

Role of Underutilized Fruits for Nutritive Value and Its Value-Added Products: A Review

ABSTRACT

Underutilized fruits that's are not commonly cultivated or traded on large scale grown in the mostly wild and consumed both locally and globally. It fruits are typically rich in essential carbohydrate, proteins, fats, fibres, vitamins, minerals, and bioactive compounds, offering health benefits that can address global malnutrition and micronutrient deficiencies. Additionally, many underutilized fruits, such as Aonla, Karonda, Jamun, Ber, Bael, Wood apple, Phalsa and Lasoda provide dietary fiber, supporting digestive health and reducing the risk of chronic diseases. Beyond their nutritional benefits, underutilized fruits play a key role in sustainable agriculture. Furthermore, the processing of underutilized fruits into value-added products such as Jam, Jelly, Preserve, Candy, Powder, Wine, Pickle, Fruit bar, Squash and nutraceuticals opens new economic opportunities. This transformation not only reduces post-harvest losses but also provides income for farmers, particularly in rural communities. With global market potential, these products can be marketed as functional foods, promoting health and sustainability. This review explores the diverse roles these fruits play in promoting human health, reduce malnutrition, environmental sustainability, and contribution in nation economically.

Keywords: Underutilized Fruits, nutritive value, value added products

1. INTRODUCTION

Indigenous fruit crops are more adaptable to environmental conditions and have higher nutritional value (Berwal *et al.*, 2021). Limited study has been conducted to create production procedures and utilize these neglected fruit species. Systematic cultivation of underused crops is hindered by a lack of identifiable varieties, quality planting materials, and appropriate cultural and post-harvest management procedures. Arid vegetation is rich in edible fruit-bearing and food-producing species. Around 30 plant species in the Indian dry zone have food purposes, with 19 bearing edible fruits and having horticultural relevance (Rathore, 2009). Underutilized fruit crops have multiple uses, including fresh fruit, culinary and medicinal uses, and ornamental value. The locals are aware of their therapeutic and nutritional advantages. Nowadays, customers are paying more attention to the nutritional value and overall health of the foods in their basket. Underutilized fruit crops are widely used as medicinal plants in India, including Unani, Ayurveda, and Homoeopathy. Consuming fruits can reduce non-communicable diseases like cardiovascular disease, type 2 diabetes, and certain cancers (Ganry, 2006). Indigenous fruits are widely available and often underutilized. India's most underutilized fruits include Aonla (*Emblica officinalis*), Bael (*Aegle marmelos*), Wood Apple (*Feronia limonia*), Jamun (*Syzygium cumini*), Ber (*Ziziphus mauritiana*), Karonda (*Carissa carandas*), Phalsa (*Grewia subinaequalis*) and Lasoda (*Cordia myxa*).

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Tropical fruits are underutilized yet serve a crucial role in meeting the demand for healthy, flavourful, and appealing natural foods with medicinal benefits. It is anticipated that natural goods would contain soluble dietary fiber, which lowers cholesterol and lipids in the body to facilitate easy bowel movements and strengthens the immune system (Singh and Bhatnagar, 2019). Fruit post-harvest losses are higher in underdeveloped countries compared to well-developed ones. Losses from harvest to consumer point might reach 30-40%, amounting to millions of crores of rupees. Fruit processing is required to offer fair returns for growers and enhance their economic situation. Processed products such as jam, jelly preserve, candy, powder, pickle, fruit bar, squash and wine. This also contributes to reducing underemployment in agricultural areas during the off-season. Perishable fruits are seasonal surpluses that are often squandered due to inadequate handling, distribution, marketing, and storage facilities. Excessive production of perishable fruits during one season might lead to market gluts and scarcity in other seasons. Food preservation is crucial for conserving and utilizing fruits, preventing gluts, and maximizing surpluses during the off-season. Modern methods must be used to increase storage life and preserve products for off-season use on a large or small scale (Bhattacharyya and Bhattacharjee, 2007; Jena et al., 2013). Analyzing production, processing, marketing, and upgrading strategies for fresh and processed fruit, as well as developing niche markets for high-value produce, opens up new potential for developing nations' producers and exporters to fulfill required requirements.

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2. NUTRITIVE VALUE OF UNDERUTILIZED FRUITS

Underutilized fruits, which are frequently overlooked in mainstream diets, are nutrient-dense and provide a wide range of health advantages due to their distinct vitamin, mineral, and phytochemical profiles. Here is an overview of the nutritional value of some of the most underused fruits:

2.1 AONLA

Scientifically known as (*Emblica Officinalis*), this plant is part of the Euphorbiaceae family. Aonla organic products are highly nutritious, have medicinal benefits, and contain high levels of vitamin C. Ascorbic acid and tannins may be derived from natural sources. The synthesis of natural products is influenced by environmental factors. Aonla is particularly rich in vitamin C. According to (Singh and Singh, 2004), the mash of a new organic product includes 200-900 mg of vitamin C. Natural product juice offers nearly 20 times as much vitamin C as squeezed oranges.

