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Harnessing Bael Fruit's Medicinal Properties in Soap Formulation and Evaluation

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Abstract: *This research focuses on the formulation and comprehensive evaluation of a medicated herbal soap incorporating Bael (Aegle marmelos) fruit and Orange (Citrus sinensis) peel powders, both known for their extensive traditional medicinal and dermatological applications. The aim is to develop a safe, effective, and eco-friendly alternative to commercial soaps that often contain harsh chemicals. The selected herbs offer a combination of therapeutic properties including antioxidant, anti-inflammatory, antimicrobial, wound-healing, exfoliating, and skin-brightening effects. A glycerin-based soap base was utilized due to its moisturizing properties, and the formulation process involved the integration of standardized herbal powders and essential oils. Evaluation parameters included physical properties (pH, foam retention, moisture content, appearance), chemical stability, and biological assays such as antioxidant activity. Results revealed that the soap maintains skin-compatible pH, provides satisfactory lather and cleansing action, and exhibits high antioxidant potential with minimal skin irritation risk. The findings highlight the potential of integrating traditional herbal ingredients into modern cosmetic formulations, supporting a growing consumer demand for natural, sustainable, and functionally superior skincare products. This study also lays the foundation for the future development of customized herbal cosmetic lines targeting specific skin conditions.*

Keywords: Herbal Soap, Aegle marmelos, Orange Peel, Skincare, Antioxidant, Antimicrobial, Natural Ingredients, Glycerin Base, Ayurvedic Formulation, Soap Evaluation, Skin Health, Sustainable Cosmetics, Traditional Medicine, Bael Fruit

I. INTRODUCTION

Skin is the largest sensory organ in the body. It serves as a barrier that protects the body organs and gathers sensory data from the surroundings. Additionally, it aids in keeping the body's temperature at a healthy level. Diverse distinctive cells and structures can be found in the skin. The hypodermis, dermis, and epidermis are the three primary layers. Each layer contributes in a unique way to how the skin works as a whole. As skin imparts a specialized function to body wellbeing, it is necessary for us to keep it away for skin diseases and alignments. Skin conditions are a prevalent illness. It harms people of all ages, including newborns and the elderly, and does so in several different ways. Infections, allergies, sun exposure, injuries, and other factors can all lead to skin issues . Ever since the earliest times, people have employed medicinal plants as a form of treatment. Various medicinal plants' fruits ,leaves, stems, and roots have been used as a natural cure to treat a diversity of maladies and afflictions. Even if many plant-based treatments have been replaced by synthetic alternatives, ayurvedic products nevertheless stand out for their effectiveness and safety . The anti-oxidant, anti-bacterial, cytotoxic, anti-microbial, hypotensive, anti-diuretic, anti-inflammatory, anti-spasmodic, anti-diabetic, antihemorrhagic, and anti-helminthic qualities of numerous herbs are discovered with high nutritional value. Owing to their high medical value, cost-effectiveness, availability, and compatibility, incorporation of natural products to a preparation helps in treating practically all diseases and skin issues . The active compounds which provide these plants their therapeutic benefits are isolated and used topically in creams, soaps, oils, and ointments to treat skin conditions like acne, eczemas, wounds, and ringworms as well as for cosmetic and anti-microbial purposes. The therapeutic benefits of plants are used in a variety of formulations for both medical

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and cosmetic purposeA report published by WHO stated that a whopping 34% of all occupational disorders are skin diseases and data of 2020 revealed that skin diseases death in India reached 17,857 i.e. 0.21% of total deaths. So, in order to counteract the situation, the best option is to incorporate herbal potentials in the formulation, which provide fewer effects and impart good treatment options with lesser side effects and higher safety.So, the present work focuses on the preparation of medicated herbal soap incorporating different herbs active potentials, making it antioxidant and antibacterial active soap, which can be used as a regular bathing soap.[1]

Soap

A number of cleaning and lubrication products contain soap, which is a salt of fatty acids. Soaps are typically used in homes for bathing, cleaning, and other household tasks. Soaps are employed in industry as catalyst precursors, thickeners, and ingredients in certain lubricants. When soap is used for cleaning, it dissolves dirt and debris, making it easier to remove from the item being cleaned. When soaps function as emulsifying oils or surfactants, water can carry them away.[2]

Types of Soap

Traditional Soaps- For millennia, traditional soaps have been an essential part of personal hygiene, usually made by saponifying fats and oils with alkaline ingredients. Their high alkalinity, however, has the potential to irritate the skin and promote transepidermal water loss by upsetting the skin's natural barrier. Traditional soaps may worsen symptoms of dry skin diseases like eczema by depleting intracellular lipids, leaving the skin red, rough, and scaly. This effect is most noticeable in those with these conditions.[3]

Fig 1

Herbal Soap- Herbal soap is a natural alternative to conventional soap that is often made using botanical herbs and plant-based ingredients. They are often free from harsh chemicals and artificial fragrances, making them suitable for individuals with sensitive skin. Common ingredients include lavender, chamomile, peppermint, and tea tree oil, each providing unique therapeutic benefits.[4]

Fig 2

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Glycerin Soaps

Glycerin soaps are renowned for their transparency and moisturizing properties. They are produced through a manufacturing process that retains glycerin, a natural humectant that attracts moisture to the skin. This characteristic makes them particularly beneficial for individuals with dry or sensitive skin, as glycerin helps to lock in the skin's natural moisture and prevent over-drying. Additionally, glycerin's gentle nature and low pH make these soaps suitable for sensitive skin types, as they help maintain the skin's natural barrier and reduce the likelihood of irritation. For more information on glycerin soaps.[5]

Fig 3

Syndet Bars

Syndet bars, or synthetic detergent bars, are formulated with synthetic surfactants instead of traditional soap. They are designed to be gentler on the skin, maintaining its natural pH balance and minimizing irritation. Syndets are often recommended for individuals with sensitive or dry skin. For a comprehensive evaluation of syndet bars and their benefits.[6]

Fig 4

Advantages of Herbal Soap:

Natural Ingredients:

- Gentle on Skin: Herbal soaps often contain natural oils, herbs, and plant extracts that can be gentler than synthetic chemicals found in commercial soaps.
- Fewer Chemicals: These soaps typically lack harsh chemicals, preservatives, or artificial fragrances, making them a good choice for people with sensitive skin or allergies.

