Processing for value addition of minor fruits

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Abstract
Fruits are staple food in human diet; India enjoys a prominent position on the pomological map of the world. Despite the increasing fruit production at the global level, a significant amount of fruit produced is lost or wasted due to poor post-harvest management. The total losses from harvest to the consumer point are as high as 30-40%, which is worth thousands of crores of rupees and about 10-15% of fresh fruits shrivel and stale, lowering their market value and consumer acceptability. Therefore, processing fruits into value-added products is one of the strategies to reduce post-harvest losses and promote consumption of fruits. In this transaction, processing of minor fruit crops into a variety of products with extended shelf life provides opportunity to consumers all over the country to enjoy them throughout the year. Adding value to the original crop also helps the farmer not only to overcome the spoilage and losses, but also fetches high returns due to the newly added technology. It provides convenience & safe food to consumers and promotes diversification and commercialization of agriculture by providing effective linkage between consumers and farmers and moreover, it will make farm produce more exportable.

Keywords: Value addition, minor fruit crops, shelf life, processing

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. 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 minor fruits like pomegranate, aonla, bael, jamun, Karonda, passion fruit, phalsa, pomegranate, 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) [2]. They are in general accepted as being rich in vitamins, minerals and dietary fibre and therefore, are an essential ingredient of a healthy diet.

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 crore rupees. Fruit processing and value addition is necessary where it ensures fair returns to the growers to improve their economic condition. Food processing 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 offseason in both large and small scale (Jena et al., 2013) [4]. A value chain perspective is used to identify various routes by which the value of food exports can be increased.

Pomegranate is one of the most important fruit crops in India because of its adaptable nature, high profitability and being cultivated on a commercial scale in India and the fruits are good source of nutrients and bioactive compounds, mainly anthocyanins which exhibit strong chemo-preventive activities such as anti-mutagenicity, anti-hypertension, anti-oxidative potential and reduction of liver injury. The research on the development of the new pomegranate derived products such as minimally processed pomegranate seeds, jams, marmalades, single strength juices, jellies, juice concentrates, frozen seeds, carbonated beverages, pomegranate wine, pomegranate syrup etc., has been carried out recently. The processed products such as anardana, juice, concentrate; syrup and jelly were highly acceptable because of their nutritive and dessert qualities and palatability. Along with pomegranate, value addition of some minor fruits is by processing them into various products is explained in this paper.
Pomegranate
Pomegranate indicates the great scope for the processing into value added products having extended shelf life. The fruit disorders such as sun burnt husks, splits and cracks and husk scald on whole fruit reduces marketability and consumer acceptance. The new sector of pomegranate processing allows the use of the fruits with low quality fruits that cannot be commercialized, for the preparation of the new products. The activity of research and development on pomegranate has aimed at the application of new refrigerated technologies to extend the commercial shelf life of pomegranate. The pomegranate can be processed into products like minimally processed fresh arils, juice, squash, beverage, molasses, juice concentrates, frozen seeds, jam, jelly, marmalades, grenadine, wine, seeds in syrup, pomegranate spirits, pomegranate powder, pomegranate rind powder, anardana, confectionery, pomegranate seed oil etc. shown in a flow chart Fig.1.

Minimally Processed (Ready to Eat) Pomegranate Products
Fresh pomegranate arils as earlier discussed, tedious, difficult and time consuming procedure in the preparation of the arils, makes the pomegranate fruit unpopular as a table fruit. In recent years, minimally processed “ready-to-eat” pomegranate arils have become popular due to their convenience, high value, unique sensory characteristics and health benefits. Minimal processing of pomegranate mainly consists of washing with the sanitizing agents to reduce the initial microbial load, pH modifications, use of antioxidants, modified atmosphere packaging and temperature control. The best results with the cultivar ‘Mollar de Eche’. Technologies such as smart packaging and the use of natural or non-destructive products as preservatives (such as honey, aloe vera gel and chitosan and UV-C radiation) should be done in combination with MAP.

Frozen arils
After preparing the arils same as that of minimally processed arils, the arils were packed in the polyethylene bags with syrup of 15°Brix. The arils were then frozen in a chest freezer. The juice contain of aril enters the syrup during freezing. The arils should be eaten frozen to avoid an excessive loss of turgence.

