

Formulation and Characterization of an Organic Herbal Bathing Powder for Skin Care Applications

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ABSTRACT

The present investigation focuses on the formulation and characterization of an organic herbal bathing powder prepared from natural ingredients such as rice, green gram, urad dal, neem leaves, hibiscus leaves, rose petals, white turmeric, vetiver and Tanner cassia. The developed formulation was evaluated using UV-Visible and FT-IR spectroscopic techniques to identify the presence of bioactive functional groups. The UV-Visible spectral analysis exhibited absorption peaks at 284, 425, 553 and 685 nm, indicating the presence of plant-derived chromophoric compounds. FT-IR spectral studies confirmed the presence of hydroxyl, aliphatic and unsaturated functional groups. Quality and safety assessments were carried out through microbial limit tests, total ash analysis and moisture content determination. Microbiological studies confirmed the absence of Salmonella species, indicating the microbial safety of the product. The low ash and moisture contents further suggested good purity, stability and reduced risk of microbial contamination. Overall, the findings indicated that the formulated herbal bathing powder is safe, biodegradable, skin-compatible and suitable alternatives to synthetic cosmetics.

Keywords: Herbal bathing powder; Formulation; Characterization; Microbiological evaluation; Safety assessment

1. Introduction

Cosmetics play a significant role in human civilization for centuries and are commonly used for cleansing, beautifying and enhancing physical appearance. Modern cosmetic industries largely depend on synthetic chemicals such as parabens, sulphates, artificial fragrances and preservatives to improve shelf life and product stability. However, prolonged use of synthetic cosmetic products may cause skin irritation, allergies, hormonal imbalance and environmental pollution. These adverse effects have encouraged researchers and consumers to explore herbal and organic alternatives for safer skin care applications [1-3].

Herbal cosmetics are formulations prepared using naturally derived ingredients obtained from medicinal plants, flowers, cereals and herbal extracts. Such products are considered safer due to their biodegradability, reduced toxicity and skin compatibility. Traditional Indian systems such as Ayurveda and Siddha have long recommended herbal

bathing powders as natural cleansers and skin protectants. These formulations provide antimicrobial, antioxidant, anti-inflammatory, and moisturizing benefits without causing harmful side effects [4].

Nallangumaavu, a traditional South Indian herbal bathing powder, is widely used for maintaining healthy skin. It consists of herbal ingredients such as neem leaves, green gram, rose petals, hibiscus leaves, turmeric, vetiver and rice flour, which collectively help in cleansing, exfoliation, skin brightening and soothing irritated skin [5].

In the present investigation, an organic herbal bathing powder is prepared from rice, green gram, urad dal, neem leaves, hibiscus leaves, rose petals, white turmeric, vetiver and *Tanner cassia* to develop a natural and eco-friendly skin care formulation. The study also aims to characterize the prepared formulations using spectroscopic techniques and evaluate their physicochemical and microbiological properties to ensure quality, safety and effectiveness.

2. Experimental Section

2.1 Materials

Rice, green gram, urad dal, neem leaves, rose petals, hibiscus leaves, *Tanner cassia* flowers, white turmeric and vetiver roots were used for the preparation of herbal bathing powder. Hibiscus leaves, neem leaves and *Tanner cassia* flowers were directly collected from the plant source. Rose petals, urad dhal, green gram and rice were purchased from the market and herbs like vetiver, white turmeric are purchased from ayurvedic shop.

2.2 Preparation of Organic Bathing Powder

Neem leaves, hibiscus leaves, rose petals and *Tanner cassia* flowers were washed thoroughly and dried under shade at room temperature to preserve their medicinal properties. The dried ingredients were powdered separately. Rice, green gram, and urad dal were cleaned and ground into fine powder. Vetiver and white turmeric were crushed and blended with the powdered herbal ingredients. All powdered materials were mixed uniformly and sieved to obtain a smooth herbal bathing powder. The prepared powder was stored in airtight containers.

2.3 Characterization Techniques

The UV-Visible absorption spectrum of the herbal bathing powder was recorded using a Shimadzu UV-1800 spectrophotometer. FT-IR spectral analysis was carried out using the KBr pellet method in the range of 400-4000 cm^{-1} with a Shimadzu IR Affinity-1 spectrophotometer.

2.4 Microbial Limit Test

2.4.1 Total Viable and Aerobic Bacteria Count

The total viable and aerobic bacterial count of the herbal bathing powder were determined by mixing 1 g of the bathing powder with 10 mL of Tryptic Soy Broth (TSB). Serial tenfold dilutions (10^{-1} to 10^{-10}) were prepared, and 0.1 mL aliquots from the 10^{-4} , 10^{-5} and 10^{-6} dilutions were spread onto Nutrient Agar plates. The plates were incubated at 37°C for 24 h and colonies containing fewer than 300 colony-forming units (CFU) were counted. The bacterial count was expressed as CFU per gram of the sample.

