



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Sea buckthorns Beverages



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CHAPTER 1

INTRODUCTION

1.1. Status and Market Size

Sea buckthorn (*Hippophae* spp.L.) is an ecologically and economically important plant of trans-Himalayan region that belongs to the family Elaeagnaceae. Seabuckthorn is commonly known as ‘cold desert gold’ because of its multifarious uses. Potential of Sea buckthorn in India has been recognized by several R&D organizations. However, Sea buckthorn industry is still in its nascent stages. In India, the total area under Sea buckthorn is 13,000 ha. And approximately 600 tons of berries are harvested annually.

The species is a wind pollinated dioecious shrub. It has silvery deciduous leaves and colourful red, orange or yellow berries that remain on the shrub throughout the winter. The plant is hardy and it can withstand extreme temperatures from 43°C to 40°C and it is considered to be drought tolerant. The shrub develops extensive root system having ability to fix atmospheric nitrogen. It is therefore an ideal plant for soil erosion control, land reclamation, wildlife habitat enhancement and farm stand protection in temperate region. Sea buckthorn grows naturally without much of human interference.

The fruits are rich in phytochemicals which exhibit excellent radical scavenging properties. The fruit has excellent nutritional qualities as well as unique taste, colour and flavour. The medicinal value of Sea buckthorn was recorded as early as the 8th century in the Tibetan medicinal classic ‘rGyud Bzi’.

Sea buckthorn fruit is highly perishable and the lack of storage facilities and processing machinery leads to minimum utilization of the fruit. Converting the fruit into value added products will help in increasing the popularization of the fruit in domestic and international markets.

Currently, the demand for Sea buckthorn far exceeds the supply capacity of the region. Large scale cultivation of Sea buckthorn has the potential to be a key means of sustainable development for trans-Himalayan areas. The primary processing of converting the fruit into juice, seeds and hull is done in the fruit production areas. These products are then marketed to firms outside the region who add further value to each of these materials.

1.1.1. Socio-economic significance

The trans-Himalayan region of India is rich in diversity of wild edible plant species. Wild edible plants are very important for the well being of the populations in the region, not only as sources of supplemental food, nutritionally balanced diets, medicine, fodder and fuel, but also for developed methods of resource management, which may be fundamental to the conservation of some of the world's important habitats.

Sea buckthorn berry collection has become an important activity in the Trans-Himalayan region since 2001. Berry harvesting is done for a short period of 20-30 days in September. Approximately 0.8% of the total population of Leh district is directly benefitted from berry collection. The berry collectors earn around Rs.255 per kg of berry harvested and this income generation is highly significant for their livelihoods as well as the region's economy. Majority of the berry collectors are from the needy section of the society and women constitute 67.4% of the work force.

The fruit is an important source of indispensable nutrients and components with high cosmoceutical properties. The primary products such as juice, seed and hull are highly valuable and the primary processing happens in fruit growing areas, given the region's topography and the climatic conditions. The harvesting and primary processing are very significant in the employment and income generation of the local people. The fruit offers opportunity for farmers living in mountains to maintain a sustainable livelihood providing nutritious foods, different types of medicines and reduces soil erosion.

1.1.2. Commercially important varieties

Three varieties of Sea buckthorn are seen in India, namely *Hippophae rhamnoides*, *H. salicifolia* and *H. tibetana*. These species have different morphology i.e. size and shape of plants as well as fruits.

Among the three species, *H. rhamnoides* is a shrub or small tree form (2-5 m), *H. salicifolia* is a small or large tree (4-9 m), whereas *H. tibetana* is a under shrub (0.2-0.6 m). Fruit size varies from 8 to 27 g/100 fruits in *H. rhamnoides*, 30-35 g in *H. salicifolia* and 15-21 g in *H. tibetana*. Colour of the fruit varies from red to reddish orange in *H. rhamnoides*, yellow in *H. salicifolia* and orange with green strips in *H. tibetana*.

Table 1: Distribution of the Sea buckthorn fruit varieties

Species	Ladakh	Himachal	Uttarakhand	Sikkim
<i>Hippophae rhamnoides</i>	Present	Present	Not seen	Present
<i>Hippophae salicifolia</i>	Not seen	Present	Present	Present
<i>Hippophae tibetana</i>	Present	Present	Present	Present

1.1.3. Production status of Sea buckthorn fruit

Sea buckthorn grows naturally in five Himalayan States (Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh). Ladakh remains the major site for natural Sea buckthorn resource with over 70% of the total area (13,000 ha) under Sea buckthorn in the country. Using satellite data, it is estimated that area under pure Sea buckthorn in Ladakh is 7184 ha while the area under mixed Sea buckthorn is 2083 ha. Despite the vast area under natural forest, the mean annual berry harvest is less than 5% of the total available Sea buckthorn resource in the region. There is no production data available.

Species	Ladakh	Himachal	Uttarakhand	Sikkim
Total Area (Ha)	9,267	1000	2000	800
Area (%)	70.9	7.6	15.4	6.1

1.1.4. Composition & Nutritive Value of Sea buckthorn fruit

The fruit of sea buckthorn is rich in nutrients and medicinal compounds such as vitamins, carotene, flavonoids, essential oil, carbohydrates, organic acids, amino acids, and minerals. Protein level of Sea buckthorn is fairly high for a fruit and this explains the cloudy or opalescent juice. Vitamin C content has been reported as high as 600 mg/100 g of fruit. Vitamin E content is 160 mg/100 g of fruit.