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Table-1 Chemical Composition of Aonla Fruits

Nutrients	Nutrient value per 100g edible portion
Moisture	80.22- 89.36
Ascorbic acid (mg/100g)	200- 1500
Acidity (% citric acid)	1.25- 3.24
TSS (^o Brix)	10.32- 16.00
Reducing sugar (%)	1.04- 4.09
Non-reducing sugar (%)	3.05- 7.23

Total sugars (%)	7- 9.6
pH	2.20- 3.21
Protein (%)	0.65- 0.98
Tannin (% gallotannic acid)	0.35- 0.64

Source: (Singh *et al.*, 2004)

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2.2 KARONDA

Karonda (*Carrisa carandus* L.) is a native plant of India belonging to family Apocynaceae and popularly known as Christ's thorn. In India, it is grown on a limited scale in Rajasthan, Gujarat, Bihar, West Bengal and Uttar Pradesh. The plant is mostly used as an ingredient or condiment in cold drinks, Indian food, and spices. In order to flavor the fruit, cloves and sugar are occasionally added in place of apples while making apple tarts. As shown by (Chandra, 1972 and Siddiqui *et al.*, 2003), fruits are frequently combined with green chilies to create a delicious dish that is served with chapattis in many parts of India. According to (Khare *et al.*, 2008), the root is ground up with lime juice, horse urine, and camphor in Konkan, India, as a treatment for itching.

Table-2 Chemical Composition of 100g Karonda Fruits

Nutrients	Fresh Fruit	Dried Fruit
Energy (Calorie)	42	364
Moisture (%)	91	18.4
Fat (%)	2.9	9.6
Carbohydrate (%)	2.9	67.1
Protein (%)	1.1	2.3
Mineral (%)	-	2.8
Calcium (mg)	2.1	160
Phosphorus (mg)	28	60
Iron (mg)	-	39.1
Vitamin C (mg)	200-500	1

Source: (Tripathi *et al.*, 2014)

2.3 JAMUN

Jamun (*Syzygium cuminis keels*) belongs to the family Myrtaceae. Jamun is an important medicinal herb used in a variety of traditional medical systems. It effectively treats diabetes, aggravation, ulcers, and the run. It contains high levels of anthocyanins and glucosides.

Organic products contain anti-oxidant compounds such as flavonoids, phenolics, carotenoids, and nutrients that are beneficial to human health, reducing the risk of degenerative diseases, and preventing macromolecular oxidation (Kubola *et al.*, 2011). The seeds contain jambosine, an alkaloid, and the glycoside jambolin or antimellin, which inhibits the diastatic conversion of starch into sugar.

Table-3 Chemical Composition of Jamun Fruit

Nutrients	Fruit	Seeds
Moisture (%)	82.19	16.34
Crude protein (%)	2.15	1.97
Crude fat (%)	0.83	0.65
Crude fiber (%)	1.76	4.19
Ash (%)	2.04	2.18

Source: (Choptra, 1958 and Raza *et al.*, 2015)

2.4 BER

Ber, also known as Indian Jujube (*Zyziphus mauritiana*), belongs to the Rhamnaceae family. This fruit tree thrives in marginal or poor soils, when other commercial fruit plants struggle or fail. Jujube seeds contain saponins, jujubogenin, and obelin lactone (Maciuk *et al.*, 2004 and Abdoul, 2016). Jujube wood is used for firewood or charcoal production, and its leaves are fed to sheep and goats (Feyssa, 2011).

The fruit is high in vitamins C, A, B, carotenoids, protein, Ca, P, K, Rb, Br, La, and sugars (fructose, glucose, and galactose) (Anjum, *et al.*, 2018). The smoke from its burned leaves is also used to treat skin, cough, and cold conditions. Ber fruit is often consumed within 4-5 days of harvest due to its limited shelf life.

Table-4 Chemical Composition Fresh Fruit of Ber

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	82.01
Carbohydrate (g)	5.4 - 10.5
Protein (g)	0.8
Fat (g)	0.07
Fibre (g)	0.60
Calcium (mg)	25.5
Phosphorus (mg)	26.8
Iron (mg)	0.76-1.8
Vitamin B3 (mg)	0.02-0.024
Vitamin C (mg)	65.8-76.0
Vitamin A (carotene) mg	0.021

Source: (Morton, 1987)

2.5 BAEL

Aegle marmelos (Bael) is an important indigenous fruit of India and belongs to Rutaceae family. The bael fruit contains riboflavin, which can be used to treat beriberi. Unripe fruit can treat diarrhea and dysentery, while marmelosin in the fruit can treat stomach disorders (Hasan *et al.*, 2010). Bael plant parts contain medicinal compounds such as coumarins, alkaloids, sterols, and essential oils. These compounds have analgesic, anti-inflammatory, anti-antifungal, anti-microfilaria, hypoglycemic, anti-dyslipidemic, antiproliferative, wound healing, insecticidal, and anti-fertility properties (Neeraj *et al.*, 2017).

