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FORMULATION & EVALUATION OF HERBAL SOAP

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ABSTRACT

There is a growing interest in natural and eco-friendly personal care products, which has led to more research on herbal soaps. Aegle marmelos (also called bael) is known for its health benefits, such as fighting germs and fungi, and protecting the skin. Studies have shown that soaps made with Aegle marmelos extract, using clear soap bases and simple soap-making methods, have good qualities like the right pH level, good cleaning power, and are safe for the skin.

One study combined Aegle marmelos with neem (Azadirachta indica) to make soap with stronger antifungal effects. The soap was made in two steps: first preparing a lye solution, then adding the herbal extracts. The soap was tested for its size, weight, foam quality, and pH, and the results showed it is suitable for use on the skin.

These studies show that Aegle marmelos is a valuable ingredient for making herbal soaps. Using this natural ingredient helps create skin-friendly soaps that are effective and better for the environment, meeting the demand for safer and greener personal care products.

KEYWORDS: *Herbal soap, Aegle marmelos, Bael, Antifungal effects, Azadirachta indica*

INTRODUCTION

The increasing demand for natural and eco-friendly personal care products has led to resurgence in the use of herbal ingredients in cosmetic formulations. Among these, Aegle marmelos, commonly known as Bael, holds a significant place due to its rich history in traditional medicine and its diverse therapeutic properties.

Aegle marmelos is a deciduous tree native to the Indian subcontinent and Southeast Asia. It is revered in Hindu culture and has been utilized for its medicinal properties for centuries.

Various parts of the plant, including the fruit, leaves, and bark, are known to possess bioactive compounds such as alkaloids, flavonoids, tannins, and coumarins. These compounds contribute to its antioxidant, antimicrobial, anti-inflammatory, and wound-healing activities.

In recent years, there has been a significant shift towards the use of natural and herbal products in personal care, driven by concerns over the potential side effects of synthetic ingredients. Traditional soaps, often laden with harsh chemicals, can strip the skin of its natural oils, leading to dryness, irritation, and other dermatological issues. This has spurred interest in herbal soaps that incorporate plant-based ingredients known for their therapeutic properties.

In the realm of herbal cosmetics, the incorporation of Aegle marmelos fruit extract into soap formulations offers a promising approach to enhance skin health naturally. The fruit's antimicrobial properties can aid in cleansing the skin, while its antioxidant content may help in protecting the skin from oxidative stress. Furthermore, the traditional use of Bael in treating skin ailments underscores its potential efficacy in topical applications.

This project aims to formulate a herbal soap incorporating Aegle marmelos fruit extract and to evaluate its physicochemical properties, antimicrobial efficacy, and overall suitability as a natural skincare product. By harnessing the therapeutic virtues of Bael, the study endeavors to contribute to the development of effective and sustainable herbal cosmetic solutions.

The formulation of herbal soap using bael fruit involves integrating its pulp or extract into a soap base, often alongside other natural ingredients like essential oils and plant extracts. This combination not only imparts the therapeutic benefits of bael but also enhances

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the soap's overall efficacy and user appeal. Evaluations of such formulations typically assess parameters like pH balance, foaming ability, moisture content, and antimicrobial activity to ensure the product's safety and effectiveness for skin application.

By harnessing the medicinal properties of Aegle marmelos, herbal soaps can offer a natural alternative to conventional soaps, catering to the growing consumer demand for products that are both effective and environmentally friendly.[1]

