



Herbal Effervescent Therapy: Antifungal Bath Bomb Loaded with *Melaleuca alternifolia* and *Salvia rosmarinus*

Sneha Pachore*¹, Gayatri Gelande², Bhagyashree Shinde³

¹Assistant Professor (Pharmaceutics)

1 Indira University School of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India

2 SCES's Indira College of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India

^{2,3}Student, Indira College of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India.

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ABSTRACT

Fungal skin infections are a prevalent and persistent dermatological condition affecting people of all ages around the world. The increasing frequency of fungal infections is largely caused by factors including high perspiration, humid weather, inadequate personal cleanliness and weakened immune systems. Conventional antifungal treatments include oral antifungal medications, topical creams, ointments, and powders. Long-term usage of these formulations, however, may result in negative side effects such as skin irritation, hypersensitivity reactions, drug resistance, and low patient compliance. Herbal-based formulations have gained popularity in recent years because of their natural origin, enhanced patient acceptability, cost-effectiveness, and safety profile. Using herbal oil made of tea tree oil (*Melaleuca alternifolia*) and rosemary oil (*Rosmarinus officinalis*), the current effort seeks to create and assess an antifungal herbal bath bomb. Bath bombs are novel cosmetic dosage forms that combine medicinal properties with relaxation, aromatherapy and better bathing experience. The formulation was developed using sodium bicarbonate and citric acid as effervescent agents along with Epsom salt, rice starch, coconut oil, tocopherol, and Tween 20. The prepared herbal bath bombs were evaluated for physical appearance, pH, effervescence time, foaming ability, washability and antifungal activity against *Candida albicans* using the agar cup plate method. The results demonstrated that formulation possessed significant antifungal efficacy, skin-friendly pH, effervescence and acceptable physicochemical characteristics. Hence, herbal bath bombs can be considered a promising, safe, and effective alternative for the management of fungal skin infections while enhancing overall bathing comfort and relaxation.

Keywords: Bathbomb, antifungal activity, herbal extracts, *Rosmarinus officinalis*, *Melaleuca alternifolia*, *Candida albicans*

1. INTRODUCTION

The skin is the largest organ of the human body and acts as a protective barrier against environmental hazards such as microorganisms, chemicals, ultraviolet radiation, and physical injury. It plays a vital role in thermoregulation, sensation, metabolic functions, and prevention of excessive water loss. Despite its protective nature, the skin is highly susceptible to infections caused by bacteria, fungi, parasites, and viruses.¹

Fungal infections of the skin, also known as superficial mycoses, are among the most common dermatological conditions worldwide. These infections are mainly caused by dermatophytes, yeasts, and molds. Among these, *Candida albicans* is one of the most frequently encountered fungal pathogens responsible for cutaneous candidiasis. Clinical manifestations include itching, erythema, scaling, inflammation, burning sensation, and discomfort, which adversely affect the quality of life of patients.²

Conventional antifungal therapies are effective but are often associated with limitations such as side effects, poor compliance, unpleasant odour, greasy texture, and recurrence of infection after discontinuation of therapy. Moreover, increasing resistance to synthetic antifungal agents has become a major concern.^{2,3}

Herbal formulations have gained increasing attention due to their therapeutic efficacy, minimal side effects, and better compatibility with human skin. Essential oils derived from medicinal plants possess potent antifungal, antibacterial, antioxidant, and anti-inflammatory properties. Incorporating herbal ingredients into novel dosage forms such as bath bombs can significantly improve patient compliance by providing both medicinal and recreational benefits.^{2,3,4,5,8}

1.1 Herbal Ingredients



Fig. 1 & 2: Herbal Ingredients – Rosemary oil & Tea Tree

Tea Tree Oil (*Melaleuca alternifolia*): Tea tree oil is widely recognized for its antifungal, antibacterial, and anti-inflammatory properties. It contains active constituents such as terpinen-4-ol and α -terpineol, which disrupt fungal cell membranes and inhibit fungal growth. Tea tree oil is commonly used in the treatment of fungal infections, acne, dandruff, and skin inflammation.^{4,6}

