paniculatus,* and *Gomphrena globosa*: Formulation and *In Vitro* Assessment

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ABSTRACT

Objective: This study aimed to formulate, optimize, and evaluate a polyherbal anti-acne shower gel incorporating ethanolic extracts of *Berberis aristata* (Daruharidra), *Celastrus paniculatus* (Jyotishmati), and *Gomphrena globosa* for the management of acne-prone skin.

Materials and Methods: Ethanolic extracts of the three medicinal plants were prepared and incorporated into a Carbopol-based shower gel. The formulations were evaluated for key physicochemical and performance parameters, including appearance, pH, viscosity, spreadability, foamability, foam stability, washability, and surface tension, to assess their suitability for topical application and consumer acceptability. The anti-acne potential was investigated using an agar well diffusion assay against *Propionibacterium acnes*, a primary etiological agent in acne. Antimicrobial activity was compared among individual extracts, binary combinations, the triple-herbal combination, and a standard reference.

Results: The optimized polyherbal shower gel exhibited desirable characteristics for daily topical use, including a skin-compatible pH (5.37–6.04), smooth and homogeneous texture, good spreadability, and ease of application. The formulation showed stable foam, appropriate viscosity (215–298 cP) consistent with a pleasant gel-like consistency, and surface tension values of 36.43–38.67 dyne/cm, indicative of effective cleansing properties. In antimicrobial assays, the triple-herbal combination (J + D + G) produced the largest zone of inhibition against *P. acnes* (40 mm at 40% concentration), demonstrating greater activity than any single extract, binary combination, or standard control.

Conclusion: The developed polyherbal shower gel shows promising potential as a safe, natural, and eco-friendly topical formulation for routine care of acne-prone skin, combining favorable physicochemical attributes with strong in vitro anti-acne activity.

INTRODUCTION:

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit characterized by obstruction of hair follicles with sebum and keratinous debris. Its pathophysiology involves four principal factors: follicular hyperkeratinization, increased sebum production, colonization by *Cutibacterium acnes* (formerly *Propionibacterium acnes*), and an associated inflammatory response. Clinically, acne vulgaris is diagnosed based on the presence of both

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non-inflammatory lesions (open and closed comedones) and inflammatory lesions (papules, pustules, nodules, and cysts). The condition arises from increased microbial activity and inflammation within the pilosebaceous glands, commonly triggered or exacerbated by hormonal fluctuations that alter sebaceous gland function.

Epidemiological data suggest that acne affects approximately 20.5% of individuals across different age groups, with the highest prevalence during adolescence. It is estimated that more than 85% of boys and 75% of girls experience acne during their teenage years, of whom nearly 30% present with moderate to severe disease, and approximately 40% continue to exhibit active lesions into adulthood. Moreover, a systematic analysis from the Global Burden of Disease study has identified acne as one of the most common dermatological conditions worldwide, ranking it among the top ten global diseases in terms of prevalence. A wide range of therapeutic modalities is available for acne management, including conventional and herbal formulations in various dosage forms such as tablets, capsules, creams, soaps, gels, lotions, face washes, and emulgels, reflecting the ongoing interest in both pharmacological and plant-based interventions for this condition [1,2].

Herbal cosmetics, characterized by their favorable safety profiles and reduced propensity for adverse effects, have experienced substantial growth in global consumer markets. Current market analysis indicates that the herbal cosmetics sector is valued at approximately USD 84 billion, representing a significant 21.9% share of the overall cosmetics industry. Projections suggest continued expansion, with the market anticipated to reach USD 132 billion by 2033. The selection between synthetic and herbal formulations is determined by individual factors including personal preferences, skin type, and specific therapeutic or cosmetic objectives. Nevertheless, herbal cosmetic formulations offer a potentially safer and more sustainable alternative for consumers seeking to minimize exposure to synthetic chemical ingredients while leveraging the therapeutic benefits of botanically derived skincare solutions [3].

Shower gels are liquid cleansing formulations designed for topical application during bathing and are formulated to effectively remove surface contaminants, including dirt, sebum, and other dermatological impurities while maintaining skin integrity. These products typically incorporate emollient and humectant agents to provide hydrating properties superior to traditional solid soaps, thereby minimizing potential xerosis and irritation associated with conventional bar cleansers. Shower gels are characterized by their ability to generate stable lather when applied with mechanical aids such as loofahs or washcloths, or upon direct application to hydrated skin. The formulations often contain fragrance compounds and skin-conditioning agents that enhance sensory appeal and post-cleansing comfort. Following application and gentle massage to facilitate mechanical cleansing, the product is readily rinsed with water, leaving the skin clean, hydrated, and aesthetically pleasurable. The inclusion of surfactants, emollients, and conditioning agents in shower gel formulations addresses both cleansing efficacy and dermatological acceptability, making them suitable for routine personal hygiene and therapeutic skincare applications [4,5].