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Skin Nourishing:

- Many herbal soaps contain ingredients like aloe vera, tea tree oil, and lavender, which can be moisturizing, anti-inflammatory, and soothing for the skin.
- Some herbal soaps have additional properties like antioxidants that can help in maintaining skin health and reducing the effects of aging.

Environmentally Friendly:

- Being made from natural ingredients, herbal soaps are generally more eco-friendly than synthetic ones. They're biodegradable and often come in minimal or recyclable packaging.

Antibacterial and Healing Properties:

- Certain herbs, like neem, rosemary, and peppermint, are known for their antibacterial and antimicrobial properties, helping to cleanse and heal the skin effectively.
- Herbal soaps can be beneficial for skin conditions such as acne, eczema, or psoriasis, depending on the specific herbs used.

Aromatherapy Benefits:

- Many herbal soaps incorporate essential oils, which provide aromatherapy benefits, helping to reduce stress and promote relaxation.

Disadvantages of herbal soap:

Shorter Shelf Life:

- Because they are made from natural ingredients without synthetic preservatives, herbal soaps can have a shorter shelf life. They may spoil or lose effectiveness more quickly than commercial soaps.

Potential Allergic Reactions:

- While generally gentler, some people may still have allergic reactions to certain herbs or oils used in herbal soaps. It's important to test a small patch of skin first to avoid irritation.

Less Lather:

- Herbal soaps may not lather as much as commercial soaps, which are often formulated with lathering agents. Some people prefer the rich foam that synthetic soaps provide.

Cost:

- Herbal soaps can be more expensive than regular soaps due to the high-quality natural ingredients and the small-scale production process, which might not be affordable for everyone.

Variable Effectiveness:

- The effectiveness of herbal soaps can vary depending on the type and concentration of herbs used. Some herbs may not work well for every skin type, so the soap may not always provide the desired results.

Applications:

Daily Body Cleansing

- Purpose: Herbal soaps can be used as a gentle, natural option for daily body washing.
- How to Use: Apply the soap directly to wet skin, lather, and rinse off. Some herbal soaps are specifically designed to be moisturizing and soothing for the skin

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Face Wash

- Purpose: Many herbal soaps are formulated to be mild enough for facial use, helping to cleanse the face without stripping natural oils.
- How to Use: Wet your face with lukewarm water, create a lather with the soap, and gently massage it into the skin. Rinse thoroughly. Certain herbal soaps contain ingredients like aloe vera, tea tree oil, or chamomile, which are beneficial for different skin types (like acne-prone or sensitive skin).

Acne Treatmen

- Purpose: Herbal soaps with antibacterial properties (such as those containing neem, tea tree oil, or turmeric) can help manage acne and reduce breakouts.
- How to Use: Use the soap on the affected area, lathering and leaving it on for a minute or two to allow the active ingredients to work. Regular use may help control excess oil and prevent clogged pores.

Skin Conditions Relief

- Purpose: Herbal soaps can be helpful for managing various skin conditions such as eczema, psoriasis, or dry skin.
- How to Use: Soaps with soothing ingredients like lavender, calendula, and chamomile can be used to calm inflamed skin. Gently cleanse the affected areas and follow with a moisturizer to lock in hydration.

Hand washing

- Purpose: Herbal soaps are a great choice for frequent hand washing, offering a gentler option for the skin compared to harsher, chemical-laden soap.
- How to Use: Wet your hands, lather the soap, and rub for at least 20 seconds to cleanse. The natural oils in the soap help prevent hands from becoming dry and cracked.

Relaxation and Aromatherapy

- Purpose: Herbal soaps with aromatic essential oils (such as lavender, rose, or sandalwood) can be used in the shower or bath to promote relaxation and relieve stress.
- How to Use: Simply lather the soap under running water and inhale the soothing scent as you cleanse your skin. Some soaps even have ingredients like eucalyptus, which can help clear sinuses and rejuvenate the body.

II. DRUG PROFILE

Aegle marmelos Linn. (Bael)

Fig 5

Biological source:-

Aegle marmelos L. (Family: Rutaceae) is a medium-sized deciduous tree cultivated in India with the common name "Bael" or "Wood apple." It grows in India, Bangladesh, Ceylon, Thailand, and Indo-China (Parichha, 2004). Fruit, leaf, root, and bark are being used (Nigam and Nambiar, 2015).[7]

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Taxonomical Classification:-

Table 1

Kingdom: Plantae
Subkingdom :Tracheobiona
Superdivision:Spermatophyta
Division: Magnoliophyta
Class :Magnoliopsida
Subclass :Rosidae
Order :Sapindales
Family:Rutaceae
Genus :Aegle
Species :Aegle marmelos

Is a plant that is commonly distributed across India. Aegle marmelos correa is also called as bael, bilva, sriphal, or shivadruma (the Shiva tree in Sanskrit). This medication contains a number of phytochemicals, including alkaloids, tannins, essential oils, gums, resins, coumarin, and polysaccharides. This plant's fruits, stems, bark, and leaves are all edible. It has therapeutic characteristics and is used to treat a variety of eye and skin disorders.

