

Notes on the Agro-Processing of Deciduous Fruit Including Apples, Apricots, Figs, Grapes, Pears, Peaches and Plums

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Abstract: Farmers facing current economic realities are searching for new options of surviving and expanding their business. One of the many opportunities to grow markets, turnover and profits is by adding value to farm produce. Options need to be selected carefully based on sound information and knowledge of the opportunities presenting themselves seen in the light of the strengths and weaknesses of individual farms. Food processing takes place on various scales: small-scale processing usually takes place in the household kitchen, whereas larger scale food processing is done in factories and bakeries. However, regardless of the scale of food processing being undertaken, the processes involved are the same. These processes are known as unit operations and are carried out in sequence. The aim of this document is solely to provide the reader with some basic information on food processing in order to realize the extent of the operations involved in the manufacture of deciduous fruit products. The needs and values of every individual processing entrepreneur is unique to the individual and can only be addressed properly by a team of experts. This document does not cover any legal aspects, international, national or local laws, quality management, marketing, financing etc. It is to be used solely as an oversight on the processing of deciduous fruit, including apples, apricots, figs, grapes, pears, peaches and plums and is to be used as a starting guide from where an interested party can gain a brief overview of the extent of products and processing options available for processing these fruits.

Keywords: Processing, Apples, Apricots, Figs, Grapes, Pears, Peaches, Plums

1. Introduction

Faced with the current economic realities, farmers worldwide are searching for new options of surviving, as well as expanding their business. One of the many opportunities to grow markets, turnover and profits, is by adding value to farm produce through further processing.

Most value added food products available to consumers have been processed in some way or other, even if said processing is as simple as cleaning the product before it is packed in plastic or net bags. Two types of processing methods may be carried out on raw produce or materials:

- 1) Primary processing includes the simplest of processing such as washing, peeling, chopping, ageing, the milling of wheat for flour, and the processing of sugarcane;
- 2) Secondary processing involves the conversion of primary processed products into more complex food products and includes procedures such as mixing,

depositing, layering, extruding, drying, fortifying, fermentation, pasteurization, clarification and heating, to name but a few [17].

Without the aid of food processing, we as consumers would not have the convenience of the large variety of food products available in supermarkets and other food outlets. Processing of raw products has a number of advantages:

- 1) It allows for the year-round availability of food that have only a limited growing season, or is not grown in certain areas due to soil and climate factors, processing examples being frozen and canned fruit, vegetables as well as meat products;
- 2) Processing extends the shelf-life of products, such as canned fish and UHT milk;
- 3) Food processing improves the safety of our food supply through processes intended to destroy harmful bacteria and packaging helps in the prevention of food tampering.

Food processing takes place on various scales: small-scale processing usually takes place in the household kitchen, whereas larger scale processing is carried out in factories and bakeries. However, regardless of the scale of food processing being undertaken, the processes involved are the same. These processes are known as unit operations and are carried out in sequence. The aim of this article is solely to provide the reader with some basic information on food processing in order to realize the scope of the operations involved [17].

2. Processing Options by Product

2.1. Apples

- 1) Acetous bacterial oxidation and alcoholic fermentation of apple juice is used to produce apple cider vinegar [1]. It is fermented to the point where it contains in the region of 5-12% acetic acid.
- 2) Apple-jelly: This product is made by concentrating and gelling unsweetened apple juice. It is served as a condiment with various meat dishes [8].
- 3) Apple juice – clarified: The production of apple juice is essentially a milling and pressing operation, followed by a series of clarification steps including enzymatic depectinization, filtration, centrifugation, and polishing. The product is sold in a ready-to-drink form and has a Brix value (total soluble solids) of 12 °Brix [2].
- 4) Apple juice – cloudy: Cloudy apple juice is extracted in the same way as clear apple juice, but is not clarified. The product requires the addition of ascorbic acid or flash heating immediately after pressing to minimize browning reactions. The finished product is further preserved by pasteurization or aseptic packaging [11]. Non-transparent bottles or cartons are generally used as packaging containers.

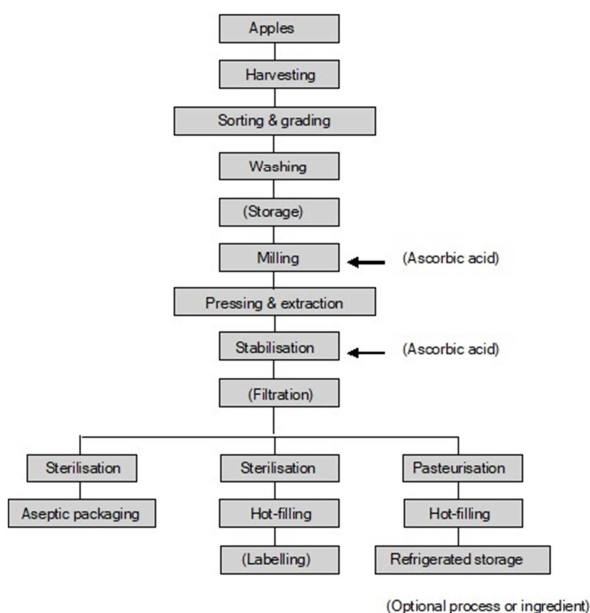


Figure 1. Apple Juice – Cloudy. [1, 4-6, 9, 10, 12]

- 5) Misshaped and/or undersized apples are cooked and pulped to produce applesauce. The main use of applesauce is in side dishes such as condiments, as well as in baked goods [1, 2].
- 6) Canned apples: Firm ripe apples are used for the manufacturing of canned apple slices. The apple used must be of good size, shape and quality and should be graded so that after peeling and slicing the segments are approximately the same size. Canned apple slices are a convenience product that is used to replace the fresh product. It has a long shelf life and thus extends the availability of the seasonal fresh product. It is mainly used as a breakfast food or in bakery products.