Table-5 Chemical Composition of Bael Fruit

Nutrients	Nutrient value per 100g edible portion
Water (g)	57.46
Protein (g)	2.13
Fat (g)	0.3
Carbohydrates (g)	29.07
Ash (g)	1.3
Carotene (mg)	54.5
Thiamine (mg)	0.10
Riboflavin (mg)	1.03
Niacin (mg)	0.9
Ascorbic Acid (mg)	75
Tartaric Acid (mg)	1.98

Source: (Singh *et al.*, 2012)

2.6 WOOD APPLE

The only species of its genus in the "Rutaceae" family is the wood apple (*Feronia limonia*). It grows naturally on the arid plains of India, Pakistan, and Sri Lanka. It is also occasionally grown in orchards, beside roads, and on the edges of fields. Wood apple has excellent therapeutic properties. (Ramakrishna *et al.*, 1979), found that all parts of the fruit, including pulp, seed, and oil, have therapeutic properties. In India, the fruit is used as a liver and cardiac tonic, and when unripe, it can treat diarrhea, dysentery, hiccup, sore throat, and gum disease (Mondal *et al.*, 2002).

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Table-6 Chemical Composition of Wood Apple Fruit

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	74.00

Protein (%)	7.30
Carbohydrates (g)	15.50
Riboflavin(mg)	170
Vitamin C (mg)	2 .00
Calcium (%)	0.17
Phosphorus (%)	0.08
Iron (%)	0.07

Source: (Morton, 1987)

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2.7 PHALSA

Phalsa (*Grewia subinaequalis*) belongs to the Tiliaceae family. Fruits are a source of vitamins and minerals. The fruit contains primarily citric acid and trace amounts of malic acid. It is rich in vitamin A and antioxidants. Fruits have high levels of flavonoids, carotenoids, and anthocyanins. Phalsa fruits contain potassium, which helps with energy metabolism and blood pressure regulation. Fruits contain proteins, amino acids, vitamins, minerals, and bioactive substances such as anthocyanins, tannins, phenolics, and flavonoids, making them valuable sources of nutrition.

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Table-7 Chemical Composition of phalsa fruit

Nutrients	Nutrient value per 100g edible portion
Moisture (%)	80.8
Carbohydrate (%)	21.1
Protein (%)	1.5
Fat (%)	0.9
Fibre (%)	1.2
Calcium (mg)	129
Phosphorus (mg)	39
Potassium (mg)	375
Iron (mg)	3.1
Vitamin B3 (mg)	0.3
Vitamin C (mg)	22
Vitamin A (carotene) ug	419

Source: (Gopalan *et al.*, 1989)

2.8 LASODA

Cordia myxa L. locally known as Gonda, Lasora or lehsua belongs to Boraginaceae family. Minor fruits provide significant benefits for horticulture in the 21st century, including profitability, productivity, sustainability, crop quality, food safety, environmental protection, and rural economic development. Lasoda is a fast-growing tree with a lovely inverted dome/umbrella crown. It is used as an avenue tree and ornamental furniture, and its ovate, alternating, and stalked leaves are used as feed during hot summers when green grasses are not available, as well as for lac insect rearing (Ahuja *et al.*, 2020 and Reddy, 2019). The trees produce white hermaphrodite blooms in March and unripe green fruit from April to June. Green fresh veggies and pickles are commonly employed, particularly during times of limited access to traditional vegetables (Bhatnagar *et al.*, 2016). Fruit is a natural source of

antioxidants such as carotenoids, ascorbic acid, phenols, minerals, crude fiber, protein, ascorbic acid, ash, and vitamins. These nutrients are necessary for human health and disease treatment.

Table-8 Chemical Composition of Lasora

Nutrients	Nutrient value per 100g edible portion
Carbohydrate (%)	57.08
Crude protein (%)	8.32
Crude lipid (%)	2.2
Crude fibre (%)	25.7
Potassium (mg)	7.83
Sodium (mg)	1.62
Calcium (mg)	0.46
Iron (mg)	0.51

Source: (Aberoumand, 2011)

3. VALUE-ADDED PRODUCTS FROM UNDERUTILIZED FRUITS

Underutilized fruits are frequently disregarded in traditional agricultural and commercial marketplaces, despite their enormous potential for generating value-added products. We can eliminate waste, create revenue, and introduce people to new, healthful options by changing these fruits into a variety of inventive solutions. Here are some strategies to successfully use underused fruits:

3.1 Processed Products of Aonla

The various prices comprised goods arranged from Aonla organic products, such as murabba, chawanparash, and triphala. Recently, esteem expansion has introduced new products such as aonla sweets, natural jam, chutney, pickle, squash, preserve, juice, sharbat, vinegar, and more. Natural powder is also used in the preparation of toiletries and makeup. Various groups in India are developing new handling techniques and conducting research to increase the use of Aonla. Aonla has numerous dietary benefits and should be included as a regular part of one's diet. (Hasan *et al.*, 2010) suggest that it can also help with uterine drainage, leucorrhoea, and blood release.

