

## Phytochemical Approach to Acne Management: Formulation and Evaluation of a Polyherbal Soap

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### ABSTRACT

Acne, commonly referred to as *acne vulgaris*, is a chronic skin disease due to abnormalities of sebum production in sebaceous glands caused by *staphylococcus epidermis* bacteria. *Acne vulgaris* suppresses an individual's self-confidence by causing distress concerning the physical appearance, which affects a significant number of individuals during puberty and is delineated by adolescence. Antibiotics that suppress *Propionibacterium acnes* are the standard acne treatment but are becoming less effective due to the appearance of antibiotic-resistant strains. Several treatments have been introduced to decrease the aesthetic and psychological problems caused by acne. Bacterial skin infections are most common, requiring significant attention for treatment and maintaining healthy skin. Medicinal plants have a long history of use among skin diseases and have been shown to possess low side effects. These plants are a reliable source for the preparation of new drugs. Some herbal plant powders have antibacterial activity. The present study aims to formulate antibacterial polyherbal face soap using Neem powder, Fuller's earth, Lemon peel, Activated Charcoal, Sandalwood powder, Tea Tree Essential Oil, and Tocopherol. The antibacterial activity of the prepared formulation was tested using the agar well diffusion method against the organism *Staphylococcus aureus*. The prepared polyherbal formulation exhibited an excellent antibacterial effect. The prepared formulation was evaluated for various physicochemical parameters such as organoleptic characteristics, pH, foam height & retention, skin irritation, & high-temperature stability, for which good characteristics were observed. Prepared Polyherbal soap had a good appearance, better cleansing & foaming effect & did not have any side effects.

Keywords- personal care, soap, acne, herbal, formulation, antibacterial

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### INTRODUCTION

Acne is a follicular skin condition that mostly affects the face, neck, and trunk's pilosebaceous unit. About 85% of teenagers get acne infections, which can last until adulthood. It is one of the most common diseases affecting people and is contagious. It is distinguished by various patches of scaly, red skin (seborrhea), pinhead-sized nodules (nodules), blackheads, whiteheads, huge papules (nodules), and occasionally scarring (pimples). Even while severe acne is frequently inflammatory, it can also be non-inflammatory. Hair follicles and the sebaceous glands that are attached to them are among the skin structures in the pilosebaceous unit that alter acne. Typically, androgen stimulation is necessary for these alterations. Regardless of gender, *acne vulgaris* more frequently develops during adolescence during puberty and is typically caused by an increase in body androgens [1, 2]. *Propionibacterium acnes*, the primary acne-causing microbe, is susceptible to anaerobic growth in the sebum-enriching skin state that results from this process. Acne lesions also contain *Pityrosporum ovale*, *Staphylococcus aureus*, and *Staphylococcus epidermidis*. [3]

Scarring and discomfort brought on by *acne vulgaris* might result in lifetime issues with self-esteem. It is the ninth most prevalent disease in the world, affecting 650 million people. (Ahmad *et al.* 2019). Multiple medications, topical applications, and oral medications can all be used to treat acne. Common acne treatments have significant antibacterial, anti-inflammatory, follicular hyperkeratinization normalisation, and sebum production decreases mechanisms of action. Acne can be treated with direct injections of steroids into inflammatory cysts, microdermabrasion, chemical peels, radiofrequency, light, or laser

therapy, but none of these regimens is without risks. The conventional acne treatment is an antibiotic that kills *P. acnes*, but its efficacy is waning as more strains emerge that are resistant to it. Patients with acne and infectious skin problems frequently receive alternative and complementary therapy, which includes medicinal plants. [4]. Mild acne sufferers frequently choose to self-treat with over-the-counter acne treatment medications, and a recent study reveals that products with tea tree oil are a popular option [5]. Cosmetics by themselves are insufficient to properly care for skin and other body parts due to the numerous chemical poisons and microorganisms that can damage and infect the skin. The usage of medicinal plants has a long history, and research has proven that they have few negative side effects. Drugs for acne vulgaris tend to have side effects; as a result, developing new Ayurveda cosmetics from medicinal plants may be a viable option. (Yadav and Gupta, 2019) Herbal cosmetics are another name for ayurvedic cosmetics, and the natural components of herbs have no negative effects on the human body. Among the many botanical compounds that are currently offered on the market, the majority of herbal supplements are based on a few botanical ingredients that have a long history of use in traditional or folk medicine. Tea tree oil works across the board to combat yeasts like *C. Albicans*, Gram-positive and Gram-negative bacteria, methicillin-resistant *S. aureus*, and Gram-positive and Gram-negative bacteria.