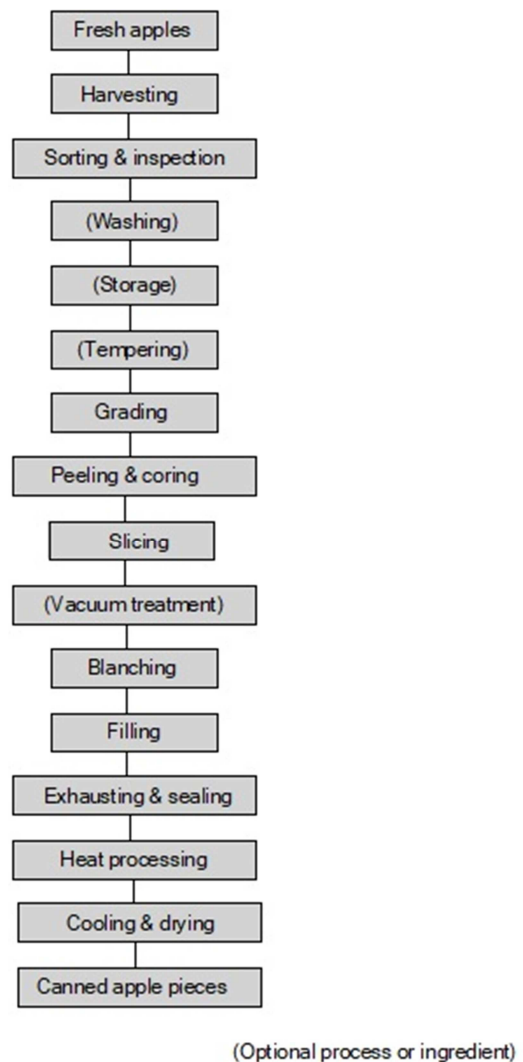


Figure 2. Canned Apples. [1, 4-6, 9, 10, 12]

- 7) De-flavored apple juice concentrate: The concentrate is produced from apple juice that is aroma stripped, depectinized, clarified and finally evaporated. During the evaporation process a 12 °Brix apple juice is converted into a 70 - 73 °C juice concentrate plus an aroma essence concentrate of around one hundred fold.
- 8) Dehydrated apple pieces have a moisture content below 3.5%. It has a shelf life of several years at ambient

temperatures. It is produced from dried (evaporated) apple pieces that undergo a secondary dehydration process. Dehydration takes place in tunnel dryers or continuous belt dryers.

- 9) Dried apple rings (also called evaporated apples) is a product containing between 22 and 25% moisture and is classified as an intermediate or semi-dried apple product. Processing steps include peeling, slicing and artificially drying of fresh apples, and this product is most often used in the confectionary industry or in fruit snacks.
- 10) Frozen apples – IQF: Fresh apple slices are individually quick frozen (IQF) to produce a product that maintains its individual identity and gives the perception of "fresh fruit". This makes it ideal for inclusion into bakery products as well as fillings. The IQF method preserves the cell structure, texture, color, flavor and aroma of the apples better than the straight pack method where the product is frozen after packaging.

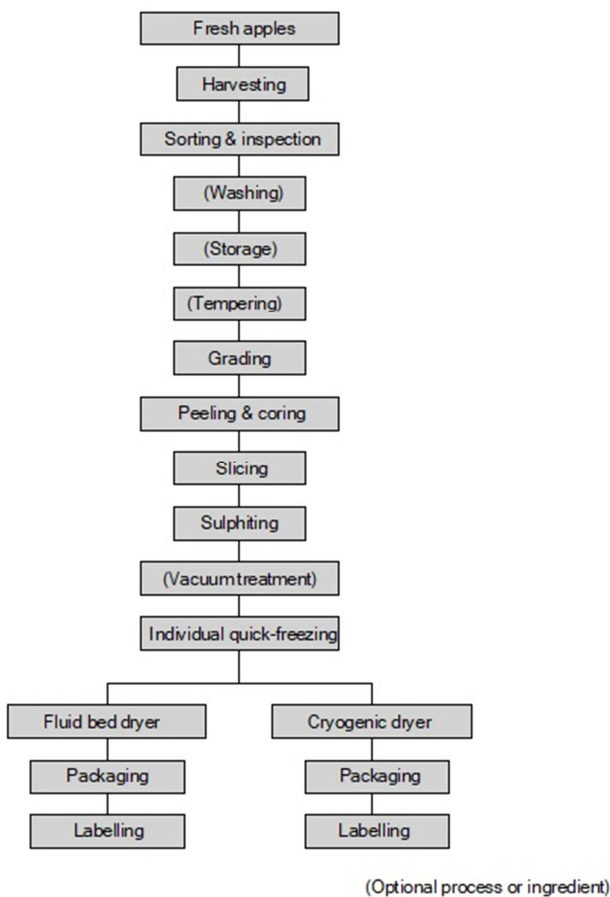


Figure 3. Frozen Apples – IQF Method. [1, 4-6, 9, 10, 12]

- 11) Straight pack frozen apples are ideally suited for use in large scale production of processed apple products such as bakery products, sauces, fillings etc. where the shape, texture or structure of the apple tissue is not of major importance. The apple slices are frozen after packaging by a relatively slow process compared to the IQF-method and this causes damage to the apple tissues.

- 12) Apple cider is a product which is created through apple juice which has been partially or completely fermented [2]. Potable water may be added to the process if required. The final product must have a base alcohol content of 5% (v/v) [3].

2.2. Apricots

- 1) Apricot nectar is a cloudy juice that contains various added ingredients such as sugar [14]. Apricot nectar can be manufactured from fresh apricots of good quality or from frozen apricots or from apricot puree.



Figure 4. Apricot Nectar.