Table 2: Nutritive value of Sea buckthorn fruit per 100 g of edible portions

Nutrients	Per 100g
Carbohydrates	5g
Protein	1g
Fat	2 g
Moisture	91g

Crude fibre	0.5g
Vitamin C	909 mg
Vitamin A	1500µg
Vitamin E	3mg
Sodium	6mg
Potassium	420mg

Source: Directorate of Arecanut and Spices Development, Ministry of Agriculture and Farmers Welfare and USDA Food composition data base.

1.1.5. Health benefits of Sea buckthorn fruit

In Ladakh region, local traditional doctors often prescribe preparations from Sea buckthorn for treatment of common problems like indigestion, throat infection, gynecological problem, ulcer, gastritis, bronchitis, acidity, diarrhea, hypertension, blood disorder, fever, tumor, gallstone, cough, cold, food poisoning etc.

Sea buckthorn is known for its medicinal properties for treatment of oral mucositis, vaginal mucositis, cervical erosion, duodenal ulcers, skin ulcers, cancer, sluggish digestion, stomach malfunctioning, neoplasia, thrombosis, hepatic injury, tendon and ligament injuries etc.

Clinical trials on patients with ischemic heart disease have shown that total flavonoids of Sea buckthorn reduce cholesterol level and improve cardiac function.

The oil absorbs ultraviolet light and promotes healthy skin and this unique property of Sea buckthorn oil is being recognized and sought by the cosmetic industry.

1.2. Indian Market Outlook

Sea buckthorn industry is still in its nascent stages, with total area under Sea buckthorn 13,000 ha. Approximately 600 tons of berries are harvested annually from wild plants, which is less than 5% of the total available Sea buckthorn resource. This is mainly due to short harvesting season, coincidence of harvesting period with that of other crops, and unorganized plantation, which all restrict harvesting of only a fraction of the available resource.

The berry being delicate and highly perishable one, needs to be processed the same day of harvesting. There is a need to develop cold chain facilities in major Sea

buckthorn growing areas to prolong the time between harvest and processing. Due to this perishable nature, only primary processing happens in cultivating areas – pulp, seeds, etc are transported to manufacturers from primary processing centers. With proper handling and processing technology, the fruit and its value added products can be commercialized to its potential.

In recent years, there has been a tremendous shift of consumer preferences from aerated drinks to packaged fruit juices - Rs.1500 crore size market in India. Packaged fruit juices market is growing by and large and is forecasted to grow at more than 15% CAGR in the coming years. Fruit drinks with less than 30% fruit juice hold 50-60% of the market. Consumers nowadays have inclination towards health proposition and they are thinking and selecting options which are good for their health.

Greater utilization of under-utilized or wild edible plants that are of local or regional importance will effectively increase nutritional security. By improving the linkage between production and utilization, the biodiversity of traditional crops can be safeguarded.

1.3. Value added products from Sea buckthorn fruit

1.3.1. Sea buckthorn RTS beverage

The fruit juice is mixed with strained syrup solution (as per requirement) and the beverage is filled in glass bottles and corked tightly. The bottles are pasteurized at desirable time temperature combination and cooled to room temperature. The RTS bottles are stored at ambient temperature and usually chilled for serving.

1.3.2. Sea buckthorn fruit squash

The fruit juice is strained to remove seed and unwanted particles from juice. The juice is measured to prepare sugar syrup. The sugar syrup is prepared by mixing 1.8 kg sugar, 1 L water and 15 g citric acid and then strained to remove dirt and scum. Once the sugar is completely dissolved, the syrup is mixed with juice homogeneously. Permitted level of preservative is added and the squash is bottled in clean and sterilized bottles.

1.3.3. Sea buckthorn Jam & Jelly

Using pectin as a setting agent, the fruit pulp can be converted to jam and jelly (in

combination with other fruits) by adding sugar and boiling.

1.3.4. Cosmetic products like UV protective oil & cream

The cream and oil are highly demanded for cosmetic products.

1.3.5. Feed additive

The leaf, berries and colorant extraction leftovers have a significant role in use as feed additives.

1.3.6. Food colorant

Sea buckthorn yellow isolated from the residues after extraction of pulp is a valued food colorant.

1.4. Harvest & Post Harvest handling of Sea buckthorn

1.4.1. Harvesting & yield

Sea buckthorn berry is harvested by hand using 'beat the bush' method in September. The harvesting season for Sea buckthorn in India is very short, 20-30 days in September. This harvest period coincides with that of other crops. A natural sea buckthorn habitat can yield 750 to 1500 kg of berries / hectare

1.4.2. Harvesting method

Harvesting can be done manually or mechanically. Mechanical fruit harvesters can be classified as either direct harvesters or indirect harvesters. A direct harvester relies on direct contact with the fruit, while an indirect harvester removes the fruit without contact.

In India, harvesting is still done by hand picking or hand cutting. This difficult and labour intensive process requires about 1500 hours per hectare. Many harvesters are based on the principle of cutting off fruit-bearing branches. Developing of thorns (2–5 cm long) at early ages (2–3 years old) is a drawback, especially for hand harvesting.

The harvesting is performed manually by beating the branches of sea buckthorn with a stick. Polythene sheet is placed on the ground just below the canopy. Tip of a branch is held with one hand while beating with a stick with the other. The berries that fall on the polythene are collected in a bucket. Harvested berry is transported to the

processing unit in 10 kg capacity food grade plastic trays.

