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Nutrient-dense jam made from herbal fruit: Preparation and evaluation

Chaitanya A. Gulhane *, Vaishnavi S. Nachane, Aishwarya V. Gudwar and Pramod V. Burakale

Dr. Rajendra Gode Institute of Pharmacy, Amravati, Maharashtra, India.

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Abstract

Bael being an indigenous fruit occupies an important place from medicinal point of view. Bael contains various phytochemicals like alkaloids, tannins, essential oils, gums, resins, coumarin, polysaccharide that makes it useful in many ailments. Beetroot is an excellent food which is important for development and growth of human body. It is rich source of antioxidant and minerals. It contains betalain essential for cardiovascular health. It plays another role as a natural colour in the textile industries. This project aims to formulate and evaluate the various medicinal properties of Bael fruits in the jam. Papaya is used in the jam hence it possesses medicinal properties like anti-inflammatory hypoglycaemic. Citric acid is used as preservative gelatin is also mixed in Bael jam as thickening agents. The present article therefore deals with the processing of Bael and Papaya fruit into nutritive jam which is enhancing consumer satisfaction and nutritional status.

Keywords: Bael fruit; Papaya; Beetroot; Medicinal properties; Processing aspects

1. Introduction

Fruits are of great importance in human nutrition. However, due to their perishable nature and seasonal availability, they are generally processed into more stable forms such as jams, jellies, juices, pickles and many more products. Jam is a popular food item due to its low cost and high organoleptic profiles. Jam should contain approximately 67-68% total soluble solids (TSS) along with 45% fruit pulp at least, while according to the 'Codex Alimentarius Commission' jam need to contain TSS approximately greater than 65%. It tends to apprehend shape, but normally less firm compared to jelly. Jam has prolonged shelf life so that it can be available round the year. Production of jam requires ingredients (fruit pulp, acid, gelatine and sugar) of correct quantities for having desired finished product. Raw material quality and process of manufacturing are the exponents to the quality of finished goods (Nindo et al., 2005). Citric acid is considered necessary to create a network between sugars as a dehydrating agent that makes a closer connection between molecules (Suutarinen, 2002). Pectin is purified polysaccharide generally extracted from the peel of citrus fruits. Pectin is a thickening agent since it brings changes in the texture and flow behavior of the finished product. Jam is a processed fruit product having an intermediate moisture content which is prepared by boiling homogenised fruit pulp with sugar, acid, and pectin. It may have some other ingredients like preservatives, flavouring or colouring compounds. It should have a proper consistency so that it could easily spread and should be firm enough so that it does not flow like a fluid. Jam should contain at least 68.5% total soluble solids, and the fruit should contribute at least 45% of the total weight of jam. Sugar present in jam reduces its water activity resulting in longer shelf life. Worldwide, several types of fruits have been used for making jams. Since the food products are governed by consumer choices, the development of new products is quite important for the fruit industries. For the preparation of herbal jam Bael Fruit is a rich source of variety of nutrients that are useful for human health since it contains a number of phytochemicals which has pharmacological activities. Bael is also known as begal-quince, golden apple, and stone apple in India and a sacred tree in places where Hindus live. Bael trees are usually planted near temples dedicated to Lord Shiva and routinely worshiped by the devotees. Bael is one of the most appreciated plants used in ayurvedic medicine by the Indian and other South Asian

*Corresponding author: Chaitanya A. Gulhane

inhabitants in ancient history. Bael mentioned in the renowned book CharakaSamhita, a comprehensive compilation of all the essential ayurvedic information, which identified bael as a necessary item in ayurvedic medicine. The tree is aromatic, and all the parts are medicinally important. Fruits, leaves, bark, roots, and seeds are used in ayurvedic and folk medicine systems to treat various ailments or the preparation of jam {2}.

1.1. Medicinal properties of bael

1.1.1. Diarrhoea and dysentery

Chronic diarrhoea can be treated with the use of bael fruit especially half-ripe or unripe fruit. Dried bael fruit powder is the best one for this purpose. Unripe fruits may be baked and after that, it may be mixed with jaggery for consumption {3}. The astringency of unripe fruit is the key to treat chronic diarrhoea and dysentery.

1.1.2. Diabetes

Diabetes is known to occur in the human body to lack of insulin, so in the treatment of diabetes it is required to get insulin externally, in similar fashion bael can replace insulin by enhancing the external glucose uptake ability {4}.

