



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Mandarin Orange Marmalade



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CHAPTER 1

INTRODUCTION

1.1. Status and Market Size

Mandarin is a group name for a class of oranges with thin, loose peel. These are treated as members of a distinct species, *Citrus reticulata* Blanco. The name "tangerine" could be applied as an alternate name to the whole group, but in the trade, it is usually confined to the types with red-orange skin. Mandarins include a diverse group of citrus fruits that are characterized by bright coloured peel and pulp, excellent flavor, easy-to-peel rind and segments that separate easily. The exact location of origin of Mandarin fruits is not clearly identified. It is believed that Mandarins is a native of south eastern Asia and the Philippines. In Asia, it is most abundantly grown in Japan, southern China, and India. Mandarin is very important fruit crop, second only to banana.

Mandarin is very important fruit crop, second only to banana. It is the most common among citrus fruits grown in India. Mandarin is grown mainly in Assam, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Nagaland, Rajasthan, Tamil Nadu and West Bengal. It is usually consumed in raw form or in fruit salads as well as juice. It occupies nearly 40% of the total area under citrus cultivation in India.

In India, in terms of area under cultivation, citrus is the third largest fruit after Banana and Mango. Nagpur mandarin is one of the best mandarins in the world. Production of this fruit crop in central and western part of India is increasing every year.

1.1.1. Commercially grown varieties

1. Khasi Orange

Grown in Assam and Meghalaya, this variety's fruits globose to oblate, surface smooth, colour orange-yellow to bright orange, rind thin with very little adherence, segments usually 10, pulp vesicles uniformly orange, texture coarse, juice abundant with well-blended flavour.

2. Coorg Orange

Prevalent in Karnataka, these fruits are oblate, colour bright yellow and uniform, rind medium thick with little adherence, segments usually between 9 to 11, pulp yellow with fine texture

and abundant juice

3. Kinnow Orange

Popular in Punjab and Haryana regions, these fruits are medium-size, slightly oblate in shape, rind moderately thick, adherence with the pulp quite strong, thick mesocarp, easily peelable surface, smooth and glossy, fruit colour yellowish orange at full maturity, segments 9 to 10, firm, pulp yellowish orange, very juicy somewhat acidic. The variety is cold resistant.

4. Darjeeling Orange

Cultivated in West Bengal and Sikkim, these fruits are comparatively smaller in size, slightly flat in shape, colour yellowish to orange when fully ripe, rind thin, adherence little, juice abundant and sweet flavour.

5. Nagpur Oranges

These fruits are yellowish green to orange, oblate, rind thin, fine texture and good flavour and taste. Size is medium and the skin is easily peelable. This variety is prevalent in Maharashtra, Tamil Nadu and Bihar.

6. Kinnow orange (hybrid Mandarin).

In Haryana and Punjab Kinnow orange (hybrid Mandarin) is grown.

1.1.2. Cultivation Scenario

Mandarins grow successfully in all frost free tropical and sub-tropical regions upto 1,500 m. above mean sea level. An annual rainfall of 100-120 cm. and temperature ranging from 100-350 C is suitable for cultivation of the crop. Mandarins can be grown in a wide variety of soils but medium or light loamy soils with slightly heavy sub-soil, well-drained with pH of 6.0-8.0 are ideal for cultivation.

The total area of Mandarin, during 2008-09 was 245.49 thousand hectares in the country. Maharashtra is the main Mandarin producing state in the country, having the highest area 126.00 thousand hectares (51.33 per cent), followed by Madhya Pradesh, 31.47 thousand hectares (12.82 per cent) and Meghalaya 10.06 thousand hectares (4.09 per cent) during the same period. More than 65 per cent of the total area under Mandarin in India is in these three important Mandarin growing states. In other Mandarin growing states, the area was less than

4 per cent of the total area covered under Mandarin in the country.

In Maharashtra, the Mandarins are mainly grown at Satpura hills (Vidharba region) while in West Bengal they are grown at the hilly slopes of Darjeeling. In Karnataka, Coorg is the main producing area. In Tamil Nadu, Wynad, Nilgiri, Palani and Shevroy hills are the major Mandarin growing belts. The hills of Meghalaya (Khasi, Dusha, Garo, Jaintia), Mizoram, Tripura, Sikkim and Arunachal Pradesh are the others Mandarin growing states. Similarly, Assam, Brahmaputra valley and Dibrugarh districts are famous for Mandarin production.