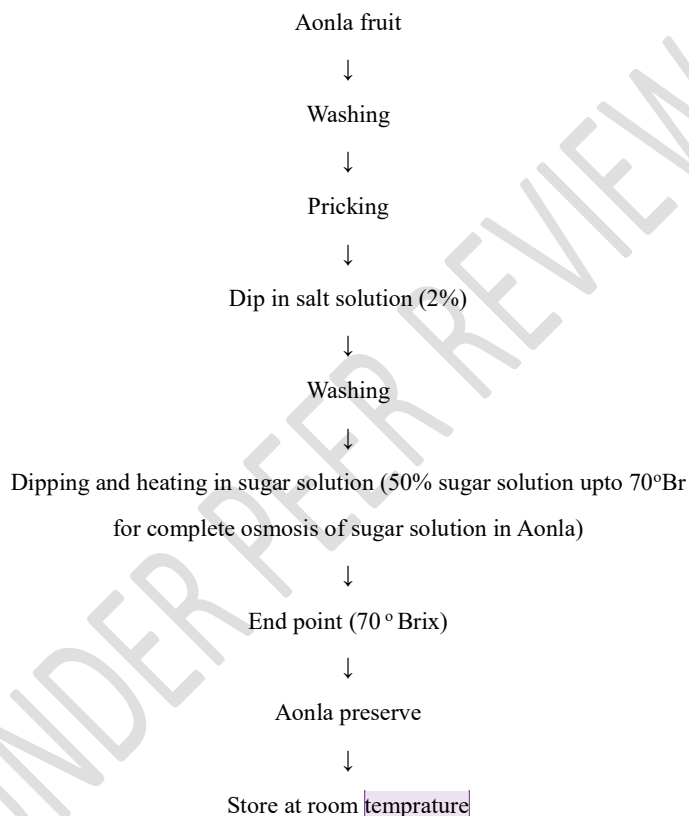
- **Jam**

Jam is a concentrated fruit product with a thick body and natural fruit flavors. Fruit's high sugar concentration and pectin content help preserve it. To make it, boil the fruit pulp and juice with sugar until it's thick enough to hold the fruit tissues together. Fruit jam should include 45% fruit percentage and 68% total soluble solids.

- **Preserve**

Aonla preserve, also known as aonla murabba in India, is a highly popular traditional product. It purifies blood, lowers cholesterol levels, and improves vision (Ranote and Singh, 2006). Preserves are made by impregnating matured, entire or large pieces of fruit with sugar until soft and clear. Fruit should make up at least 55% of the preserve. Pricking (piercing) is done in aonla to reduce astringency and allow syrup to penetrate the fruits.

Chart- 1. FLOW CHART OF PRESERVE



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3.2 Processed Products of Karonda

Fruits are used to make jam, jelly, sauce, candy, carissa cream, jellied salad, pickles, and chutney. (Nalawadi *et al.*, 1975), have shown that dried fruits can replace raisins. The ripe fruit produces gummy latex when boiled, but produces a rich red juice that clears when cooled, making it a delightful drink during the summer.

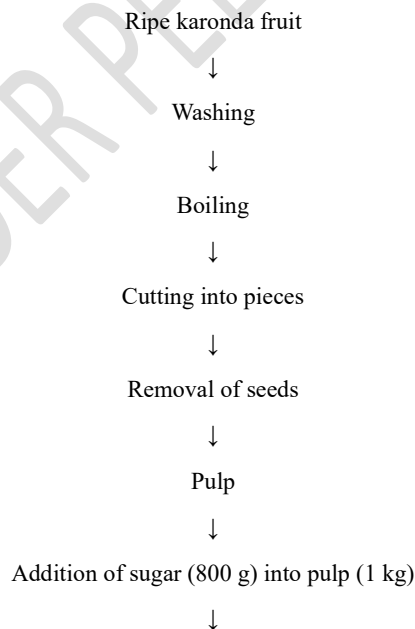
- **Candy**

To make candy, unripe Karonda fruit is blanched in 500 ppm potassium metabisulphite using hot water. The prepared slices of fruit were steeped in syrup of 60, 65, or 70°Brix with citric acid, cane sugar, and jaggery at various percentages. The sugar and jaggery solution was made at a concentration of 60 °Brix. After 24 hours of steeping, syrups were drained and concentrations were gradually increased by °Brix till reaching 70 °Brix. Fruit slices were drained of syrup, rinsed with tap water, and dried in the shade for 24 hours. After drying, the candy was packed in 250 gage polythene bags and stored at room temperature (Patil *et al.*, 2014).