By this 'beat the bush' method, a person cannot harvest more than 2 to 3 kg of ripe fruits per hour besides the plant is also severely damaged. For increasing capacity and efficiency, ICAR has developed four sea buckthorn harvesting tools for 2 species of sea buckthorn. Clipper with handle (cost Rs.480/each) developed is found to be the most effective tool, which collected 6.7 kg fruit/hr, as compared to 3.1 kg/hr by traditional method.

1.4.3. Storing and Transporting

Sea buckthorn berries when overripe carry a strong musky odour with rancid taste, detectable even in the field. Washing may reduce or change the odour. To avoid this problem, berries must be harvested at the correct stage, quickly transported to the processing plant, and be cooled immediately to temperatures around 4° to 6°C to retard growth of microorganisms. If the berries are to be stored more than a few days, they should be frozen, preferably by individual quick freezing techniques. The berries are thawed and processed to products as required on demand. Juice extracted by pressing or centrifugal techniques must be stored under refrigeration and requires pasteurization and freezing for long term storage. Alternatively, fruit may be processed into pasteurized or sterilized finished products and stored in that form at room temperature. The shelf life even of sterilized product is limited but improved in refrigerated storage.

CHAPTER 2

Processing of Sea buckthorn Beverage

2.1 Process Flow for Production of Sea buckthorn Beverage

Sea buckthorn Beverage is a product made by blending the fruit juice with sugar syrup to meet the specifications for the category and then subjecting it to sufficient heat treatment such as pasteurization or sterilization before or after packing. RTS or fruit beverage should contain at least 10 per cent fruit juice and 10 per cent total soluble solids besides about 0.3 per cent acid. It is not diluted before serving; hence it is known as ready-to-serve (RTS).

The ingredients that are used in the production of Sea buckthorn beverage are the Sea buckthorn fruit juice, sugar, water, permitted additives such as acidity regulator, stabilizer, anti-oxidant, colour and flavouring substances. The amount of sugar and water required should be calculated based on the TSS content and acidity of the fresh extracted Sea buckthorn fruit juice. The additives are to be added as per the levels prescribed in FSSAI standards.

The unit operations in the production of Sea buckthorn beverage are explained below.

2.1.1. Berry inspection & cleaning

This is an important step to remove damaged berries, twigs, leaves and other debris collected during harvesting. The first step in cleaning is done by rolling the berry on a wet surface (L×W: 7'6" × 3') placed at an angle of 40-50°. The leaves and damaged berries stick to the wet surface and are removed manually. Twigs and other debris that does not stick to the wet surface are removed by hand. Since the harvesting methods are crude, there is a lot of debris involved, resulting in a process loss of about 13±3 %.

2.1.2. Washing

The berries are then washed in water and the remaining leaves and damaged berries that float on the surface are removed with a sieve. Manual washing or mechanical washing by spray or bubble washer may be done. The washed berries are drained well off the water before they go to extraction.

2.1.3. Juice extraction

Juice extraction from berry is done with a pulper. Cleaned berries are fed into the pulper to obtain pulp. The unbroken seeds and hull are separated as a cake. The yield of pulp is around $74 \pm 3\%$ and the cake with seeds is around: $24 \pm 3\%$

2.1.4. Clarification

If rested, raw juice separates into 3 layers, due to different density fractions which is undesirable. The top layer is thick, creamy and orange; it contains Sea buckthorn oil. The middle layer contains the liquid fraction from the pulp and the lower fraction consists of the sediment.

To prevent this undesirable natural separation, the juice is separated in a cream separator. This process separates the juice into two fractions: fat rich “cream” and opalescent juice. The cream contains sea buckthorn oil and makes up 3 to 4% of the total juice mass, while the opalescent juice is processed into the beverage. The sediment fraction accumulates at the bottom of the juice fraction

If the pulp oil is left in the juice, it will cause an oil layer to be formed on the juice surface. This will create an unsightly and undesirable oil ring on the package surface after the juice is removed. Centrifugal reduction of the juice oil content below about 0.1% will eliminate the floating oil problem. As the oil is removed by the disk stack centrifuge, the coarse sediment will be sedimented to the bottom of the bowl and can be removed automatically by the dislodging mechanisms present in the centrifuge.

2.1.5. Filtration

Filtration is done to remove any remaining sediment portion from the clarified juice. This step makes the juice impurity free and highly suited for further processing. Vibratory filter can be used to avoid sludge formation

2.1.6. Syrup preparation & Blending

The required amount of sugar and water (based on the calculations with raw juice parameters and desired final product parameters) are mixed in a vat to prepare the syrup. The mix is gently heated to dissolve the sugar completely. Once the sugar is dissolved, the

fruit juice is added and blended well. The other permitted additives such as acidity regulator, stabilizer, permitted colours and natural flavouring substances are then added according to the permitted levels. All these are blended well together to ensure a homogenous beverage.

2.1.7. Bottling, exhausting & capping

The prepared beverage is filled into clean and sterile bottles. The filled bottles are exhausted and capped. Exhausting is done to remove the air in the headspace of the bottles.

2.1.8. Pasteurization

The capped bottles are pasteurized at 95°C for 3 minutes in Pasteurization tunnel or batch pasteurizers. This High Temperature Short Time (HTST) combination is preferred because the fruit juice is delicate and has heat sensitive components.

