

Processing for Value Addition of Underutilized Fruit Crops

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Abstract

India enjoys a prominent position on the pomological map of the world. The varying weather conditions of this country provide suitable environment for growing a variety of fruits. These fruits are available in abundance and also in different seasons. This has resulted in limited scope for expansion of other minor fruits, though they are nutritious, and are the main source of livelihood for the poor. Most of the underutilized fruits of the tropics are often available only in the local markets and are practically unknown in other parts of the world. A large number of these fruits can grow under adverse conditions and are also known for their therapeutic and nutritive value and can satisfy the demands of the health-conscious consumers. However, some of these fruits are not acceptable in the market in fresh form due to their acidic nature and astringent taste. Hence, there is a need to concentrate on research efforts in diversification and popularization of such underutilized fruit crops. To achieve this, there is a need to create demand for such fruit crops in the domestic and international markets. This, to some extent, can be achieved through developing suitable processing and marketing strategies for these underutilized fruits.

Keywords: Tropical fruits, underutilized fruits, value added products, nutrition, processing.

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1.0 Introduction

Fruits are undoubtedly very important for nutrition security with high potential of value addition and foreign exchange earnings. Fruits are now considered as an important item of commerce as they have gained enormous market potential. India accounts for 12.5% of the total world population of fruit crops and ranks second with the production of 75 million tons in 2013 (FAO, 2014). Post-harvest losses of fruits are more serious in developing countries than those in well-developed countries. The total losses from harvest to the consumer point are as high as 30-40%, which is worth thousands of crores rupees. Tropical fruits, which are at present underutilized, have an important role to play in satisfying the demand for nutritious, delicately flavoured and attractive natural foods of high therapeutic value. Today, consumers are becoming increasingly conscious of the health and nutritional aspects of their food basket. The tendency is to avoid chemicals and synthetic foods and preference for nutrition through natural resources. The underutilized fruits like aonla, bael, jamun, karonda, passion fruit, phalsa, pomegranate, pumpkin, tamarind, wood apple etc. are the main sources of livelihood for the poor and play an important role in overcoming the problem of malnutrition (Gajanana *et al.*, 2010). They are in general accepted as being rich in vitamins, minerals and dietary fibre and therefore, are an essential ingredient of a healthy diet (Table 1).

Fruit processing is necessary where it ensures fair returns to the growers to improve their economic condition. It also helps to mitigate the problem of under-employment during off-season in the agricultural sectors. The perishable fruits are available as seasonal surpluses during certain parts of the year in different regions and are wasted in large quantities due to absence of facilities and know-how for proper handling, distribution, marketing and storage. Furthermore massive amounts of the perishable fruits produced during a particular season results in a glut in the market and become scarce during other seasons. Food preservation has an important role in the conservation and better utilization of fruits in order to avoid the glut and utilize the surplus during the off-season. It is necessary to employ modern methods to extend storage life for better distribution and also processing techniques to preserve them for utilization in the off-season in both large and small scale (Bhattacharyya and Bhattacharjee, 2007; Jena *et al.*, 2013).

An analysis of production, processing, marketing channels and upgrading strategies for fresh and processed fruit with development of niche markets for high-value produce creates new opportunities for developing countries' producers and exporters that can meet the required standards. A value chain perspective is used to identify various routes by which the value of food exports can be increased. Value addition to underutilized fruits by processing them into various products is explained in this paper.

Table: 1 Composition of important underutilized fruits

Fruits	Moisture (%)	Protein (g)	Fat (g)	Minerals	Fiber (g)	Carbohydrates (g)	Carotene (μ g)	Vitamin (mg)
Aonla	81.8	0.5	0.1	0.5	3.4	13.7	9	600
Bael fruit	61.5	1.8	0.3	1.7	2.9	31.8	55	8
Jamun	83.7	0.7	0.3	0.4	0.9	14.0	48	18
Passion fruit	76.3	0.9	0.1	0.7	9.6	12.4	54	25
Phalsa	80.8	1.3	0.9	1.1	1.4	14.7	419	22
Pomegranate	78.0	1.6	0.1	0.7	5.1	14.5	0	16
Pumpkin	92.6	1.4	0.1	0.6	0.7	4.6	50	2
Tamarind	20.9	3.1	0.1	2.9	5.6	67.4	-	-
Wood apple	64.2	7.1	3.7	1.9	5.0	18.1	61	3

