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Research Article

Formulation And Evaluation of Herbal Antibacterial Hand Wash Containing Boerhavia Diffusa Powder

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ABSTRACT

This study aimed to formulate and evaluate a herbal antibacterial hand wash containing Boerhavia diffusa powder. Boerhavia diffusa, a traditional medicinal plant, has been reported to possess antibacterial properties. The poly herbal hand wash was formulated using a combination of B. diffusa powder, surfactants, humectants, and preservatives. The antibacterial activity of the formulated hand wash was evaluated against a panel of common bacterial pathogens using the agar diffusion method. The results demonstrated significant antibacterial activity against all tested bacteria, including Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumoniae. The hand wash also exhibited good physicochemical properties, including pH and foam formation. These findings suggest that the formulated hand wash containing B. diffusa powder has the potential to be an effective and safe alternative to conventional antibacterial hand washes.

INTRODUCTION

An herb is a plant or plant extract including leaves, bark, roots, seeds, stems and flowers, which have many properties like anti-inflammatory, antibacterial, antiseptic, emollient, and many others. Thus, there is a wide range of demand for herbal cosmetics in skin care systems and also herbs are easily available in nature. The natural content present in the herbs does not have any toxic effects on the human body; instead, they provide useful

minerals that could be used to beautify and cleanse the skin.^[1] Punarnava, scientifically known as *Boerhavia diffusa*, is a plant renowned for its rejuvenating properties, deeply rooted in Ayurvedic medicine. The name 'Punarnava' is derived from the Sanskrit words "Punar" (again) and "Nava" (new), reflecting the plant's regenerative nature, as it dries up in summer and regrows during the monsoon season.^[2] This herb,

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often referred to as 'Spider Lings' due to its sprawling, low-growing habit, belongs to the *Nyctaginaceae* family. Punarnava has been used for centuries in both Ayurvedic and Unani systems for its various medicinal benefits. It is particularly valued for its ability to support the renal system, treat seminal weakness, reduce high blood pressure, and promote overall body renewal and vitality. appetizer, alexiteric, eye tonic etc. The roots of this plant are utilized for various medicinal purposes, including treating jaundice, ascites, internal inflammations, asthma, and piles, while its juice serves as an antidote to rat poison.^[2]

Biological source:

Punarnava, often referred to as the "life-giver," has long been valued in traditional medicine for its

remarkable healing properties. Known for its rejuvenating effects, it helps revitalize the body, improving energy levels and overall vitality. The herb has a powerful diuretic action, aiding in the removal of excess fluids from the body, thus reducing swelling and bloating. Its ability to balance the digestive system also makes it effective in treating conditions like indigestion and constipation. In addition to promoting heart health by supporting proper circulation and lowering blood pressure, Punarnava is also recognized for its positive impact on liver function, detoxifying the body and supporting healthy lipid and cholesterol levels.^[3]

Language/Regions/Countries	Names
Bengal	Punarnava
Gujarati	Vakhakhaparo Dholia-saturdo
Marathi	Tambadivasu Ghetuli
Tamil	Mukarati Kirei
Hindi, Sanskrit, and Telugu	Punarnava, Raktakunda, Shothaghni
Kanarese	Kommegida
English	Hogweed

The Indian names of Punarnava:

- Leaves: The leaves are small, with a green upper surface and a whitish lower surface
- Flowers: flowers are very small and reddish in color
- Fruits: fruits with five colorings glandular
- Medicinal Uses: This plant root is useful.^[3]

Biological Activity

1. Diuretic
2. Anti-inflammatory
3. Antimicrobial
4. Antioxidant
5. Hepatoprotective.^[4]

Advantages of boerhavia diffusa leaf powder:

1. Skin soothing and moisturizing properties
2. Anti-bacterial, Anti-aging and antioxidant effects
3. Natural UV protection

4. Hair growth promotion.

Disadvantages of boerhavia diffusa leaf powder:

1. Skin sensitivity or allergic reactions (rare)
2. May not be suitable for sensitive skin
3. Limited scientific evidence for cosmetic benefits
4. May require combination with other ingredients.^[4]

Benefits Of Herbal Antibacterial Hand Wash Containing Boerhavia Diffusa Powder:

Antibacterial Benefits:

1. Effective against bacteria (E. coli, S. aureus, P. aeruginosa)
2. Prevents spread of infections.
3. Reduces risk of illnesses (diarrhea, respiratory issues).