2.4.2 Total Yeast and Mould Count

About 1 g of the bathing powder was aseptically mixed with 10 mL of TSB. Serial tenfold dilutions (10^{-1} to 10^{-10}) were prepared, and 0.1 mL aliquots from the 10^{-5} , 10^{-6} and 10^{-7} dilutions were spread onto Potato Dextrose Agar plates. The plates were incubated at 25°C for 72 h and colonies containing fewer than 50 CFU were counted. The results were expressed as CFU/g of the sample.

2.4.3 Identification of *Salmonella* sp

About 1 g of the sample was inoculated into 10 mL of TSB medium and incubated at 37°C for 18 - 24 h. The enriched culture was streaked onto *Salmonella-Shigella* agar and incubated at 37 °C for 18 - 48 h. The presence of black-centered colonies indicated presumptive positive results for *Salmonella* sp.

2.5 Total Ash Content

About 2 g of herbal powder was taken in a clean dry crucible. Heated slowly, then incinerated in a muffle furnace at 500 - 550 °C until a white/grey ash was formed. Cooled in a desiccator and weighed.

$$\text{Total ash} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

2.5.1 Acid-Insoluble Ash

The collected ash was treated with 25 mL of 2N HCl, boiled and filtered. The residue was washed, ignited along with the filter paper, cooled and weighed to determine the acid-insoluble ash content.

$$\text{Acid insoluble ash} = \frac{\text{Residue weight}}{\text{Original sample weight}} \times 100$$

2.5.2 Water-Soluble Ash

The total ash is taken and mixed with boiled water and filtered. The insoluble residue was collected, ignited and weighed. The weight of the residue was subtracted from the total ash to determine the water-soluble ash content.

Water insoluble ash = total ash – insoluble part in water

2.6 Moisture Analysis

The empty dish was dried in an oven, cooled in a desiccator and weighed to obtain the dish weight (W_1). About 2 g of herbal powder was added and weighed again to obtain the initial weight (W_2). The sample was then dried at 105°C for 3 h, cooled in a desiccator, and reweighed to obtain the final weight (W_3). Drying was continued until a constant weight was achieved to ensure complete moisture removal.

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

3. Results and Discussion

3.1 Characterization of Herbal Bathing Powder

The organic herbal bathing powder is characterized by UV-Visible and FT-IR spectral techniques. The absorption spectrum of the herbal bathing powder in ethanol shows absorption peaks at 284, 425, 553 and 685 nm indicating $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ electronic transitions (Fig. 1).

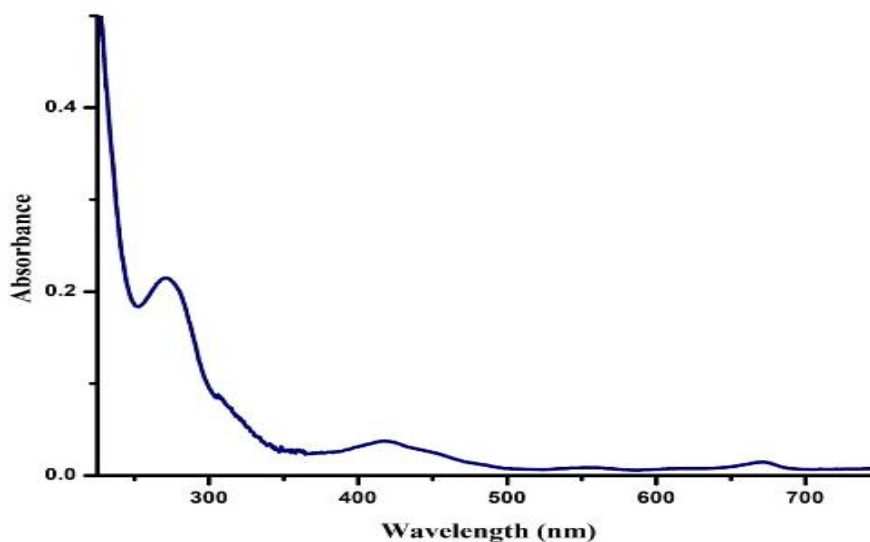


Fig. 1 UV-Visible spectrum of herbal bathing powder

The FT-IR spectrum of the herbal bathing powder shows a broad and intense peak at 3454 cm^{-1} corresponds to O–H stretching vibrations of hydroxyl groups such as alcohols or phenols, and indicates H-bonding. The bands observed at 2937 cm^{-1} and 2636 cm^{-1} indicate the C–H stretching vibrations of aliphatic $-\text{CH}_2$ and $-\text{CH}_3$ groups, confirming the presence of hydrocarbon chains. A distinct peak at 2264 cm^{-1} suggests the presence of either a nitrile ($\text{C}\equiv\text{N}$) or alkyne ($\text{C}\equiv\text{C}$) functional group. The absorption at 1637 cm^{-1} may be attributed to $\text{C}=\text{C}$ stretching vibrations of alkenes or possibly $\text{C}=\text{O}$ stretching in conjugated systems or amide linkages. The band around 1402 cm^{-1} indicates CH_2 bending or O–H deformation,

while the absorption at 569 cm^{-1} lies in the fingerprint region, often associated with skeletal vibrations. Overall, the FT-IR analysis indicates that the sample contains hydroxyl groups, aliphatic hydrocarbons, unsaturation ($\text{C}=\text{C}$), and possibly nitrile or alkyne functionalities, suggesting that the material is organic mixture and plant-derived extract with multiple functional groups (**Fig. 2**).