Herbal soap is produced exclusively from uncultivated botanicals. With stronger anti-inflammatory, antibacterial, antiseptic, and insect-repellent actions, it is intended to provide calming effects and reduce redness, pimples, inflammations, and skin irritations. With the natural healing properties of plant oils like tea tree and neem, all the therapeutic nutrients provide calming effects. A comprehensive method for treating acne is far more effective. The finest results for polyherbal acne soap come from combining all these substances.

#### **Scientific Rationale:**

In today's fast-paced world, people have severe skin issues. Pollution, diet, and more screen time are the main reasons for the same. Due to time constraints, people cannot take care of their skin. Acne is one of the major skin problems that need to be addressed. Amid a pandemic, effective acne treatments are in vain as there are new resistant strains of bacteria. There are plenty of commercial acne treatments available, but they are often expensive and ineffective and come with unwanted side effects. Soaps are applied to external skin use. Many commercial soaps cleanse the skin and may contain artificial fragrances. Our aim and objective are to formulate, develop and evaluate a polyherbal soap that can cleanse and smooth the skin and reduce Vulgaris Acne. The product should be cheaper and more effective. Bacterial skin infections are most common among people, requiring significant attention for treatment and maintaining healthy skin. Some herbs have antibacterial activity.

The objectives of this study are to develop polyherbal soap possible for the treatment of acne along with assessing the organoleptic parameters and evaluating the antimicrobial activity of the developed product. *Azadirachta indica* (Neem Powder) - Neem tree has attracted worldwide prominence owing to its wide range of medicinal properties; neem leaves and their constituents have been demonstrated to exhibit anti-inflammatory, antihyperglycemic, antiulcer, antimalarial, antifungal, antibacterial, antimutagenic, and anticarcinogenic properties. Neem leaves possess diverse pharmacological properties like anti-inflammatory, antipyretic, and antimicrobial.

*Solum Fullonum* Multani Mitti (Fullers Earth): Mother Nature's baby powder. Clay was one of the earliest substances to be used as a beauty mask to draw oils from the skin, a natural moisturizer for hairs, teeth, gums, and hair, to remove pimple marks, treat sunburn, help unclog pores, to cleanse the skin of flakes and dirt.

*Citrus Limon Peel* (Lemon Peel powder) - Treats acne, has Skin lightening properties, and Reduces skin marks and spots. Phytochemicals present are flavonoids, saponins, steroids, terpenoids, tannins, and alkaloids.

*Santalum Album* (Sandalwood Powder) - Soothes sunburn and Removes suntan, Anti-aging properties. Phytochemicals present are Terpenoids, saponins, phenylpropanoids such as phenolics, proanthocyanins, flavonoids, phenolics, condensed tannins, o-quinines, and polyphenols.

5. Activated Charcoal – An essential characteristic of activated carbon is its adsorption capacity. It removes a wide variety of organic-based contaminants and some inorganic contaminants. Using it as an active ingredient in our polyherbal soap adds to its value by enhancing the role of absorbing dust particles and opening the clogged pores, so the herbs do their work on the skin.

6. *Melaleuca Alternifolia* (Tea Tree Essential Oil) - Tea Tree oil has antimicrobial, anti-inflammatory, anti-infectious, antiseptic, antiviral, and bactericidal properties. Useful to treat Abscesses, Acne, Blisters, Insect bites, Rashes, and Wounds.