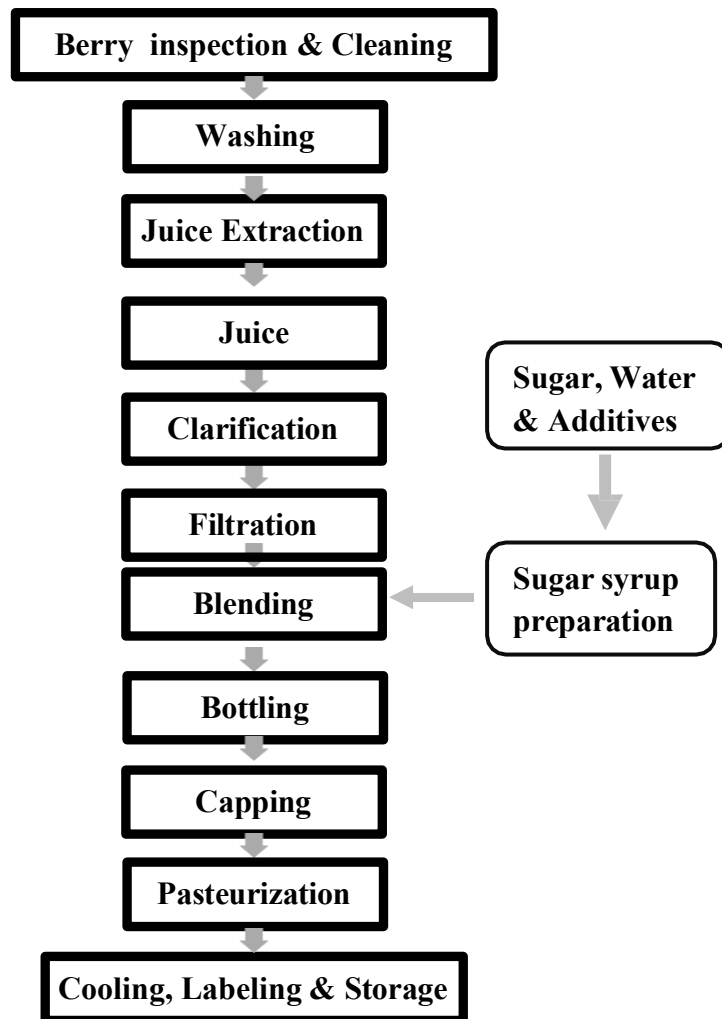
Alternatively, pasteurization of the beverage can be done by UHT (Ultra High Temperature) processing also, at 115-118°C for 3 seconds. Plate or Tubular heat exchangers are used. Here the beverages are pasteurized first, cooled and then packed aseptically in Tetra pack containers or plastic bottles.

UHT processed beverages can also be packed in bag in box type of packaging for bulk handling. The advantages are longer shelf life and less loss of nutrients.

2.1.9. Cooling, Labeling & Storage

After pasteurization is complete, the bottles should be cooled down to room temperature and then labelling is done. Then the bottles are stored/ transported.

2.1.10. Flowchart for Sea Buckthorn Beverage processing



2.2 Critical Process Parameters for Quality Control

- ❖ After cleaning, the berries should be processed as soon as possible
- ❖ If immediate processing is not possible, their temperature must be reduced immediately to 4 to 6°C and stored.
- ❖ Cleaning of the berries to remove diseased and damaged or pest-infested berries and also stems, leaves, or other debris collected during harvesting is very important
- ❖ Washing the fruit prior to juice extraction is very important for removing the microbial load as well as for removal of dust and dirt clinging to the fresh berry.
- ❖ Washing may reduce or adjust the musky odour that is often prevalent with sea buckthorns.

- ❖ A wetting agent or detergent in the wash water or bubble washing would be beneficial.
- ❖ The cream should be removed properly, as this impacts the organoleptic as well as storage quality of the product
- ❖ The packaging materials must be clean and sterile.
- ❖ The pasteurization should be done using High Temperature Short Time as the juice has heat sensitive properties
- ❖ Judicious use of permitted additives such as emulsifier and stabilizer gives a stable product.

2.3 Defects in Processing

- ❖ Improper cleaning and remnant debris would affect flavour by contributing off flavours from rotted berries or “green” flavours from leaves and stem material.
- ❖ Sea buckthorns have a musky odour often associated with them. Improper washing cannot remove this odour.
- ❖ If cream is not removed properly, it results in the formation of an oil layer on the juice surface, creating an oil ring on the packaging surface. This is unappealing and undesirable from the consumer’s point of view.
- ❖ Presence of air bubbles (in the cloud particulates) will cause phase separation and possible oxidation of the product.
- ❖ The juice being delicate has loss of flavour and development of off-flavour if heated beyond the conditions indicated.
- ❖ Over-heating destroys sensitive but important nutrients like vitamin C.
- ❖ Under-heating will result in product spoilage as well as increase the risk of consuming an unsafe product.
- ❖ Fruits that are over-ripe or have been stored too long will produce obvious and unpleasant flavours in the product.

CHAPTER 3

Packaging of Sea Buckthorn Beverage

Food Packaging may be defined as the process of containing or enclosing manufactured food products in proper chosen packaging material for the particular product through a suitable system, thereby protecting it during distribution, storage, sale and use.