1.1.3. Anti-microbial activity

Bael is reported to be extraordinary in protection against a wide variety of pathogenic organism which include antibacterial, antitumor, antiviral, anti-inflammatory, anti-fungal {4}. Marmelide extracted from bael have shown antimicrobial activity when experimented with coxsackieviruses B1- B6, in an assay described by plaque inhibition assay at 96h. Without doing any toxic effects to host cells the extract is proved to have antiviral activity. In comparison to ribavirin, an anti-microbial drug, marmelide has been found to have more potential activity. The virucidal activity of marmelide and extract follows inhibition at the primary phase of a replicative cycle like adsorption as well as penetration {5}.

1.1.4. Anti-cancer activity

By improving the immune system of the body Bael extract help in anti-cancer activity {6}. When doxorubicin treatment is applied to mouse bone marrow, the produced genotoxic effects may be retarded by Bael extract. Treatment is done for 5days at a stretch before doxorubicin is applied, which brings about the reduction in the increase of normochromatic erythrocyte and micro nucleated polychromatic frequency produced with doxorubicin treatment {7}. Anti-neoplastic effect has been exhibited by D-limonene, eugenol, citral obtained from Bael extract {8}.

1.1.5. Anti-hyperlipidemic activity

Bael extract is reported to be able to reduce the lipid level. The antihyperlipidemic effect has been exhibited by Bael extract {9}. Umbelliferone present in Bael exhibits anti-hyperlipidemic activity. Saponins and coumarins in Bael leaf extract can reduce the cholesterol level {10}. Free cholesterol levels as well as ester cholesterol level has been reduced with Bael fruit powder {11}. Fasting blood glucose or FBG diabetic rats are treated with 250mg/kg aqueous Bael seed extract which results in reduction of blood glucose level by 60.85% {12}.

1.1.6. Anti-ulcer activity

Anti-ulcer activity exhibited by Bael has been reported in different studies. Gastric ulcer induced by lipopolysaccharide in rats has been administered orally with methanolic extract of Bael {13}.

1.1.7. Nephroprotective activity

The nephroprotective activity of Bael leaf extract has been obtained in Wistar rats. Increased serum creatinine, blood urea nitrogen level is the proof of gentamicin nephrotoxicity. Gentamicin can increase the MDA level also decrease catalase, glutathione levels. Bael extract can effectively reduce the increased serum creatinine, blood urea nitrogen level. This proves the nephroprotective activity {14}.

1.1.8. Anti-asthmatic activity

Leaf decoction of Bael is effective in reducing phlegm in cold and asthma. Studying with guinea pig ileum, the tracheal chain it shows an antagonistic effect on contraction evolved by histamine {15,16}. The presence of aegeline in Bael leaf helps to prohibit the release of histamine from mast cells {17}.

1.1.9. Immunity enhancer

Bael juice rich in vitamin C and antioxidants that helps to increase the immunity. Drinking Bael juice daily in the monsoon season will help in preventing infection due to virus anti-bacteria.

1.2. Experimental

1.2.1. Bael

Bael is one of the important fruit trees of Indian origin and it has been known in India from pre-historic times. Its medicinal properties have been dealt with in “CharakSamhita”, an early medicinal treatise in Sanskrit. The pulp of fruit contains many functional and bioactive compounds such as carotenoids, phenolics, alkaloids, coumarins, flavonoids, terpenoids and other antioxidants, which may protect against chronic diseases. The fruit is aromatic, cooling and laxative. The ripe Bael fruit is a tonic, restorative, laxative and is good for heart and brain, whereas mature Bael fruit is astringent, digestive, stomachic. The fruit is used for the treatment of diarrhoea and dysentery. Bael fruit is not consumed as a table fruit due to its hard shell, mucilaginous pulp and a large number of seeds and fibres in its pulp, although, it has a great potential for processing into several products viz., ready-to-serve drink, nectar, squash, preserve, candy, cheese and toffee {18}.

Biological source: Bael consist of the unripe or half riped fruits or their slices or irregular pieces of *Aeglemarmelos* Corr.