Gopalan *et al.* (1978)

2.0 Processing

There are many reasons for processing fruits besides the development of a business with a good return on investment for the owners such as to prevent post harvest losses, to eliminate waste, to preserve quality, to preserve the nutritive value of the raw materials, to make seasonal horticultural produce available throughout the year, to put them in convenient form for the user, to safely put the food away for emergencies and to develop new products, to increase the value of the product and also better return to the farmers. So, ultimately it will be beneficial to producer, processors and consumers.

Food processing/ preservation, in the broad sense, refer to all the measures taken against any kind of spoilage in food. It is the process of treating and handling food in such a way so as to stop or greatly slow down spoilage to prevent food borne diseases while maintaining nutritional value, texture and organoleptic quality as well as increasing shelf life. Proper packaging and storage of processed/preserved products are also important aspects of agro-processing to retain quality of fresh horticultural produce which could be adversely affected by physical damage, chemical reactions, microbiological changes and attack by insects and rodents.

There is great scope for processing and value addition to the underutilized fruits into various products like jam, jelly, preserve, candy, confectionery, pickle, fruit drinks, dried products etc. Processing technology developed by various authors for these fruits is explained as under:

2.1 Aonla

Aonla fruits are used in traditional Indian systems of medicines, like *ayurvedic* and *unani* for treating ailments like common cold, gastric troubles, chronic diarrhoea and dysentery, headache, constipation, enlarged liver, diabetes, bronchitis, jaundice and fever, etc. (Chadha, 2003; Agarwal and Chopra, 2004). *Aonla* fruit is sour and astringent in taste; hence it is not popular as table fruit. The fruit however has excellent nutritive and therapeutic value;

thus has great potentiality for processing into value added products. It is a rich source of ascorbic acid and contains about 20 times more vitamin C than citrus fruit (Shankar, 1969).

2.1.1 Aonla Products

Aonla fruits are highly perishable in nature and hence its storage in atmospheric conditions after harvesting is very limited, which is accompanied by browning of the skin, loss of glossiness and vitamin C content (Kumar and Nath, 1993; Singh *et al.*, 2005). Due to its highly acidic and astringent nature, the fruit in fresh form or as a table fruit is not popular and consequently, it is used in the preparation of various ayurvedic tonics like *chayvanprash*, *triphala*, etc. However, *aonla* fruits are processed into a number of food products like preserve, jam, jelly, candy, toffee, pickle, sauce, squash, juice, RTS beverage, cider, shreds, dried powder, etc (Tandon *et al.*, 2003; Singh *et al.*, 2005; Jain *et al.*, 2006; Sagar and Kumar, 2006; Goyal *et al.*, 2008; Bhattacharjee *et al.*, 2011). Process flow chart for production of various *aonla* products is given as below (Fig 1 to 4).

2.2 Pumpkin

Pumpkin is grown throughout tropical and subtropical countries. This fruits is mainly consumed as vegetable, though it is used in traditional medicines in countries like in China, India, Brazil, Argentina, Mexico, America, Yugoslavia. In Austria the pumpkin seeds have been used as source of oil (Caili *et al.*, 2007). Both pumpkin flesh as well as seeds is rich in nutritive components (Longe *et al.*, 1983; Lazos, 1986; Asiegbu, 1987; El-Adawy and Taha, 2001; Al-Khalifa, 1996). Pumpkin provides valuable source of carotenoids that have a major role in the nutrition in the form of pro-vitamin A. Despite being rich and cheap source of carotenoids, pumpkin is neglected for utilization in culinary purposes due to some myths and cannot be stored for longer time due to degradation of carotenoids. Consumption of foods containing carotene helps prevent skin diseases, eye disorders and cancer (Bendich, 1989). Incorporation of β -carotene rich -