The following are the major functions of packaging, each of which must be understood by the food manufacturer

- Containing and safety of product that is of paramount importance.
- Increasing the shelf-life and ensuring longer availability
- Facilitating the handling, storage and distribution.
- Protecting against biological, chemical and distribution damages
- Providing convenience - at all stages of handling and to the consumer.
- Information about the product contained through the labelling.
- Security through a tamper evident design.
- Contribution to the product image through structural and graphic design - as a marketing and advertising tool.
- Environment protection by taking responsibility of empty packaging material after its use.

3.1 Characteristics of packaging material for fruit beverages

- The primary packages for fruit beverages must have the following characteristics:
- It should allow heat transmission (fast heat transfer during heating and cooling) or heat-resistant (to high filling temperature).
- It must be absolutely leak-proof and able to prevent contamination by moisture, air and micro-organisms by assuring vacuum sealing.
- It should be sturdy in order to prevent handling and storage hazards.
- “Product quality maintenance” i.e. the package should not react with and change the properties of the product over a given period of storage and preservation.
- It should have resistance towards sunlight, storage temperature and atmospheric humidity.

3.2 Packaging material for fruit beverages

They contain fruit juice, water, sugar, dextrose, invert sugar etc. The major deterioration that occurs in fruit beverages is loss of nutrition, physico-chemical changes and microbial growth. The product characteristics to be considered in relation to packaging are acidic character, presence of enzymes and Vitamin C, colour and flavour. Spoilage of fruit juices is mainly due to yeast; its growth depends upon the temperature. Hence every living yeast cell must be removed or suppressed by pasteurization, filtration and/or preservatives.

3.2.1. Primary Packaging materials

For packaging of beverages various packaging materials can be used. Glass is in major use and also among plastics HDPE, PVC, PS, PP etc. and Aluminium foil, are being used.

1. Metal Containers - Lacquered

Tinplate cans made of low carbon mild steel of 99.75% purity, coated with tin with easy open ends are used. These tinplate containers are either 3 piece or 2 piece containers. They are lacquered internally to prevent corrosion by food containing high acid content and sulphur content.

2. Glass bottles

The use of glass bottles for the packaging of fruit beverages was widespread although the hot-fill/ hold/ cool process had to be applied with care to avoid breakage of the containers. Glass is still the preferred packaging medium for high quality fruit beverages. However, over recent years, an increasing proportion is being packed aseptically, into cartons. The improvements that have occurred in glass bottle packaging are:

- Light weight
- Surface coating to increase abrasion resistance
- Use of wide mouth containers fitted with easy-open-caps.

3. Plastic Containers

Fruit juices contain organic substances, which are sensitive to bacterial contamination. Packaging of such products is done through hot filling, to achieve extended shelf-life, PET bottles are usually used for hot filling applications. Special features are added to the

containers through design and manufacturing process. The package is heat-set in order to improve the temperature resistance of the containers. PET resins with a higher T_g (glass transition) temperature and/or a faster rate of crystallisation are used. Normally hot-filled PET bottles are designed about 1.5 times heavier than cold-filled bottles. Reinforcing ribs and grooves are also provided along the circumference and base of the bottle. After filling and capping operations, the liquid continues to cool, which results in formation of vacuum. The bottle wall can deform under the influence of vacuum, and this problem is overcome by providing vacuum panels in the container side wall. Generally, lower levels of PET copolymer are preferred and intrinsic viscosities of about 80 are acceptable.

4. Flexible Packs

Flexible plastic packages offer economic savings over conventional glass and metal containers but they are permeable to oxygen. Therefore, it is critical to select a flexible package that minimizes the permeability to oxygen. Flexible laminated pouches like metallised polyester/polyester/ polyethylene are used for hot fill packaging method without retorting for acidic fruit juices. These are used either as flat pouches or stand-up pouches. However, the shelf-life of the product in these pouches is limited.

5. Aseptic Packages

Ready to serve fruit beverages and fruit pulps / concentrates, packed in aseptic packages provide excellent protection for fruit juices / pulps. These aseptic packages are made by combining thermoplastic with paperboard and aluminium foil. Their multi-layered construction enables the carton to protect the contents from various factors responsible for spoilage. The aluminium foil layer is a strong barrier for O₂ and light. The inner plastic layer made of polyethylene makes it possible to seal through the liquid. The outer paper layer provides stiffness making it possible for the cartons in a brick shape, thus, enabling maximum utilisation of available storage and transportation space. Excellent graphics are possible leading to good display and shelf appeal and also providing information regarding the product. The aseptic process makes the product bacteria-free before being packaged. These packs are shelf-stable at room temperature and the shelf-life and nutrient composition of the fruit juice is influenced by the barrier properties of the tetrapak.

3.2.2. Secondary & Tertiary packaging materials

- **Secondary packaging**

Secondary packages are mainly used to group primary packages. The beverage products in primary packaging are overwrapped in secondary packaging materials. Materials are used for Secondary packaging of Beverage products include Cellophane, PP or OPP film, Cardboard labels and paper wraps.

- **Tertiary packaging**

Tertiary packaging is useful for bulk handling, storage and transportation. Fully packed beverage products are placed in open or closed folding cartons, trays or display cartons at the tertiary packaging stage. The packed cartons are sealed with cellophane.

3.2.3. Bulk packaging materials

a. Bag-in-Box System

It consists of a collapsible bag within a rigid container, a filling machine to introduce the liquid product into the bag and a dispenser to draw the product out. The outer container can be a box, a crate or a drum. The bag actually consists of two bags. An inner bag contains the liquid and an outer bag provides the barrier properties. Both are heat-sealed at the edges. The tubular spout fitted to the bag aids in filling and dispensing of the product.

