Formulation And Evaluation of Herbal Bath Bomb for Antifungal Activity

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Abstract—**The current research paper aims at developing and analyzing an herbal bath bomb with antifungal properties to create an effective, safe, and environmentally friendly cosmetic product. As the popularity of natural and herbal formulations of skincare products grows, the present study focuses on alternatives to synthetic compounds, which can be very irritating to the skin and lead to several side effects, and that is the use of plant-derived compounds. The herbal bath bomb was designed on the basis of such key ingredients as sodium bicarbonate, citric acid, magnesium sulfate, cornstarch, herbal actives like cinnamon oil, that have antifungal, antimicrobial, anti-inflammatory, and skin-soothing effects. The acid-base interaction between sodium bicarbonate and citric acid makes the bath bomb effusive, which increases the release of active ingredients and also gives a patients experience in the bathing process. The ready-made preparations were tested on different parameters such as the physical appearance, pH, the time of effervescence, clearness, solubility, stability and skin irritation. The data showed that the formulations had good physicochemical characteristics, skin-compatible pH and good effervescence. The tests conducted on skin irritation proved that the product was safe to use topically. The antifungal and therapeutic properties of the formulation were also due to the presence of herbs. To sum up, the formulated herbal bath bomb product proved to have great potential as a multifunctional cosmeceutical product which can be used both as both therapeutic and cosmetic. This paper emphasizes the practicability of integrating herbal actives into effusive delivery systems and justifies its use in the contemporary skincare. More research could be done to provide more stability, increase production, and investigate other herbal blends in an attempt to expand the pharmaceutical use.**

Index Terms—**pH – Potential of Hydrogen, CO_2 – Carbon Dioxide, $NaHCO_3$ – Sodium Bicarbonate $C_6H_8O_7$ – Citric Acid, $MgSO_4$ – Magnesium Sulphate, F1, F2, F3 – Formulation 1, Formulation 2, Formulation 3, gm – Gram, ml – Millilitre,°C – Degree Celsius.**

Scientific / Academic Terms WHO – World Health Organization, HD – Hydro-distillation, MAHD Microwave-Assisted Hydro-Distillation, API – Active Pharmaceutical Ingredient, UV – Ultraviolet.

I. INTRODUCTION

In recent years, there has been a significant change in the cosmetics and personal care sector, with a growing emphasis on natural and herbal products. It is this paradigm shift that is largely being fuelled by the growing consumer awareness of health, sustainability and environmental considerations. While conventional synthetic chemicals provide rapid cosmetic effects, they can also have negative impacts on skin health, cause allergic reactions, and pose environmental risks. Consequently, consumers are increasingly looking for alternatives that are seen as safer, skincare friendly and eco-friendly.

Antifungal activity is the ability of a substance such as a medicine, natural compound or nanoparticle to kill (fungicidal) or inhibit the growth (fungistatic) of fungi. These agents act by disrupting cell walls, membranes and/or fungal metabolism, most notably against Candida fungi.

The popularity of herbal formulations is attributed to the growing trend of sustainability and holistic health across the world. Herbal cosmetics are made from natural ingredients like plants, minerals and essential oils, which are generally biodegradable and less polluting to the environment compared to synthetic products. This trend has created a new class of product: cosmeceuticals, cosmetics that provide therapeutic benefits as well as improving beauty.

One such innovation is the bath bomb, which has become a new and versatile product that combines the elements of luxury cosmetics and therapeutic skincare. Bath bombs, once consumed as self-care luxury products, are now being repurposed as vehicles for

active herbs, and beyond simply being a pleasure product, are a health one too. Their effervescent properties, along with the herbal compounds, make them an exciting product to create and offer to consumers who are in need of relaxation, rejuvenation, and natural skincare.

Fig no 01 Effervesent of Herbal Bath Bomb

S. No.	Parameter	Herbal Bath Bomb (Marketed)	Synthetic Bath Bomb (Marketed)
1	Ingredients Source	Natural (plant-based oils, herbs, essential oils)	Artificial chemicals, synthetic fragrances
2	Skin Safety	Generally safe, mild, less irritation	May cause irritation or allergies
3	Fragrance	Natural aroma (essential oils)	Strong artificial fragrance
4	Colorants	Natural colorants (clays, plant extracts)	Synthetic dyes and pigments
5	Therapeutic Effect	Provides relaxation, aromatherapy benefits	Mainly cosmetic, limited therapeutic effect
6	Environmental Impact	Eco-friendly, biodegradable	May harm environment due to chemicals
7	Cost	Slightly expensive due to natural ingredients	Usually, cheaper
8	Shelf Life	Shorter shelf life	Longer shelf life
9	Skin Nourishment	Contains vitamins, antioxidants	Limited or no nourishment
10	Examples	Herbal brands (e.g., neem, lavender-based products)	Commercial synthetic bath bombs