## MATERIAL AND METHODS

Ingredients used – Glycerine Soap base, Neem powder, Fuller's earth, Lemon peel powder, Activated charcoal, Sandalwood powder, Vitamin E oil, Tea tree essential oil.

The Melt and pour soap process method – A glycerin soap base is used. There is no usage of lye. It is easy and the least dangerous compared to cold-processed and hot-processed soap-making methods.

### Collection of samples:

Melt and pour glycerine Soap base, Fuller's earth, activated charcoal, Sandalwood powder, Vitamin E oil, and Tea tree essential oil were collected from the local market. The soap base used was of analytical grade.

### Collection, identification, and processing of plant:

The fresh leaves of *Azadirachta indica* were collected from different matured plants in a steel vessel. They were washed well with distilled water. The leaves were dried on the terrace under sunlight for two days. The dried leaves were cut into small pieces. The dried leaves were appropriately ground into a grinder. To obtain the fine powder, it was sieved, so fine powder form was obtained. The powder was stored in airtight bottles for the study.

Used lemon peels were taken from the kitchen. The peels were cut into small pieces. They were dried under sunlight on the terrace for four days. The pieces were correctly ground in a grinder. The dried peels were crushed to obtain lemon peel powder. The sample was then passed through a sieve to obtain a fine powder.

## FORMULATION

Sr No.	Ingredient	Quantity (gms)
1	Glycerine soap base	100
2	<i>Azadirachta indica</i>	2.5
3	Fuller's earth	1.5
4	Lemon peel	2.0
5	Activated Charcoal	0.5
6	Sandalwood powder	1.5
7	Tea Tree Essential Oil	6 drops
8	Vitamin E Oil	2 ml

## METHODOLOGY:

The formulation process for the polyherbal acne soap began with solidified basic glycerine soap being weighed and broken down into smaller pieces. These pieces were then transferred into a steel vessel and heated in a water bath to melt the soap base. A glass rod was used to continuously stir the mixture to ensure that the soap base was fully liquefied. Once the soap base was fully melted, the powder compositions were added to the mixture. To avoid lumps, the mixture was continuously stirred for 15 minutes until it became homogeneous. At this point, Vitamin E oil and Tea Tree essential oil were added, and the mixture was stirred slowly. The homogenous mixture was removed from the water bath and poured into a mould, where it was allowed to solidify. The soap was kept under physical observation for any characteristic changes during the solidification process. Once the soap had solidified at room temperature, it was removed from the mould and allowed to set further. The final product was a polyherbal acne soap that had been formulated using selected medicinal plants. The soap was expected to have therapeutic properties for the treatment of acne, and the use of Vitamin E oil and Tea Tree essential oil were expected to enhance the overall efficacy of the soap.

### Evaluation of physicochemical parameters

To verify the quality of the soap formulation, several physicochemical parameters were examined.

Organoleptic evaluation- Done by sensory and visual inspection. The naked eye checked the colour and clarity against a white background, and the odour was checked by smelling.

Determination of pH- The pH was determined using a digital pH meter.

Foam Height: A sample of soap weighing 0.5 grammes was dissolved in 25 millilitres of distilled water. Then, pour it into a 100 ml measuring cylinder after adding water to make the volume 50 ml. 25 strokes were administered while standing, waiting for the aqueous volume to reach 50 ml before measuring the height of the foam above the aqueous fluid.

Foam Retention: A 100 ml graduated measuring cylinder was filled with 25 ml of the 1% soap solution. A hand was placed over the cylinder, and it was shaken ten times. For four minutes, the foam volume was measured at 1-minute intervals.

Primary Skin Irritation Test: Twenty volunteers were selected, and the prepared soap was given to them and checked for irritation.

Higher Temperature Stability: The soap was allowed to stand above 50° Celsius.

### Antimicrobial testing of the prepared sample:

The soap sample was tested for its antimicrobial properties. It was done by the well diffusion method. The microorganism used was *Staphylococcus aureus*. In this method, two types of soap solutions were prepared. One by dissolving 1gm of soap in 100 ml sterile distilled water and the other by dissolving 5gms of soap in 100 ml sterile distilled water. Two concentrations were prepared 1% soap and 5% soap solution. The plates were then incubated for 24 hours. The zone of inhibition was calculated.