Bael fruit is a seasonal fruit that is only accessible in May and June and cannot be utilized all year. Xanthotoxol imperatorin marmelin marmesin psoralen. allo- imperatorin are the major constituents of bael fruit. The fruit was traditionally used to cure diabetes, respiratory problems, inflammation, dysentery, and diarrhoea. Aloevera has been recognized and used for generations for its healing, medicinal, and skin-care benefits. Miller family asphodelaceae aloe, barbadensis Fibers, organic acids, minerals, monosaccharides, and polysaccharides are the main comps Vera.[8]

Chemical Constituents of Bael:-

- **Alkaloids:** The alkaloids comprise the largest single class of secondary plant substances. New alkaloids from the leaves of Aegle marmelos were reported viz., ethyl cinnamamide, O-3,3-(di methylallyl) halfordinol, N-2-methoxy-2-[4-(3',3'- dimethylallyloxy) phenyl] ethyl cinnamamide etc.
- **Terpenoids:** The essential oil of Aegle marmelos (L.) Correa leaves were studied very much extensively in India by various workers since 1950. a-Phellandrene was found to be the common constituent of the essential oil from leaves, twigs and fruits.a-Phellandrene (56%) and p-cymene (17%) were reported from leaf oil. Later, similar report was published on leaf essential oil by many workers.
- **Coumarins:** Marmelosin, marmesin. imperatorin, marmin, alloimiperatorin, methyl ether, xanthotoxol, scopoletin. scoparone, umbelliferone. psoralen and marmelide has also been reported.
- **Phenylpropanoids:** These are naturally occurring phenolic compounds, which have an aromati three-carbon side chain is attached. Among the phenylpropanoids are included hydroxycoumarins, and lignans. The most widespread plant coumarin is the parent compound, coumarin itself, which o twenty-seven plant families. Marmesin was established as a new compound from leaves, which is also a constituent of heartwood and root
- **Tannins:** The maximum tannin content in bael fruit was recorded in the month of January. There is as much as 9% tannin in the pulp of wild fruits, less in cultivated type. Tannin is also present in leaves as skimmianine, it is also named as 4, 7, 8-trimethoxyfuro-quinoline.
- **Polysaccharides:** Galactose, arabinose, uronic acid and L- rhamanose are obtained on hydrolysis.
- **Flavonoids:** Mainly includes Rutin, Flavone, flavan-3-ols, flavone glycosides.[9]

Morphology of Beal Fruit :-

1. **Size and Shape**: Bael fruit is typically large and spherical or slightly pear-shaped. The size of the fruit can vary, but it generally ranges from 5 to 12 centimeters in diameter. The shape may be slightly irregular, with a prominent equatorial ridge or furrow dividing the fruit into two halves.

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2. **Surface Texture:** The surface of bael fruit is usually smooth but may have slight ridges or wrinkles. When ripe, the skin of the fruit turns from green to yellowish-green or yellow, depending on the cultivar and ripeness.
3. **Skin and Peel:** The skin or peel of bael fruit is thick and tough, with a leathery texture. It is typically green when unripe, gradually turning yellowish-green or yellow as the fruit ripens. The peel is often covered with a waxy coating that helps protect the fruit from moisture loss and microbial degradation.
4. **Flesh and Pulp:** Beneath the thick peel, bael fruit contains soft, aromatic, and fibrous pulp. The pulp is pale orange or yellow-orange in color and has a sweet, aromatic flavor with a hint of acidity. The pulp is divided into numerous segments, each containing one or more seeds surrounded by a gelatinous sac.
5. **Seeds:** Bacl fruit contains numerous seeds embedded within the pulp. The seeds are surrounded by a mucilaginous pulp or sac, which helps protect them and aids in seed dispersal. The seeds are typically oblong or ellipsoidal in shape and may vary in size depending on the cultivar.[10]

Effect of Beal Fruit on Skin:-

Antioxidant Properties:

Bael fruit contains various bioactive compounds, including flavonoids, phenolic compounds, and vitamin C, which possess antioxidant properties. Antioxidants help neutralize free radicals in the body, which can prevent oxidati stress and damage to the skin cells. This may contribute to maintaining youthful and healthy-looking skin.

a) Flavonoids and Phenolic Compounds: Bael fruit is abundant in flavonoids and phenolic comp potent antioxidants. These compounds scavenge free radicals, preventing them from causing oxi cellular components such as DNA, proteins, and lipids. Flavonoids like quercetin and rutin, alon acids such as gallic acid and ellagic acid, contribute to the antioxidant activity of bael fruit.

b) Vitamin C: Bael fruit is a good source of vitamin C (ascorbic acid), which is a powerful water-soluble antioxidant. Vitamin C acts as a free radical scavenger, donating electrons to neutralize free radicals and regenerate other antioxidants like vitamin E. It also plays a crucial role in collagen synthesis, promoting skin health and wound healing.

c) Health Benefits: The antioxidant properties of bael fruit may contribute to various health benefits, including protection against chronic diseases such as cardiovascular disease, diabetes, and cancer. Additionally, antioxidants help maintain skin health by protecting against UV-induced damage, promoting collagen synthesis, and reducing the appearance of wrinkles and age spots.[11]