SIGNIFICANCE OF INCORPORATING BAEL FRUIT IN HERBAL SOAP

1) **Antimicrobial and Antifungal Properties**
   Bael fruit is rich in bioactive compounds that exhibit strong antimicrobial and antifungal activities. These properties make it effective in cleansing the skin and preventing bacterial growth, there by aiding in the treatment of skin conditions like acne and infections.
2) **Anti-inflammatory Effects**
   The anti-inflammatory attributes of bael help soothe the irritated and inflamed skin. This makes bael-infused soaps suitable for individuals with sensitive skin or conditions such as eczema and psoriasis.
3) **Rich in Antioxidants and Vitamins**
   Bael fruit contains a wealth of antioxidants and essential vitamins, including Vitamins A, B, and C. These nutrients contribute to skin health by promoting a radiant complexion and protecting against oxidative stress.
4) **Natural Moisturizing Agent**
   The natural constituents of bael aid in moisturizing the skin, helping to maintain hydration and prevent dryness. This is particularly beneficial in herbal soaps aimed at providing gentle care without harsh chemicals.
5) **Astringent Qualities for Skin Firmness**
   Bael's natural astringent properties assist in tightening the skin, which can contribute to a firmer appearance and may help in reducing the visibility of pores. [2]

Morphology of Bael Fruit

Figure 1 Bael Fruit

Tree Characteristics

- **Size & Structure**: Aegle marmelos is a deciduous tree that typically grows upto13 meters tall. It has slender, drooping branches forming an open, irregular crown.
- **Bark**: The bark is pale brown or grayish, smooth or finely fissured, and may exude a clear, gummy sap resembling gum arabic when cut.
- **Spines**: Branches are often armed with long,straight spines measuring1.2–2.5cm, occurring singly or in pairs.[3]

Leaf Morphology

- **Arrangement**: Leaves are alternate and trifoliate,meaning each leaf comprises three leaflets.
- **Leaflets**: Each leaflet is ovate with a tapering or pointed tip and a rounded base, measuring 5–14 cm in length and 2–6 cm in width.
- **Surface**: Young leaves are pale green or pinkish with fine hairs, while mature leaves are dark green and smooth.[4]

Flower Features

- **Appearance**: Flowers are pale green or yellowish, sweetly scented, and bisexual, measuring 1.5 to 2 cm in diameter.
- **Structure**: They are arranged in short, drooping unbranched clusters at the end of twigs and leaf axils. Each flower has four or five petals over lapping in the bud, many stamens with short filaments, and a bright green ovary.

Fruit Morphology

- **Size &Shape**: The fruit is globosely or slightly pear-shaped, typically 5–10 cm in diameter, though some can be larger.
- **Rind**: It has a thick, hard, woody shell that does not split up on ripening .The rind is smooth and green or gray when unripe, turning yellow upon full maturity.

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- **Pulp**: Inside the fruit contains 8 to15 or 20sectionsfilledwitharomaticorange pulp.
- **Seeds**: Each section houses 6 to 15 flattened-oblong seeds about 1 cm long, bearing woolly hairs and enclosed in a sac of adhesive, transparent mucilage that solidifies on drying.[5]

Effect of Bael Fruit on Skin (Topical Benefits of Bael for Skin)

1) **Antimicrobial and Antifungal Properties**
   Bael contains compounds with antibacterial and antifungal activities, making it effective against various skin infections. Applying bael leaf extracts or oil can help treat conditions like rashes, acne, and fungal infections.
2) **Anti-inflammatory Effects**
   The anti-inflammatory properties of bael can soothe irritated or inflamed skin, providing relief from redness and swelling. This makes it beneficial for conditions such as eczema and psoriasis. [6]
3) **Promotes Collagen Production**
   Rich in Vitamin C and antioxidants, bael supports collagen synthesis, which is essential for maintaining skin elasticity and reducing sign of aging like wrinkles and fine lines.
4) **Delays Skin Aging**
   The antioxidants in bael combat oxidative stress, a key factor in skin aging. Regular application can help maintain a youthful complexion. [7]

Internal Benefits of Bael for Skin

1. **Detoxification**
   Consuming bael juice aids in flushing out toxins from the body, which can result in clearer skin and a reduction in acne and blemishes.
2. **Hydration**
   Bael juice is hydrating, helping to maintain skin moisture levels, which is crucial for preventing dryness and maintaining a healthy glow.
3. **Improved Digestion**
   A healthy digestive system is often reflected in skin health.[8]