Jams and preserves (Anar Rub)
A product known as anar rub with fairly good keeping quality can be made by concentrating pomegranate juice and heating the mixture on a slow fire for long period. The finished product has a thick consistency and contains 70-75% TSS. It can be stored for one year and utilized as a jam and the best preservation temperature reported was 5°C.

Jellies
An attractive jelly can be prepared from pomegranate juice. While making jellies, approximately 50% of the anthocyanins present in pomegranate juice were lost. Maestre, et al investigated that the acidification of juice produced a noteworthy improvement in the colour of jelly, both initially and during storage.

Anardana
Anardana is dried arils from sour wild types. It is mainly used as acidulent in place of tamarind of dried green mango (Amchur) in North India in Indian styled curries, chutney and other culinary preparations. It is also used in the preparation of digestive candies and by traditional system of Ayurvedic and Unnani medicine. The improved processing technique consists of pre cleaning, mechanized extraction of arils, solar/sun drying and packaging. After trating with sodium benzoate (600 ppm) for 10 minutes, arils are dehydrated in a drier at 45°C for 48 hrs to 10-12% moisture content. It has attractive brown colour and can be stored for a long time in glass jars.

Pomegranate molasses
It is traditional Middle Eastern ingredient made from cooked down pomegranate juice. Thick and syrupy in texture, pomegranate molasses provide tangy flavor and is dark in colour. Its sweetness comes from the concentration of the fruits natural sugars. To make ½ cup of molasses, 4 cups of juice is heated in a pan for 45 minutes, allowing it to thicken but not overcooked. The product can be stored in air tight container under refrigerated conditions for 3 months. It is typically used to flavor chutneys, curries and salad dressings to glaze or tenderize meat products.

Pomegranate powder
Low moisture pomegranate powder is prepared from pomegranate arils that have been dried and milled. The active ingredient considered in pomegranate powder is ellagic acid. The freeze dried pomegranate powder rich in ellagic acid have many applications and may be encapsulated for regular doses.

Pomegranate Wine
Wine Pomegranate juice can be utilized to make good quality wine. Sugar is added to adjust Brix to 22-23°. The pasteurized juice is fermented with starter wine yeast. The fermentation is allowed to continue until desired level of alcohol is obtained. The wine is clarified by bentonite treatment or by centrifugation. The wine aged in the same manner as red grape wine.
Aonla/Amalaki/Amla (*Emblica officinalis*)
The fruit is the richest source of vitamin C (500-600 mg/100 g) and is a diuretic and laxative which helps in curing insomnia, scurvy, haemorrhage, leucorrhoea, constipation, premature ageing and used as a cooling agent to reduce the effects of sun strokes (Hasan, 2010) [3]. Aonla is also used in many hair tonics; it enriches the growth and hair pigmentation. Aonla powder and oil are traditionally used in Ayurvedic applications for the treatment of scalp and improves complexion, removes wrinkles and sun burns. The storage of Aonla depends on maturity at harvest. The fruit keeps well in cool chamber for 17-18 days compared to 8-9 days at ambient temperature. In Ayurvedic preparation like ‘Chyavanprash’ and triphala, Aonla is one of the main ingredients. Fruit products like pickle, preserve, candy, jam, syrup and dried shreds are made from Aonla. Aonla preserve is very important article of commerce and is in great demand. Streaming or blanching the fruit prior to processing can minimize ascorbic acid loss in the products. It is also used in tanning and dyeing industries. Techniques have been developed at CRIDA for separation of segments of aonla and do away with nut by steaming. These segments were used for preparation of different products. In a study on the suitability of different varieties for processing into candy, murabba and pickle, the candy of variety Chakkiya ranked first in respect of ratings for color, flavor, texture and total score and overall ranking. The variety Banarasi ranked first for texture and variety, Francis ranked first for colour. The candy of Banarasi ranked second overall. In case of murabba the variety Krishna ranked first in all attribute followed by Chakkiya, which ranked second in all attribute except texture, where it ranked first. Squash was prepared by blending Aonla juice with other juices viz., ginger, roselle, pineapple and lime. Organoleptic evaluation of squash revealed that score for color, flavour and consistency increased with addition of ginger and Roselle. The blend of aonla, ginger, roselle (80:15:5) ranked first in all attributes including overall ranking.