Gomphrena globosa (L.), commonly known as Globe Amaranth or Bachelor's Button, is a plant species indigenous to North America, Bangladesh, and India, with a long-standing history of use in traditional medicine. Ethnopharmacological records indicate its application in the management of diverse ailments, including hypertension, diabetes mellitus, renal disorders, jaundice, bronchitis, cough, fever, diarrhea, and hepatic dysfunction. The plant has also been employed as a folk remedy for diuresis, hyperthermia, empacho (a traditional gastrointestinal disorder), and as a natural food colorant. Various anatomical parts—including the leaves, flowers, and roots—are reported to possess therapeutic properties. The pharmacological potential of *G. globosa* is attributed to its rich phytochemical profile, which includes flavonoids, betacyanins, phytosterols, phenolic compounds, and terpenoids. These bioactive constituents have been associated with antioxidant, anti-inflammatory, anticancer, antimicrobial, analgesic, cytotoxic, and coagulant activities. Traditional therapeutic indications further encompass the management of generalized body pain, malaria, bacterial infections, urinary dysfunction, and hypercholesterolemia. The established medicinal uses and diverse array of bioactive compounds present in *G. globosa* underscore its potential as a promising candidate for further pharmacological investigation and the development of novel therapeutic agents [6,7].

Berberis aristata, commonly known as Daruharidra, is a spinous yellowish herb of the Berberidaceae family, found in sub-Himalayan regions, Sri Lanka, Bhutan, and Nepal. Used in Ayurveda, Homeopathy, Unani, Chinese, and Allopathy for over 2500 years, it was historically applied against plague, liver, gall bladder disorders, inflammation, hypertension, and menstrual issues. Traditionally, it treats skin diseases, diarrhoea, eye

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problems, wounds, and fever. Its fruit is rich in Vitamin C, and roots contain berberine, the main active compound. The notable formulation "Rashut" acts as a tonic, blood purifier, and ulcer remedy. Studies reveal antimicrobial, anti-inflammatory, analgesic, antipyretic, and hepatoprotective activities [8,9].

Jyotishmati (*Celastrus paniculatus* Willd.), commonly known as Malkangni, is a climbing shrub of the Celastraceae family, revered in Ayurveda as a Medhya Rasayana for enhancing intellect, memory, and brain function across all age groups. The seed oil, rich in alkaloids celastrine and paniculatine, is bitter and used for pain, inflammation, and beri-beri. Traditionally valued as a nervine tonic, rejuvenator, and antidepressant, it exhibits diverse pharmacological activities including neuroprotective, anti-Parkinson, anti-Alzheimer's, antioxidant, anti-inflammatory, analgesic, anti-arthritic, hypolipidemic, antibacterial, antifungal, and antimalarial effects [10,11].

In current study, natural ingredients including *Berberis aristata*, *Celastrus paniculatus* and *Gomphrena globosa* were chosen for the formulation and evaluation of an herbal Shower-gel

MATERIALS AND METHODS:

Materials :

Berberis aristata and *Celastrus paniculatus* was collected from Manakarnika Aushadhalaya, *Gomphrena globosa*collected from Dehu Road .Methyl paraben, Carbapol ,Rose oil, Sodium Lauryl Sulphate,Vitamin E all these excipients are collected from Chemdyes Corporation and Research-Lab fine chem industries.

Preparation of extract:

Exactly 20g of dried Daruharidra, Jyotishmati and *Gomphrena globosa* powder was taken in 150 ml of ethanol in 250 ml conical Flask, which is shaken on orbital shaker for 2-4 hrs and kept for 24-48 hrs for Soaking. Then mixture is filtered through filter paper and filtrate was collected in Previously weighed petri plate. Then Solvent is allowed to evaporate at room Temperature, and the dried extract was collected and weighed [12,13].

Preparation of Herbal Shower-gel:

The anti-acne shower gel was prepared using a two-phase process facilitated by sonication. In Phase A, Carbopol was dispersed in 20 mL of purified water in a beaker and subjected to sonication at 25.5 °C until complete hydration. Subsequently, 15 mL and then 5 mL of additional water were incorporated in a stepwise manner, with intermittent sonication and gentle stirring after each addition to minimize air entrapment and enhance formulation stability. Phase B was prepared separately by sonicating sodium lauryl sulfate in 5 mL of water, followed by the sequential addition of an aqueous methyl paraben solution, the active herbal extract(s), vitamin E, rose oil, and glycerin. Sonication was performed after each addition to ensure uniform dispersion and homogeneity of the components. Thereafter, Phase B was gradually incorporated into Phase A under continuous sonication at 25.5 °C, as outlined in Table 1, to obtain a well-blended, stable shower gel formulation with uniform distribution of all excipients and active ingredients [14,15].