Source: Own image

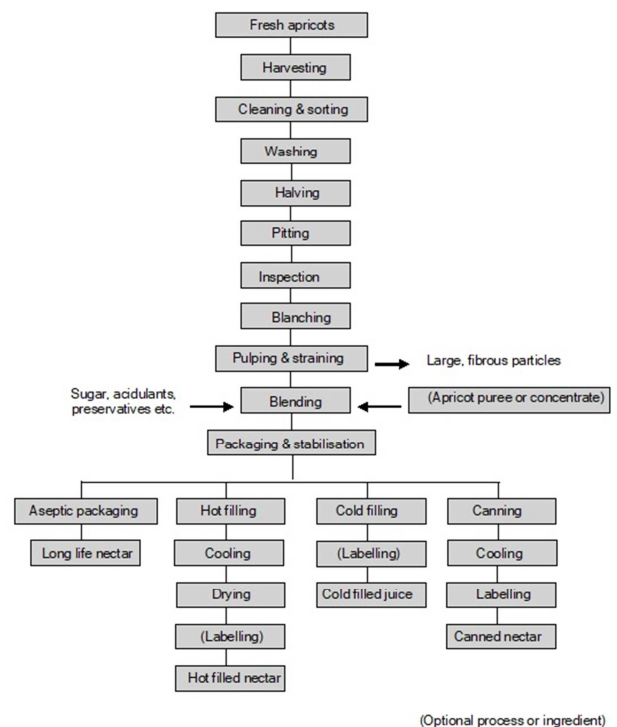


Figure 5. Apricot Nectar. [1, 4-6, 9, 10, 12, 14]

- 2) Apricot puree is prepared from whole, fresh apricots that are initially pulped before being screened. This finished puree is then frozen, canned or aseptically packaged. Another option for apricot puree is concentration of the raw product. Apricot puree is a key ingredient in syrups, apricot juices, sauces, jams, jellies and toppings.
- 3) Canned apricots: Apricots are canned in halves, slices or

cubed pieces that are preserved in fruit juice or sugar syrup of various strengths or an artificially sweetened liquor.



Figure 6. Canned Apricots.

Source: Own image

- 4) In order to produce dehydrated apricot pieces, previously dried apricot halves with a base moisture content of between 15 and 20% undergoes further drying. During this second drying process, the moisture content is further reduced to below 5%. The secondary dehydration process is done under vacuum. Dehydrated apricot pieces have numerous uses in instant cereal, nut and fruit mixes, muesli mixes and may also be ground into a powder form which can be reconstituted at a later time for use in pie fillings and purees.

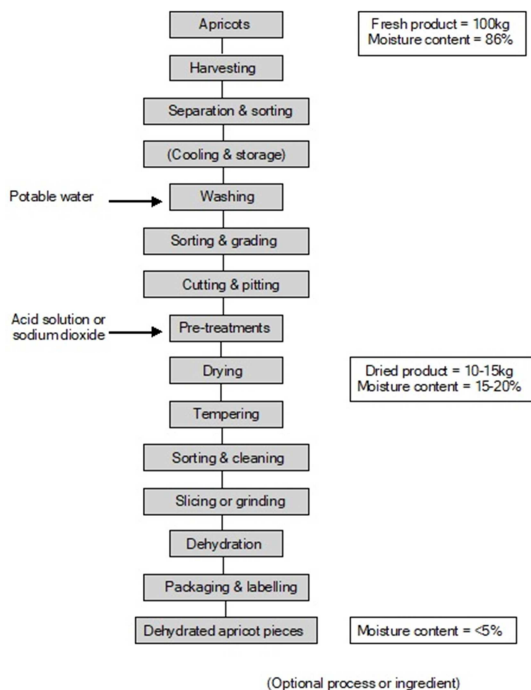


Figure 7. Dehydrated Apricot Pieces. [1, 4-6, 9, 10, 12]

- 5) In the production of dried apricots sun, as well as artificial, air drying may be employed to dry fresh apricot halves. The moisture content of the final product should be between 15 - 20%. Dried apricots are used in fruit snacks and as recipe ingredients, and possesses a soft and chewy texture with characteristic apricot flavor.

- 6) Frozen apricot concentrate: Apricot concentrate is basically apricot puree that has been concentrated by an evaporation process.
- 7) Freezing is ideally suited for storing fresh apricots for later use in bakery products or processing into jams, purees, etc.
- 8) Apricot jam: Jam is produced from whole fruit, pieces of fruit or fruit pulp which has been cooked with sugar until a syrup with the desired solids content is reached. Once cooled, it becomes a soft gel. Ideally firm, ripe apricots are used in the production of apricot jam to ensure optimum flavor, color and development of pectin.

2.3. Grapes

- 1) Artificially dried raisins are not dried by solar energy but by forced hot air in an enclosed chamber.

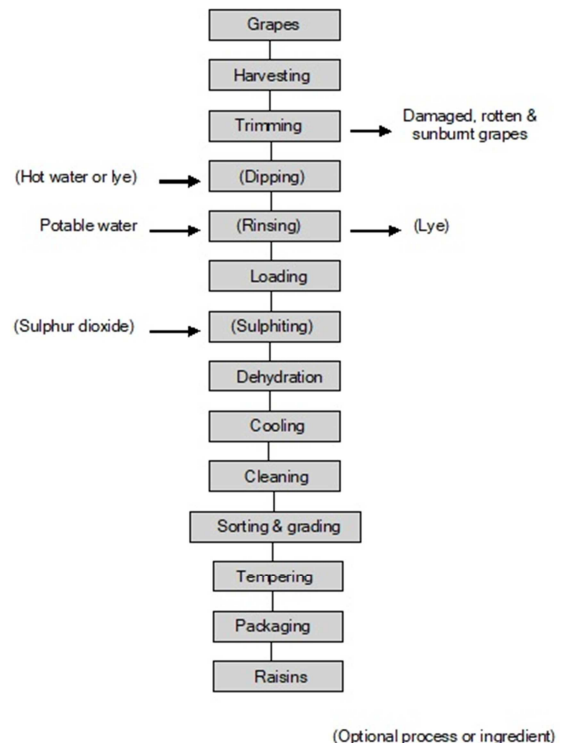


Figure 8. Artificially Dried Raisins. [1, 4-6, 9, 10, 12]

