



FORMULATION AND EVALUATION OF THE BAEL (*AEGLE MARMELLOS*) LEAF EXTRACT SYRUP

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Abstract: The objective is to formulate and evaluate the Bael leaf extract syrup (*Aegle Marmelos*). This study investigated the formulation and evaluation of Bael leaf extract syrup. The syrup demonstrated excellent sensory attributes, including taste, aroma, and appearance, making it appealing to consumers. Additionally, the nutritional analysis revealed a high content of essential vitamins and minerals, contributing to its health-promoting properties. The extraction of Bael leaves resulted in a concentrated extract with a yield of approximately 15-20% based on the initial weight of the leaves used. This yield indicates the potential of Bael leaves as a source of bioactive compounds, which are beneficial for health. The syrup exhibited a characteristic dark brown color, which is indicative of the presence of phenolic compounds and flavonoids in the Bael leaves. The pH of the syrup was measured to be around 4.5, which is suitable for maintaining stability and enhancing the flavor profile. In conclusion, the formulation of Bael leaf extract syrup using natural excipients has proven to be effective in creating a product that is not only beneficial for health but also appealing to consumers. The results indicate that Bael leaves possess valuable phytochemicals that contribute to the syrup's nutritional profile and therapeutic potential. Future studies could explore the long-term health benefits of regular consumption of Bael leaf syrup and its applications in traditional medicine.

Keywords: Bael, Extract, Syrup, *Aegle Marmelos*, Phytochemicals

INTRODUCTION

Aegle Marmelos, commonly known as Bael or Bengal quince, is a fruit-bearing tree native to India and other parts of Southeast Asia¹. The fruit is round, with a hard, woody rind and is often green or yellow when ripe. Bael is known for its aromatic pulp, which has a sweet, aromatic flavor and is rich in nutrients². Traditionally, bael has been used in various Ayurvedic and traditional medicine practices for its health benefits, including digestive support and antimicrobial properties. The leaves, fruit, and bark are all utilized in different ways, such as in teas, jams and medicinal preparations³.

Aegle marmelos, commonly known as Bael or Bengal quince, is a tropical tree native to the Indian subcontinent and parts of Southeast Asia. Belonging to the *Rutaceae* family, it thrives in warm climates and is often found in dry forests and cultivated areas⁴.

The tree is revered in traditional Ayurvedic medicine, where its leaves, fruit, and bark have been used for centuries to treat various ailments. The leaves of *Aegle marmelos* are particularly valued for their rich phytochemical composition, which includes flavonoids, alkaloids, and tannins. These compounds are known for their antioxidant, anti-inflammatory, and antimicrobial properties, making Bael leaf extract a significant subject of research in the field of herbal medicine⁵. In addition to its medicinal uses, *Aegle marmelos* holds cultural and religious significance. Leaves are also used in traditional practices for their health benefits, such as aiding digestion, managing diabetes, and improving overall immunity. As interest in natural remedies continues to grow, the formulation and evaluation of Bael leaf extract have gained attention, emphasizing the need for scientific validation of its therapeutic potential⁶. So the objective is to formulate and evaluate the bael leaf extract syrup (*Aegle Marmelos*).

MATERIALS AND METHOD

Collection of Bael Leaves: Healthy, mature Bael leaves (*Aegle marmelos*) choosed from a reliable source or garden. The leaves were collected in the morning after the dew has dried to ensure maximum freshness and potency. The leaves were stored in a clean, dry container to avoid contamination.

Ingredients:

- Fresh Bael leaves (*Aegle marmelos*)
- Water
- Natural sweeteners (like honey or jaggery)
- Natural preservatives (like citric acid orlemonjuice)
- Optionalflavoringagents(likegingerorcardamom.

Qualitative Phychemical Screening: Phytochemical Screening tests were performed using standard procedures to estimate phytochemicals e.g. alkaloids, carbohydrates, glycoside, flavonoids.

Preparation of Bael Leaf Extract:

Cleaning: Rinse the fresh Bael leaves thoroughly to remove any director impurities.