2. Anti-inflammatory Effects:

Some studies have indicated that bael fruit extracts possess anti-inflammatory properties. Inflammation is linked to various skin conditions, including acne, eczema, and psoriasis. By reducing inflammation, bael fruit extracts may help alleviate symptoms associated with these skin conditions.[12]

3.Anti-Microbial Effects:

Some studies have suggested that bael fruit extracts exhibit antimicrobial activity against various bacteria and fungi. This property may be beneficial for maintaining skin health by preventing infections and controlling acne-causing bacterial.[13]

4. Wound Healing:

In traditional medicine systems like Ayurveda, bael fruit has been used topically for wound healing purposes. It is believed to possess properties that promote the regeneration of skin tissue and accelerate the healing process. However, more scientific research is needed to validate these claims .The wound healing technique comprises different steps namely inflammation, the proliferation of the cell, and contraction in the formation of collagen lattice, Reddening, pain, edema are basic symptoms associated with wound and also occur during inflammation. The release of reactive oxygen species is found to be a defense mechanism.[14]

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5. Bael extracts have shown antibacterial, antifungal, and antiviral activities.

The antibacterial effect of bael was found on pathogenic Shigella dysenteriae, and the inhibitory activity was believed to be from coumarin compounds present in the extract. An antidiarrheal activity reported in Shoba and Thomas could also be due to the same or similar compounds. As an alternative to conventional antibiotics, a combination of bael and a popular antibiotic f-lactum was used, and inhibitory activity on ß-lactam resistant S. dysenteriae and S. flexneri was obtained .[15]

Orange Peel

Fig 6

Biological Source:-

Orange peels, derived from the fruit of *Citrus sinensis*, are rich in bioactive compounds such as phenolics, flavonoids, tannins, limonoids, and ascorbic acid. These constituents contribute to their antioxidant, antimicrobial, and anti-cancer properties.[16]

Taxonomical Classification:-[17]

Table 2

Kingdom: Plantae
Phylum: Angiosperms (Magnoliophyta)
Class: Eudicots
Order: Sapindales
Family: Rutaceae
Genus: *Citrus*
Species: *Citrus sinensis*

Chemical Constituents of Bael:-

Alkaloids: The alkaloids comprise the largest single class of secondary plant substances. New alkaloids from the leaves of Aegle marmelos were reported viz., ethyl cinnamamide, O-3,3-(di methylallyl) halfordinol, N-2-methoxy-2-[4-(3',3'-dimethylallyloxy) phenyl] ethyl cinnamamide etc.

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Coumarins: Marmelosin, marmesin. imperatorin, marmin, alloimiperatorin, methyl ether, xanthotoxol, scopoletin. scoparone, umbelliferone. psoralen and marmelide has also been reported.

Phenylpropanoids: These are naturally occurring phenolic compounds, which have an aromati three-carbon side chain is attached. Among the phenylpropanoids are included hydroxycoumarins, and lignans. The most widespread plant

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coumarin is the parent compound, coumarin itself, which o twenty-seven plant families. Marmesin was established as a new compound from leaves, which is also a constituent of heartwood and root

Tannins: The maximum tannin content in bael fruit was recorded in the month of January. There is as much as 9% tannin in the pulp of wild fruits, less in cultivated type. Tannin is also present in leaves as skimmianine, it is also named as 4, 7, 8-trimethoxyfuro-quinoline.

Polysaccharides: Galactose, arabinose, uronic acid and L- rhamanose are obtained on hydrolysis.

Flavonoids: Mainly includes Rutin, Flavone, flavan-3-ols, flavone glycosides.[18]

Morphology of Orange Peel:-

Size and Shape:

The orange peel, derived from the fruit of *Citrus sinensis*, varies in thickness depending on the cultivar and growing conditions. The fruit itself is generally round to slightly oblate, with a diameter ranging from 6 to 12 cm. The peel typically constitutes 20-30% of the total fruit weight.

Surface Texture:

The outer surface of the orange peel (flavedo) is rough, dimpled, and slightly uneven, containing numerous oil glands that give it a characteristic citrus aroma. The peel color changes from green to bright orange as the fruit ripens, though some varieties may retain green patches.

Skin and Peel:

The peel consists of two layers:

Flavedo (Outer Layer): Thin, pigmented layer containing essential oils and carotenoids.

Albedo (Inner Layer): Thick, spongy, and white, making up the majority of the peel. It is rich in pectin and flavonoids.

The peel is semi-thick to thick, with a leathery texture, protecting the fruit from dehydration and microbial attack.

Flesh and Pulp:

The pulp is segmented, with each segment enclosed by a thin membrane. The color of the pulp ranges from yellow-orange to deep orange. The pulp is juicy and rich in sugars, acids, and phytochemicals.

Seeds:

The seeds are small, oval, and slightly pointed, enclosed within the juice vesicles. Some orange varieties are seedless, while others contain multiple seeds, which are typically white or pale yellow in color.[19]

Effect of Orange Peel on Skin:-

Orange peel (*Citrus sinensis*) is rich in bioactive compounds such as flavonoids, phenolics, essential oils, and vitamin C, making it beneficial for various skin conditions.

1. Antioxidant Properties

Orange peel contains flavonoids (hesperidin, naringin, rutin) and vitamin C, which help combat oxidative stress and protect the skin from premature aging.

Carotenoids in the peel also contribute to skin brightening and UV protection.

2. Anti-Inflammatory and Soothing Effects

The essential oils and flavonoids in orange peel have anti-inflammatory properties that help in reducing redness, irritation, and acne-related inflammation.