- 2) Cold pressed grape juice: The juice is extracted from the grapes by mechanical or physical means without the application of heat.
- 3) Grape jam is produced from clean, sound grapes that were harvested before reaching full maturity [15, 16]. Jam is a product, which consists of whole fruit, pieces of fruit, fruit pulp or fruit puree of one or more types of fruit with fruit juice or concentrated fruit juice as an optional ingredient, and may contain permitted food additives and sweeteners [1].
- 4) Grape jelly is produced through the concentration and gelling of unsweetened grape juice. Jelly consist of either the juice or aqueous extracts of one or more types of fruit or of the juice and aqueous extracts of one or more types

of fruit which has been clarified by filtration or other means, and may contain permitted food additives and sweeteners [10, 15, 16].

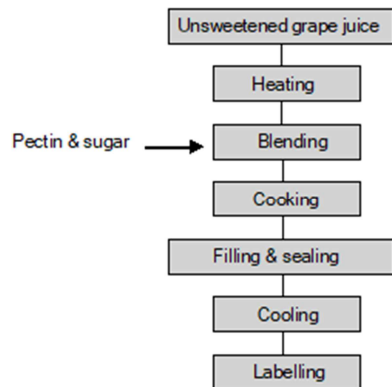


Figure 9. Grape Jelly. [1, 4-6, 9, 10, 12]

- 5) Grape juice concentrate is obtained by the process of water removal from refined grape juice to yield a final unfermented product at least double the standard strength and preserved in a permitted manner. The grape juice concentrate is mainly used in combination with other juice concentrates to produce multi fruit juice mixtures.

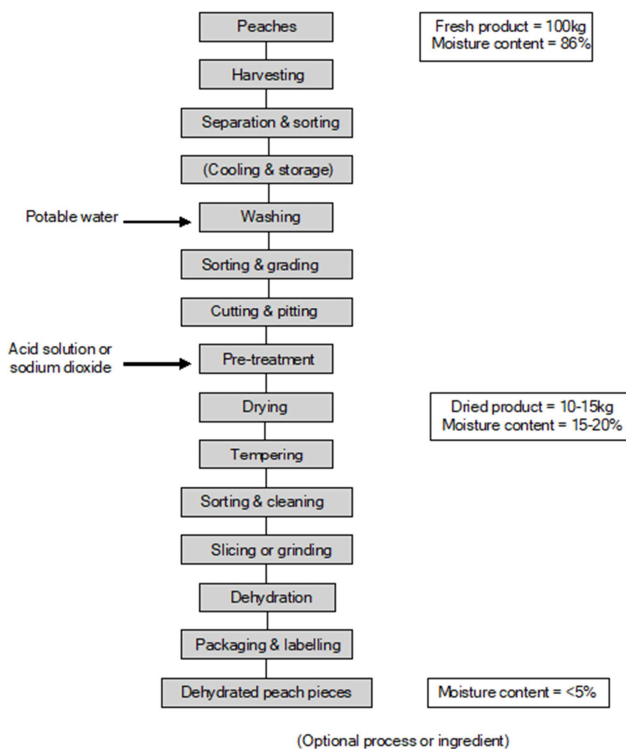


Figure 10. Grape Juice Concentrate. [1, 4-6, 9, 10, 12]

It can also serve as a sweetener in fruit spreads and other related products.

- 1) Grape pigments are extracted from the skins and pips after the juice has been expressed from the grapes. Grape pigment powder is dark red in color and is hygroscopic (attracts water). It is unstable at $\text{pH} > 4.2$ and is used to

color marzipan, chewing gum, hard boiled sweets, jellies and milk shakes, etc.

- 2) The pips of grapes contain approximately 12% oil which can be extracted and used as a coating for raisins in order to improve the appearance and pliability of the product. Grape seed oil also has industrial uses in soap and paint manufacture.
- 3) Grape vinegar is produced through the natural fermentation of grape juice. Vinegar plant or yeast culture in added to wine, which is the started material for the production of vinegar. Micro-organisms of the *Acetobacter* spp. facilitates fermentation of the wine which converts the alcohol in acetic acid [15, 16].
- 4) Hot pressed grape juice: Juice is extracted from grapes by mechanical or physical means after the application of a heat treatment known as the hot-break process. The hot-break process involves heating the crushed grapes prior to the addition of a pectolytic enzyme to break down pectins to ease the extraction of juice. This process also helps the extraction of color from the skins into the juice, especially for red grape juice.

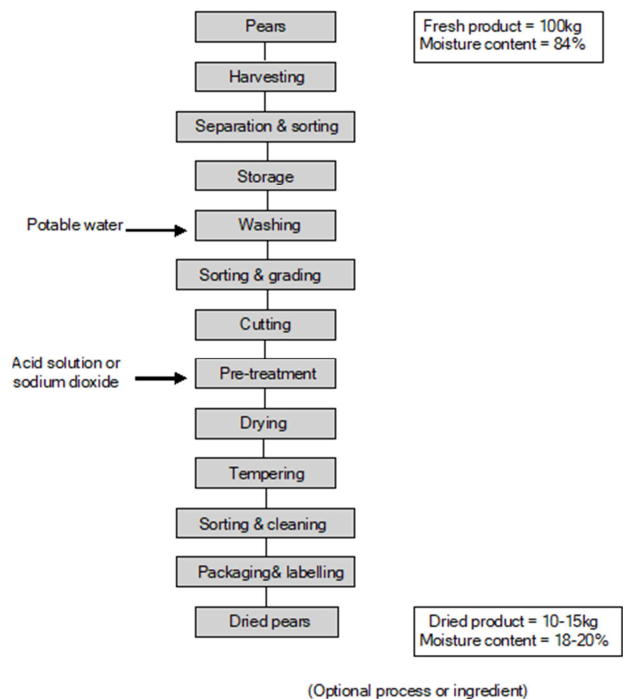


Figure 11. Hot Pressed Grape Juice. [1, 4-6, 9, 10, 12]