Table: Comparison Between Marketed Herbal and Synthetic Bath Bombs

Why Herbal Bath Bomb

An herbal bath bomb is an effervescent formulation enriched with natural herbs, essential oils, and plant-based ingredients that provide relaxation, skin nourishment, and wellness benefits. Unlike conventional bath bombs, herbal variants avoid synthetic dyes, fragrances, and harsh chemicals, making them gentler, more therapeutic, and environmentally sustainable.

Herbal medicine, rooted in ancient traditions such as Ayurveda, emphasizes the use of plants and plant extracts for healing. Herbs contain bioactive compounds that can promote wellness, treat minor ailments, and serve as the foundation for modern pharmaceuticals. Integrating these principles into bath bomb formulations enhances their therapeutic potential, transforming them into holistic skincare agents.

The basic mechanism of bath bombs involves a chemical reaction between citric acid and sodium bicarbonate, which releases carbon dioxide upon contact with water. This effervescence not only creates a visually appealing and soothing bathing experience but also acts as a vehicle for delivering active ingredients, fragrances, and essential oils. The incorporation of herbal components elevates their functionality. For example:

- Sodium bicarbonate (Baking soda): Cleanses and softens skin by neutralizing acidity and removing impurities.
- Magnesium sulfate (Epsom salt): Acts as a muscle relaxant, reducing fatigue and promoting relaxation.
- Citric acid: Provides effervescence, maintains pH balance, and enhances skin compatibility.
- Cinnamon oil: Offers antifungal and antimicrobial properties, contributing to skin protection.

These botanicals, revered in traditional medicine systems, contribute to skin cleansing, rejuvenation, and overall wellness. By combining effervescence with herbal actives, bath bombs evolve from mere cosmetic indulgences into therapeutic cosmeceuticals.

Scientific Rationale

The development of herbal medicated bath bombs addresses rising consumer preferences for affordable, natural, and effective skincare solutions. Unlike conventional bath bombs, which often rely on synthetic fragrances and colorants, herbal bath bombs

incorporate bioactive compounds that provide measurable therapeutic benefits.

II. AIM & OBJECTIVE

Aim: - Formulation And Evaluation of Herbal Bath Bomb for Antifungal Activity

Objectives

1. To evaluate the physical appearance (color, texture, and consistency) of the prepared bath bomb formulations.
2. To compare multiple formulations (F1, F2, F3) and identify the most effective composition based on evaluation parameters.
3. To study the therapeutic benefits of herbal ingredients incorporated in the bath bombs, including antimicrobial, anti-inflammatory, and moisturizing effects.
4. To explore the potential pharmaceutical applications of bath bombs as a delivery system for topical treatments.
5. To establish the commercial and industrial relevance of herbal medicated bath bombs as cost-effective, eco-friendly, and sustainable skincare products.

III. DRUG AND EXCIPIENTS PROFILE ACTIVE INGREDIENTS

1. Baking Soda (Sodium Bicarbonate)

Baking soda serves as the primary alkaline component in bath bombs, reacting with citric acid to produce carbon dioxide bubbles, creating the fizzing effect.
Properties: Alkaline, mild abrasive, skin-soothing.Benefits: Helps to cleanse and soften the skin, balances pH levels, and promotes relaxation.
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Fig no: -02 baking soda

2.Citric Acid:

Citric acid acts as the acidic component in bath bombs, reacting with baking soda to produce carbon dioxide gas, resulting in fizzing.
Properties: Acidic, antioxidant, exfoliating.
Benefits: Enhances the fizzing action, helps to exfoliate dead skin cells, and contributes to a refreshing bathing experience.

Fig no: -03 citric acid

IV. EPSOM SALT (MAGNESIUM SULFATE)

Epsom salt provides a source of magnesium and sulfate ions, which can be absorbed through the skin.
Properties: Hygroscopic, muscle-relaxant, anti-inflammatory.
Benefits: Helps to relax muscles, alleviate tension, reduce inflammation, and promote overall well-being.