As little as 3 litres or as much as 1000 litres, can be packed. The bag is the “life” of the system. The bag itself consists of three components:

- i. An inner layer
- ii. An outer layer
- iii. A spout

The function of the inner layer, the one in contact with the product, is to provide the bag with seal integrity. The seals are to be strong enough to withstand constant mechanical and chemical “pressure” for at least twice the expected shelf-life of the product. Plastic films manufactured from high performance polyethylene, with excellent sealing and puncture properties are usually used as inner layer materials.

The function of the outer layer is to provide the bag with barrier commensurate with the expectation of the shelf-life of the product. In this respect, bag in box scores over other

packaging forms, because unlike other packaging materials like jars and cans, the barrier property and hence the cost of this packaging form can be varied. The shelf-life expectations and storage condition play an important part in determining what the barrier requirements of the outer layer need to be. The standard outside layer is a metallised film laminate, which under standard conditions has an OTR of $1\text{cc}/\text{m}^2 / 24\text{hrs}$.

The spout and cap assembly are made of injection moulded plastics. The spout is provided with a flange, which is welded to the bag's inner layer during bag's manufacture. The spout and cap have two functions. They are used to fill the product in the bag and are also used to dispense the product from the pack. Several spout types are available ranging from a simple bung like configuration to ones, which can only be opened on the filling machine. The caps come with various tamper evident features as well.

b. Rigid Containers

The purpose of this container is to hold the bag during storage, transportation and use. As is evident, the bag being made from flexible films, is incapable of being stored and transported by itself. Hence, each bag is individually stored into rigid outer container post filling. For packs of capacity below 50 litres, corrugated fibreboard cartons are generally used as the rigid containers. Beyond that plastics and metal drums are used. For very large bags, 1000 litres, + polygonal (6-8 faces) corrugated fibreboard containers made from 7 to 9 ply are used, though there are other alternatives as well.

CHAPTER 4

Food Safety Regulations & Standards

According to FSSAI Standards 2.3 Fruit & Vegetable Products category 2.3.10 Thermally Processed Fruit Beverages / Fruit Drink/ Ready to Serve Fruit Beverages under Food Safety Standards and Additives 2011

1. Thermally Processed Fruit Beverages / Fruit Drink/ Ready to Serve Fruit Beverages (Canned, Bottled, Flexible Pack and/ Or Aseptically Packed) means an unfermented but fermentable product which is prepared from juice or Pulp/Puree or concentrated juice or pulp of sound mature fruit. The substances that may be added to fruit juice or pulp are water, peel oil, fruit essences and flavours, salt, sugar, invert sugar, liquid glucose, milk and other ingredients appropriate to the product and processed by heat, in an appropriate manner, before or after.
2. The product may contain food additives permitted in these regulations including Appendix A. The product shall conform to the microbiological requirements given in Appendix B. The product shall meet the following requirements: —
 - (i) Total Soluble solid (m/m): Not less than 10.0 percent
 - (ii) Fruit juice content (m/m) (All other beverage/drink): Not less than 10.0 percent
3. The container shall be well filled with the product and shall occupy not less than 90.0 percent of the water capacity of the container, when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20°C which the sealed container is capable of holding when completely filled.

Appendix A: Permitted Additives for Thermally processed Fruit Beverages

Additive	Limit	Additive	Limit
Lauric arginate ethyl ester	50 mg/kg	Saccharins	300 mg/kg
Curcumin	200 mg/kg	Erythrosine	100 mg/kg
beta-Carotenes, vegetable	200 mg/kg	Tartaric acid, L (-)	GMP
Carotenoids	200 mg/kg	Tartrazine	200 mg/ kg
Annatto	200 mg/ kg	Carmoisine	200 mg/kg
Saffron	GMP	Riboflavins	50 mg/kg
Ponceau 4R	200 mg/ kg	Sulfites	350 mg/kg
Sorbates	1000 mg/kg	Sunset yellow 200 mg/kg FCF	200 mg/ kg
Propylene glycol alginate	GMP	Indigotine (Indigo carmine)	200 mg/ kg
Alginic acid	GMP	Brilliant blue FCF	200 mg/kg

Sodium alginate	GMP	Fast green FCF	200 mg/kg
Calcium alginate	GMP	Benzoates	600 mg/kg
Glycerol ester of wood rosin	100 mg/ kg	Sodium aluminium silicate	5 g/ kg

Appendix B: Microbiological standards for Thermally processed fruit products

	Sampling Plan		Limit (cfu)	
	N (Number of units comprising a sample)	C (Maximum allowable number of units having microbiological counts above m)	Min (Microbiological limit that may be exceeded number of units c)	Max (Microbiological limit that no sample unit may exceed)
Process hygiene criteria				
Aerobic Plate Count	5	1	1 x 10 ² /g	1 x 10 ³ /g
Yeast and Mold Count	5	1	50/ g	1 x 10 ² /g
Enterobacteriaceae	5	0	Not detectable as per prescribed method	
Staphylococcus aureus (Coagulase + ve)	5	0	Absent/25 g	
Food safety criteria				
Salmonella	5	0	Absent/25 g	
Listeria monocytogenes	5	0	Absent/25 g	
Sulphite Reducing Clostridia (SRC)	NA	NA	NA	NA
E. Coli 0157 and Vero or Shiga toxin producing E coli	5	0	Absent/25 g	
Vibrio cholerae	5	0	Absent/25 g	

Contaminants, Toxins and Residues

Metal Contaminants

Product: Fruit juices (including nectars, Ready-to-drink)

Name of metal contaminant	Parts per Million or mg/kg or mg/L
Lead	0.05

Crop contaminants and naturally occurring toxic substances

Product: Non-alcoholic beverages

Name of naturally occurring toxic substances	Maximum limit, (mg/kg or ppm)
Saffrol	10

Food Safety and Standards (Packaging and Labelling) Regulations, 2011.