### RESULTS AND DISCUSSION

Antibacterial poly herbal soap formulation and assessment were completed satisfactorily. We looked at the polyherbal soap's physicochemical characteristics, including colour, smell, appearance, and pH. The formulation has an appropriate pH of 8.3, a dark greenish-black hue, a fragrant smell, and a pleasing look. Tests for primary skin irritation, foam height, retention, and other evaluations were also completed successfully. The created soap had an excellent look. It was a solid compound that was dry, stable and did not change colour. Without any additional surfactants, it is foamy. When tested on 20 volunteers, it demonstrated good skin compatibility and did not irritate.



Fig : Herbal Soap

The herbal soap had a greenish-black appearance, indicating that activated charcoal and neem gave the primary colours. Overall, plant-based herbal soap exhibits greater foam stability and creation. The pH of the skin ranges from 4.5 to 6.5. To minimise irritation, skin care products should have a pH that is as close to this range as possible. The pH of soaps sold on the market is typically between 9 and 10. The pH of the herbal soap formulation is closer to the skin's pH range at 8.3.

Tea tree essential oil, *Azadirachta indica*, and citrus limon were selected for this product because of their demonstrated antibacterial and anti-inflammatory qualities. According to a recent study of the effectiveness and safety of tea tree oil treatments for acne, the antibacterial and anti-inflammatory properties of the oil are responsible for the treatments' success. In theory, *P. acnes* present in acne lesions are affected by antibiotic action [8]. The anti-inflammatory activity may reduce the innate immune reactions and inflammatory reactions to *P. acnes* in the skin which is prone to acne. According to Ayurveda, citrus fruits like lemon and orange have effective antibacterial properties against both gram-positive and gram-negative microbes. [6]

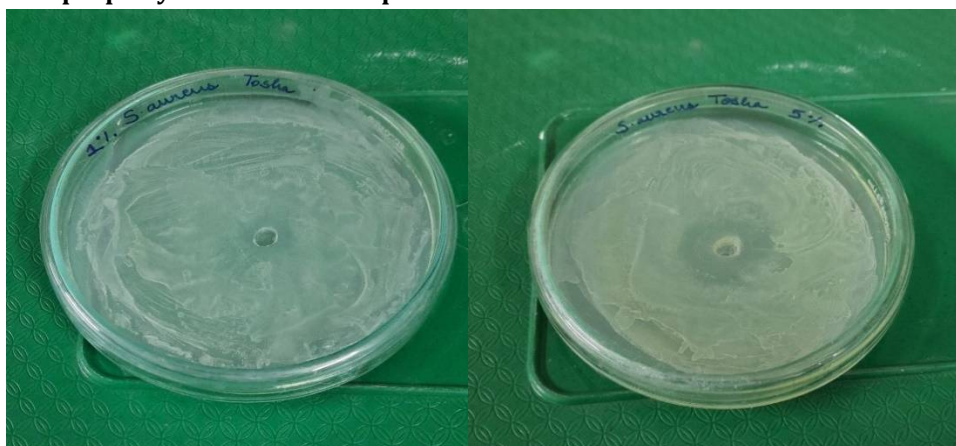
The Australian shrub *Melaleuca alternifolia* (Myrtaceae) is used to make tea tree oil, an essential oil that is extracted using steam distillation. Tea tree oil has been employed as a remedy. Australia has mostly been used as a topical antibacterial or anti-inflammatory since the 1920s. Previous research has shown that using products containing tea tree oil can help treat acne since there are fewer lesions left over after treatment [7]. Terpinene-4-ol, one of the oil's more than 98 constituents, is primarily responsible for antibacterial activity. Tea tree oil has been shown to have anti-*Staphylococcal* activity. The components of the oil penetrate deeply into the skin and aid in the regeneration of skin that has been destroyed by skin illnesses brought on by bacteria, fungi, and germs that cause acne. Lemon is a powerful all-natural antibacterial that works against typical skin microorganisms that proliferate when sebum is present. When applied to the skin, lemon's low pH aids in the removal of germs and bacteria. Indian females have depended on neem leaves' curative qualities to heal acne for generations. Neem has anti-microbial, anti-bacterial, anti-fungal, and antiviral properties. Gram-positive and gram-negative bacteria are both affected by neem [9-12]. Bacteria that cause acne, such as *Propionibacterium acnes* and *Staphylococcus epidermidis*, are prevented from growing. The ethanol extract of *Azadirachta indica* was found to have the