1.1.3. Production status of Mandarin Orange

Assam, Karnataka, Madhya Pradesh, Maharashtra, Mizoram, Nagaland, Rajasthan and Tamil Nadu are the main Mandarin producing states in India. The total production of Mandarin in India during 2017-18 was 5101.11 thousand tonnes. The share of Madhya Pradesh in Mandarin production was the highest with 41.24 per cent (2103.4 thousand tonnes) of the total production of the country, followed by Punjab, Maharashtra and Rajasthan with 23.69 per cent, 15.64 per cent, and 6.23 per cent respectively. These four states account for more than 86 per cent of Mandarin production in India.

Table 1: State-wise production of Mandarin Orange (2017-18)

S.No	State	Production (‘000 Tonnes)	% share
1	Madhya Pradesh	2,103.64	41.24
2	Punjab	1,208.42	23.69
3	Maharashtra	797.95	15.64
4	Rajasthan	317.68	6.23
5	Assam	203.72	3.99
6	Karnataka	79.07	1.55
7	Arunachal Pradesh	69.74	1.37
8	Nagaland	47.33	0.93
9	Meghalaya	45.24	0.89
10	Others	228.32	4.48
	Total	5101.11	

Source: National Horticulture Board

1.1.4. Composition & Nutritive Value of Mandarin Orange

Table 2: Nutritive value of Mandarin Oranges per 100 g of edible portions

Parameter	Per 100 g
Moisture	82.6-90.2 g
Protein	0.61-0.215 g
Fat	0.05-0.32 g
Fiber	0.3-0.7 g
Ash	0.29-0.54 g
Calcium	25.0-46.8 mg
Phosphorus	11.7-23.4 mg
Iron	0.17-0.62 mg
Carotene	0.013-0.175 mg
Thiamine	0.048-0.128 mg
Riboflavin	0.014-0.041 mg
Niacin	0.199-0.38 mg
Ascorbic Acid	13.3-54.4 mg

Source: Nutritive value of Indian foods, NIN, 2019

Table 3: Composition of Mandarin Orange varieties per 100 g of edible portions

Composition	Nagpur Mandarins	Coorg Mandarins	Kinnow Orange
Average weight of fruit (g.)	100-125	97-101	145-189
Peel (g.)	20-27	2.62-2.67	0.45
Juice(g)	45-55	49.5-54.0	38.6- 40.2
Pomace (g.)	25-28	-	39.3- 42.0
TSS (⁰ Brix)	8-14	10.0-11.5	9.0- 9.5
Acidity (as anhydrous citric acid, %)	0.3-0.5	0.87-1.1	0.64- 0.77
Essential oil (%) (v/w)	2.2-3.1	-	-
Pectin (%) (fresh wt. basis)	3.5- 4.5	-	-
Ascorbic acid (mg/100 ml juice)	33.6-35.0	40.2-41.6	18.7

Source: Mandarin in India- CFTRI, Mysore

1.1.5 Nutritional benefits of Mandarin Orange

The health benefits of oranges are well known for centuries. The oranges are not just known for its high vitamin C content; these are also a good source of beta carotene, a powerful antioxidant to check free radical damage, magnesium for blood pressure, potassium for cardiovascular health, and thiamin for converting food to energy. It is also rich in dietary fiber and contains folates, niacin, pantothenic acid, pyridoxine, riboflavin, vitamins A, E and K, and phytonutrients. Folate in oranges helps prevent birth defects and is good for the heart. The importance of folate to human health to reduce neural tube birth defects by up to 75% when taken by women prior to conception and during pregnancy. Folate has also been associated with a reduced risk of heart disease by lowering blood serum homocystine levels.

Pectin found in oranges is a dietary fiber reported to reduce the serum cholesterol, hypercholesterolemia and promote the excretion of fats, bile acid, cholesterol and possess growth suppression of prostate cancer cell. Therapeutical value of carotenoids found in orange could be the important first line of defence against ROS and also took part in catalytic activity. It helps in the deactivation of carcinogens. In orange good quantity of naringenin is found and this helps the management of diabetic neuropathies. Citrus fruit extracts represent an excellent candidate for nutraceuticals and functional foods geared towards the management of diabetes, cardiovascular diseases and cancer.