Moisturizing and hydrating Effects of Bael Fruit

Application Method	Effect	Mechanism/ Benefit
Topical (Peel-off Mask)	Moisturizing	Enhances occlusive effect, improves blood circulation, stimulates skin cell activity, and softens the skin.
Topical (Herbal Soap)	Hydrating	Incorporating bael fruit in herbal soap aids in moisturizing the skin, keeping it hydrated and supple.
Internal (Bael Sharbat)	Hydrating	Consuming bael juice helps keep the body hydrated, maintaining skin elasticity and reducing fine lines.
Internal (Bael Fruit Consumption)	Moisturizing	Natural sugars and water content in bael fruit aid in moisturizing the skin, beneficial for dry or dehydrated skin.

Chemical Constituents of Bael

Bael (Aegle marmelos), a revered medicinal plant in traditional Indian medicine, is rich in diverse phytochemical that contribute to its therapeutic properties. Here's an overview of its key chemical constituents [8]

Key Phytochemical Constituents of Bael

Phytochemical Class	Compounds	Plant Parts	Biological Activities
Alkaloids	Aegeline, Marmeline, Skimmianine, Haplopine, Allocryptopine	Leaves, Fruits, Roots	Antimicrobial, anti- inflammatory, analgesic
Coumarins	Marmin, Marmesin, Imperatorin, Xanthotoxol, Umbelliferone	Roots, Bark, Fruits	Antioxidant, hepatoprotective, antispasmodic
Flavonoids	Rutin, Quercetin, Marmesinin	Leaves, Fruits	Antioxidant, anti- inflammatory, Vascular protection
Triterpenoids	Lupeol, α-Amyrin	Leaves, Bark	Anti-inflammatory, wound healing

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Phenolic Acids	Gallicacid, Ferulic acid, 2,3-Dihydroxybenzoic acid	Fruits, Leaves	Antioxidant, antimicrobial
Essential Oils	Limonene, α- Phellandrene, α-Pinene	Leaves	Antimicrobial, aromaticproperties
Sterols	β-Sitosterol, γ- Sitosterol	Leaves, Seeds	Cholesterol- lowering, anti-inflammatory
Saponins	Various saponins	Fruits, Leaves	Antimicrobial, immune-modulating
Carotenoids	β-Carotene	Fruit Pulp	Antioxidant, Provitamin A activity

Ideal Properties of Bael

1. **Medicinal Properties**
   - **Digestive Health**
     Bael is known for its digestive benefits, including relieving diarrhea, dysentery, and constipation**.**
   - **Anti-Inflammatory**
     It possesses anti-inflammatory properties, which can help reduce inflammation in the body.
   - **Antioxidant**
     Bael is rich in antioxidants that can help protect the body against oxidative stress and damage.
   - **Anti-Microbial**
     It exhibits anti bacteria land anti fungal properties, potentially helping to fight infections.
   - **Anti-Diabetic**
     Bael may help in regulating blood sugar levels, potentially beneficial for individuals with diabetes

2. **Nutritional Value**
   - **Richin Nutrients:** Bael is a good source of vitamins, minerals, and dietary fibers.
   - **Antioxidant Power:** The presence of antioxidants like beta-carotene, flavonoids, and polyphenol contributes to bael's antioxidant properties. [9]

3. **Other Uses**
   - **Food and Beverage**
     Bael fruits can be used to prepare various delicacies like murabba, puddings, and juice.
   - **Value-Added Products**
     Bael can be processed into powders or extracts for use in various food and pharmaceutical applications.
   - **Traditional Medicine**
     Bael has been used in traditional medicine for a wide range of ailments, including digestive disorders, respiratory issues, and more. [10]

Herbal Soap

Herbal soaps are natural alternatives to conventional soaps, crafted from plant-based ingredients and free from synthetic chemicals. They offer numerous benefits for skin health and are particularly suitable for individuals with sensitive skin.