Limonene and hesperidin are known to soothe skin irritation and promote skin barrier function.

3. Skin Brightening and Hyperpigmentation Control

High levels of vitamin C and natural AHAs (alpha hydroxy acids) help in reducing dark spots, hyperpigmentation, and uneven skin tone.

It promotes collagen production, improving skin elasticity and reducing fine lines.

4. Antimicrobial and Acne Prevention

The essential oil (limonene, myrcene, linalool) in orange peel has antimicrobial properties against acne-causing bacteria (*Propionibacterium acnes*).

The astringent effect of orange peel helps control excess sebum production, reducing breakouts.

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5. UV Protection and Anti-Aging

Flavonoids and polyphenols in orange peel act as natural UV protectants, reducing sun damage.

The antioxidant effect prevents collagen breakdown, keeping the skin youthful.

6. Wound Healing and Skin Repair

Studies show that hesperidin and vitamin C accelerate wound healing, making orange peel beneficial for minor cuts and scars.[20]

III. MATERIAL AND METHODS

Table 3

Ingredients	Quantity	Uses
Glycerin Base [water (H2O) sodium hydroxide (NaOH) coconut oil stearic acid glycerin alcohol propylene glycol]	75%	Hardening, Moisturizing Properties Surfactant
Beal Fruit Powder	0.5%	Anti-inflammatory. Antioxidant, Antimicrobial, Wound Healing Antibacterial
Orange Peel powder	0.5%	Exfoliation, Brightening, Anti-aging
Tea tree	2- 3 drops	Perfume
Pink colour	2- 3 drops	Colourant

Preparation of Glycerin Soap Base:

Fig 7

Plant-based oils are the source of glycerin, also known as glycerol. Additionally, fermented foods like bread, wine, and beer naturally contain it. In 1779, a Swedish chemist "accidentally" found this chemical by boiling a combination of olive oil. He determined that the fat that resulted was glycerin. Glycerin has been used to make soap since the middle of the 1800s. Certain plant oils are heated in this procedure, and the resulting solution is then allowed to cool and solidify into bars.

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Glycerin is considered nontoxic and environmentally friendly. But that doesn't necessarily mean it's hypoallergenie. "Hypoallergenic" is a term that means a particular product isn't likely to cause an allergic reaction. The US. Food and Drug Administration doesn't recognize this attribute or regulate the way this term is used. That means that cosmetic manufacturers can label their products as hypoallergenic without having any scientific proof to support their claim. Although pure glycerin isn't likely to cause an allergic reaction, any added ingredients in OTC products might. The only way to determine your allergy risk is to do a patch test before you do a full application.[21]

Formulation of Glycerin Soap Base:

Table 4

Ingredients	Quantity
Water	40ml
Sodium Hydroxide	10gm
Coconut Oil	70ml
Stearic Acid	30gm
Glycerin	17gm
Alcohol	70ml
Propylene Glycol	90ml

Sodium hydroxide [NAOH]: Sodium hydroxide, commonly known as lye, is used in soap making because it reacts with fats and oils to create soap through a process called saponification. In simple terms, it transforms the oils and fats into soap, which is essential for cleansing properties.

Coconut Oil: Coconut oil is a popular ingredient in soap making because it produces a hard, cleansing bar with a rich lather. It contains lauric acid, which contributes to the soap's cleansing and foaming properties. Additionally, coconut oil adds moisturizing properties to the soap, making it suitable for various skin types.

Stearic Acid: Stearic acid is a saturated fatty acid commonly used in soap making as a hardening agent and to provide stability to the soap's lather. It contributes to the firmness and longevity of the soap bar, enhancing its texture and durability. Additionally, stearic acid can also add moisturizing properties to the soap, leaving the skin feeling soft and smooth.

Glycerin: Glycerin is a natural byproduct of the soup-making process called saponification. It is a humectant, meaning it attracts moisture to the skin, helping to keep it hydrated. Glycerin is often retained in handmade soaps, contributing to their moisturizing properties and making them gentler on the skin compared to commercial soaps, which often have the glycerin removed.

Alcohol: Alcohol, such as ethanol or isopropyl alcohol, can be used in soap making to dissolve certain ingredients or to create designs in the soap. It can also help in evaporating excess water from the soup mixture, speeding up the curing process, However, excessive use of alcohol can lead to a drying effect on the skin, so it's essential to use it judiciously.

Propylene Glycol: Propylene glycol is a synthetic compound often used in cosmetics and personal care products as a humectant, solvent, and preservative. In soap making, it can be added to increase lather and improve the texture of the soap. However, some people may have sensitivities to propylene glycol, so it's important to use it cautiously and consider potential allergic reactions.

Method of preparation:

Measuring and Weighing Ingredients:

Gather the following ingredients:

Table 5

40 ml water (H2O)
10 gm sodium hydroxide (NaOH)
70 ml coconut oil

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30 gm stearic acid
17 gm glycerin
70 ml alcohol
90 ml propylene glycol

Make sure to measure accurately for consistent results.

2. Preparing the Lye Solution:

In a well-ventilated area, carefully mix the sodium hydroxide (NaOH) with the water (H2O), Always add the NaOH to the water, not the other way around.

Stir until the NaOH is completely dissolved. This solution is your lye.

3. Mixing the Oils and Fats

Combine the coconut oil, stearic acid, glycerin, alcohol, and propylene glycol in a heat-resistant container.Heat the mixture gently until everything is melted and well-blended. You can use a double boiler or microwave for this step.