capacity to prevent acne in a study on an anti-acne formulation made from herbal extracts. In this investigation, Propionibacterium and Staphylococcus epidermis were successfully eradicated by the anti-acne solution [7].

#### Physicochemical Parameters of Herbal Soap Formulation:

Sr No.	PARAMETER	OBSERVATION
1	Colour	Greenish Black opaque
2	Odour	Fragrant
3	pH	8.3
4	Foam height	12 cm
5	Foam retention	6 min
6	High-Temperature Stability	It withstands temperature
7	Skin Irritation Test	No irritation to the skin

#### Antimicrobial property of the herbal soap formulation:



Preliminary antimicrobial sensitivity screening test findings are shown in the table that is given below.

Sr No.	Herbal soap solution %	Zone of inhibition (mm) <i>S. aureus</i>
1.	1%	12 mm
2.	5%	25 mm

The antibacterial poly herbal soap formulation proved beneficial and had excellent activity against *Staphylococcus aureus*.

Allopathic medications are thought to have side effects such as contact allergies, local irritation, scaling, photosensitivity, itching, pruritus, redness, skin peeling, etc., whereas herbal medications are seen to be safer overall. Acne treatments with herbal plants and their components are efficient. Herbal remedies are advised since they are effective detoxifiers that may rid your body of harmful toxins and enrich it with beneficial nutrient minerals. Due to its annoying side effects, patients are less likely to use other acne treatment medicines, which results in poor patient compliance. These issues, as well as others, such as price, underscore the need for safer, more cost-effective methods, such as those provided by herbal therapy. Given the rising issue of antibiotic resistance, the antibacterial properties of plant extracts are particularly intriguing. When used as alternatives to antibiotics, plant extracts may assist to slow down the emergence of resistant organisms because many plants naturally possess antibacterial and anti-inflammatory characteristics. Acne treatments made from herbs and plants are becoming more and more common, and various writers have demonstrated their efficacy [14-15].

All other criteria were appropriate, and the commercial standard soap formulation demonstrated significant antibacterial action. As a result, the prepared herbal soap needs to be standardised and is a promising replacement for conventional soaps that contain chemicals. While the antifungal activity of herbal soaps may not be noticeably better than that of conventional soap in comparison tests, phytochemicals found in the herbs strengthen, hydrate, and nourish the skin. For people of all ages whose skin reacts to the majority of synthetic chemical skin care products, herbal soaps are an excellent option. Impressively, the produced formulations showed zones of inhibition of 12 mm and 25 mm when tested for antibacterial activity. The produced mixture performed well in testing for various evaluations. It doesn't irritate the skin in any way. Additionally, the created soap was evaluated for several physicochemical characteristics as pH appearance and odour, which showed positive results.

Prospects include sensory analysis of the polyherbal acne soap along with various antimicrobial tests for *Propionibacterium acnes* and *Staphylococcus epidermidis* can be done to test the efficacy of other acne-causing microorganisms. The effectiveness, safety, ideal applications, and standardisation of herbal treatments all require additional study. Since ancient times, several herbal treatments have been practised with positive anecdotal outcomes [16-18]. The use of herbal remedies to treat dermatologic problems has yielded notable outcomes in a small number of randomised, controlled trials. Knowing what typical herbal substitutes are available and what interactions or side effects may occur is crucial for better patient counselling.

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