- 5) Cream-of-tartar is the common name given to tartrates that are extracted from the skins and pips (must/pomace) of grapes after juice extraction. The sediment from the wine vats and filter cakes is also a good source of tartrates. Cream of tartar and other tartrates are refined and are used in pharmaceutical preparations and as food additives.

2.4. Peaches

- 1) Dehydrated peach pieces are produced from sun- or artificially dried peach halves that are cut into smaller

pieces and dehydrated under vacuum conditions to a moisture content of below 5%. Dehydrated peach pieces is an ingredient in muesli and instant cereal mixes, and in nut-and-fruit mixes. Dehydrated peach pieces may also be ground down to a powder form that can be reconstituted for pie fillings, purees etc.

- 2) Dried peaches are used both as fruit snacks and as recipe ingredients. The dried product retains its characteristic peachy flavor and has a chewy and soft texture. Usually freestone peaches that have a deep orange color is preferred and both natural (sun or solar) and artificial drying methods may be used to dry the peaches to a final moisture content of 15 to 20%.
- 3) Frozen peaches are ideally suited for use in large scale production of peach products e.g. bakeries, biscuit manufacturers, etc. and as a way of storing product for later use in e.g. jams, purees, etc.
- 4) Peach chutney is a condiment with a sweet and tangy flavor. It is traditionally served with curries, hot & cold meats as well as savories and can be prepared from either green or ripe peaches. Other ingredients including fruits and vegetables such as onion and green pepper, sugar, vinegar and various spices and thickening agents are added to the chutney preparation [7, 9].

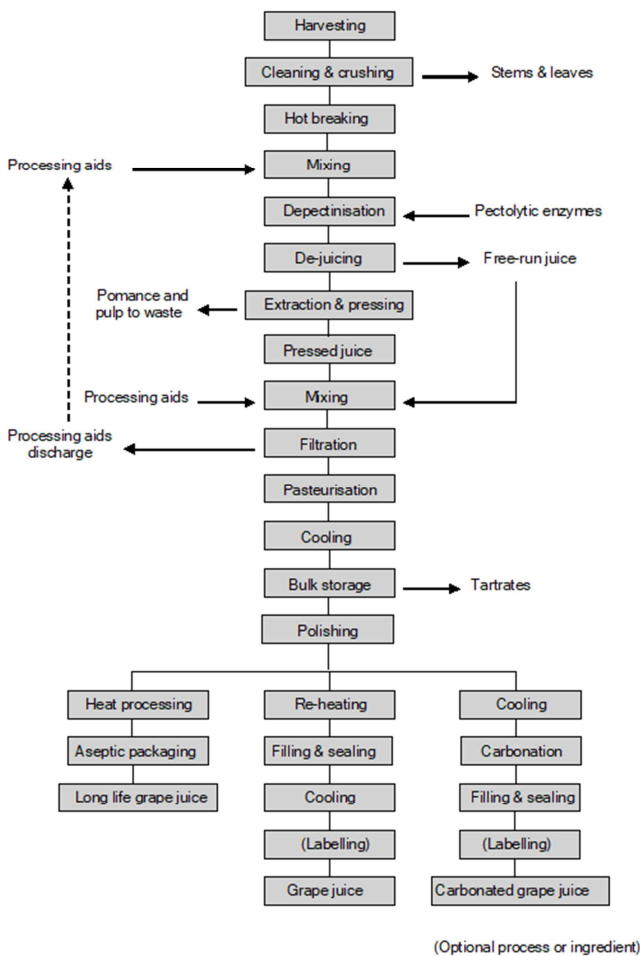


Figure 12. Dehydrated Peach Pieces. [1, 4-6, 9, 10, 12]

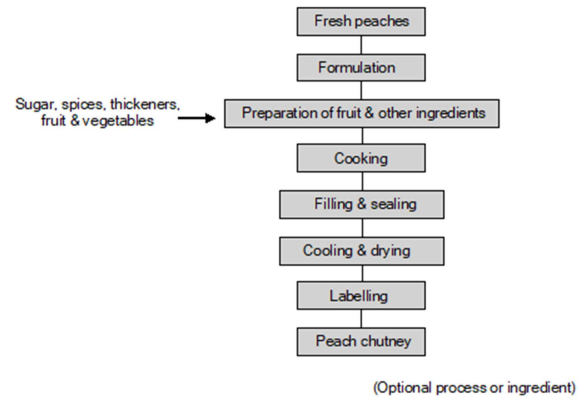


Figure 13. Peach Chutney. [1, 4-6, 9, 10, 12]

- 5) For the production of peach jam, the peaches must be harvested at the firm-ripe stage. This ensures maximum flavor, color and pectin development that is vital in the production of a successful jam [9, 13].
- 6) Peach nectar is a cloudy juice that contains various added and optional ingredients. The production of a nectar aims at creating a homogenous, poly-dispersion system with a significant proportion of undissolved pulp dispersed in a viscous solution. The final product has a soluble solids content 12 °Brix. Yellow freestone peaches are preferred for peach nectar due to their delicate flavor and thinner consistency after heat processing.
- 7) Peach puree is produced by peeling and pitting peach halves. These prepared peach halves then undergoes a pulping and screening process. The puree is preserved through freezing, canning or aseptic packaging. Peach puree is used in the preparation of peach nectar and juices, syrups, sauces, toppings and jams.