- **Jam**

Karonda fruits in India range from purple to deep crimson and are used to produce jam. Ripe fruit contains acids, micro and macro nutrients, and can be combined with sugar to make jams. The fruits have a high pectin content, making them excellent for commercial jam or jelly production. Fresh and undamaged karonda fruits are washed and sliced into halves. After removing the seeds, place the fruits in a pan with a heavy bottom and water. The fruits are cooked in water till soft. Sugar (1150 g sugar/kg karonda pulp) is added and stirred until the end point is reached, as determined by drop test, TSS (68-70%), and sheet test. To make smooth jams, strain sensitive fruit through a sieve to create a smooth pulp, then add sugar. Once cooled, place it in a glass bottle. FPO requirements require jam to contain at least 68% TSS and a maximum fruit content of 45% (w/w). According to (Wani *et al.*, 2013), this jam has a shelf life of at least three months.

Chart 2- FLOW CHART OF JAM



Heating



Karonda jam (end point 68.5° Brix)

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3.3 Processed Products of Jamun

The prepared natural products are used to create energizing health drinks, jams, squashes, powder, and wine. Jamun is known for producing high-quality wine similar to Port. Cognac and "jambava" alcohol are made from matured Jamun juice. Jamun organic products are used to manufacture high-quality vinegar with a clear purple color, pleasant aroma, and mild flavor. Ready Jamun organic product juice is used to make sauces and drinks.

- **Powder**

In India, just a few food businesses have released health claim powders with jamun as an ingredient. Shahnawaz and Sheikh conducted research on preserving jamun in powder form (Shahnawaz *et al.*, 2008). The powder was kept in glass containers and maintained at 25±2°C and 90% RH. The factors measured were moisture content, color, and stickiness. The product had a predicted shelf life of almost 300 days.

- **Wine**

(Shukla *et al.*, 1991) employed *Saccharomyces cerevisiae* to standardize wine production, yielding 10.93-11.23% ethanol depending on the cultivar selected. Pre-treating the pulp with pectic enzyme (0.25%) and aging the final product for 6 months improved the sensory acceptance of the wine. Enzyme treatment boosted acidity and ethanol concentration while decreasing reducing sugar and tannin levels in the finished wine. (Chowdhury and Ray, 2007), found that fermenting jamun fruit with *S. cerevisiae* var bayanus resulted in 6% ethanol and a high anthocyanin concentration (60 mg/100 mL) in jamun wine.