- Family: Rutaceae
- Sub family: Aurantioideae
- Kingdom: Plantae
- Order: Sapindales
- Genus: *Aegle*
- Species: *A.marmelos* {19,20}

1.2.2. Papaya

Carica papaya Linn belonging to family Caricaceae is commonly known as papaya in English, Papita in Hindi and Erandakarkati in Sanskrit. The plant is native to tropical America and was introduced to India in 16th century. The plant is recognised by its weak and usually unbranched soft stem yielding copious white latex and crowded by a terminal cluster of large and long stalked leaves, is rapidly growing and can grow up to 20m tall. Traditionally leaves have been used for treatment of a wide range of ailments, like in treatment of malaria, dengue, jaundice, immunomodulatory and antiviral activity. Young leaves are rich in flavonoids (kaempferol and myricetin), alkaloids (carpaine, pseudocarpaine, dehydrocarpaine I and II), phenolic compounds (ferulic acid, caffeic acid, chlorogenic acid), the cynogenetic compounds (benzylglucosinolate) found in leaves. Both leaf and fruit of the *Carica papaya* Linn. possess carotenoids namely β -carotene, lycopene, anthraquinones glycoside, as compared to matured leaves and hence possess medicinal properties like anti-inflammatory hypoglycaemic, anti-fertility, abortifacient, hepatoprotective, wound healing, recently its antihypertensive and antitumor activities have also been established. Leaves being an important part of several traditional formulations are undertaken for standardization for various parameters like moisture content, extractive values, ash values, swelling index, etc {21}.

- Biological Source: Papaya is the riped fruits of *carica papaya* linn.
- Family: Caricaceae
- Kingdom: Plantae
- Subkingdom: Tracheobionta
- Order: Brassicales
- Genus: *Carica*{22}.

1.2.3. Beetroot

It has wide range of application in dairy and production of value-added functional food. Food product mainly as colouring agent and for products. Beetroot extract is used in beverages, dairy products, cereals jams, jellies, candies, ice cream, yoghurt, sauces. In conclusion, beetroot is one of the oldest tuber roots known to mankind and is used as therapeutic and functional food ingredients from ancient time. It is used as natural food colouring.

Biological Source: It consist of Fresh root of *Beta vulgaris*

- Family: Chenopodiaceae
- Kingdom: Plantae
- Subkingdom: Tracheobionta
- Order: Caryophyllales
- Genus: *Beta*
- Species: *B. vulgaris* {23}.

2. Materials and method

2.1. Materials

2.1.1. Bael

All the Baels used in the preparation of jam were taken from the Bael plant itself.

2.1.2. Papaya

Papaya was taken from the local market.

2.1.3. Beetroot

Beetroot was taken from the local market.

2.1.4. Gelatine

Gelatine was taken from the local shop.

2.1.5. Citric Acid

Citric acid was purchased from the amazon. It was manufactured by M.M Khicha& Co Prince tower, Chennai. The batch no. of citric acid is RHA/18/1.

2.1.6. Sugar

Sugar was purchased from the local grocery shop.

2.2. Instruments

Table 1 Provide acaption to the table

Sr. No.	Name of Instruments	Company
1.	Hand Refractometer	ERM
2.	Mixer	Champion
3.	Brookfield viscometer	Shimadzu FTIR- 8400S
4.	Incubator	Lab Hosp

2.3. Method

2.3.1. Sampling

Fresh and properly ripe Bael, mango and beetroot fruits were taken. Then fruits were washed manually to remove any dust or foreign particles on their surface. We purchase the other excipients such as pectin, citric acid and sugar {23}.

2.3.2. Pulp Extraction

Papaya and Beal both fruits were peeled de-seeded and chopped manually into small pieces. The fruits were then ground individually using a mixer grinder, till the pulp become uniform and homogenous. The ground pulps were then strained through an 80- mesh strainer {23}.

2.4. Formulation Table:

Here we have taken the different quantities for the preparation of jam.

Table 2 Formulation Table

Sr. No.	Ingredients	Quantity
1.	Bael	80 gm
2.	Papaya	60 gm
3.	Beetroot	8 ml
4.	Sugar	50 gm
5.	Gelatine	1 gm
6.	Citric acid	1 gm

2.5. Procedure

2.5.1. Inspection

The first step of jam production is the selection of ripe fruits. These fruits are handpicked and categorized based on their colour, smell and appearance. Rotten or damaged fruits are removed.

2.5.2. Washing

Selected fruits are now washed with water. Water is not forced instead of Dump and spray washers are used in industries to prevent fruits from getting damaged. The fruits were then ground individually using a mixer grinder, till the pulp become uniform and homogenous. The ground pulps were then strained through an 80-mesh strainer.