4.Combining the Oils and Lye Solution:

Slowly add the lye solution to the melted oils and fats.Stir thoroughly to ensure proper mixing. The lye will react with the oils to create soap.

5. Blending and Mixing the Soap Base:

Use a stick blender to blend the mixture. This helps emulsify the ingredients and promotes saponification.Continue blending until the mixture reaches a thick, pudding-like consistency (known as "trace").

6.Pouring and Curing the Soap Base

Pour the soup base into a mold of your choice. Silicone molds work well.

Allow the soap base to cool and harden. This may take a few hours to overnight.

Once solidified, remove the soap base from the mold and cut it into desired shapes.

7. **Storage:**

Store your soup base in an airtight container or wrap it with cling film to prevent moisture absorption.

Fig 7

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Preparation of Beal Fruit Soap:

Fig 8

A. Prepare Bael Fruit powder:

1. Sourcing and Preparation:

.Obtain ripe bael fruits: Choose fully mature, ripe, yellowish bael fruits from a local market.

Wash and grade: Wash the bael fruits thoroughly and grade them based on ripeness and quality.

Pulp extraction: Carefully break the rigid exocarp (outer shell) and scoop out the pulp, including the seeds and fibers.

Pulp separation:Separate the pulp from the shell and transfer it into a clean stainless-steel container.

2. Drying Methods:

Sun Drying: Spread the pulp on trays and dry it under the sun for 2-3 days at 35-40°C.

Tray Drying: Dry the pulp in a hot air oven at temperatures like 60°C or 70°C.

3. Powdering and Storage:

Grinding: Once the pulp is dried, grind it into a fine powder using a grinder.

Sifting: Sift the powder to ensure fine particle size.

Storage: Store the bael fruit powder in a clean, dry, and airtight container to maintain its quality.

B. Prepare Orange Peel Powder:

1. Sourcing and Preparation:

Obtain ripe oranges: Select fresh, ripe, and preferably organic oranges from a local market.

Wash and peel: Wash the oranges thoroughly to remove any dirt or pesticides. Peel the oranges carefully to remove the outer zest.

Remove excess pith: Try to remove the white inner pith from the peel as it can be bitter.

2. Drying Methods:

Sun Drying: Spread the orange peel pieces evenly on trays and leave them under the sun for 3-4 days until they are completely dry. Ensure the temperature remains between 35-40°C (95-104°F).

Oven Drying: Alternatively, place the peel pieces in an oven set at a low temperature (around 50-60°C) for about 4-5 hours until they are dry and brittle. Be sure to monitor the process to avoid burning.

3. Powdering and Storage:

Grinding: Once the peel is fully dried, grind it into a fine powder using a grinder or blender.

Sifting: Sift the powder to remove larger particles and ensure a fine, smooth texture.

Storage: Store the orange peel powder in a clean, dry, and airtight container to maintain its flavor and quality. Keep it in a cool, dark place to prevent any moisture or light exposure.

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Fig 9

C. Melt Glycerin Soap Base:

1.Cut the glycerin soap base into small cubes for easier melting.

In a double boiler microwave-safe container, melt the glycerin soup base according to the manufacturer's instructions. If using a microwave, heat in short bursts, stirring frequently to avoid overheating.

2.Add Bael Fruit Powder:

Once the glycerin soap hase is fully melted, remove it from the heat source.

Stir in the bael fruit extract gradually, mixing it thoroughly into the melted soap base. The amount of bael fruit powder added will depend on your preference for scent and color intensity

4.Optional: Add Fragrance and Color:

If desired, add a few drops of essential oils for fragrance.

You can also add natural colorants like turmeric powder for a yellow hue. Start with a small amount and adjust until you achieve the desired color.

5. Pour into Molds:

Carefully pour the bael fruit-infused soap mixture into soap molds. Tap the molds gently on the countertop to release any air bubbles.

6. Allow to Cool and Set:

Let the soap molds sit undisturbed until the soap has cooled and hardened completely. This typically takes a few hours, depending on the size and depth of the molds.

7. Unmold and Store:

Once the soap has fully set, gently remove it from the molds.

Store the bael fruit soap bars in a cool, dry place until ready to use. It's best to wrap them individually in wax paper or plastic wrap to prevent moisture loss and preserve the scent.[22]

Fig 10

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Evaluation of Soap

The following Physico-chemical parameters were assessed for determining the quality of prepared formulation against marketed herbal Soap.

Physical parameters :

Colour: The colour of formulation was checked manually and observed.

Odour: The Smell of Formulation was checked by applying preparation on hand and feel the fragrance.

Appearance: Visually checked the appearance of the formulation.

pH : The pH of the prepared soap was measured by digital pH meter. The prepared formulation was dissolved in 100 ml distilled water and kept for 2 h. pH measurement of the solution was done using a previously calibrated pH meter.

% free Alkali content : The beaker containing 10g of dried soap was then filled with 150 ml of distilled water. To dissolve the soap, it was heated for 30 to 40 min at reflux on a water bath. This solution was cooled, transferred with the washings to the 250 ml conical flask, and the capacity was filled with distilled water. Two drops of the phenolphthalein indicator were added to 10 ml of the soap solution in the titration flask. The solution was then titrated against 0.1M HCl until it turned colorless.

Foam Retention : A 25ml graduated measuring cylinder was filled with 10 ml of the one percent soap solution, then the cylinder was covered with a hand and shook ten times for 4 minutes, the volume of foam was measured at 1-minute intervals. it was discovered to be 5 minutes. Volume of foam was measured to be 12 ml after 4 minutes and remained constant.