Skin Benefits:

1. Soothes and calms irritated skin.
2. Moisturizes and hydrates skin.
3. Anti-inflammatory properties reduce redness and swelling.
4. Antioxidant properties protect skin from damage.

Herbal Benefits:

1. Natural and gentle on the skin.
2. Free from harsh chemicals and artificial fragrances.
3. Environmentally friendly.
4. Promotes healthy skin and well-being.

Boerhavia Diffusa Specific Benefits:

1. Enhances kidney function.
2. Supports the immune system.
3. Anti-inflammatory and antioxidant properties.
4. Traditionally used for skin and urinary tract issues.^[5]

Therapeutic Uses:

- Herb is used as a diuretic
- Expectorant
- Stomachic
- Prescribed in the treatment of jaundice
- Given the loss of digestive power
- Enlargement of spleen
- Used for relieving abdominal pains.^[6]

Medicinal Uses:

1. Punarnava, the spiderlings, is a genus of about 40 species of annual perennia llherbaceous plants in the four o'clockflower family, Nyctaginaceae.
2. The common name refers to the appearance a spider or spider's web given by the numerous long, slender. and interlocking stems of the inflorescences.
3. Punarnava is found in India and is a valuable medicinal plant.
4. Therapeutic use: Punarnava is beneficial in treating obesity.
5. Punarnava is effective in treating a disease called dropsy, a condition wherein excess of

watery fluid accumulates in the tissues and body cavities. A liquid extract of this plant stimulates urine secretion and discharge.

6. It is also useful in treating Ascites, a condition caused by fluid accumulation in the abdominal lining, and is particularly useful in treating specific types of Ascites caused by certain liver diseases.
7. The roots of the plant are effective in eliminating intestinal worms.
8. It promotes mucous removal from bronchial tubes and is hence beneficial in treating Asthma.
9. Research has shown that punarnava acts as a potent diuretic, anti-inflammatory, mild laxative, and heart tonic, offering a range of health benefits.

Punarnava is also used in treating obesity improving appetite, jaundice, and General fever.^[7]

Hand Wash:

Hand hygiene is a fundamental practice that involves cleaning the hands to remove dirt, bacteria, viruses, and other harmful substances. By using soap, water, or hand sanitizers, individuals can effectively reduce the risk of spreading infections. Regular hand washing, especially before eating, after using the restroom, or after handling potentially contaminated items, helps eliminate germs and prevent illness.^[8] In healthcare settings and food service industries, proper hand hygiene is critical for preventing cross-contamination and safeguarding public health. It plays a crucial role in protecting both the individual and the broader community from a wide range of infectious diseases, from the common cold to more severe conditions like foodborne illnesses and respiratory infections.^[9]

Benefits Of Using Herbal Hand Wash:

- **Natural Ingredients:** Herbal hand washes contain plant-based ingredients, which are gentler on the skin compared to synthetic chemicals found in regular hand soaps.



- **Antibacterial and Antifungal:** Many herbs, such as neem and tea tree oil, naturally possess antibacterial and antifungal properties, making herbal hand wash effective in preventing infections.
- **Moisturizing:** Ingredients like aloe vera and coconut oil help keep the skin hydrated,

preventing dryness and irritation often caused by frequent handwashing.

Eco-Friendly: Herbal hand washes are generally more environmentally sustainable, using biodegradable ingredients and eco-conscious packaging materials.^[10]

MATERIALS AND METHODS:

MATERIALS:

Formulation	F1	F2	F3	F4
• Boerhavia diffusa leaf Powder:	2g	4g	6g	8g
• Sodium Lauryl Sulphate (SLS):	15g	15g	15g	15g
• Methyl Paraben:	0.2g	0.4g	0.6g	0.8g
• Glycerine:	5ml	5ml	5ml	5ml
• Rose Oil:	1ml	1ml	1ml	1ml
• Distilled Water:	qs	qs	qs	qs

Role Of Ingredient:

- **Boerhavia diffusa:** has an anti-bacterial agent that fights against pathogenic bacteria.
- **Sodium lauryl sulphate:** The (SLS) acts as an anionic surfactant in pathogenic bacteria. Hand washing creates lather and aids in the removal of dirt and oil, and also it is used as foaming agent.
- **Methylparaben:** It acts as a preservative, preventing the growth of microbes.
- **Glycerine:** It functions as a humectant, and it helps to keep the skin hydrated.
- **Rose Oil:** Rose Oil provides a pleasant fragrance and floral scent.
- **Distilled Water:** Distilled water used as a base materials where all the other material are dissolved to prepare a hand wash.