Evaluation Parameters:

The prepared formulations were assessed using various parameters, including physical assessment, pH, viscosity, spreadability, washability, greasiness and antimicrobial activity.

Physical Assessment: The prepared formulations were inspected visually for its color, odor and clearity [16].

Determination of pH: A 10% v/v solution of allShower-gel formulationswere prepared and the pH of resultant formulations assessed using a digital pH meter. Calibration was conducted with phosphate buffers of pH 7 and 4 prior to measuring pH of formulations [17,18].

Viscosity: Using a digital viscometer the viscosity of a sample was assessed. Each container of Shower-gel formulation was positioned within a designated container to prevent spillage. The viscosities of the Shower-gel were then measured at different rotations per minute (rpm) [19,20].

Spreadability: The spreading capacity of the formulated Shower-gelwas measured after 24h of preparation. The spreading diameter of 1gm of formulation was evaluated by placing it between two 7x3cm glass plates. The weight tied on the upper plate was 20gm and the length of plate was 7cm.

The following equation was used to access the spreadability: $S = m \times l/t$
Where,S= Spreadability of formulation (g.cm/sec), m= Weight tied to the upper plate (gm)
l= Length of the glass plate (cm), t= Time taken for the upper plate to slide the entire length (sec) [21,22].

Determination of Surface Tension

The purpose is to determine the cleansing efficiency and spreading behavior of the formulation. A pycnometer was used to measure the

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density of each Shower-gel solution at room temperature and 10% v/v concentration. These Samples were then moved to a stalagmometer so that the surface tension could be measured [23,24].

Foam Test
The purpose is to assess the foaming capacity, which reflects cleansing ability. Test tubes containing and without oil were filled with small amounts of 10% v/v Shower-gel solutions. Twenty shakes were applied to each test tube, and using a Reference scale, the height of the foam was measured in milliliters at intervals of 0, 5, 10, 15, 20, 25, and 30 minutes [25,26].

Antimicrobial activity: To evaluate the antimicrobial activity against *P. acnes*, agar medium was prepared by dissolving Muller Hinton medium and nutrient agar in 500 ml of distilled water. The solution was heated until boiling and autoclaved for sterilization, alongside sterilized Petri plates and beakers. After cooling, the agar was poured into the Petri plates and allowed to solidify on a sterile platform. A microbial suspension was prepared by mixing a small amount of bacterial inoculum with 10 ml of sterile distilled water in a test tube. One drop of this suspension was evenly spread on each agar plate using a triangle spreader. Wells were then created in the agar to accommodate different formulations at concentrations of 40%, 20%, 10% and 5%. The plates were incubated at 28°C for 20-24 hours. During incubation, antimicrobial activity was assessed by measuring zones of inhibition around the wells. Larger zones indicated stronger antimicrobial effects against *P. acnes* [27,28].

RESULT AND DISCUSSION:

The present investigation focused on the development and evaluation of a polyherbal anti-acne shower gel incorporating *Berberis aristata* (Daruharidra), *Celastrus paniculatus* (Jyotishmati), and *Gomphrena globosa*. The formulation strategy prioritized both therapeutic efficacy and consumer acceptability, with the final composition detailed in Table 1. Comprehensive physicochemical and antimicrobial assessments were conducted to evaluate performance relative to marketed anti-acne cleansers, with comparative data summarized in Table 2.

Physical Characteristics
All prepared formulations exhibited a homogeneous, translucent gel matrix with a characteristic rose-like aroma and stable chromatic profile. Visual inspection throughout the observation period confirmed absence of phase separation, syneresis, or particulate sedimentation, indicating robust gelling and emulsification characteristics of the selected excipient system (Fig. 1).

pH Profile
The pH values of the polyherbal formulations ranged from 5.37 to 6.04, aligning closely with the physiological pH of human skin (4.5–6.5). This dermatologically compatible pH minimizes disruption of the stratum corneum barrier and reduces potential for irritation upon repeated topical application. The marketed comparator exhibited a pH of 6.07, confirming that the experimental formulations fall within an acceptable range for daily use (Fig. 2).