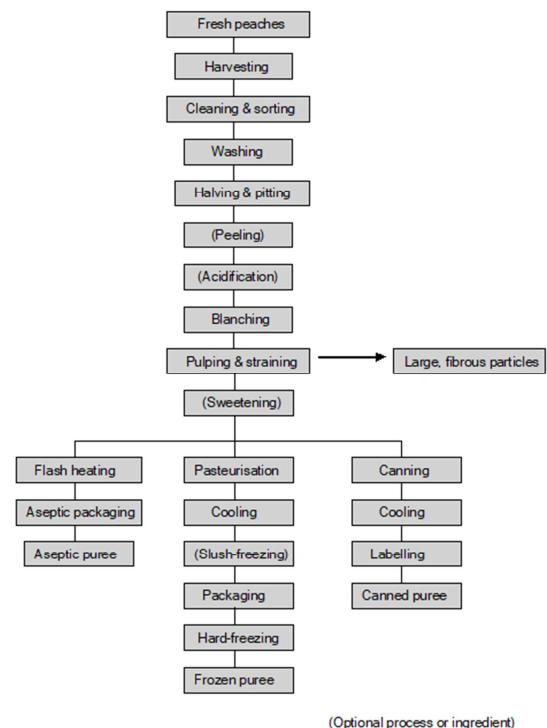


Figure 14. Peach Puree. [1, 4-6, 9, 10, 12]

- 8) Canned peaches: Peaches are canned in halves, slices or cubed pieces in fruit juice or sugar syrup of various strengths or artificially sweetened liquor.

2.5. Pears

- 1) Dried pears are classified as a semi-dried (intermediate moisture) product and contains between 18 and 22% moisture. The main uses of dried pear halves are in confectionary ingredients and fruit snacks. It stored at ambient temperatures, the final product has a shelf life of approximately 90 days, whereas when it is stored at temperatures below 7°C, the shelf life is significantly extended. Yield: 10 tons of fresh pears = 1 to 1.5 tons dried pears.
- 2) Frozen pears are ideally suited for use in large scale production of pear products, e.g. bakeries, biscuit manufacturers, etc. and as a way of storing product for later use in e.g. jams, purees, etc.

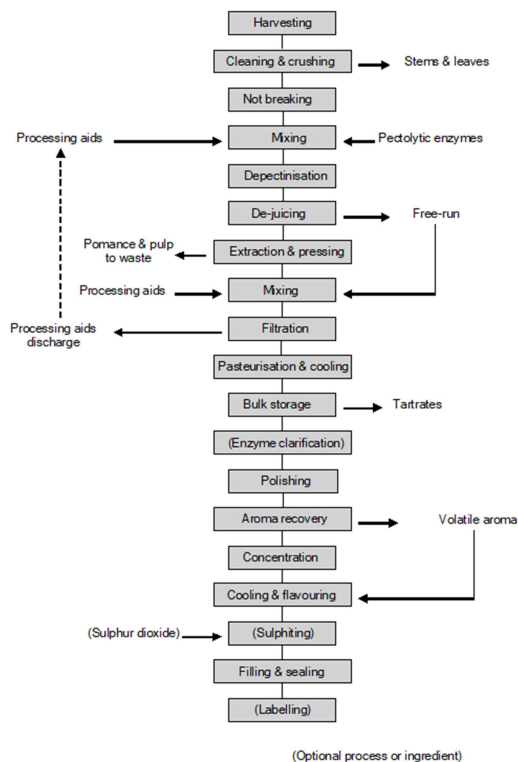


Figure 15. Dried Pears. [1, 4-6, 9, 10, 12]

- 3) Pear concentrate is basically pear puree that has been concentrated by an evaporation process. The pear are pulped, depectinized and concentrated to produce a product which can be used in confectionary products, beverages, sauces, flavorings and fillings and in fruit juices after dilution. The pear concentrate of 28 - 31% solids is preserved by aseptic canning or freezing.
- 4) Pear nectar is a cloudy juice that contains various added and optional ingredients. Pear nectar can be manufactured from fresh pears of good quality or from concentrated pear puree. The production of nectar aims at creating a homogenous, poly-dispersion system with a

significant proportion of un-dissolved pulp dispersed in a viscous solution. Nectar is legally required to contain a certain minimum percentage of fruit juice/pulp. In the case of pear nectar this figure is 40%. The final product has a soluble solids content 13 - 15 °Brix.

- 5) Peeled and cored pear halves are used for the preparation of pear puree, with subsequent processing including pulping and screening processes. The final product is mainly preserved through freezing or canning although a further processing option includes concentration. Under optimum processing conditions the final product contains 12% soluble solids and gives a yield of 89%. Pear puree is sued in the preparation of a number of products including juices, syrups, jams, and toppings.

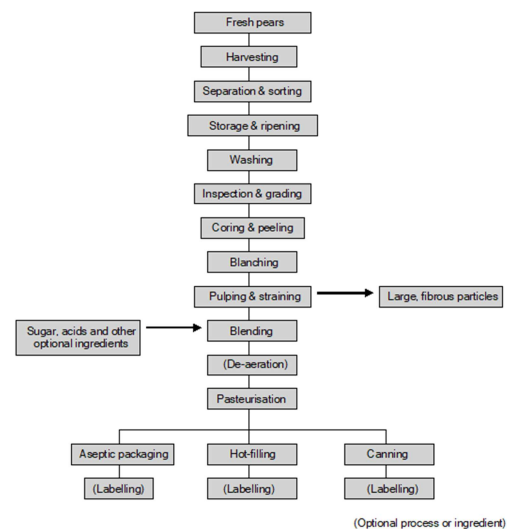


Figure 16. Pear Nectar. [1, 4-6, 9, 10, 12]

- 6) Pear relish is defined as a condiment with a sweet-and-sour favor. It contains ingredients such as preserved fruit and/or vegetables as well as spices. Pear relish specifically is prepared from firm green pears or firm mature pears and the relish is traditionally served with curries, hot & cold meats and savories.