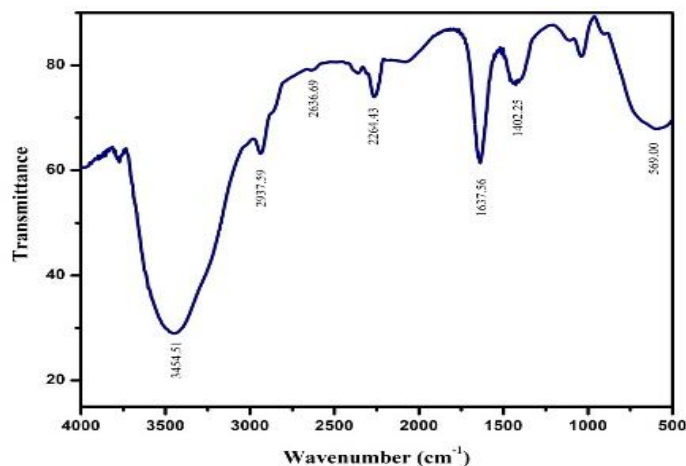


Fig. 2 FT-IR spectrum of herbal bathing powder

3.2 Microbial Limit Test

The total viable and aerobic bacteria count is performed to determine the microbial load present in the herbal bathing powder. At dilution levels of 10^{-5} and 10^{-6} , the colonies are found to be too numerous to count. At 10^{-7} dilution, the bacterial count is recorded as 32×10^8 CFU/g, indicating the presence of viable aerobic bacteria in the sample (**Fig. 3**).

The total yeast and mould count is carried out to evaluate fungal contamination in the herbal bathing powder. At dilution levels of 10^{-4} , 10^{-5} , and 10^{-6} , the colonies are observed to be too numerous to count, indicating a high yeast and mould population in the sample (**Fig. 4**). The presence of *Salmonella* sp. is examined using Salmonella–Shigella agar. No black-centered colonies are observed on the agar plates, confirming the absence of *Salmonella* sp. in the prepared herbal bathing powder (**Fig. 5**).



Fig. 3 Total viable and aerobic bacteria count



Fig. 4 Total yeast and mould count



Fig. 5 Identification of *Salmonella* on SS agar

3.3 Determination of Total Ash Content

The total ash content of the organic bathing powder is determined to evaluate the amount of inorganic residue remaining after complete combustion. The total ash value is found to be 1.27%, indicating a low level of inorganic matter and good purity of the formulation. This value falls well within the acceptable international limit for herbal powders, where total ash is generally recommended to be below 10%. The acid-insoluble ash value, which represents siliceous impurities such as sand and dirt, is found to be 9.3%. The water-insoluble ash content is determined as 5.8%, indicating the presence of a small amount of inorganic material insoluble in water. These ash values provide important information regarding the purity, quality, and safety of the herbal bathing powder.

3.4 Determination of Moisture Content

The moisture content of the organic bathing powder is evaluated to determine the amount of water present in the formulation, as moisture plays an important role in the stability, quality, and shelf life of herbal products. Excess moisture can promote microbial growth and degradation of phytoconstituents, whereas low moisture content enhances product stability and storage life.

The moisture content of the herbal bathing powder is found to be 0.2185%, indicating very low water content in the formulation. This low moisture level confirms adequate drying.

of the powder and reduces the possibility of microbial contamination during storage. The obtained value falls well below the standard acceptable moisture limit for herbal powders, which is generally below 10%. Therefore, the prepared herbal bathing powder shows good stability, purity, and suitability for long-term storage and safe consumer use.

Conclusion

The present investigation successfully demonstrated the formulation and characterization of an organic herbal bathing powder from natural ingredients. UV-Visible and FT-IR spectral analyses confirm the presence of bioactive phytoconstituents and important functional groups responsible for the therapeutic and skin-protective properties of the formulation. The microbial analysis confirms the absence of *Salmonella* sp., indicating the microbiological safety of the prepared product. The herbal bathing powder also exhibits low ash and moisture contents, reflecting good purity, stability and minimal inorganic contamination. The low moisture level further enhances shelf life by reducing the risk of microbial growth and degradation of active constituents during storage. Overall, the formulated herbal bathing products are safe, biodegradable, skin-compatible, and eco-friendly alternatives to synthetic cosmetic products. The study highlights the potential of traditional herbal ingredients in developing effective and sustainable personal care formulations.

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