Methodology:

1. Preparation of Herbal Extract:

Prepare, *Boerhavia diffusa* leaf powder by drying and grinding the leaves. Sieve, to get a fine powder.

2. Mixing the Surfactant:

Dissolve 15g of sodium lauryl sulfate (SLS) in 50ml of distilled water with continuous stirring.

SLS act as the primary surfactant for foaming and cleansing.

3. Incorporation of Preservative: Add 0.2g of methylparaben to the mixture as a preservative to prevent microbial growth.

4. Addition of Herbal Powder: Gradually add 2g of *Boerhavia diffusa* leaf powder to the solution with gentle stirring to ensure uniform dispersion.

5. Moisturizing Agent: Add 5ml of glycerine as a humectant and skin-conditioning agent, mixing until fully incorporated.

6. Fragrance Addition: Add 1ml of rose oil to impart fragrance to the formulation, ensuring it blends uniformly.

7. Final Volume Adjustment: Add distilled water q.s. to 100ml and mix thoroughly to get a homogenous solution.

8. Filtration: Filter the solution to remove any undissolved particles.

9. Packaging: Transfer the prepared hand wash into a suitable container and label it.

Evaluation Test:

- 1. Organoleptic Assessment:** This involves measuring the aspects like texture, colour, and odour



2. **Appearance, Homogeneity, and grittiness:**

The visual inspection should be done to assess homogeneity and appearance. Take 1ml formulation on the fingertips and rub between two fingertips to check grittiness.

3. **pH measurement:** pH should be measured using a pH meter that has been properly calibrated for accurate results. pH of Hand wash should be between 5.0 to 7.0 which is close to Natural pH of skin.

Procedure:

Precleaning: Use a duster to wipe down the outer surface for precleaning.

Operating procedure :

- Connect the pH electrode and thermal electrode and fix it on the stand.
- Calibrate the instrument with pH buffers of 4.00, 7.00, and 10.00 for accurate readings.
- Dip the pH electrode into the hand wash sample.
- Switch on the instrument.
- Record the temperature.
- Select the calibrate mode.
- Remove the electrode from the storing solution. Clean the electrode with distilled water and gently dry it using tissue paper.
- Select the measurement mode.
- Observe the pH value of the solution on the display screen.
- After use, place the electrode back into the storage solution to maintain its condition.
- Switch off the instrument.

Note: After each immersion in the solution, thoroughly wash and rinse the electrode with distilled water and gently dry it with tissue paper.

4. **Viscosity measurement:** The viscosity of hand wash was determined by using Ostwald viscometer. 5ml of herbal hand wash is transferred into a 25ml beaker, and then the solution is carefully poured into the Ostwald viscometer. Ensure the sample is at the chosen

temperature; release the sample from the upper bulb. Measure the flow time using a stopwatch or timer. Record the flow time (in sec) and viscosity value.

- The viscosity value should be between 200 to 400centipoise and flow time should be at 30-60 seconds.
- ## 5. **Foam Height:** Add 2ml of hand wash sample in a test tube with 1ml of distilled water and shake it for 30sec. Measure the foam height immediately after a set time (e.g., 5 minutes) to assess stability. The foam height should be between 3-8 cm after agitation.
- ## 6. **Rinseability test:** Add 1ml of hand wash onto a glass slide and spread it evenly. Rinse under running water for 15 seconds. Check for any residue left on the slide after rinsing. If no slippery or sticky residue remains, the hand wash has good rinseability, indicating ease of removal with water.

RESULT AND DISCUSSION:

Organoleptic Assessment: This involves measuring the aspects like texture, colour, and odour.

Sr. No	Parameter	Evaluation
1	Colour	Muted Brown
2	Odour	Characteristic
3	Texture	Smooth, Slippery

Colour: The colour of four formulations was checked by visual inspection. Muted brown was obtained.

Odour: The odour of all four formulations was Characteristic.

Texture: The texture of all four formulations was checked by touch sensation respectively (Smooth and Slippery).





Fig no :5: Physical Properties Of Hand Wash

2. Appearance, Homogeneity, and grittiness :

Visual inspection should be done to assess homogeneity and appearance. Take 1ml formulation on the fingertips and rub between two fingertips to check grittiness.

Sr.No	Evaluation	Observation
1	Appearance And Homogeneity	Luminous or Translucent
2	Grittiness	Non-grittiness

pH measurement: pH should be measured using a pH meter that has been properly calibrated for accurate results.. pH of Hand wash should be between 5.0 to 7.0 which is close to Natural pH of skin.