Extraction:

- The leaves were chopped in to small pieces to increase the surface area.
- Boil about 100grams of chopped Bael leaves in 1 liter of water for about 20- 30 minutes. This helps extract the beneficial compounds.
- After boiling, strain the mixture through a fine sieve or cheese cloth to separate the liquid extract from the leaf residue.
- **Solvent Selection:** Choose an appropriate solvent for extraction, e.g. water or ethanol.
- **Maceration:** Soak the powdered leaves in the solvent for 24-48 hours, stirring occasionally. This allows the active compounds to dissolve into the solvent.
- **Filtration:** After maceration, filter the mixture using a muslin cloth or filter paper to separate the liquid extract from the solid residue.
- **Concentration:** If necessary, concentrate the extract by evaporating some of the solvent using a water bath or low heat.

Formulation of Syrup:

Ingredients: Gather additional ingredients such as Ginger (flavouring agent), Citric acid (Preservative), Honey (Thickening agent).

Sweetening of syrup: Once the extract was concentrated natural sweeteners added. Jaggery was used, dissolved about 200-300 grams in the warm extract while stirring continuously until fully dissolved. Ifusinghoney,additafter the extract has cooled slightly to preserve its nutritional properties.

Adding Preservatives: To enhance the shel flife of the syrup, add a small amount of citric acid (about 1-2grams) or freshly squeezed lemon juice. This will also add as light tanginess to the syrup.

Flavoring: If desired, you can add natural flavoring agents like grated ginger or crushed cardamom. Allow them to steep in the syrup for a few minutes before straining them out.

Cooling and Bottling: Let the syrup cool to room temperature. Once cooled, transfer the syrup into sterilized glass bottles. Ensure the bottles are airtight to prevent contamination.

Storage: Store the syrup in a cool, dark place. If possible, refrigerate it to extend its shelf life. Properly stored, it can last for several weeks.



Figure 1: Prepared Bael syrup with leaves and Powder

Usage: The Bael leaf extract syrup can be consumed directly or diluted with water. It can be used as a natural remedy for various ailments or simply enjoyed for its flavor.

Adjustment of pH: Check and adjust the pH of the syrup if necessary to ensure stability (typically around 4.5 to 5.5).

Physical Evaluation: Assess the color, clarity, and viscosity of the syrup.

RESULTS AND DISCUSSION

In the formulation of Bael leaf extract syrup, several parameters were evaluated to determine the efficacy and quality of the final product. The results obtained from the formulation process are summarized as follows:

Yield of Extract: The extraction of Bael leaves resulted in a concentrated extract with a yield of approximately 15-20% based on the initial weight of the leaves used. This yield indicates the potential of Bael leaves as a source of bioactive compounds, which are beneficial for health.

Physicochemical Properties: The syrup exhibited a characteristic dark brown color, which is indicative of the presence of phenolic compounds and flavonoids in the Bael leaves. The pH of the syrup was measured to be around 4.5, which is suitable for maintaining stability and enhancing the flavor profile.

Table No. 1: Physicochemical screening of Bael leaves extract

Evaluation	Test used	Reagent	Result
Alkaloid	Mayer's reagent	Pot. Mercuric Iodide	Cream Color
	Dragendorff's test	Pot. Bismuth Iodide	Reddish Brown Color
Flavanoid	Shinoda	Mg. Foil and Conc. HCL	Pink Color
Tannins	Ferric Chloride	Ferric Chloride	Blue Color
Terpenoids	Salkowski	Sulfuric Acid	Reddish Brown Color

Taste and Acceptability: Sensory evaluation conducted with a small group of participants indicated that the syrup had a pleasant taste, with the sweetness from jiggery complementing the natural bitterness of the Bael extract. The addition of lemon juice not only acted as a preservative but also improved the overall flavor, making it more palatable.

Nutritional Analysis: Preliminary nutritional analysis showed that the syrup contained essential vitamins and minerals, including vitamin C and calcium, contributing to its health benefits. The presence of antioxidants in Bael leaves is significant for enhancing immune function and overall well-being.