Moisture content : A sample of soap weighing 10g was weighed right away and noted as "wet weight of the sample." Using the appropriate drying equipment, this wet sample was dried to a constant weight at a temperature not to exceed 115 °C. After cooling, the sample was weighed once more to determine its "dry weight."

The following equation was used to calculate the sample's moisture content. %Weight = A-B/B × 100 Where; %Weight = % of moisture in sample, A = weight of wet sample (gm), B = weight of dry sample (gm).

Alcohol insoluble matter :50 ml of warm ethanol was introduced to a conical flask containing a 5 gm sample of soap in order to dissolve it. Using tarred filter paper and 20 ml of warm ethanol, the liquid was filtered and then dried at 1050 C for an hour. The weighted filter paper had dried out.[23]

Biological parameters:

Antioxidant activity

Antioxidant activity was carried out using the reducing power method. In this approach, a rise in the reaction mixture's absorbance denotes a rise in antioxidant activity or reducing power. In this procedure, 2.5 ml of 0.2 Molar phosphate buffer (pH 6.6) and a 1 percent w/v solution of potassium ferricyanide are combined with 1 ml of test sample diluted with distilled water (2.5 ml). After that, this combination is incubated for 20 min at 500 °C. After incubation, the mixture is recovered, and 2.5 ml of 10% C2HCl3O2 is added. The reaction mixture is centrifuged for 15 min at 250 rpm, and the upper supernatant layer of the solution (2.5 ml) is removed and combined with 2.5 ml of purified water and 0.1 percent ferric chloride (0.5 ml). In comparison to a control, the resultant solution is exposed to UV at 700 nm[24]

IV. RESULT AND DISCUSSION

Physical Parameters:-

Table 6

Sr.no	Parameters	Observation
1.	Colour	Brownish Red
2.	Odour	
3.	Apperance	Good
4.	State	Solid
5.	Clarity	Crystal Clear

pH :- The pH of the soap was between 4.5 to 7 as it is the pH appropriate for face as well as body.

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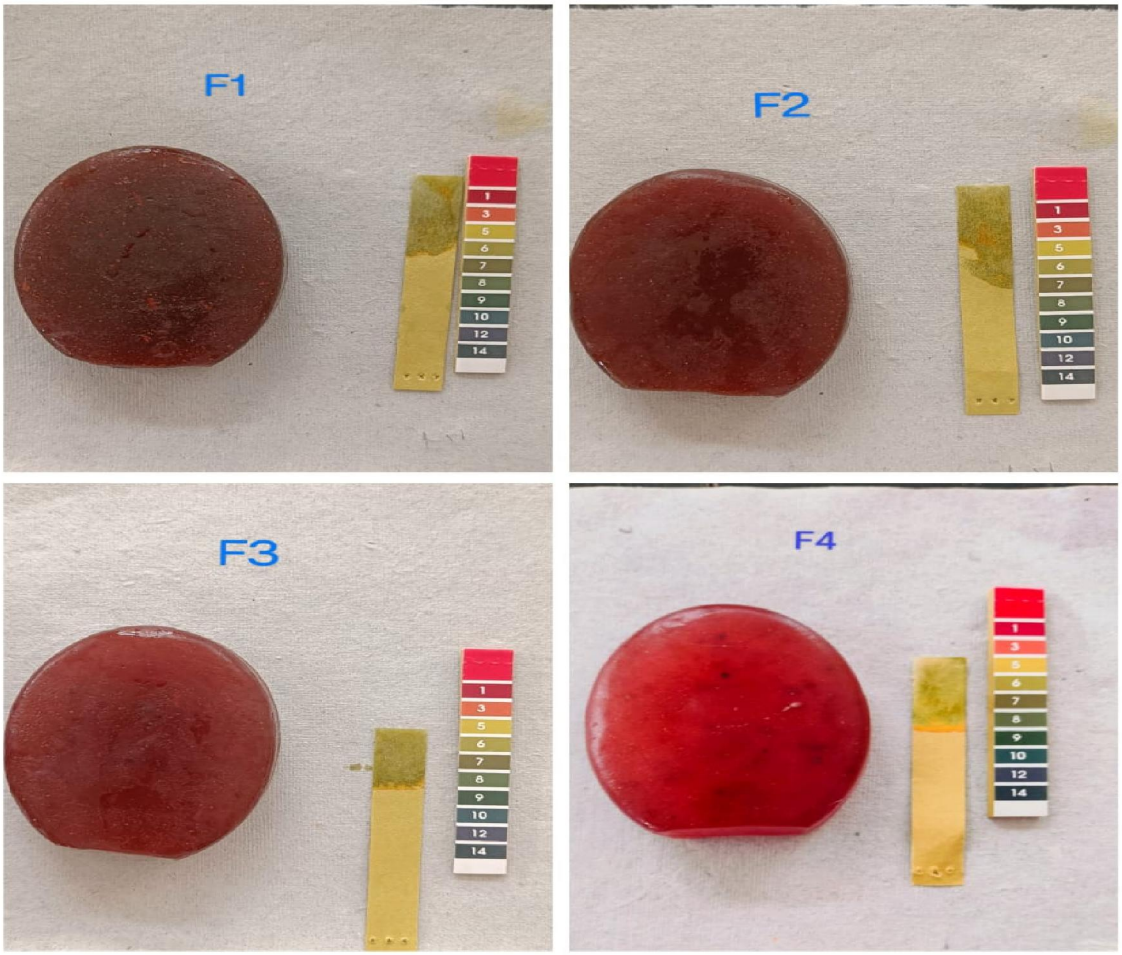
Fig 11