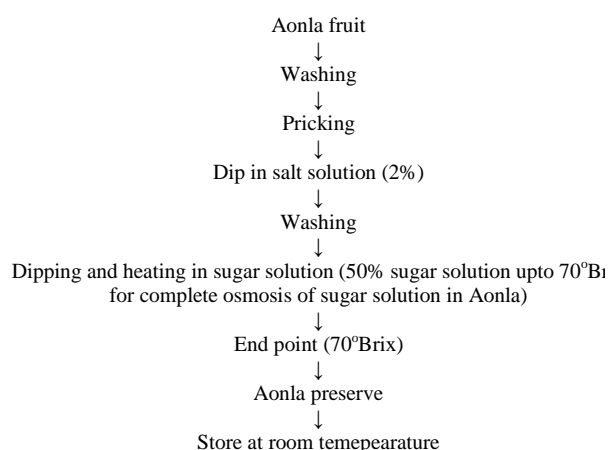


Fig 1: Flow chart for production of Aonla preserve

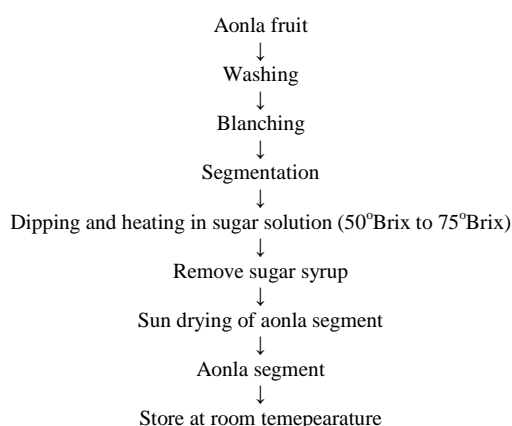


Fig 2: Flow Chart for Production of Aonla candy

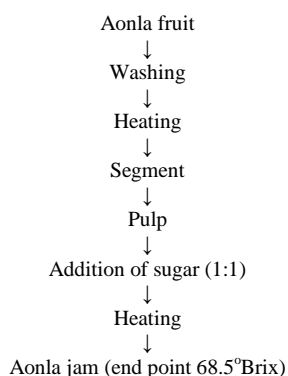


Fig 3: Flow chart for production of Aonla jam
Source: Goyal *et al.* (2008)

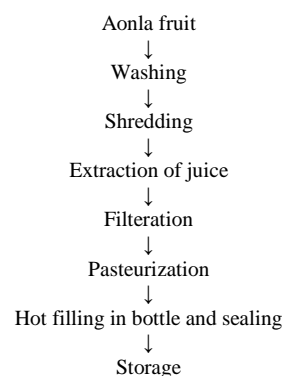


Fig 4: Flow chart for production of Aonla juice

materials in the human diet are therefore, considered a cost-effective approach to vitamin-A related health problems (Berteram and Bortkiewicz, 1995). Moreover, the anti diabetic properties (Quanhong *et al.*, 2005) of pumpkin have generated interest in consuming this fruit.

2.2.1 Pumpkin Products

Pumpkins are cheaper as compared to carrots in cost and are abundantly available in market. Carotene content of some Spanish pumpkin varieties was found to be higher than that of carrots (Wu *et al.*, 1998). Hence, UNO has given lot of importance to pumpkin due to its rich carotene content. Pumpkin due to its larger size (approx 2-8 kg/fruit) has less consumer acceptance as fresh vegetable. Due to surplus production and less consumer demand there is crash in prices during the season causing loss of growers. On the other hand, its scarcity during off-season results in higher market price causing loss to consumers.