2.5.3. Addition of sugar

Sugar and pectin are added to the prepared fruit pulp in the required quantity using the suggestion of recipe development services. Water can be added to lower the concentration. A network is formed as sugar is added because it frees up the pectin chains and binds the water molecules together.

2.5.4. Boiling

One of the most critical steps in jam making is boiling, which has to be done with more patience. The prepared mixture kept on the flame. After a few mins, the sugar starts to dissolve the room is filled with a fruity smell.

2.5.5. Addition of citric acid

The required amount of citric acid is added while boiling. To ensure the proper setting of jam temperature of heating is maintained at 105 C or 68-70%TSS. To check the background of the jam sheet test is conducted. Sheet test is conducted by taking a small portion of jam and cooked a little then it is allowed to drop from the spoon if the jam drops or flakes the jam is prepared perfectly if not the jam is boiled for some more time. After adding the citric acid. Add the one gram of gelatine. Judging of end-point (sheet test).

2.5.6. Filling into hot sterilized glass bottles (100g capacity)

Bottles are sterilized before the hot jam is poured into it, cooling of these hot bottles is done by putting it into the water bath. Paraffin wax or other waxes are used for waxing after which metal caps are vacuum capped to the bottle. Sealing with cap.

2.5.7. Storage

Bottled jam is now ready to be stored, and these are kept in a cool and dry place and protected from direct sunlight. Bottled jams have a shelf life of at least 12 months. The food development industry must check this properly.

2.6. Evaluation Parameter

- Sheet or Spoon Test
- Cold Plate Method
- Wrinkle Test Method
- Antimicrobial Activity
- Viscosity Test

2.6.1. Sheet or Spoon Test

Test A small portion of jam is taken out during in a spoon or wooden ladle and cool slightly. It is then allowed to drop. If the product falls off a sheet or flakes instead of flowing in a continues stream or syrup, it means that end point has been reached and the product is ready. Otherwise, boiling is continued and the sheet test is positive {24}.

2.6.2. Cold Plate Method

Pop a plant in the freezer at the beginning of cooking time once the jam has reached its setting time has thickened, spoon a bit jam on the cold plate and tilt it vertically so the jam runs {25}.

2.6.3. Wrinkle Test

Take the jam off the heat while testing push your finger through the jam on the plate, if the wrinkles are appearing the test is pass. If it floods back into fill the gap then the jam does not pass the test {26}.

Solubility Test

- Principle

The hand- held refractometer is and instrument that uses the principle of refraction of light to detect the contain or concentration of soluble substances in a liquid {27}.

We took two solvents (Water, 90% Alcohol). Firstly, we checked the solubility of jam in 90% alcohol (1gm in 9ml of 90% alcohol), The result showed that jam was insoluble in alcohol After that we checked the solubility of jam in water. The result showed that jam was soluble in water.

- Procedure

Place a small amount of liquid (usually 2-5 drops) on the prism and secure the cover plate. This will evenly distribute the liquid on the prism. Point the prism end of the refractometer towards a light source and focus the eye piece until the scale is clearly visible {27}.

Table 3 Solubility Table

Jam	Solvent	Quantity of solvent
1gm	Alcohol	2 ml
1gm	Water	2 ml

2.6.4. Antimicrobial Activity

All the synthesized compounds were tested in vitro against gram-positive bacteria (*Staphylococcus Aureus*) 2079, Antimicrobial activity was determined as follows:

- Preparation of Sterile Plates
- Preparation of Slants
- Preparation of Media

Preparation of Sterile Plates

All the petri plates were clean properly by using detergent, then rinse with methanol and dry in hot air oven at 120°C. Plates were mark at bottom side and wrap in paper. The plate was sterilized by keeping them in hot air over at 160°C for 1 hr {28}.

Nutrient broth for Bacteria

Accurately weighed nutrient broth (3gm) dissolved in distilled water (250ml). Autoclave the solution (for 15min.at15lbs). After cooling the solution transferred it in two test tubes in sterile area {29}.

Nutrient Agar for Bacteria

Accurately weighed beef extract (2.5gm) peptone (2.5gm) sodium chloride (1.25gm) Agar (2.5g) dissolved in distilled water (250ml). Autoclave the solution (for 15 min. at 15lbs). After cooling the solution transferred it in two test tubes or pour it into petri plate in sterile area. Keep the slant at 37°C at inclined position {28}.