Chart 3- FLOW CHART OF WINE

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Jamun fruits



Washing



Blanching

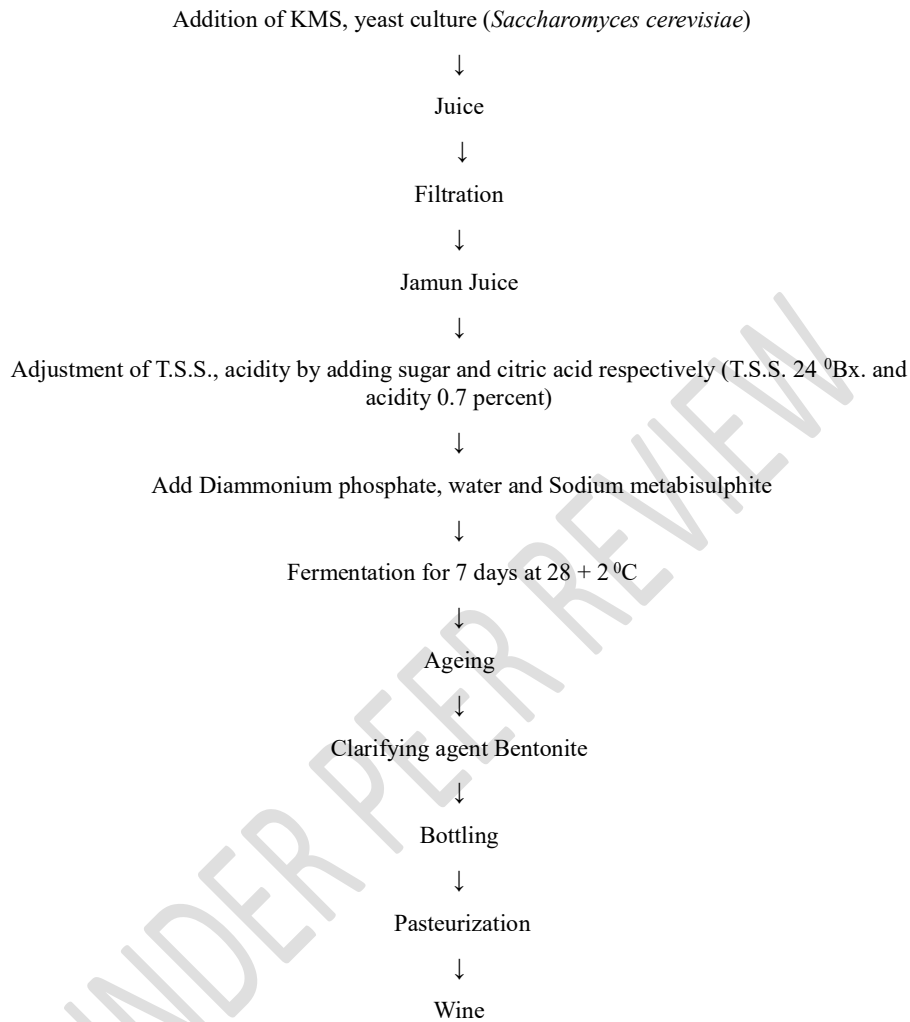


Pulping



Filtration





3.4 Processed Products of Ber

Ber fruit can be used to make a various products including jam, sweets, preserves, powder, murabba, drinks, wine, pickles, and ready-to-serve. The root and bark decoction can treat dysentery and diarrhea, while the leaf decoction is effective as a gargle for sore throats and bleeding gums. Ber root powder offers therapeutic potential for treating ulcers, fevers, and wounds, according to (Diengngan *et al.*, 2015).

- **Jam**

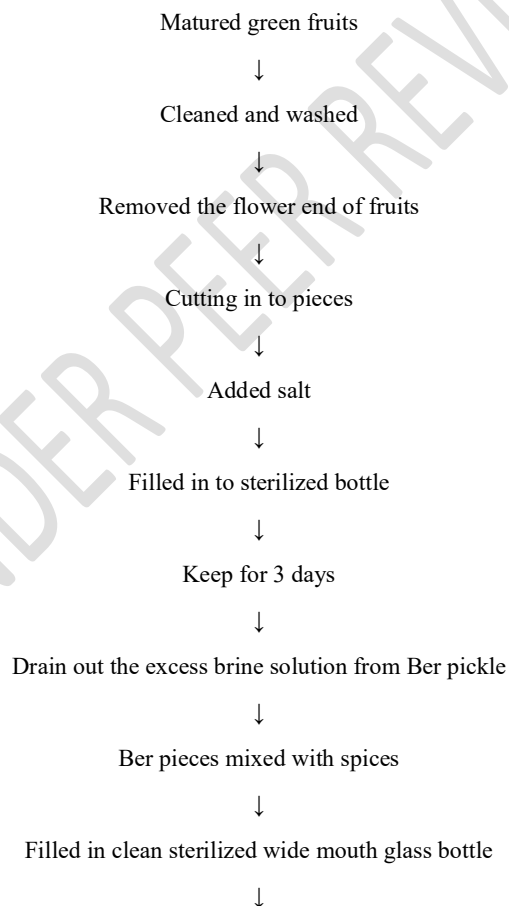
Jams are a common fruit preserve made from whole fruit, bits of fruit, pulp, or puree, with or without juice. According to (Ranganna, 1977), fruit juice can be optimally combined with carbohydrate sweetener, water, and processed to an appropriate consistency.

- **Pickle**

Pickling is the preservation of food through anaerobic fermentation in brine or immersion in vinegar. Ber fruit are not excellent for pickling due to their high mucilage content and mild acidity. (Shobha and Bharati, 2007), developed a systematic pickling technique for ber to increase value. Lemon and salt were employed as acidulants in pickle manufacture, with three different variations using different amounts of salt, lemon, and spices.

Chart 4- FLOW CHART OF PICKLE

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Covered the fruits with lemon juice and vinegar



Corked



Storage at room temperature

3.5 Processed Products of Bael

Bael fruit is considered underutilized due to its lack of commercial growth and widespread trading. According to (Singh, 2007), it is cultivated, traded, and consumed locally. Several bael-processed items, including preserves, candy, sweets, panjiri, toffee, and jam, have been developed by scientists and researchers. (Rakesh *et al.*, 2004) provided standardized recipes for bael processed products.

- **Preserve and candy**

Preserves and candy are made by impregnating mature (tender green) fruits with sugar until they become soft and translucent. The minimum fruit portion and total soluble solids in preserves are 55 and 70%, respectively (Lal *et al.*, 1960). Fruits contain more than 75% water and can rot quickly if not stored properly. Removing water from fruits can extend their shelf life. Osmotic dehydration preserves the flavor, color, and texture of fruits while preventing microbiological decomposition (Bongirwar, 1997). It also allows for longer storage times. Candied fruit refers to fruit pieces that have been impregnated with sugar or glucose syrup, then drained and dried. To prevent fermentation, the impregnated fruit's sugar level is kept around 75%. Bael candy is made by draining fruit slices from syrup and drying them in an oven at 55-60°C for 8-10 hours. (Srivastav and Kumar, 1993), recommend at least 25% fruit pulp or juice, 40-50% TSS, and 1% acid. To create squash from bael fruit pulp, TSS was adjusted and preservatives were added, including sodium metabisulphite at 350 ppm SO₂ (Bhat and Kaul, 2006) and sodium benzoate at 1g/liter. The squash was placed in sterilized bottles, pasteurized at 80°C for 30 minutes, cooled, and wax-sealed for airtightness (Kenghe, 2008).