The ultimate solution to the above said problem is the dehydration of pumpkin and its utilization in various food products. Drying helps in increasing the shelf life, smaller space for storage and lighter weight

for transportation. The dehydrated pumpkin will also become the most concentrated source of carotenoids (Akpinar and Bicer, 2004). Drying helps in breaking up cellular structure of pumpkin and emulsify carotenoids, thus increasing their bio-availability (Mathur and Mathur, 2005)

Kulkarni (2008) worked on production technology of pumpkin powder, which resulted in a superior quality, carotene and mineral rich, self stable pumpkin powder for various food uses. The technology involves blanching and sulphiting of approximate size of pumpkin pulp cube followed by drying under specified conditions and packaging the powder in light/oxygen barrier type packs. Process technology standardized by the author is given in Fig 5.

The studies of Pavlova *et al.* (1996) showed that addition of pumpkin powder to wheat flour at a concentration of 20% had a positive effect on structural and mechanical properties of cracker dough. Finished crackers were characterized by a pleasant flavour, aroma and improved nutritional and biological values. Attempts were made to prepare pumpkin (*Cucurbita maxima*, Var. MPH-1) powder using vacuum drying and evaluated for supplementation in *bhajiya*, an-

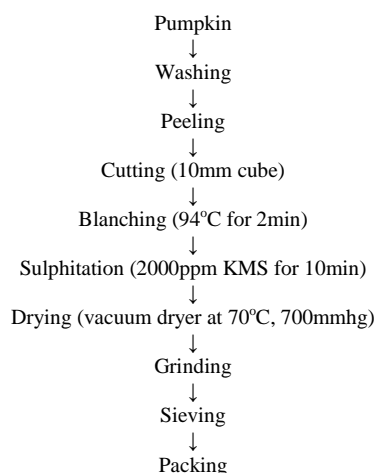


Fig 5: Process technology for production of pumpkin powder

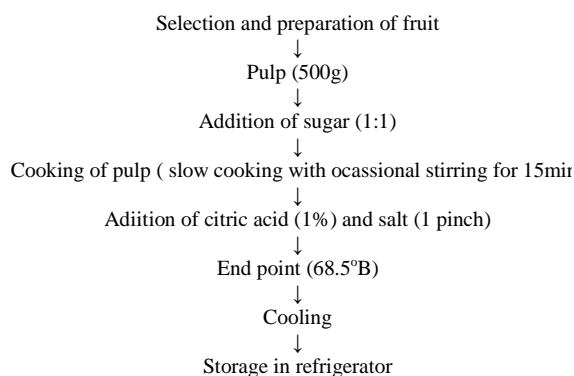


Fig 6: Flow chart for production of Wood apple fruit jam
Source: Vidhya and Narain (2011)

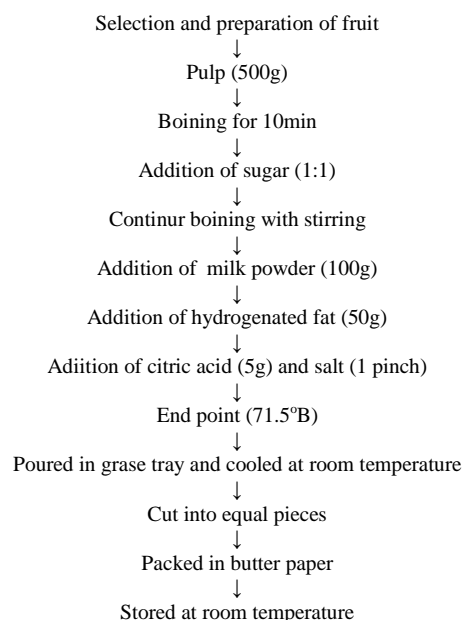


Fig 7: Flow chart for production of Wood apple fruit bar
Source: Vidhya and Narain (2011)

Indian savory by Kulkarni and Joshi (2013a). Level of carbohydrate, crude fibre, ash, calcium and potassium was found considerable increased in *bhajjiya* prepared by replacing gram flour with pumpkin powder at the rate of 7.5% (w/w). Kulkarni and Joshi (2013b) prepared biscuits by replacing wheat flour with pumpkin powder at different levels. Biscuit prepared by replacing wheat flour with pumpkin powder at the level of 2.5% (w/w) was found to be more acceptable from sensory point of view and thereafter sensory score was reduced.