Packaging and labelling:

The product covered by this standard shall be labelled in accordance with the Food Safety and Standards (Packaging and Labelling) Regulations, 2011.

Definitions :In these regulations unless the context otherwise requires:

1. “Best before” means the date which signifies the end of the period under any stated storage conditions during which the food shall remain fully marketable and shall retain any specific qualities for which tacit or express claims have been made and beyond that date, the food may still be perfectly safe to consume, though its quality may have diminished. However, the food shall not be sold if at any stage the product becomes unsafe.
2. “Date of manufacture” means the date on which the food becomes the product as described;
3. “Date of packaging” means the date on which the food is placed in the immediate container in which it will be ultimately sold;
5. “Lot number” or “code number” or “batch number” means the number either in numerical or alphabets or in combination thereof,
 - representing the lot number or code number or batch number,
 - being preceded by the words “Lot No” or “Lot” or “code number” or “Code” or Batch No” or “Batch” or any distinguishing prefix
 - by which the food can be traced in manufacture and identified in distribution.
10. “Use – by date” or “Recommended last consumption date” or “Expiry date” means the date
 - which signifies the end of the estimated period under any stated storage conditions,

- after which the food probably will not have the quality and safety attributes normally expected by the consumers and the food shall not be sold

11. “Vegetarian Food” means any article of Food other than Non- Vegetarian Food as defined in regulation 1.2.1(7).

Packaging General Requirements

Containers made of plastic materials should conform to the following Indian Standards Specification, used for packing or storing whether partly or wholly, food articles namely :-

- i. IS : 10146 (Specification for Polyethylene in contact with foodstuffs);
- ii. IS : 10142 (Specification for Styrene Polymers in contact with foodstuffs)
- iii. IS : 10151 (Specification for Polyvinyl Chloride (PVC) in contact with foodstuffs);
- iv. IS : 10910 (Specification for Polypropylene in contact with foodstuffs);
- vii. IS: 12252 - Specification for Polyalkyleneterephthalates (PET)

Product-specific Requirements

Packaging requirements for Fruits and Vegetables Products

- Every bottle in which any fruit product is packed shall be so sealed that it cannot be opened without destroying the licensing number and the special identification mark of the manufacture to be displayed on the top or neck of the bottle

For Bottled fruits, juices and vegetables, only bottles/ jars capable of giving hermetic seal shall be used.

- Juices, squashes, crush, cordials, syrups, barley waters and other beverages shall be packed in clean bottles securely sealed. These products when frozen and sold in the form of ice shall be packed in suitable cartons. Juices and Pulps may be packed in wooden barrels when sulphited.
- Fruits and Vegetable products can also be packed in aseptic and flexible packaging material having food grade quality conforming to the standards laid down by BIS.

Labelling General Requirements

1. Every pre-packaged food shall carry a label containing information as required here under unless otherwise provided, namely -

2. The particulars of declaration to be specified on the label shall be in English or Hindi in Devnagri script: Provided that nothing herein contained shall prevent the use of any other language in addition to the language required under this regulation.
3. Pre-packaged food shall not be described or presented on any label or in any labelling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect;
4. Label in pre-packaged foods shall be applied in such a manner that they will not become separated from the container;
5. Contents on the label shall be clear, prominent, indelible and readily legible by the consumer under normal conditions of purchase and use;
6. Where the container is covered by a wrapper, the wrapper shall carry the necessary information or the label on the container shall be readily legible through the outer wrapper and not obscured by it;
7. License number shall be displayed on the principal display panel in the following format, namely:-



Provided that the existing products of a unit shall comply with the requirement of this clause on and after the six months of commencement of the Food Safety and Standards (packaging and labeling) Amendment Regulation ,2013.

Labelling of Pre-packaged Foods

In addition to the General Labelling requirements every package of food shall carry the following information on the label, namely, —

1. The Name of Food: The trade name or description of food contained in the package.
2. Ingredient: *(For a single ingredient product, it can be mentioned as such.)*
3. Nutritional information —
4. Nutritional Information or nutritional facts per 100 gm or 100ml or per serving of the product shall be given on the label containing the following: —
energy value in kcal;

the amounts of protein, carbohydrate (specify quantity of sugar) and fat in gram

5. Declaration regarding Veg or Non veg

Every package of Vegetarian Food shall bear a declaration to this effect by a symbol and colour code as stipulated below for this purpose to indicate that the product is Vegetarian Food.

The symbol shall consist of a green colour filled circle, having a diameter not less than the minimum size specified in the Table below, inside the square with green outline having size double the diameter of the circle, as indicated:



iv. Size of the logo (vegetarian)

S No	Area of principal display panel	Minimum diameter mm
1.	Upto 100 cms. Square	3
2.	100-500 cm square	4
3	500-2500 cm square	6
4	>2500 cm square	8

The symbol shall be prominently displayed on the package having contrast background on principal display panel, just close in proximity to the name or brand name of the product and on the labels, containers, pamphlets, leaflets, advertisements in any media.