Rheological Behavior
Viscosity measurements at 50 rpm revealed values between 215 and 298 cP across batches. Notably, the Daruharidra-Gomphrena combination achieved the maximum viscosity (298 cP), substantially exceeding that of the commercial product (182 cP). This elevated viscosity may contribute to prolonged skin contact time, thereby enhancing the delivery of bioactive phytoconstituents and improving overall cleansing efficiency (Fig. 3).

Spreadability
Spreadability indices under a 10 g load ranged from 10.42 to 11.09 g·cm/sec, markedly superior to the marketed formulation (4.67 g·cm/sec). These values indicate that the prepared gels disperse readily upon application, facilitating uniform distribution over the skin surface and ensuring consistent therapeutic coverage (Fig. 4).

Surface Tension
Surface tension values of the experimental formulations (36.43–38.67 dyne/cm) were marginally higher than that of the commercial gel (35.57 dyne/cm), yet remained within the optimal range for effective removal of sebaceous debris without inducing excessive cutaneous dryness or compromising barrier function (Fig. 5).

Foam Characteristics
Foam stability assessments demonstrated sustained lather retention up to 30 minutes, ensuring persistent foam during application. This attribute contributes to enhanced user satisfaction and provides adequate time for mechanical cleansing and deposition of active compounds.

Antimicrobial Efficacy
Agar well diffusion assays against *Cutibacterium acnes* (formerly *Propionibacterium acnes*) revealed pronounced zones of inhibition for all herbal combinations. The triple-herbal formulation (J+D+G) produced the most substantial inhibition

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zone (40 mm at 40% w/v concentration), surpassing individual extracts, binary combinations, and the standard antibiotic control (Fig. 7; Table 3). This enhanced antimicrobial activity is attributed to the synergistic action of key phytoconstituents: berberine from Daruharidra, celastrine and paniculatine from Jyotishmati, and flavonoids and betacyanins from *Gomphrena globosa*. These bioactive molecules are known to disrupt bacterial cell wall integrity, inhibit metabolic pathways, and modulate inflammatory mediators, thereby exerting potent anti-acne effects. The observed superiority of the polyherbal combination over monotherapy aligns with contemporary phytopharmacological evidence supporting synergistic multi-component approaches for enhanced antimicrobial and anti-inflammatory outcomes. The favorable physicochemical profile, coupled with robust antimicrobial efficacy, suggests that this formulation offers a viable natural alternative for acne management

CONCLUSION:

The developed polyherbal shower gel incorporating *Berberis aristata*, *Celastrus paniculatus*, and *Gomphrena globosa* demonstrates excellent physicochemical properties and superior antimicrobial efficacy against *C. acnes* compared to marketed counterparts. The formulation exhibits skin compatible pH, optimal viscosity, enhanced spreadability, and stable foam characteristics, ensuring both therapeutic effectiveness and consumer acceptability. The synergistic antimicrobial activity of the triple-herbal combination underscores its potential as a safe, natural, and eco-friendly option for routine acne care. Future studies should focus on long-term stability assessments, in vivo efficacy and safety evaluations, and clinical trials to validate therapeutic outcomes in human subjects.

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CONFLICT OF INTEREST

We have no conflict of interest to declare.

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Table1: Optimization of antiacne Shower-gel

Sr no	Ingredients	Quantity required			
		F_1	**F_2**	**F_3**	**Final**
1	Daruharidra(g)	0.4	0.4	0.4	0.4
2	*Jyotishmati*(g)	0.5	0.5	0.5	0.5
3	*Gomphrena globosa*(g)	0.5	0.5	0.5	0.5
4	Carbopol 934(g)	0.37	0.4	0.44	0.44
5	Sodium Lauryl Sulphate (g)	1	1	1	1
6	Methyl paraben (g)	0.1	0.1	0.1	0.1
7	Rose oil (drops)	0-1	1-2	2-3	1-2
8	Vitamin E (drops)	0-1	1-2	2-3	1-2
9	Water (ml)	qs	qs	qs	qs

Table2: Evaluation study of Antiacne Shower-gel

Parameter	D+J	D+G	J+G	Mixture	Marketed
Color	Yellow	Slight orange	Pale yellow	Pale yellow	Blue
Odour	Rose like	Rose like	Rose like	Rose like	Rose like
Clarity	Clear gel	Clear gel	Clear gel	Clear gel	Clear gel
Foam test(15 rpm)	37	35	36	36	34
pH	5.37	5.97	6.04	5.85	6.07
Viscosity (50 rpm)	267	298	225	215	182
Surface(dyne/cm) Tension	38.67	37.45	37.86	36.43	35.57
Spreadability (10 gm)	10.42	11.02	10.58	11.09	4.67