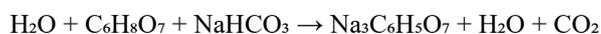
Rosemary Oil (*Rosmarinus officinalis*): Rosemary oil possesses antifungal, antioxidant, and antimicrobial activities. It improves blood circulation, promotes skin healing, and enhances formulation stability. Rosemary oil also imparts a pleasant fragrance, increasing the sensory appeal of the bath bomb.⁵

1.2 Bath Bomb:

A bath bomb is a compacted solid preparation consisting of dry and semi-moist ingredients molded into various shapes and sizes. Bath bombs are designed to fizz and dissolve rapidly when placed in water, releasing fragrance, color, and active ingredients. Although the term "bath bomb" may sound aggressive, the formulation is safe, gentle, and scientifically interesting.^{1,9}

The primary mechanism of action of a bath bomb is based on effervescence. Bath bombs mainly contain a weak organic acid such as citric acid and a basic compound such as sodium bicarbonate. These components remain inactive under dry conditions but react vigorously in the presence of water. This reaction produces carbon dioxide gas, resulting in fizzing and bubbling effects.^{8,9,11}

The chemical reaction involved in effervescence can be represented as follows:



The release of carbon dioxide not only provides a pleasurable sensory experience but also facilitates uniform dispersion of essential oils and herbal actives throughout the bath water. This enhances skin contact and improves therapeutic efficacy.^{1,8,12}

Bath bombs also contain additional excipients such as starch, Epsom salt, and oils. Starch acts as a binder and moisture absorber, while Epsom salt (magnesium sulphate) provides muscle relaxation, stress relief, and soothing effects on inflamed skin. The ratio of sodium bicarbonate to citric acid plays a crucial role in determining the intensity and duration of effervescence.^{10,11,12}

The increasing prevalence of superficial fungal infections and the growing interest in natural therapeutic alternatives have encouraged the exploration of plant-derived bioactive compounds for topical applications. Essential oils such as tea tree (*Melaleuca alternifolia*) and rosemary (*Salvia rosmarinus*) have been widely reported to possess antimicrobial and antifungal properties due to the presence of bioactive constituents including *terpinen-4-ol*, *1,8-cineole*, and *α -pinene*. Despite their therapeutic potential, their effective delivery in user-friendly topical systems remains a challenge. Effervescent bath formulations offer a convenient approach for dispersing active ingredients uniformly in bath water while improving consumer acceptability and ease of application.



Therefore, the present study aimed to formulate and evaluate an effervescent herbal bath bomb incorporating tea tree and rosemary essential oils and to investigate its physicochemical properties, stability, dermal safety, and antifungal activity against *Candida albicans*. The study further seeks to explore the feasibility of using an effervescent herbal delivery system as a supportive topical approach for managing superficial fungal infections.

1.3 Applications: Herbal bath bombs offer a wide range of cosmetic and therapeutic applications:^{2,7,9,10,11}

- Management and prevention of fungal skin infections
- Improvement of skin hygiene and cleanliness
- Relaxation of muscles and relief from body fatigue
- Stress reduction and mental relaxation
- Moisturization and nourishment of the skin
- Aromatherapy and enhancement of mood
- Improvement of blood circulation during bathing
- Supportive therapy in inflammatory skin conditions

2. MATERIAL AND METHODS

Table 1: Materials

Sr. No.	Ingredient	Name and address of commercial suppliers
1	Sodium Bicarbonate	HTMC Group, 33 Ambassador Apartments, 61A Park Street, Kolkata, West Bengal, 700016.
2	Citric Acid	HTMC Group, 33 Ambassador Apartments, 61A Park Street, Kolkata, West Bengal, 700016.
3	Magnesium Sulphate (Epsom Salt)	ANALAB FINE CHEMICALS, MUMBAI-400053
4	Rice Starch	Bluecraft Agro, Bahadur Shah Zafar Marg, New Delhi - 11 00 002
5	Tween 20	Mohini organics, Mumbai
6	Tea Tree Oil	Pure Source India, Near CRPF Camp Najafgarh, New Delhi-110072 (India)
7	Rosemary Oil	Pure Source India, Near CRPF Camp Najafgarh, New Delhi-110072 (India)