Ber/Indian Jujube (*Ziziphus mauritiana*)
It belongs to the family Rhamnaceae, ideal fruit tree for arid and semi-arid regions which bear fruits of greenish yellow to reddish brown having high amount of vitamin C (85-95 mg per 100 g). More vitamin C was found in the fruit flesh near the seed rather than near the skin of the fruit (Krivenov et al., 1970) [3]. The decoction from root and bark is good for dysentery and diarrhoea and leaf decoction is useful as gargle in sore throat and in bleeding gums. The seed kernels are aphrodisiac.

Ber fruit are consumed as such or can be processed into different fruit products. Juicy varieties are better suited for pulp and juice extraction. The fully ripe, well-developed fruits are washed de-stoned and juicer extracts juice. Ber juice can
be used for the preparation of ready-to-serve beverage. Carbonated beverage of ber is highly acceptable and has excellent keeping quality. Dehydrated for is prepared by treating ber fruits with sulphur dioxide at 3.5-10 g/kg for 3 hours followed by sun drying, or cabinet drying below 15% moisture. Ber can be utilized for candy and ber pulp can be processed into wine. The steps include diluting the pulp, adding pectinase enzymes adjusting proper Brix with sugar, addition of yeast, fermentation, stabilization and clarification.

**Fig (Ficus carica)**

Fig was an important food crop in ancient civilization. It is a highly nutritious fruit consisting of 84% pulp and 16% skin. Besides, the fruit also contains protein, calcium, iron, vitamin A and thiamine at varying concentrations. The fruit is valued for its laxative property. It is applied for boils and other skin. The latex is used to coagulate milk and leaves are used medicinally as diuretic, demulcent, emollient and anthelminthic properties. Fresh figs are nutritious and used as dessert or for making jam, jelly, pudding, cakes, dried, preserved, candied or canned.

**Tamarind (Tamarindus indica)**

It is native to Tropical Africa and belongs to the family Fabaceae. It is the ‘Indian date’ and is one of the most important fruits of India. In Tripura, it is locally called “tentul” (Das et al., 2013) [1]. It is a large sized, long-lived evergreen tall tree with a spreading crown. It is an excellent tree for social forestry and agro forestry. This crop is highly suitable for wastelands due to its multi ferrous uses and capacity to withstand adverse agro-climatic conditions. The fruit of tamarind a pod 5 to 15 cm long, 3 to 10 seeds surrounded with edible pulp which is principal souring agent or for sauces, chutney, in beverages and in general cooking. Pulp is carminative, laxative, given as infusion in bifilousness and febrile conditions. It is also used in drying and tanning and for polishing and cleaning metal ware. The tartaric acid is extracted from unripe fruits. The polysaccharide (jellose) is extracted from seeds, which is used as a sizing material in the cotton and jute industries. Besides, polyose obtained from the seed is good substitute for fruit pectin in the preparation of jam, jelly or marmalade. The bark and leaves are used for tanning. Tamarind balls are prepared after taking out seeds from the fruit. Tamarind paste and tamarind juice concentrate are the other commercial products.

**Roselle (Hibiscus sabdarifa L)** which grows well even when sown in September under rainfed conditions in Alfisols can be utilized for processing into different products. It can be a very good source for colouring fruit products that don’t have attractive colour. With the ban on coal tar food dyes, it is easy to arouse interest in Roselle as a colouring source. Today, Roselle is attracting the attention of food and beverage manufactures and pharmaceutical concerns who feel it may have exploitable possibilities as a natural food product and as a colorant to replace some synthetic dyes. Juice made by cooking a quantity of calyces with ¼ water ratio to amount of calyces is used for cold drinks and may be frozen or bottled if not for immediate needs. In West Indies and America (tropical) Roselle is prized primarily for the cooling lemonade like beverage made from calyces.

**Roselle sauce**: After extraction of color, acids and pectin for jelly making, the calyces mass could be further processed to a sauce which was organoleptic cally highly acceptable.

**Jellies with Guava – Roselle blends**

Calyces of roselle can be used as a source of colorant for guava jelly, since there is a problem of browning in guava jelly during storage. Organoleptic evaluation of jellies prepared from different proportions of guava – roselle (calyces) revealed the preference of tasters for blending at 85:15 proportion to get jelly with attractive color. Roselle calyces can be used with guava for jelly making without significant change in guava flavour.