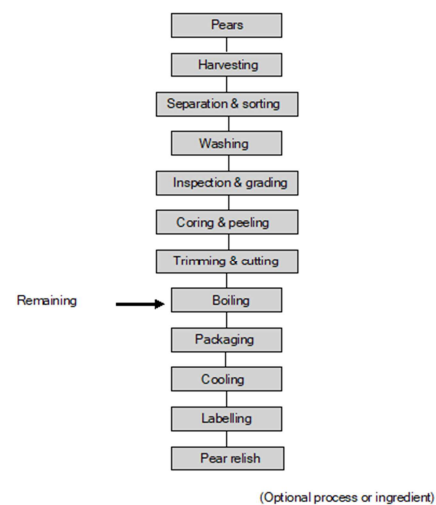


Figure 17. Pear Relish. [1, 4-6, 9, 10, 12]

- 7) Pears are canned in halves or cubed pieces as part of a fruit cocktail mixture in a fruit juice or a sugar syrup of various strengths or an artificially sweetened liquor. The canned product is a convenience product that is used to replace the fresh product. It has a long shelf life and thus extends the availability of the seasonal fresh product. It is used as a breakfast food or in bakery products.

2.6. Plums

- 1) Canned prunes are produced by canning dried prunes in a sugar syrup solution. This produces a ready-to-eat end product with a soft texture.
- 2) Firm-ripe plums with a full-bodied flavor and a high solids content are used in the production of dried prunes. The ideal final product should have a moisture content of between 18 and 20%. The final texture should be soft and chewy with a sweet taste. The product yield is usually in the order of 25 to 35%. Prunes are the product of plums varieties that can be dried without removal of the pip.

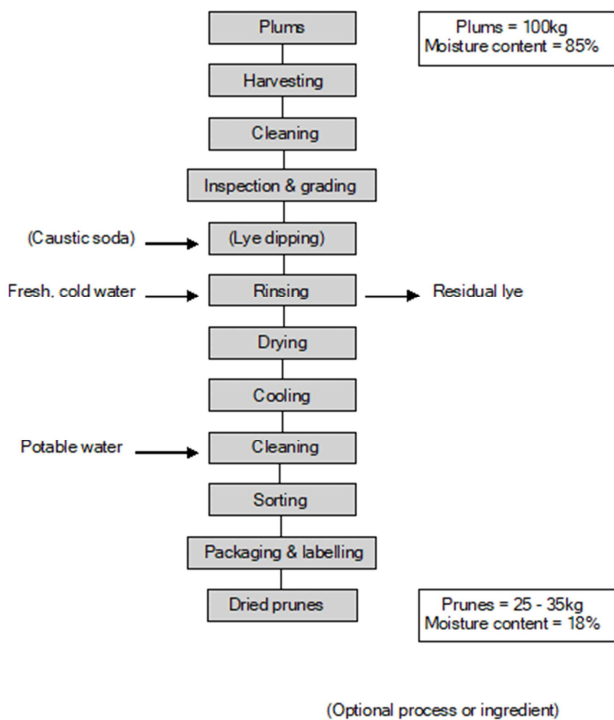


Figure 18. Dried Prunes. [1, 4-6, 9, 10, 12]

- 3) Frozen prune juice concentrate: Prune juice produced by the disintegration method is concentrated to approximately 60 °Brix by an evaporation process. The juice is preserved by freezing. The concentrate is used as the base for the preparation of single-strength prune juice.
- 4) Prune juice (diffusion method): Prune juice is prepared from dried prunes and consists of a water extract of the dried fruit, as against the squeezing of the fresh product. Commercial single strength prune juice has a concentration of 19 - 21 °Brix and is a popular breakfast beverage in some countries. The produce is mostly

packaged and preserved by canning, although aseptic processing can also be employed. Prune juice can be manufactured by a diffusion or disintegration method. The diffusion method is very simple by seldom used for large scale processing of prune juice.

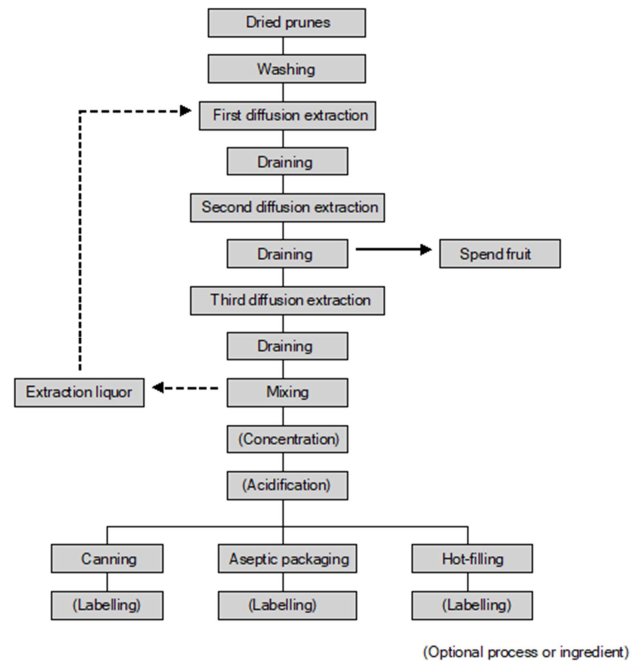


Figure 19. Prune Juice – Diffusion Method. [1, 4-6, 9, 10, 12]