Foam Retension:

Table 7

Time(min)	Foam Volume (ml)
0	7
1	5
2	3
3	2.5
4	2

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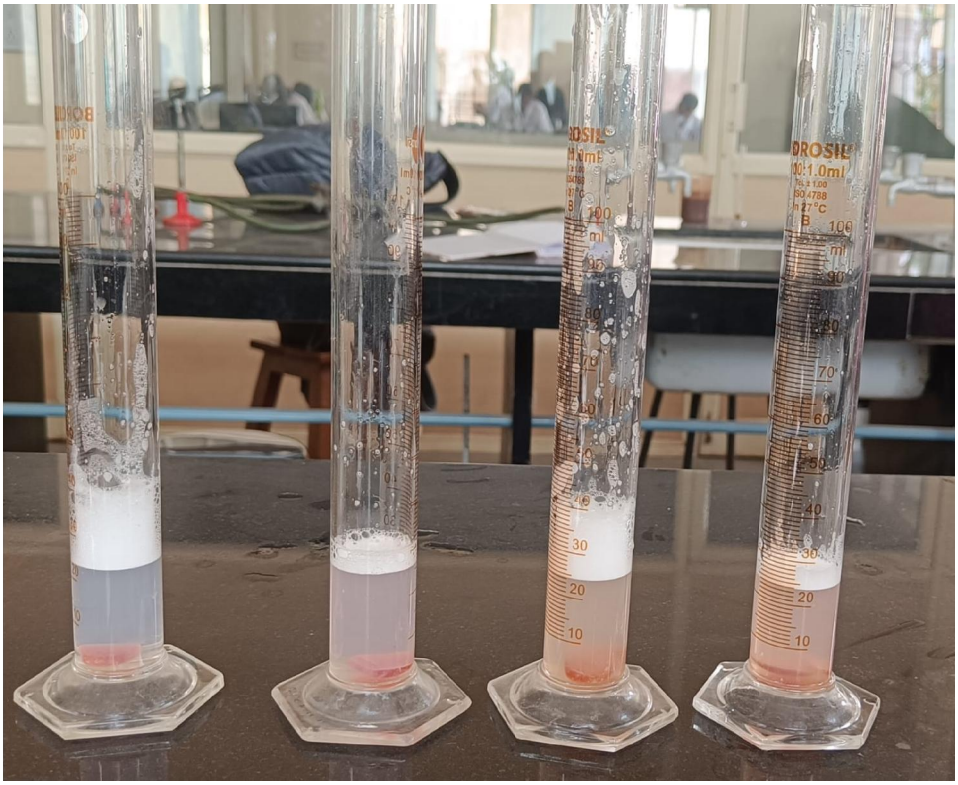
Fig 12



Moisture content & Alcohol insoluble matter:

Table 8

Sr.no	Parameter	Observation
1.	Moisture Content	3.2
2.	Alcohol Insoluble Matter	17.6

V. CONCLUSION

The formulation and evaluation of herbal soap using Bael fruit extract and Orange Peel powder not only underscores the potential of these traditional ingredients in modern skincare, but also provides a promising foundation for future product development. Both Bael fruit and Orange Peel powder offer distinct and valuable benefits—Bael fruit's therapeutic properties combined with Orange Peel powder's exfoliating and skin-brightening effects make this soap formulation a balanced and holistic skincare solution.

The study's findings reveal that the soap maintains an optimal pH level, produces a satisfying lather, and demonstrates effective cleansing while remaining gentle on the skin, with minimal risk of irritation. These characteristics align with the growing consumer preference for natural, sustainable, and safe skincare products.

Furthermore, the combination of Bael fruit and Orange Peel powder opens the door for continued research and development in the field of herbal cosmetics, emphasizing the potential for these ingredients to be incorporated into other personal care products. With further optimization, this herbal soap could become a key player in the market, offering consumers an eco-friendly and effective alternative to synthetic skincare options. Overall, the study highlights the value of natural ingredients in skincare formulations and contributes to the broader movement toward cleaner, more sustainable beauty solutions.

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Summary

The study on the formulation and evaluation of herbal soap using Bael fruit and Orange Peel powder aimed to explore the potential of incorporating these traditional medicinal plants into skincare products. Bael fruit, known for its therapeutic properties in traditional medicine, and Orange Peel powder, recognized for its exfoliating and skin-brightening benefits, were used as key ingredients in the soap formulation.

The researchers focused on extracting active constituents from both Bael fruit and Orange Peel powder and integrating them into a soap base. The formulation process involved careful consideration of parameters such as pH balance, lathering properties, cleansing efficacy, exfoliation, and the potential for skin irritation.

Following the formulation process, the herbal soap underwent comprehensive evaluation for performance and safety. Results indicated that the soap formulated with both Bael fruit extract and Orange Peel powder maintained an optimal pH level, produced satisfactory lather, and demonstrated effective cleansing. Additionally, the Orange Peel powder contributed to gentle exfoliation, while the Bael fruit extract provided therapeutic effects. The soap exhibited minimal potential for skin irritation, making it safe for various skin types.

In conclusion, the study demonstrates that Bael fruit and Orange Peel powder have significant potential as natural ingredients in skincare formulations, offering both cleansing and therapeutic benefits, along with gentle exfoliation. The research suggests that with further optimization, soaps made with these ingredients could meet the growing demand for natural and sustainable skincare products.

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