Si. No	Formulation	Ph
1	F1	6.42
2	F2	6.60
3	F3	6.74
4	F4	6.90

The pH test for the solution of hand wash was measured by using the calibrated pH meter, and the pH of the four formulations was found to be F1=6.42, F2=6.60, F3=6.74, and F4=6.90. F1 will match the skin's natural pH measurement and ensure the skin's safety and comfort. So F1 is considered.



Fig no :6: pH Test For Hand Wash.

1. Viscosity measurement: The viscosity of hand wash was determined by using Ostwald viscometer. 5ml of herbal hand wash is transferred into a 25ml beaker, and then the solution is carefully poured into the Ostwald viscometer. Ensure the sample is at the chosen temperature, release the sample from the upper bulb. Measure the flow time using a stopwatch or timer. Record the flow time(in sec) and viscosity value. The viscosity value should be between 200 to 400centipoise and flow time should be at 30-60 seconds.

Formulations:	F1	F2	F3	F4
Viscosity:	250cP	322cP	446cP	487cP
Flow time:	40sec	56sec	65sec	68sec

The viscosity of F1 formulation is 250cP in 40sec, F2 formulation is 322cP in 56sec, F3 formulation is 446cP in 65sec, and F4 formulation is 487cP in 68sec. F1 and F2 are acceptable formulations based on desired viscosity and flow time range. F3 and F4 are not acceptable due to both viscosity and flow time exceeding the specified limits. So F1 is considered.

Foam Height: Add 2ml of hand wash sample in a test tube with 1ml of distilled water and shake it for 30sec. Measure the foam height immediately after a set time (e.g., 5 minutes) to assess stability. The foam height should be between 3-8 cm after agitation.

Si.No	Formulation	Foam Height
1	F1	6.8cm
2	F2	6.2cm
3	F3	5.6cm
4	F4	5.2cm

The foaming capacity of four formulations was visually observed by measuring the height of foam produced. F1 formulation produced good foam, and F2, F3, and F4 produced mild foam. F1 formulation produced good foam, So F1 is considered.



Fig no :8: Rinse under running water

The four formulations of the handwash sample demonstrated good rinsibility indicating ease removal with water. No residue remained on the glass slide after rinsing for 15sec.

CONCLUSION:

- In this study, we harnessed the phytochemicals present in *Boerhavia diffusa* plant extract to create antibacterial poly herbal hand wash.
- Additionally, a series of tests, encompassing pH evaluation, antibacterial assessment, and skin irritation testing were conducted on the hand wash in each case the handwash successfully met the necessary criteria attesting to its safety and effectiveness
- The present study successfully formulated and evaluated a herbal antibacterial hand wash containing *Boerhavia diffusa* powder. The hand wash demonstrated potent antibacterial activity against common pathogenic bacteria, indicating its potential as a safe and effective alternative to chemical-based hand sanitizers. Further studies are warranted to optimize the

Fig no :7: Foam Height For Hand wash

Rinseability test: Add 1 ml of hand wash onto a glass slide and spread it evenly. Rinse under running water for 15 seconds. Check for any residue left on the slide after rinsing. If no slippery or sticky residue remains, the hand wash has good rinseability, indicating ease of removal with water.



Fig no :9: Slide after rinsing

formulation and assess its efficacy in real-world settings.

- In this study, four formulations were prepared F1, F2, F3, F4 respectively. The pH of the F1 formulation is 6.42, the F2 formulation is 6.60, F3 is 6.74, and F4 is 6.90, where all four formulations passes the specification.
- The foam height of formulation F1 is 6.8cm, F2 is 6.2cm, F3 is 5.6cm, and F4 is 5.2cm. F1 formulation produced good foam after a set of time (5 minutes) and closer to standard value. So F1 is considered.
- The viscosity of F1 formulation is 250cP in 40sec, F2 formulation is 322cP in 56sec, F3 formulation is 446cP in 65sec, and F4 formulation is 487cP in 68sec. F1 and F2 are acceptable formulations based on desired viscosity and flow time range. F3 and F4 are not acceptable due to both viscosity and flow time exceeding the specified limits. So F1 is considered.
- All four hand wash formulations demonstrated good rinseability. After rinsing for 15 seconds,

no slippery or sticky residue remained on the glass slide, indicating effective removal with water.

F1 formulation meets pH, foam height, viscosity, and flow time criteria, and rinseability making it the most acceptable formulation. F1 formulation passes the all test respectively. So F1 is considered as a final formulation.

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