**Passion fruit (Passiflora edulis)**

It is native to tropical America. It produces fruits with unique flavour and aroma for fresh eating and processing as well. Passion fruits are fair to good source of provitamin A, ascorbic acid, riboflavin and niacin and have a high mineral content. The pulp obtained after scooping from the fruits when cut in halves are added to fruit salads, ice-cream or fruit juice. Other processed products include juices, jelly, jam, squash, etc. (Menzel 1985) [6].

**Karonda (Carissa carandas)**

It is a hardy, evergreen, spiny and indigenous shrub which thrives well as rainfed crop. The fruit belongs to the family Apocynaceae. Fruits, sour and astringent in taste, are a very rich in iron contains a good amount of vitamin C. They also contain proteins, carbohydrates, fat, fibre and calcium. Fruits can also be used in dyeing and tanning industries. Karonda fruit is considered to be antiscorbutic and is also very useful in curing anaemia, stomach ache and is anthelminthic. The ripened fruits may be eaten as dessert or used for the preparation of jelly, sauce, carissa cream or jellied salad. Unripe fruits are used for making pickles, sauces and chutney. The dried fruits may act as a substitute for raisins (Cheema et al., 1971). The wine prepared from ripe fruits contains about 14.5 to 15% alcohol and is very much liked by wine fanciers (Nalawadi 1975) [7].

**Phalsa (Grewia subinaequalis)**

Being highly perishable, the fruit must be utilized within 24 hours after picking. The popularity of phalsa fruit is due to its attractive colour ranging from crimson red to dark purple and its pleasing taste. The juice when extracted gives a deep crimson red to dark purple colour and is very popular. It is rated very high in indigenous system of medicine. The juice is extremely refreshing and is considered to have a cooling effect especially in hot summer. Heating the crushed phalsa fruit to 50°C gives the highest recovery of the juice with an appropriate quantity of anthayanin and other soluble and insoluble materials. Studies have shown that addition of cane sugar to the juice has a protective effect on colour stability.

**Custard apple**

It is generally picked when it becomes creamy yellow between the segments and begins to crack slightly. Custard apple is highly perishable and cannot be stored for long time. It can be stored successfully for 9 weeks at 7-10°C with 85% to 95% RH. Lower storage temperature induces chilling injury. The pulp can be frozen successfully for use in ice-cream industry. At CRIDA, a simple technique has been developed for manual extraction of custard apple pulp by rotatory motion of a round hair comb in the scooped fruit held in stainless steel sieve. This pulp can be supplied to the ice-cream industries.

**Jackfruit (Artocarpus heterophyllus)**

The fruit is used both in the unripe and ripe stage. Raw
jackfruit is popularly used as a vegetable. Fully mature but unripe fruits are harvested and appearance and a dull sound upon tapping judge fruit maturity. Ripe jackfruit is consumed as a dessert fruit. Jackfruit chips are prepared by frying ripe or semi-ripe fruits. A palatable beverage concentrate can be made from jackfruit pulp by adding sugar, citric acid and water. In addition high class canned, frozen and dried products such as nectar, preserves confections etc., can be prepared from the ripe fruits. The green jackfruit utilized for making pickle, canned and curried vegetables. The wastes (skins, peels and cores), which constitute about 45% of the total fruit weight, have been found to be a fairly good source of pectin.

**Bael fruit (Aegle marmelos)**

The bael fruit is known for its medicinal properties. The bael fruit is one of the most nutritious fruits contains 1.19 mg of riboflavin/100 g edible portion. It may be noted that no other fruits has such a high content of riboflavin. Bael fruit has been used from time immemorial for processing in the mature green form to prepare preserves. The difficulty in the extraction of ripe bael fruit pulp is overcome by addition of water equal in weight to the pulp, adjusting the pH to 4.3 with citric acid and heating at 80oC for one minute, before passing through the extractor/pulper. Addition of water dilutes the mucilage and the application of heat rot only inactivates the enzymes but also helps in dissolving the mucilage uniformly throughout the pulp. The fruit pulp thus obtained has almost the same consistency and colour as mango pulp. Ripe Bael fruit pulp, if extracted properly can be used for the preparation of various fruit products viz., nectar squash/leather/slab, powder etc., which can be commercially exploited.

**References**