- **Jam**

Jam is a concentrated fruit product with a strong body and natural flavor. Fruit's pectin and high sugar content help preserve it. To make it, boil the fruit pulp and juice with sugar until it's thick enough to hold the tissues in place. Fruit jam should have a minimum of 45% fruit and 68% total soluble solids.

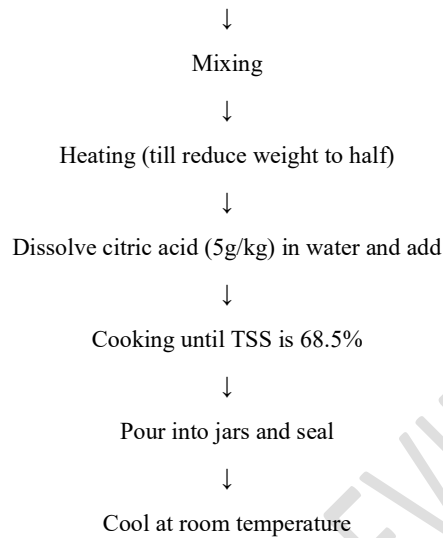
Chart 5- FLOW CHART OF JAM

Fruit Pulp



Addition of 1 kg sugar, 10 g pectin/kg fruit pulp

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3.6 Processed Product of Wood Apple

Fruit pulp can be used to prevent value-added products such as preserves, candy, sherbet, juice, chutneys, jam, jelly, squash and fruit bar. Although the pulp can be eaten raw, it is often frozen or processed into jam. It can be used with coconut milk to create a healthy beverage or frozen into ice cream. Wood apple is beneficial for digestion by destroying worms in the colon and addressing digestive issues.

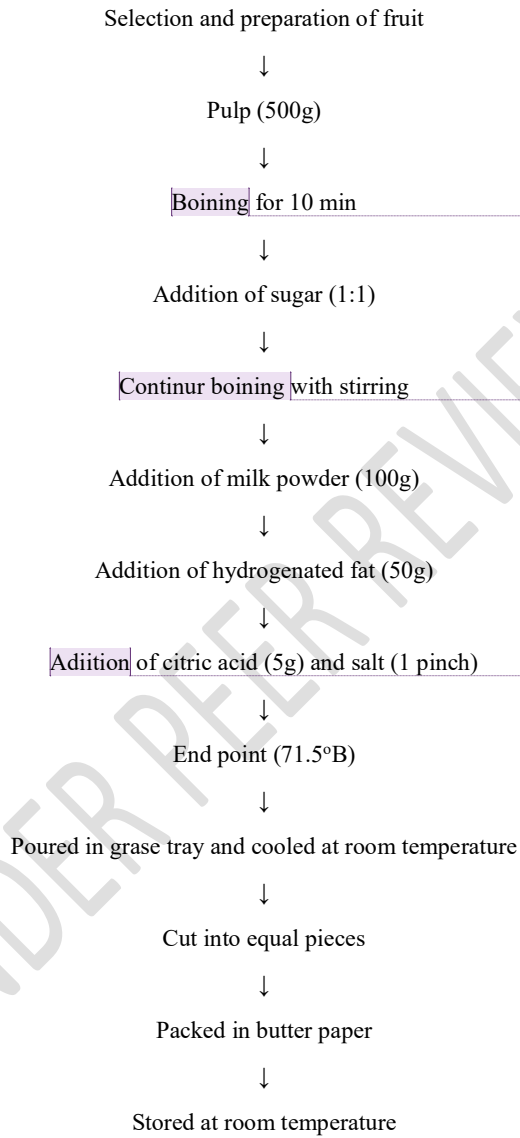
Jelly

Fully mature fruits were utilized in the preparation of wood apple jelly. The pulp was scraped from the shell with a knife or spoon, and the seed was separated manually using a sieve. Wood apple juice was extracted. After extracting juice from wood apple fruit, a pectin test was conducted to determine the appropriate amount of sugar to add for a stable jelly. Sugar was added to the extract and heated until it reached a Brix TSS of 65. The juice and sugar mixture was cooked to get the appropriate jelly consistency. The prepared jelly was put into a sterilized widemouth bottle and sealed with an airtight (Singhania *et al.*, 2022).

- **Fruit Bar**

Fruit Bar is a nutritious snack with a chewy feel comparable to dried raisins. It contains dietary fiber and natural sugars. Selection and preparation of fruits Pulp (500 grams) Boil for 10 minutes. Adding sugar (1:1) Continue boiling while stirring. Add 100g of milk powder. Addition of hydrogenated fat (50g). Add citric acid (5g) and salt (1 pinch) End point: (71.50 °B) poured into a glass tray and cooled to room temperature. Cut in equal pieces. Packed in butterpaper. Store at room temperature (Vidya and Narain, 2011).