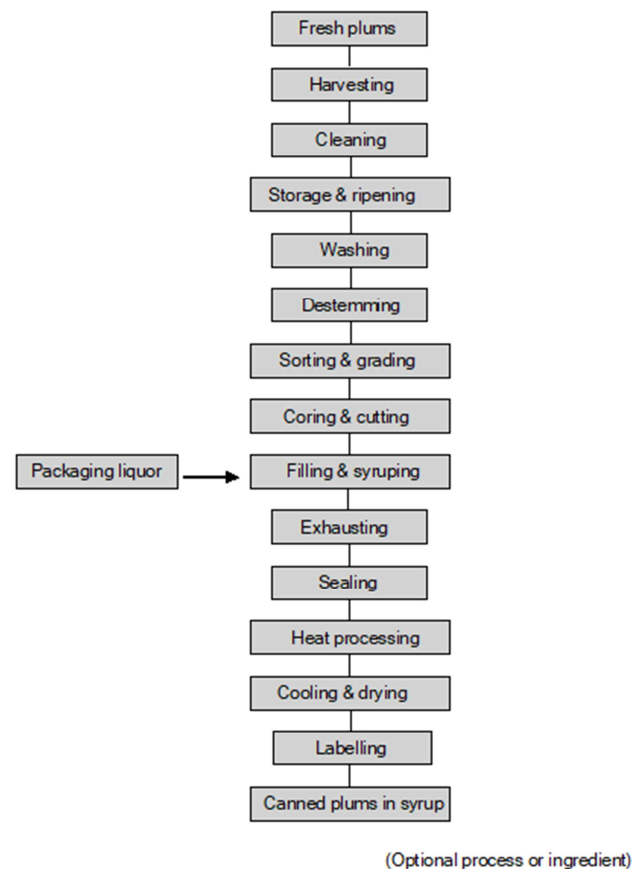
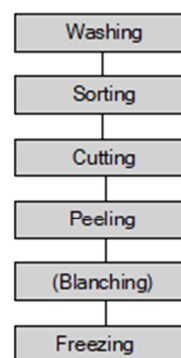


Figure 20. Canned Plums. [1, 4-6, 9, 10, 12]

- 5) Prune juice (disintegration method): Prune juice is prepared from dried prunes and consists of a water extract of the dried, disintegrated fruit, as against the squeezing of the fresh product. Commercial single strength prune juice has a concentration of 19 - 21 °Brix and is a popular breakfast beverage in some countries. The produce is mostly packaged and preserved by canning, although aseptic processing can also be employed. The disintegration method yields about 2271 liters of 20 °Brix juice per metric ton of prunes.
- 6) Canned plums: Ripe, pitted plums are preserved by a heat processing treatment and sealing in a can. Whole pitted plums or plum pieces are canned in sugar syrup, brine or natural plum juice. The product is mainly used as a replacement for the fresh dessert fruit.

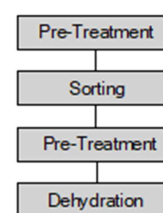
2.7. Figs

- 1) Canned Figs: Figs used in canning may be white or light brown in color. Several ingredients in addition to those mentioned in this report may be added to canned figs and these include sliced citrus fruit, spices as well as salt. To serve all consumers, dietetic packs with no added sugar or with an artificial sweetener can also be considered.
- 2) Frozen Figs: Figs may be frozen either as the whole fruit in a heavy syrup or alternatively as sliced fruit in a relationship of four parts fruit to one part water. In both cases storage must be below 0°F. Black Mission figs produce an excellent product when frozen and two methods can be employed to retain good color in the frozen product. Ascorbic acid and citric acid are helpful in maintaining good color, while it is recommended that the whole fruit be dipped for 2 – 3 minutes in a bisulfite solution of 2000ppm before being packed in a 35° Brix sugar syrup to preserve the color and flavor of the frozen fruit. The figs intended for freezing should be table-ripe, in other words considerably riper than the fruit used for canning or shipping. Furthermore the use of air-tight containers is suggested to prevent the development of off-flavors due to oxidation. Sliced fruit will benefit from a short dip in a diluted solution of Sulphur dioxide to prevent changes in flavor. Furthermore the addition of between 0.10 and 0.15% ascorbic acid to the syrup can prevent oxidation and further protect the flavor.
- 3) Preserves are largely similar to jellies except that whole fruit or large pieces of fruit are used in making the preserve. For the production of small-scale fig preserves, the figs used should be firm-ripe and no soft-ripe and should be of uniform size. Uniformity in the raw product is required to ensure that the pieces will cook evenly.
- 4) Solar dried figs are usually produced through sun (solar) drying, but mechanical drying may also be employed to produce a lower-moisture product. As the drying methods for figs differ from variety to variety, it is advisable to obtain expert information on the chosen variety, but a general process diagram is given below.



(Optional process or ingredient)

Figure 21. Frozen Figs. [1, 4-6, 9, 10, 12]



(Optional process or ingredient)

Figure 22. Solar Dried Figs. [1, 4-6, 9, 10, 12]

3. Conclusion

Food is mainly produced from four sources: animals; poultry; plants, which include fungi such as mushrooms; and marine animals. Through the use of stepwise processing methods, more complex foodstuffs are produced from these 4 resources.

All types of processing methods have an effect, however small, on the raw material, which can lead to changes in color, flavor, texture, appearance, aroma and nutritional value. Some processing methods will only create a temporary change, meaning the change can be reversed. One example of this is chocolate, which can be melted and solidified again on cooling. Most processes however, have an irreversible effect on the raw product.

For these reasons it is vitally important that any person considering agro-processing have at least a baseline knowledge of the processing options available for deciduous fruit, as well as the steps involved in each option to go from raw material/crop to finished product. The idea of “agro-processing” has long since transcended the sphere of being a “buzzword”. Its application and implementation are key to enable growth within the agricultural sector and to ensure food security for all consumers.

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