- Preparation of Media

Accurately weighed thioglycolate media (1.5g) dissolved in distilled water (50ml) and adjust the pH 7.1 using sodium hydroxide solution. Autoclave the solution at 121°C (15lbs) for 15min and transferred to five test tubes, plug the tubes with cotton. Then the slant is transferred to each with help of wire loop and place the tubes in incubator {29}.

- Disc Diffusion method

Disc diffusion method for antimicrobial susceptibility testing was carried out according to the standard method by Bauer et al. (1966) to assess the presence of antibacterial activities of the plant extracts. A bacteria culture (which has been adjusted to 0.5 McFarland standard), was used to lawn Muller Hinton agar plates evenly using a sterile swab. The plates were dried for 15 minutes and then used for the sensitivity test. The discs which had been impregnated with a series of plant extracts were placed on the Mueller Hinton agar surface. Each test plate comprises of six discs. One positive control, which is a standard commercial antibiotic disc, one negative control, and four treated discs. The standard antibiotic discs were Ofloxacin 30ugfor *S. aureus* . The negative controls were DMSO (100%). Besides the controls, each plate had four treated discs placed about equidistance to each other. The plate was then incubated at 37 °C for 18 to 24 hours depending on the species of bacteria used in the test. After the incubation, the plates were examined for inhibition zone. The inhibition zone was then measured using callipers and recorded. The test was repeated three time to ensure reliability {30}.

2.6.5. Viscosity Test

Viscosity is defined as the property of fluid which offers resistance to the movement of one layer of fluid over another adjacent layer of fluid the viscosity of formulated herbal jam was determined was carried out on brook field viscometer using spindle number 3 Determination was carried and obtained result.

Procedure For determination of viscosity

- Ensure that all the connections of the instrument are proper.
- Turn the viscometer ON.
- Take out the viscosity standard solutions in 500 ml beaker, adjust the temperature to 250C. Attach the required spindle, adjust required speed & measure the viscosity, note down the constant reading.{31}.

3. Results and discussion

3.1. Sheet test

The sheet test shows the result of the product which falls off in the form of sheet or flakes. When the product falls off a sheet or flakes instead of flowing in a continues stream or syrup, it means that end point has been reached and the product is ready then the test concluded that the product passes the test.

3.2. Cold Plate test

In the cold plate method after making the jam at the beginning of cooking time the jam is thickened then after plate tilting the vertically with jam, The test resulted as the product runs vertically and shows the positive result.

3.3. Wrinkle test

In this test the product forms the wrinkles and does not flood back, and product pass the test.

3.4. Solubility Test

Table 4 Solubility Test

Sr. No.	Solvent system	Solubilized substance %
1.	Alcohol	1%
2.	Water	2%

The result of solubility test indicates that prepared Jam showed 3% of solubilized substance in water at room temperature. Based on these results it can be concluded that 30% of Jam content are soluble in water and insoluble in alcohol.

3.5. Anti – Microbial Activity

This test is use to determine the antimicrobial activity in the prepared jam by the well diffusion method against the gram-positive bacteria "*Staphylococcus Aureus*"

The result of antimicrobial activity for the gram-positive bacteria "*Staphylococcus Aureus*" was positive



Figure 1 Antibacterial activity of Nutritive jam against *Staphylococcus Aureus*

Table 5 Antibacterial activity of Nutritive Jam Against *Staphylococcus Aureus*

Sr. No.	Test Compound Code	Antimicrobial Sensitivity Test against bacteria after 24hr. at 37 C Temp. (<i>Staphylococcus Aureus</i>)
1	Test Compound	11MM
2	Control	-
3	Reference(Ofloxacin)	16MM

3.6. Viscosity Test

Viscosity of the prepared jam is found to be 2.53pa as determined by the viscometer using spindled no.3 and 100RPM at temperature 37 °C.

4. Conclusion

It can be concluded that jam made from Bael and Papaya fruit is highly nutritious and good for human consumption. Jam prepared from Bael and Papaya fruit exhibited gradual change in moisture, Ph, total sugar and phenolics content. Bael fruit shows the medicinal properties such as anticancer, antibacterial antidiabetic. The nutritive jam also shows the antimicrobial against *Staphylococcus Aureus*. The Papaya contain high level of antioxidants vitamin A, vitamin C, vitamin E and Papaya also contain 2 enzymes, papain and chymopapain both enzyme digest protein they can help with digestion and reduce inflammation. The jam samples are safe for human consumption if prepared under safe, hygienic conditions.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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