6. Declaration regarding Food Additives-

- (i) For food additives falling in the respective classes and appearing in lists of food additives permitted for use in foods generally, the following class titles shall be used together with the specific names or recognized international numerical identifications:

Acidity Regulator, Acids, Anticaking Agent, Antifoaming Agent, Antioxidant, Bulking Agent, Colour, Colour Retention Agent, Emulsifier, Emulsifying Salt, Firming Agent, Flour Treatment Agent, Flavour Enhancer, Foaming Agent, Gelling Agent, Glazing Agent, Humectant, Preservative, Propellant, Raising Agent, Stabilizer, Sweetener, Thickener

7. Name and complete address of the manufacturer

- i. The name and complete address of the manufacturer and the manufacturing unit if these are located at different places; in case the manufacturer is not the packer, the name and complete address of the packing unit shall be declared on every package of food;

ii. Where an article of food is manufactured or packed by a person or a company under the written authority of some other manufacturer or company, under its brand name, the label shall carry the name and complete address of the manufacturing or packing, the name and complete address of the manufacturer or the company and on whose behalf it is manufactured or packed or bottled.

8. Net quantity by weight shall be declared on every package of food.

9. Lot/Code/Batch identification shall be given on the label.

10. Date of manufacture or packing.

The date, month and year in which the commodity is manufactured, packed or pre-packed, shall be given on the label.

If the 'Best before Date' of the products is

- More than three months, the month and the year of manufacture, packing or pre-packing shall be given.
- Less than three months, the date, month and year in which the commodity is manufactured or prepared or prepacked shall be mentioned on the label.

11. Best Before and Use by Date: the month and year in capital letters upto which the product is best for consumption, in the following manner, namely: —

“BEST BEFORE..... MONTHS AND YEAR

OR

“BEST BEFORE..... MONTHS FROM PACKAGING

OR

“BEST BEFORE..... MONTHS FROM MANUFACTURE (Note: blank be filled up)

12. Instructions for use:

(i) Instructions for use, including reconstitution, where applicable, shall be included on the label, if necessary, to ensure correct utilization of the food.

Sanitary and Hygienic Requirements for Food Manufacturer/ Processor/ Handler

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.

2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.
3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.
4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.
5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects.
 - No spraying shall be done during the conduct of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises.
 - Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.
6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.
7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.
8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).
9. All equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.
10. All equipments shall be placed well away from the walls to allow proper inspection.
11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.
12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.
13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.

14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.
15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.
16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.
17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.
18. The vehicles used to transport foods must be maintained in good repair and kept clean.
19. Foods while in transport in packaged form or in containers shall maintain the required temperature.
20. Insecticides / disinfectants shall be kept and stored separately and `away from food manufacturing / storing/ handling areas.

Annexure
Manufacturers & Suppliers of Food Processing Machinery

So	Name of the company	Machineries
1.	Gardners Corporation 158 Golf Links New Delhi 110003 India Tel: +91 11 2334 4287/2336 3640 Fax: +91 11 2371 7179	Juice filters, weighing machinery, Boiling equipment
2.	Bajaj Machine Private Limited 7/20 7/27, Jai Lakshmi Industrial Estate, Side-IV Sahibabad Industrial Area Ghaziabad - 201301 U.P India Tel: +91 120 22775119/22775137 Fax: +91 120 22775137 Website: www.indiamart.com/bajajmachine	Juice extractors and Pulpers
3.	Buhler (India) Pvt Ltd 13-D, K A I D B Industrial Area, Attibele Bangalore Karnataka 562107 India Tel: +91 80- 27820000 Fax: +91 80-7820001 Website: www.buhlergroup.com	Juice extractors and Pulpers
4.	Delhi Industries 4 Paharganj Lane, New Delhi 110055 India Tel: +91 11 2529720, 27525200, 27536888 Fax: +91 11 25791291	Juice extractors and Pulpers
5.	Food Packs Indiana Thrikkariyoor, Kothamangalam, Ernakulam Kerala 686692 India	Juice extractors and Pulpers
6.	Geeta Food Engineering Plot No C-7/1 TTC Area Pawana MIDC Thane Belapur Road Behind Davita Chemicals Ltd Navi Mumbai 400 705 India	Juice extractors and Pulpers

	Tel: +91 22 2782 6626/2766 2098 Fax: +91 22 2782 6337	
7.	Repute Engineers Private Limited 12/23, D-1 Block, MIDC, Chinchwad, Pune-411019, Maharashtra, India	Juice clarifier
8.	Bruckner Process Technologies No. 364, 2nd Floor, Anna Salai, Royapettah, Chennai-600006, Tamil Nadu, India	Juice clarifier
9.	Acufil Machines S. F. No. 120/2, Kalapatty Post Office Coimbatore - 641 035 Tamil Nadu, India Tel: +91 422 2666108/2669909 Fax: +91 422 2666255 Email: acufilmachines@yahoo.co.in, acufilmachines@hotmail.com	Bottle filling & Packaging equipment
10.	Autopack Machines Pvt Ltd 101-C Poonam Cambers A Wing, 1st Floor, Dr Annie Besant Road, Worli Mumbai 400018 India Tel: +91 22 2493 4406/2497 4800/2492 4806 Fax: +91 22 2496 4926 E-mail: autopack@bom3.vsml.net.in Website: www.autopackmachines.com	Bottle filling & Packaging equipment



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