Table 2: Equipment

Sr. No	Equipment	Make
1	Weighing Balance	SCHIMADZU, AX 200
2	pH Meter	EQUIPTRONICS, EQ- 614
3	Moisture Analyser	AND, JAPAN: ML-50
4	Incubator	LAB HOSP. MODEL: TC303
5	Autoclave	BIOMEDICA, MODEL: i-therm VA-Clave



3. PREPARATION OF HERBAL BATH BOMB^{1,8,9,11,12,13}

Table 3: Formula for Preparing antifungal herbal bathbombs

Sr. No.	Ingredient	Category/Function	Quantity (gm)
1	Sodium Bicarbonate	Effervescent agent, Base component, Cleansing aid	20 g
2	Citric Acid	Effervescent agent, Acid component, pH adjuster	10 g
3	Magnesium Sulphate (Epsom Salt)	Skin soothing agent, Anti-inflammatory Bath salt	4 g
4	Rice Starch	Binder, Texture modifier, Skin protectant	2 g
5	Coconut Oil	Emollient, Skin barrier enhancer	1.2 g
6	Tocopherol (Vit. E)	Antioxidant, Skin repair agent	0.4 g
7	Tween 20	Surfactant, Solubilizing agent, Dispersing agent	0.8 g
8	Tea Tree Oil	Antifungal active ingredient,	0.8 g
9	Rosemary Oil	Antimicrobial & antifungal agent, Circulation enhancer	0.4 g
10	Color	Aesthetic agent	0.2 g
11	Fragrance	Perfuming agent	0.2 g

Step 1: Preparation of Dry Phase

1. Accurately weigh sodium bicarbonate, citric acid (anhydrous), magnesium sulphate, and rice starch.
2. Pass all dry ingredients separately through sieve no. 40 to remove lumps.
3. Transfer the sieved powders into a clean, dry glass or stainless-steel bowl.
4. Mix uniformly for 5–10 minutes using geometric dilution to ensure homogenous blending.

Step 2: Preparation of Oil Phase

5. In a separate beaker, add coconut oil.
6. Incorporate tocopherol (Vitamin E) and mix thoroughly.
7. Add Tween 20 and stir gently to form a uniform mixture.
8. Add tea tree oil and rosemary oil slowly with continuous stirring to ensure proper solubilization.
9. Add color and fragrance and mix uniformly.

Step 3: Wetting

10. Slowly add the oil phase to the dry powder mixture in small portions.
11. Mix gently with continuous folding to avoid premature effervescence.
12. Check consistency by pressing a small portion in hand; the mixture should hold its shape without cracking.
13. If required, lightly spray a minimal amount of isopropyl alcohol (optional) to aid binding (avoid water to prevent early reaction).

Step 4: Molding and Compression

14. Transfer the prepared damp mass into bath bomb molds.
15. Compress firmly to ensure proper shape and mechanical strength.



16. Scrape off excess material and seal the mold properly.

17. Allow the filled molds to stand undisturbed for 10–15 minutes.

Step 5: Drying

18. Remove bath bombs carefully from molds.

19. Air dry at room temperature (25–30°C) in a low-humidity environment for 24-48 hrs.

20. Ensure complete drying to prevent cracking and premature effervescence.

Step 6: Storage & Packaging

21. Wrap individually in moisture-resistant packaging (aluminium foil or shrink wrap).

22. Store in airtight containers away from humidity and direct sunlight.

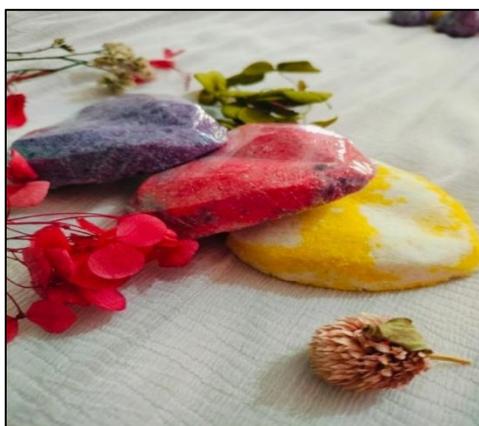


Fig.3: Prepared Herbal Antifungal Bathbombs

4. EVALUATION PARAMETERS OF HERBAL BATH BOMBS: ^{11,12,14,15}

The prepared herbal bath bombs were evaluated for the following parameters:

1. **Organoleptic Evaluation:** Evaluated visually for color uniformity, cracks, surface smoothness, and shape integrity.
2. **pH:** The pH value of this herbal antifungal bathbomb was determined by using digital pH meter in triplicate.
3. **Moisture Content:** Determined using hot air oven at 105°C for 1 hour. Done to Prevent premature effervescence and microbial growth.

$$\% \text{Moisture Content} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

4. **Effervescence time:** Add portion of bath bomb in beaker filled with distilled water. The effervescent time of a bath bomb formulation were tested both in cold and hot water.
5. **Determination of foaming ability:** The foaming ability was measured by measuring the thickness of foam formed.
6. **Total Dissolution Time:** Time required for complete dissolution without residue.



7. **Wash ability:** To evaluate the ease with which the formulation rinses off from the skin without leaving oily residue, stains, or stickiness.

8. **Skin Irritancy Test:** The irritation test was done by applying a formulation on hand's back skin and leave it for 15 minutes to check irritation reaction such as swelling, itching and redness effect on the skin.

9. **Determination of zone of inhibition (antifungal activity):** Test the antifungal activity of tea tree & rosemary essential oil bath bomb against *Candida albicans*. Microbiological assay performed via cup plate method.

10. **Stability:** Stability Testing was done at room temperatures. The visual testing was done.

5. RESULTS:^{1,9,12,13,14,15,16}

1. **Organoleptic Evaluation:** After visual inspection of the formulation, following observations were made:

Table 4: Organoleptic Evaluation

Colour:	Yellow, red & purple colour
Odour:	characteristic pleasant odour
State:	solid
Consistency:	smooth surface, no cracks

2. **pH:** The pH of the peel off mask formulation was found to be 6.3-6.5 at room temperature using a pH meter.

3. **Moisture Content:** The moisture content of the prepared antifungal herbal bath bomb was found to be 1.50% w/w, which falls within acceptable limits for effervescent formulations, indicating adequate drying and enhanced product stability.

4. **Effervescence time:** The effervescent time of a bath bomb formulation were tested both in cold and hot water, Indicates CO₂ release and active ingredient dispersion, mentioned in as below:

Table 5: effervescence time

Time (hot water)	Time (cold water)
55 sec	50 sec

5. **Determination of foaming ability:** The foaming ability was measured by measuring the thickness of foam formed. The measured thickness was 2.3cm.

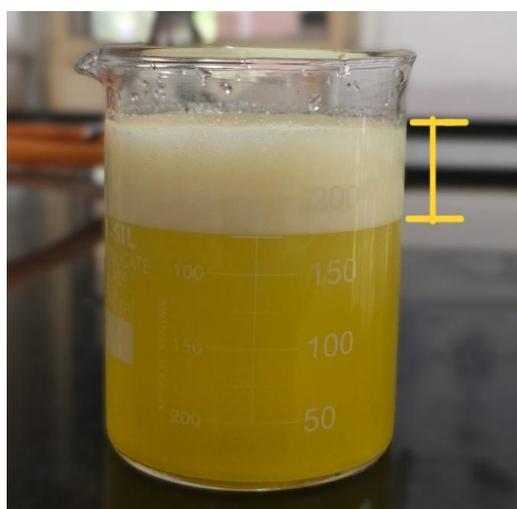


Fig 4: foaming ability of Herbal Bathbombs

6. Total Dissolution Time: The formulation exhibited a total dissolution time of 4.7 ± 0.6 min. ensuring adequate release and dispersion of antifungal essential oils in bath water without leaving visible residue.

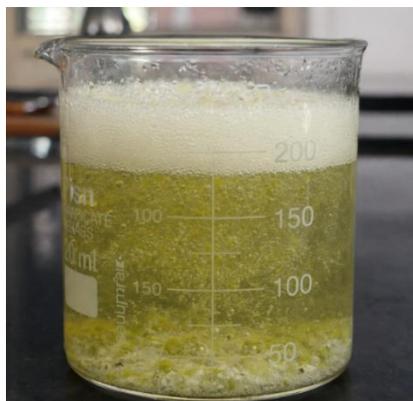


Fig. 5: Total Dissolution Time of Herbal Bathbomb

7. Washability: The formulated antifungal herbal bath bomb demonstrated excellent washability, with no visible residue or staining and minimal oily feel after rinsing.