2.3 Wood apple

The wood apple is native and common in dry plains of India and Ceylon. Wood apple is used in the preparation of chutneys and for making jelly and jam

(Morton, 1987). Wood apple has got high medicinal value. Every part of the fruit i.e. pulp, seed and oil has got its medicinal property (Ramakrishna *et al.*, 1979). The fruit is much used in India as a liver and cardiac tonic and when unripe, as a means of halting diarrhea and dysentery and for effective treatment for hiccough sore throat and disease of the gums (Mondal *et al.*, 2002).

2.3.1 Wood apple products

Wood apple can be converted into value added products like jam and fruit bar in order to avoid glut and utilize the surplus during the season, it is necessary to employ methods to extend storage life, for better distribution, to preserve them for utilization in the off-season both in large scale and home scale. Jam is more-

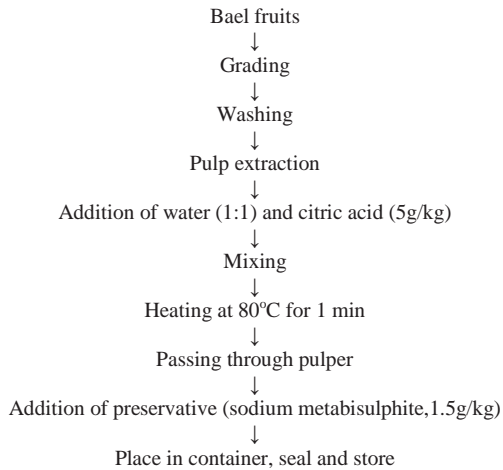


Fig 8: Flow chart for production of Bael pulp

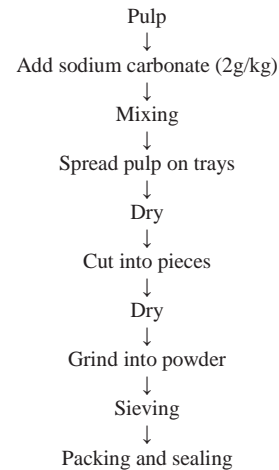


Fig 9: Flow chart for production of Bael powder

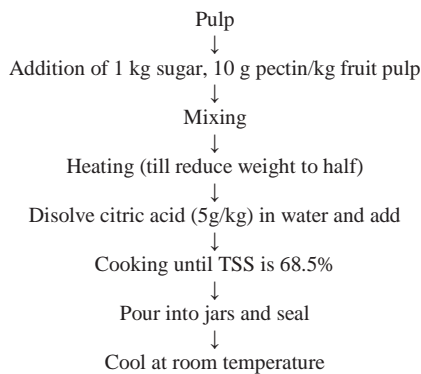


Fig 10: Flow chart for production of Bael jam

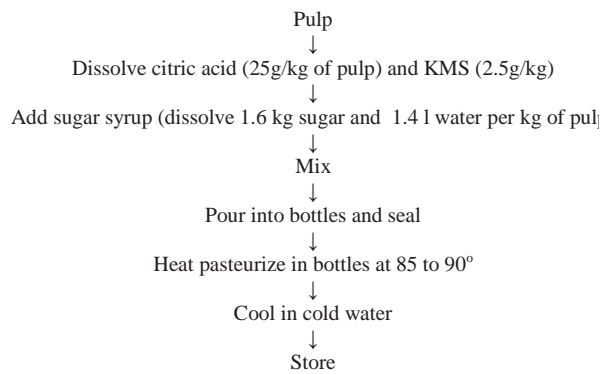


Fig 11: Flow chart for production of Bael squash

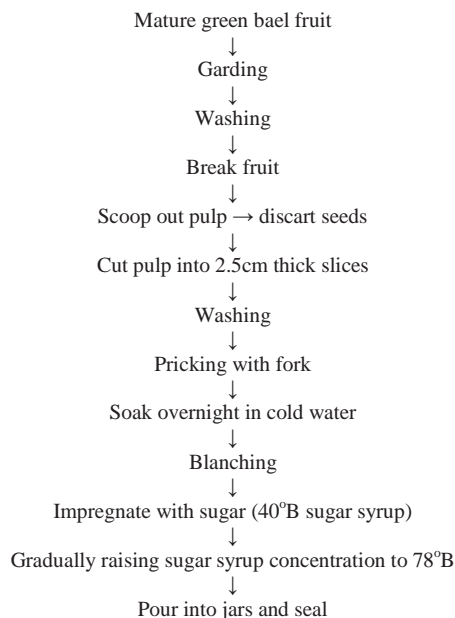


Fig 12: Flow chart for production of Bael preserve
Source: (ITDG, 2000)

or less a concentrated fruit processing which has fairly thick consistency and body. It is also rich in flavor (MacLeod and Pieris, 1981), because ripe fruits which

have developed full flavour are used in its preparation. Fruit bar is a nutritious product, has a chewy texture, similar to dried raisins and is a good source of dietary

fibre and natural sugar. Process technology developed for production of wood apple fruit jam and bar is presented in Fig 6 and 7. Wood apple juice when mixed with other fruits can serve as an excellent beverage.

Realizing the importance of wood apple fruit as a significant contributor to human well being, as a cheaper and better source of protective foods; its perishable nature and seasonality in production calls for preservation of it to be supplied throughout the year for human consumption.

2.4 Bael fruit