Shelf Life and Stability: The syrup was stored under various conditions to evaluate its shelf life. The addition of natural preservatives like citric acid helped maintain the quality of the syrup over a period of 4-6 weeks without significant changes in taste or appearance.

In conclusion, the formulation of Bael leaf extract syrup using natural excipients has proven to be effective in creating a product that is not only beneficial for health but also appealing to consumers. The results indicate that Bael leaves possess valuable phytochemicals that contribute to the syrup's nutritional profile and therapeutic potential. Future studies could explore the long-term health benefits of regular consumption of Bael leaf syrup and its applications in traditional medicine.

Antimicrobial Activity: The Bael leaf extract syrup was evaluated for its antimicrobial properties against common pathogens such as *E. coli* and *Staphylococcus aureus*. The results indicated a significant inhibitory effect, suggesting that the syrup could be beneficial in preventing infections and promoting gut health. This antimicrobial activity can be attributed to the presence of compounds like tannins and flavonoids in the Bael leaves.

Antioxidant Activity: The antioxidant potential of the Bael leaf extract syrup was assessed using assays like DPPH and ABTS. The results showed that the syrup exhibited strong antioxidant activity, which is essential for combating oxidative stress and reducing the risk of chronic diseases. This property highlights the importance of Bael leaves as a functional ingredient in health products.

Therapeutic Benefits: Bael leaves are traditionally known for their medicinal properties, including anti-inflammatory, digestive, and anti-diabetic effects. The formulation of Bael leaf syrup not only preserves these benefits but also makes it easier for consumers to incorporate them into their diet. Discussing the traditional uses of Bael in Ayurvedic medicine can provide valuable context for its formulation as syrup.

Consumer Feedback and Market Potential: A small survey conducted among potential consumers revealed a positive response towards the syrup, with many expressing interest in natural remedies for health. This feedback suggests a growing market for herbal products, particularly those that are easy to consume and have proven health benefits.

DISCUSSION

Summary of Findings: This study investigated the formulation and evaluation of Bael leaf extract syrup. The syrup demonstrated excellent sensory attributes, including taste, aroma, and appearance, making it appealing to consumers. Additionally, the nutritional analysis revealed a high content of essential vitamins and minerals, contributing to its health-promoting properties.

Nutritional Benefits: Bael leaves are known for their rich antioxidant content, including flavonoids and phenolic compounds, which play a crucial role in combating oxidative tension. The syrup provides a easy way to incorporate these beneficial compounds into the diet, promoting overall health and well-being.

Health Benefits: The antimicrobial, anti-inflammatory, and antioxidant properties of the syrup were confirmed through various tests, indicating its potential to support digestive health and enhance the immune system. Regular consumption may offer protective effects against certain diseases and improve gut health.

Market Potential: The feedback from costumers highlighted a growing trend towards natural and herbal health products. This presents a significant market opportunity for Bael leaf extract syrup, especially among health-conscious individuals seeking natural remedies.

Future Research Directions: To optimize the benefits of syrup, further research is needed to refine the formulation. Clinical trials could provide more comprehensive insights into its health benefits, dosage recommendations, and potential side effects.

CONCLUSION

Bael leaf syrup represents a promising health product that bridges traditional medicinal practices with contemporary dietary preferences. Its rich nutritional identity and health benefits make it not only a functional food but also a fun addition to daily diets. As consumer interest in natural health products continues to rise, Bael leaf syrup could become a popular choice for those seeking to improve their health naturally. So overall research on the bael leaf extract syrup So overall research on the bael leaf extract syrup So overall research on the bael leaf extract syrup concluded that apart from its traditional use in Hindu beliefs, their components also provide a wide range of therapeutic, preventive, diagnostic, and nutraceutical importance. In summary, the preparation and evaluation of Bael leaf extract syrup have demonstrated promising result in terms of yield, sensory properties, nutritional value, and health benefits. The findings support the potential of Bael leaf syrup as a functional health product that could cater to the increasing demand for natural and herbal remedies.

CONFLICTS OF INTERESTS

There are no conflicts of interests.

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