Fig. 6: Washability test for Herbal Bathbomb

8. Skin Irritancy Test: The skin irritation study of formulated product did not exhibit irritant effects, swelling, itching and redness on the skin.

9. Determination of zone of inhibition (antifungal activity): The formulated antifungal herbal bath bomb demonstrated appreciable antifungal activity against *Candida albicans*, producing a mean zone of inhibition of 21.0 ± 1.0 mm, confirming its potential as a therapeutic bath bombs adjunct for superficial fungal infections.



Fig. 7: antifungal activity



10. Stability Testing: The formulation demonstrated satisfactory stability with no significant changes in appearance, pH, dissolution behaviour, over the study period, indicating good shelf-life potential under normal storage conditions.

6. DISCUSSION:

The present study successfully developed an effervescent herbal bath bomb containing tea tree (*Melaleuca alternifolia*) and rosemary (*Salvia rosmarinus*) essential oils and evaluated its physicochemical properties, stability, antifungal activity, and dermal safety. The optimized formulation demonstrated desirable physical characteristics, including uniform structure, acceptable hardness, and controlled effervescence. Upon contact with water, the formulation dissolved completely within approximately 4.7 minutes, allowing effective dispersion of the essential oils.

The pH of the dispersed formulation was found to be 6.3–6.5, which falls within the acceptable physiological range for skin, indicating a low risk of irritation. Moisture content remained below 3% during stability studies conducted under both standard and accelerated storage conditions, suggesting good resistance to premature effervescence and acceptable formulation stability. No visible physical changes such as cracking, discoloration, or structural deformation were observed during the storage period.

Antifungal evaluation using the agar well diffusion method demonstrated significant activity against *Candida albicans*, with a mean zone of inhibition of 21.0 ± 1.0 mm. The base formulation without essential oils showed no antifungal effect, confirming that the observed activity was due to the incorporated essential oils. The antifungal effect is likely associated with the presence of bioactive constituents such as *terpinen-4-ol* in tea tree oil and monoterpenes including *1,8-cineole* and *α -pinene* in rosemary oil.

Dermal safety assessment indicated that the formulation was non-irritant, with no signs of erythema or edema observed during patch testing. Additionally, the formulation demonstrated good washability, leaving no residue on the skin after rinsing.

Overall, the study demonstrates that the developed herbal bath bomb formulation possesses suitable physicochemical characteristics, satisfactory stability, dermal compatibility, and notable antifungal activity. These findings suggest that effervescent herbal bath bombs may serve as a promising and user-friendly topical delivery system for natural antifungal agents.

7. CONCLUSION:

The present study successfully developed and evaluated an antifungal herbal bath bomb incorporating tea tree and rosemary essential oils within an effervescent delivery system. The optimized formulation demonstrated satisfactory physicochemical properties, controlled dissolution, acceptable stability, and significant antifungal activity against *Candida albicans*. The observed inhibition confirmed the contribution of plant-derived bioactive constituents, while the absence of activity in the base formulation validated the role of essential oils as the active components. Stability studies indicated resistance to premature effervescence and minimal degradation under accelerated conditions. Additionally, dermal safety assessment confirmed that the formulation was non-irritant and cosmetically acceptable. The effervescent mechanism ensured uniform dispersion of active compounds in bath water, potentially enhancing skin exposure and therapeutic effectiveness. Overall, the developed herbal bath bomb represents a stable, safe, and user-friendly natural alternative for managing superficial fungal infections, with scope for further clinical validation and extended stability evaluation.

8. CONFLICT OF INTEREST: NO

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Author -1	Sneha Pachore *– Corresponding Author (Assistant Professor) 1 Indira University School of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India 2 SCES's Indira College of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India
Author -2	Gayatri Gelande (Student) SCES's Indira College of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India
Author -3	Bhagyashree Shinde (Student) SCES's Indira College of Pharmacy, New Pune Mumbai Highway, Tathawade, Pune -411033 India

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