Bael (*Aegle Marmelos* (Linn), family Rutaceae, is also known as Bale fruit tree, growing wild throughout the deciduous forests of India. This is generally considered as sacred tree by the Hindus, as its leaves are offered to Lord Shiva during worship. The different parts of Bael are used for various therapeutic purposes, such as for treatment of asthma, anaemia, fractures, healing of wounds, swollen joints, high blood pressure, jaundice, diarrhoea healthy mind and brain typhoid troubles during pregnancy (Sharma *et al.*, 2011). The unripe dried fruit is astringent, digestive, stomachic and used to cure diarrhea and dysentery. Sweet drink prepared from the pulp of fruits produce a soothing effect on the patients who have just recovered from bacillary dysentery. The ripe fruit is a good and simple cure for dyspepsia (Parichha, 2004, Chowdhury *et al.*, 2008).

2.4.1 Bael fruit products

Various process technology for production of value added preserved products from bael fruit is given in Fig. 8 to 12. Fresh bael fruit can be stored for 15 days at 30°C when harvested at full maturity, for 1 week at 30°C when harvested ripe, for 3 months at 9°C. fruit pulp can be stored for 6 months, when stored in

heat-sealed containers. Fruit powder can be stored for a year when packed in 400 gauge polypropylene pouches and stored under dark, cool place, while fruit jam, squash and preserve can be stored for several months (ITDG, 2000).

The bael fruit pulp contains many functional and bioactive compounds such as carotenoids, phenolics, alkaloids, coumarins, flavonoids, and terpenoids and has innumerable traditional medicinal uses (Karunanayake *et al.*, 1984; Singh 1986; Nagaraju and Rao, 1990). Thus value added products can be produced by using above process technology to reduce post harvest losses, increase shelf life, value addition and increase the income.

3.0 Conclusion

Most of the minor fruits are enriched with nutritional and medicinal value, and can be grown even in wastelands without much care. Therefore, it is worthwhile to look into the organized cultivation and improvement of minor group of crops like aonla, pumpkin, wood apple, bael etc. so that their utilization can be maximized. There is always demand from consumers for new, delicious, nutritious and attractive food products. To satisfy this demand, there is a constant effort to develop products from diverse sources. The potentiality of processed products from some minor fruits in the country is still untapped. However, efforts have been made by various researchers for the development of value added products from underutilized fruits as explained above. It reflects the feasibility for the development of some diversified value added products from some of the minor fruit crops grown in India in order to minimize the wastage, to promote these products as export items and to uplift the nutritional and socio-economic status of the vulnerable communities of country.

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