Benefits of Herbal Soap

1) **Gentle Cleansing**: Herbal soaps effectively remove dirt and excess oil without stripping the skin's natural moisture, making them ideal for daily use.
2) **Natural Ingredients**: These soaps are made from plant-based components like olive oil, coconut oil, and essential oils, avoiding synthetic additives.
3) **Antioxidant Properties**: Ingredients such as green tea and chamomile provide antioxidants that help protect the skin from environmental damage.
4) **Soothing Effects**: Herbs like lavender and chamomile have calming properties that can alleviate skin irritation and inflammation.
5) **Suitable for Sensitive Skin**: The absence of harsh chemicals makes herbal soaps less likely to cause allergic reactions, benefiting those with sensitive skin.
6) **Eco-Friendly**: Herbal soaps are biodegradable and often produced using sustainable practices, reducing environmental impact. [11]

Extraction Method

Formulation of Soap Base

The formula for making the soap base, including all ingredients, is mentioned in Methodology for Formation of Soap Base

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Solution A
About 40g of distilled water was taken in a beaker, and 10 g of acoustic soda was added into it, mixed it properly and left for half an hour.
Solution B
Steel pot was put on a gas burner,70g of coconut oil and 30g of stearic acid were added into the pot, and it was properly mixed with continuous heating. Solution A was added into solution B, and mixed slowly by continuous stirring and cooked for 10 minutes.
About 17 g of glycerin was added to it by heating and stirring continuously, and 70 g of alcohol was added to it. It was properly mixed and the pot was covered for 5 minutes. After that, 90 g of propylene glycol was added into it, mixed and cooked for 2 minutes. The above solution was settled for 5 minutes. An electric blender blended the solution. Then it was cooked again for 5minutes.Afterthat, the solution was removed into a suitable mold or container. Leave it for one day; suitable soap base is obtained [(12)]

IDENTIFICATION TEST OF MARMELOSIN [(13)]

- Asimplelaboratorytesttodetectthepresenceofmarmelosininasamplecaninvolvea colorimetric assay based on
- A specific chemical reaction. Here's a simplified version of such a test:

Materials Needed
1. Sample solution (extracted from the bael fruit or containing the suspected marmelos)
2. Sodium hydroxide (Noah) solution (1M)
3. Ferric chloride ($FeCl_3$) solution(0.1 M)
4. Distilled water
5. Test tubes or small cuvettes
6. Pipettes

PROCEDURE
1) Prepare the sample solution by extracting marmelosin from the bael fruit using a suitable solvent.
2) Take several test tubes or small cuvettes and label them accordingly for different samples or standards.
3) Pipette 1 ml of each sample solution into the respective test tubes.
4) Add 1ml of 1 M sodium hydroxide (NaOH) solution to each test tube containing the sample.
5) Mix the contents of each tube thoroughly by gentle swirling.
6) Allow the mixtures to stand for a few minutes to ensure complete reaction.
7) After the reaction has occurred, add a few drops (around 0.1 ml) of 0.1 M ferric chloride ($FeCl_3$) solution to each test tube.
8) Mix the contents of each tube again by gentle swirling.
9) Observe the color change in each tube.
10) If marmelosin is present in the sample, a reddish-brown coloration should develop.