Fig no: -04 Magnesium sulphate

4. Cornstarch or Arrowroot Powder:

Cornstarch or arrowroot powder serves as a binder and filler in bath bombs, helping to absorb excess moisture and improve texture.
Properties: Absorbent, fine texture, non-irritating.
Benefits: Enhances the consistency of the bath bomb mixture, prevents clumping, and provides a smooth finish.

Fig no: -05 corn starch

Carrier Oils:
Benefits: - Helps regulate blood sugar levels
Reduces joint and muscle pain
Function: - Improves Circulation
Fights Infections
Properties: - Cinnamon oil is rich in active compounds like cinnamaldehyde and eugenol, which give it strong biological effects.

Fig no: -06 cinnamon oil

V. MATRIALS AND METHODS

Ingredients	Apparatus	Instruments
Sodium bicarbonate	Moulds	Ph meter
Citric acid	Morter pestler	Incubator
Corn starch	Weighing balance	
Magnesium sulphate	Spatula	
Cinnamon oil	Butter paper	

Preparation Of Bath Bomb

1. Ingredients were gathered: The required ingredients, including baking soda, citric acid, cornstarch, epsom salts, cinnamon oil, wild turmeric powder, and colourant, were collected.
2. Dry Ingredients Were Mixed: Baking soda, citric acid, cornstarch, epsom salts and colorant were sifted together in a mortar and pestle and mixed thoroughly to ensure a smooth, uniform mixture.
3. Herbs Were Added: Dried guava leaves powder and wild turmeric powder were added to the dry mixture.
4. Wet Ingredients Were Prepared: In a separate beaker, essential oil, carrier oil, were combined. The mixture was stirred gently.
5. Wet and Dry Ingredients Were Combined: The wet ingredients were slowly added to the dry mixture, one small spoonful at a time, to prevent the citric acid from reacting prematurely. The mixture was stirred continuously until it had a damp, sand-like texture.
6. The Mixture Was Molded: The damp mixture was packed tightly into bath bomb molds. Two halves of a mold were pressed together firmly to form a complete sphere, and excess mixture was wiped away.
7. Bath Bombs Were Left to Set: The molds were carefully removed, and were left to dry and harden for 24 hours.
8. Finished Bath Bombs Were Stored: Once completely dry, the herbal bath bombs were stored in an airtight container to preserve their scent and freshness. They undergo an acid base reaction when comes in contact with water. The following reaction is formed when bath bomb reacts with water. $NaHCO3 + C6H8O7 \rightarrow CO2 + H2O + Na3C6H5O7$ Sodium bicarbonate reacts with citric acid and produces water, carbon dioxide and trisodium citrate. The evolution of carbon dioxide gas produces fizzy bubbles.

Formulation Table. 1

Sr.no	Ingredients	Quantity	Role
1	Sodium bicarbonate	24.6gm	Weak base
2	Citric acid	6.1gm	Strong acid
3	Corn starch	12gm	Binder
4	Magnesium sulphate	6.2gm	Muscle relaxant
5	Cinnamon oil	6.2gm	Antifungal

Fig no: -07 Herbal bath bomb

Evaluation Of Herbal Bath Bomb
For Evaluation: we Perform
1. Physical appearance.
2. pH Determination.
3. Effervescent Time.
4. Skin irritation Test.

- Evaluation Test:

Effervescent time: One bath bomb is put in a 20l tup of water at 20 °C+1 °C.Whenever a clear solution without particles is obtained effervescence time has finished. Three measurements will be made of each formulation and the mean value will be reported.
1.Ph Determination Test: -
The pH of the formulations F1, F2, F3 were determined by using a digital pH meter. Standard buffer solutions of pH 4 and 7 were used to calibrate the ph meter. About 1 gm of powder was weighed and dissolved in 10 ml of distilled water. Then the measurement of pH of formulation was done by dipping the glass electrode completely into the solution three times and the average values are reported.

2. Skin Irritation Test: -
Put a small amount of the dissolved bath bomb material on a small area of skin (usually inner forearm or behind the ear). Wait 24-48 hours to check for redness, swelling, itching or irritation. If there is no adverse reaction, product is considered safe for general usage.