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

Table 3: Zone of Inhibition of antiacne Shower-gel

Abbreviation	5%	10%	20%	40%
Standard	18 mm	20 mm	22 mm	27 mm
D+G	34 mm	36 mm	37 mm	38 mm
D+J	32 mm	37 mm	36 mm	39 mm
J+G	22 mm	23 mm	25mm	30 mm
J+D+G	35 mm	34 mm	38 mm	40 mm

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

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Fig. 1:Antiacne Shower-gel formulation

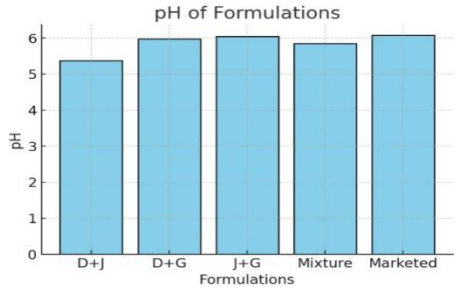

Fig. 2: Determination of pH of antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

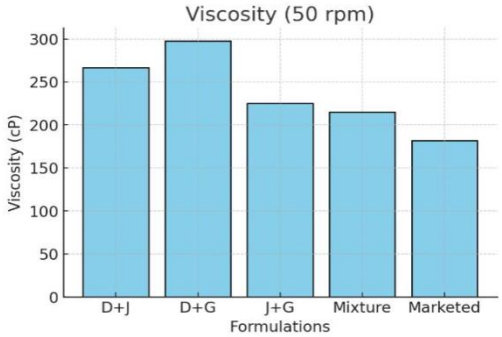

Fig. 3:Determination of Viscosity of antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

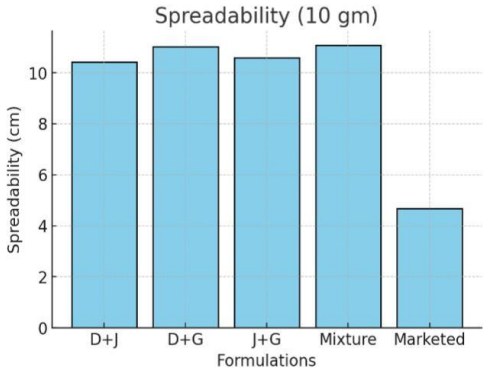

Fig. 4: Determination of Spreadability of antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globose*

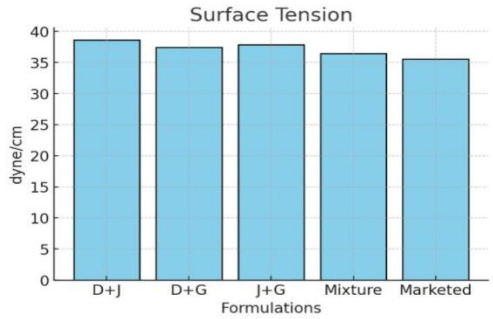

Fig. 5:Determination of Surface Tension of antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

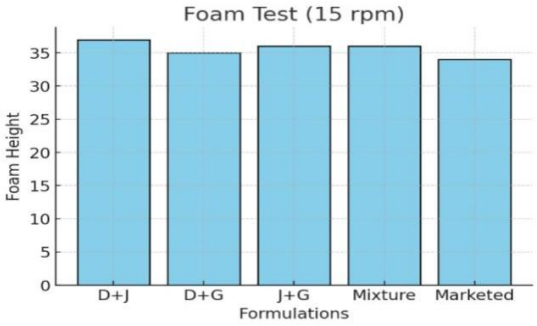

Fig. 6: Determination of Foam ability of antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*

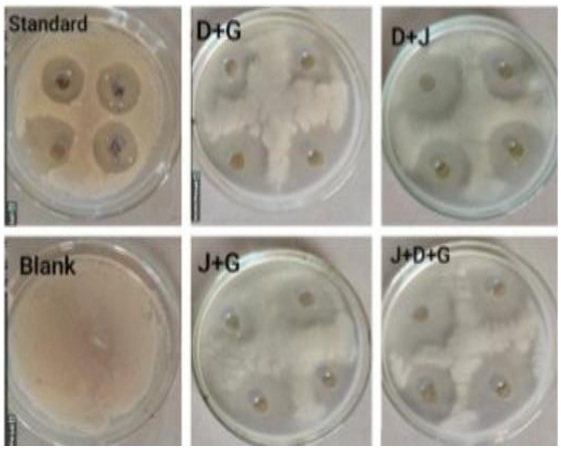

Fig. 7: Antimicrobial activity of Antiacne Shower-gel

Note: D: Daruharidra, J: Jyotishmati and G: *Gomphrena globosa*