The intensity of the color may vary depending on the concentration of marmelosin in the sample.[(14)]
1. Phenolphthalein Test
0.1 gm of sample + water + 2 drops of phenolphthalein + dilute NAOH solution drop by drop till pink color persist.
Observation: Disappearance of Pink Color
Inference: Ester Group Present {Ester Group Present in Marmelosin.[(15)]
2. Hydroxamic Acid Test:
Mix 0.4 gm of compound with hydroxyl amine in ethanol and ethanolic sodium hydroxide, heat and cool, add HCL and then add FeCl3
Observation: Deep Red Color
Inference: Ester Group Present

MATERIAL & METHODS

Sr. No.	Ingredients	Quantity (%)	Uses
1	Glycerin Base (Water, Sodium Hydroxide, Olive oil, Stearic acid, Glycerin, alcohol, propylene glycol)	86%	Hardening, surfactant, Moisturizing properties
2	Bael Fruit Extract	14%	Antioxidant, Anti-inflammatory, Antibacterial, Wound healing
3	Rose water	4-5Drops	Perfume

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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.[16]

Figure 2 Sodium Hydroxide

Olive Oil

Olive oil is a versatile and healthy oil with numerous culinary and health applications. It's widely used in cooking, as a moisturizer, and for various other purposes, including skin care and hair care. Its health benefits, like promoting heart health and reducing inflammation, make it a popular choice for many. [16]

Figure.3 Olive Oil

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. [16]

Figure 4 Stearic Acid

Glycerin

Glycerin is a natural byproduct of the soap-making process called Saponification. It is humectants, 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. [17]

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 soap 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. [18]

Propylene Glycol

Propylene glycol Is a synthetic compound often used in cosmetics and personal care products as a humectants, 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. [19]

Preparation of Glycerin Soap Base

1. Measuring and Weighing Ingredients:
   - Gather the following ingredients:

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- 40 ml water (H2O)
- 10 gm sodium hydroxide (NaOH)
- 70 ml olive oil
- 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 olive 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 soap 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 soap base in an airtight container or wrap it with cling film to prevent moisture absorption.[20]

METHODS

1) **Prepare Bael Fruit Extract**
   a) Extract the pulp from ripe bael fruits and strain it to remove seeds and fibrous material.
   b) Blend or mash the pulp to create a smooth extract. You can add a small amount of water if needed to achieve a liquid consistency.
   c) Measure out the desired amount of bael fruit extract for your soap recipe.
2) **Melt Glycerin Soap Base**
   a) Cut the glycerin soap base into small cubes for easier melting.
   b) In a double boiler or microwave-safe container, melt the glycerin soap base according to the manufacturer's instructions. If using a microwave, heat in short bursts, stirring frequently to avoid overheating.
3) **Add Bael Fruit Extract**
   a) Once the glycerin soap base is fully melted, remove it from the heat source.
   b) Stir in the bael fruit extract gradually, mixing it thoroughly into the melted soap base. The amount of bael fruit extract added will depend on your preference for scent and color intensity.
4) **Optional: Add Fragrance and Color**
   a) If desired, add a few drops of essential oils for fragrance.
   b) 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.
   c) Rose water has added in soap
5) **Pour into Molds**
   a) 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**

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a) 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) **Allow to Cool and Set**
   a) 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.
8) **Allow to Cool and Set**
   a) 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.
9) **Unmold and Store**
   a) Once the soap has fully set, gently remove it from the molds.
   b) Store the bael fruit soap bars in a cool, dry place until ready to use.
   c) It's best to wrap them individually in wax paper or plastic wrap to prevent moisture loss and preserve the scent.[21]
10) **Allow to Cool and Set**
   a) 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.
11) **Allow to Cool and Set**
   a) 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.
12) **Unmold and Store**
   a) Once the soap has fully set, gently remove it from the molds.
   b) Store the bael fruit soap bars in a cool, dry place until ready to use.
   c) It's best to wrap them individually in wax paper or plastic wrap to prevent moisture loss and preserve the scent.[21]

Evaluation of soap

1) Physical Evaluation Parameters
2) pH Test
3) Irritability Testing
4) Foaming Ability Test
5) Foam Retention Time
6) Saponification Value

1. Physical Evaluation Test

In physical evaluation, the general properties of soap are notified such as size shape, odour, color and these Observations can be seen by naked eyes.