Chart 6- FLOW CHART OF FRUIT BAR



Source: (Vidhya and Narain, 2011)

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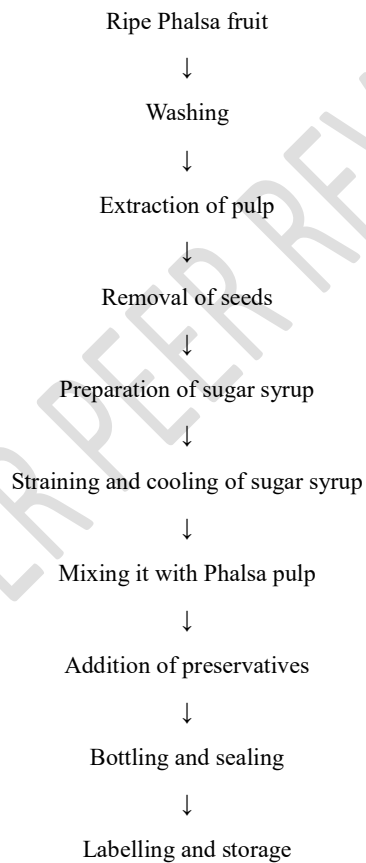
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3.7 Processed Products of Phalsa

Phalsa fruit is popular due to its appealing color (varying from crimson red to dark purple) and tasty flavor. The juice, which varies in color from deep crimson to dark purple, is often consumed. It has a high rating in indigenous medicine. This juice is refreshing and cooling, making it ideal for hot summer days. Fruits typically contain 50-60% juice, with the edible portion ranging from 69-93%. According to (Bora and Bons, 2015), the fruits are typically consumed fresh. Fruits have a cooling impact on the body and can be used to make juice, squash, syrup, and crush (Boora and Bons, 2015; Pangotra *et al.*, 2018).

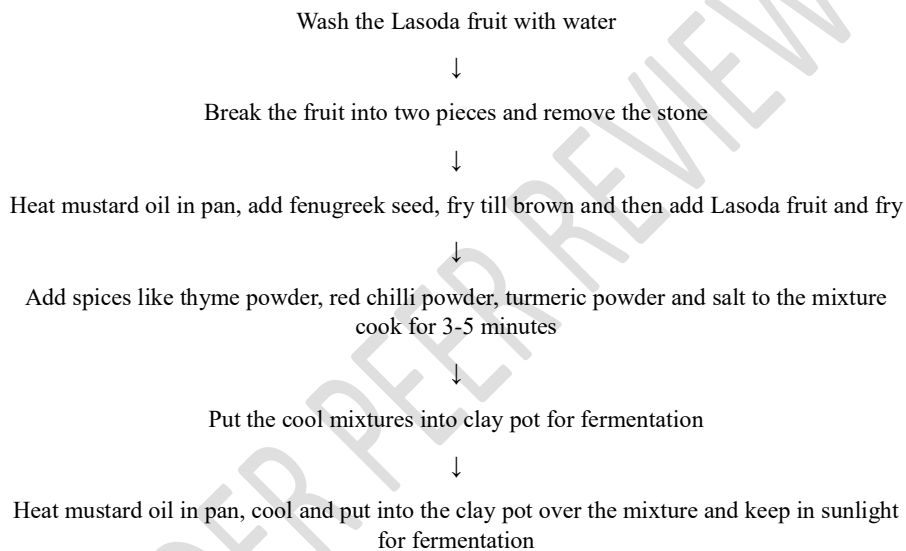
Chart 7 - FLOW CHART OF SQUASH



3.8 Processed Products of Lasoda

The tree produces small fruits in bunches that are used in traditional vegetable and pickle recipes. Its versatility has led to its association with health, sustenance, and treatment of various human illnesses. Fruits have high levels of antioxidants, including carotenoids, ascorbic acid, and phenols. Fruits are high in nutrients, fiber, and vitamins, all essential for human health (Mala, 2009). Green unripe fruits are used as vegetables and pickles. According to (Singh, 2001), fruits can be desiccated after blanching and consumed as a vegetable in the off-season.

Chart 8 - FLOW CHART OF PICKLE



DISCUSSION AND CONCLUSION

Underutilized fruits are high in important nutritive value, medicinal value, antioxidants, and bioactive substances such as carbohydrate, proteins, fats, vitamins, sugars, acids and minerals that making them effective in combating malnutrition and micronutrient deficits. Despite their benefits, these fruits are underutilized due to low consumer awareness, inadequate research, and a lack of commercialization. Harnessing their potential necessitates concentrated research and development activities, the formation of value chains, and investments in post-harvest processing technology. Underutilized processing of fruits underused into jam, jelly preserve, candy, powder, wine, pickle, fruit bar, squash, and nutraceuticals can create new markets, increase farmer income, and help to long-term development.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The authors hereby state that no generative A.I. tools, such as Large Language Models (COPILOT, ChatGPT, etc.) or text-to-image generators, were utilized during creation and editing of this work.

UNDER PEER REVIEW

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