Determination Of Effervescence: Take 500 ml of distilled water in three separate beakers, room temperature and drop about 5 gm each of all formulations (F1, F2, F3) of herbal bath bomb in the beakers. Begin the timer as soon as the bath bomb is dropped into the water. After achieving a clean bubbling free from effervescence, a bubbling time has ended. Record the effervescent time of all formulations.
Clarity testing is the process of determining the clarity of the water following a bath bomb dissolve. Fill a transparent container with 500 ml of water and drop about 5gm each of all the formulations (F1, F2, F3) of herbal bath bomb into it. Start the timer immediately after it is placed into the water. As the reaction progresses, watch the herbal bath bomb powder become dissolved and the water become clear.Check the clarity for any visible particles such as turmeric stains, leaf particles or powder residue.
Approximately 5gm each of all the formulations (F1, F2, F3) of herbal bath bomb were placed in a beaker filled with 500ml of distilled water, at the room temperature. Place the bath bomb in the water. See the bath bomb bubble away! Check if the bath bomb melts and see if there are any solids left in the water, like turmeric or powder made from a plant leaf. 6.For 1 month, all the formulations (F1, F2, F3) of herbal bath bomb were kept under room temperature and observed for any changes that will occur.

VI. EVALUATION PARAMETERS

After formulating the herbal bath bombs, they were evaluated based on four key parameters:

Physical Appearance, pH, Effervescence Time, and Skin Irritation Test. The results are presented in the table below:

S. No.	Evaluation Parameter	F1	F2	F3
1	Physical Appearance	Good	Good	Good
2	pH	7.1	6.5	7.9
3	Effervescence Time (sec)	35	42	52
4	Skin Irritation Test	None	None	None

Table no 3

VII. RESULT

The formulated herbal bath bombs (F1, F2, and F3) were evaluated for various physicochemical and safety parameters. The results obtained are summarized below:
1. Physical Appearance
All three formulations (F1, F2, and F3) showed good physical appearance with uniform shape, smooth texture, and acceptable color. No cracks or deformities were observed, indicating proper formulation and molding.

2. PH Determination
The pH values of the formulations were found to be:
- F1: 7.1
- F2: 6.5
- F3: 7.9

These values are within the acceptable range for skin application, suggesting that the formulations are skin-friendly and non-irritating.

3. Effervescence Time

The effervescence time recorded for the formulations was:

- F1: 35 seconds
- F2: 42 seconds
- F3: 52 seconds

F1 showed the fastest effervescence, indicating quicker release of active ingredients, while F3 showed a comparatively slower reaction.

4. Skin Irritation Test

All formulations showed no signs of irritation, redness, or itching during the skin irritation test, confirming their safety for topical use.

VIII. DISCUSSION AND CONCLUSION

Herbal bath bombs for antifungal activity illustrates the successful combination of traditional herbal medicine with modern cosmeceutical technology. The natural ingredients used in effervescent bath bomb formulations namely, sodium bicarbonate, magnesium sulphate, corn starch, citric acid, and cinnamon oil were added to enhance therapeutic benefits, in addition to cosmetic appeal. The formulations were validated for safety and efficacy by various parameters such as physical appearance, pH, effervescence time, clarity, solubility, stability, and skin irritation. The pH value was adapted to the physiological condition of the skin, a minimum risk of irritation was set and the effervescence time was optimized, both for the pleasant bathing experience and the complete dissolution of the active ingredients. Consumer application was supported by skin irritation tests.

Cinnamon oil showed a significant antifungal activity, consistent with its known antimicrobial properties. These were corroborated by literature data, which showed that herbal extracts like the one used in this study, such as Echinacea extract, have potent antifungal and antibacterial properties, and the addition of Epsom salt helped to improve the therapeutic potential due to its muscle-relaxing and anti-inflammatory effects. These are all reasons why herbal bath bombs are so effective, and it makes them multi-functional cosmeceutical products—relaxing, skin-friendly, and antifungal. They are also eco-friendly and affordable, which aligns with the demands of the consumers for sustainable personal care.

The research was able to develop and test herbal bath bombs that have antifungal properties and found that they are possible to use as innovative cosmeceutical products. Optimized formulations showed the desirable physical properties, skin compatibility, and therapeutic properties. The herbal actives, including cinnamon oil, provide a range of benefits including antifungal, anti-anxiety, antimicrobial and anti-inflammatory effects, while the bath bombs' effervescent appearance and fragrance keep their appeal for consumers. The results of this study reveal that herbal bath bombs are safe for use and effective for the delivery of natural actives to topical skin-care formulations. Being both cosmetic and therapeutic they are useful additions to the ever-expanding herbal cosmeceutical market. Future studies can include scaling up production, further stability studies and the investigation of other herbal combinations to expand the pharmaceutical applications.

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