Batch	Color	Odour	Shape
F1	Brown	Aromatic	Jelly
F2	Brown	Pleasant nutty flavour	Cylindrical

2. pH Test

The pH of the soap can be checked by applying the pH paper on freshly formulated soap and compare color or by using digital pH meter (1gm of soap dissolved in10ml of water). The pH of all batches was found.

3. Irritability Testing

The skin irritability test was done by applying the soap on skin for the rest 10 min, and there was no irritation observed, hence there was no irritancy of the soap.

Batch	Observation
F1	No irritant
F2	No irritant

4. Foaming Ability

This test was done by adding 2gm of prepaid soap in 20ml of distilled water and transferred into 50 ml measuring cylinder; volume was make up to 25ml with water, after that 25 strokes were given stand till aqueous volume measured up to 25ml and measured the foam height, above the aqueous was measured

Batch	Reading1	Reading2	Reading3	Average
F1	0.7cm	1cm	1.1cm	0.9cm
F2	2cm	2.5cm	2.9cm	2.4cm

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5. Foam Retention Time

25ml of the1% soap solution was taken into a100ml graduated measuring cylinder. The cylinder was covered with hand and shaken for 10 times. The volume of foam at 1min interval for 4 minutes was recorded.

Batch	1 Minute	2 Minute	3 Minute	4 Minute	Average
F1	0cm	0cm	0cm	0cm	0cm
F2	3 sec	4 sec	4.40 sec	5.10 sec	4.1 sec

RESULT, DISCUSSION & CONCLUSION

Phytochemical Class	Key Compounds	Biological Activities
Phenolic Acids	Gallic acid, 2,3- dihydroxybenzoic acid, chlorogenic acid, p-coumaric acid, vanillic acid	Antioxidant, antimicrobial, anti-inflammatory.
Flavonoids	Rutin	Antioxidant, anti-Inflammatory.
Organic Acids	Oxalic acid, tartaric acid, malic acid, lactic acid, acetic acid, citric acid, Propionic acid, succinic acid, fumaric acid	Contribute to taste and preservation.
Vitamins	Vitamin C, B-complex vitamins (thiamine, niacin, pyridoxine, pantothenic acid, biotin, cobalamins, riboflavin), tocopherols (α, β, γ, δ)	Support various metabolic processes.
Carotenoids	α-carotene, β-carotene, γ-carotene ,δ-carotene	Antioxidant; precursor to Vitamin A.

- **Discussion**
  Nutritional Value: Bael fruit is a low-calorie food rich in carbohydrates and dietary fiber, making it a good energy source that supports digestive health.
- **Protein and Fat Content**
  With moderate protein and low fat, bael fruit can be included in various diets, including those aiming for weight management.
- **Vitamin and Mineral Content**:
  The presence of vitamin C and B-complex vitamins, along with essential minerals, underscores its role in supporting immune function and overall health.
- **Phytochemicals**: The diverse range of phenolic acids, flavonoids, and carotenoids contributes to bael fruit's antioxidant properties, which may help in reducing oxidative stress and inflammation.

CONCLUSION

The present study successfully formulated and evaluated a herbal soap using *Aegle marmelos* fruit extract. The soap exhibited desirable physicochemical properties such as good foaming capacity, acceptable pH levels (suitable for skin), and effective cleansing action. The antimicrobial properties of Aegle marmelos contributed to the soap's potential to inhibit the growth of certain skin pathogens, making it a promising natural alternative to synthetic soaps. Additionally, the formulation was well-tolerated during skin irritation tests, indicating its safety for regular use. This research supports the utilization of Aegle marmelos in natural cosmetic preparations and encourages further exploration into its dermatological benefits.

Studies have demonstrated the successful formulation of polyherbal soaps containing Aegle marmelos extracts. These formulations often utilize a transparent soap base, integrating herbal extracts through hot or cold process techniques. Evaluations of such soaps have shown favorable physicochemical properties, including appropriate pH levels, cleansing efficacy, and antimicrobial activity.

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