1.1.6 Medicinal properties of Mandarin Orange

The mention of various citrus fruits has been found in Ayurvedic works of Dhanwantri (10th B.C.), Charak and Susruta written in 600 to 500 B.C. The species described are *Citrus medica* (Beejpur or Matulung), *C. jambhiri* (Jambhirinimbu), *C. aurantifolia* (Nimbuk, Kagzinimbu), *C. limetta* (Mithanimbu), *C. grandis* (Amalvetas, Chakotra), and *C. reticulata* (Narang or Santra). Mandarin is widely consumed around the world for its delicious qualities, but it also has therapeutic values that have long been used in traditional herbal medicine.

Mandarins are eaten to allay fever and catarrh. The fresh rind is rubbed on acne. The poultice of roasted pulp is used for skin diseases. Because of its bioflavonoids and inositol, complete mandarins are very useful. It contains a considerable amount of the vitamin like glucoside, hesperidin mostly (75-80%) present in the rind, rag and pulp. The infusion of immature fruit is used for the treatment of stomach and intestinal problems. The mixture of pulverized inner

bark and wine is taken as a tonic and carminative. The fresh leaves juice or a decoction of the dried leaves can be used as a carminative or useful on sores and ulcers.

In traditional Chinese medicine, the dried peel is used for abdominal swelling, to increase digestion, and to reduce phlegm, and its various parts are used to cure cutaneous problem, hemiplegia, snake bite, fever, loss of taste, chronic rheumatism, stomach ache, menorrhagia, splenomegaly, edema and cardiac diseases, bronchitis and asthma.

1.2 Indian Market Outlook

Mandarin orange is the most common among citrus fruits grown in India. It occupies nearly 50% of the total citrus area in India. Besides prevalent demand of Mandarin Oranges as fresh fruits, these can be used for the preparation of a number of processed products like orange marmalade, bottled and canned juices, squash, jam, jelly etc. Orange oil is also important citrus oil used for flavouring purposes.

India is the 5th largest producer of citrus fruits worldwide, which includes the production of mandarins, grapefruit, lime, lemons, oranges, tangerines, etc. In the country, 10% of the total area among fruit crops has been occupied by citrus fruits and the production stands as 3rd following mango and banana. Citrus fruit group including lime/lemon, mandarin/sweet orange, kinnow are mainly grown with the objective of juice production and its processing. Citrus fruits have a relatively longer post-harvest life in comparison with other tropical and subtropical fruits. Proper storage of citrus fruits for an extended period is very essential for their proper utilization in the glut season.

There is a prevalent world-wide demand of mandarin oranges as fresh fruits and products like orange marmalade, bottled & canned orange juices are bottled, frozen concentrated juice, etc. Orange oils are widely preferred for flavouring purposes. By products such as Citric acid and pectin are made from culled and unmarketable fruits.

The orange juice business in India is highly dominated by unorganised players with over 75 per cent market share. The organised retail which has only 25 per cent of the business comprises of juice bars, juice cafes and packaged juice players. With continuous technology improvements, the processing industry has been able to excel in quality, with products of better taste and as good as fresh produce available in the market.

1.3 Value added products from Mandarin Orange

1.3.1 Mandarin orange fruit juice

Juice from Mandarin is extracted either by the application of pressure to whole fruit or by reaming or pressing the halves of crosswise cut on a suitable rosette. The fruit juice is mixed with strained syrup solution (as per requirement) and the mixture is homogenized. This RTS beverage is filled in glass bottles and corked tightly. The bottles are pasteurized at 85°C for 20 min and cooled to room temperature. The RTS bottles are stored at ambient temperature and usually chilled for serving.

1.3.2 Mandarin Not from Concentrate Juice

The juice is extracted and then a closely controlled pasteurization is done to minimize juice exposure to heat. The peel oil and bitterness level in the juice are kept under control. Excessive peel oil contributes to the undesirable flavor changes that can occur in citrus juices during processing and storage. This product contains more natural juicy bits of Mandarin.

1.3.3 Candied peel

The prepared fruit peel is boiled in a sugar syrup of 30°Brix containing 3 parts of cane sugar and 1 part of corn syrup and then left in the syrup for about 24 h. The strength of syrup is raised to 40°Brix by adding a mixture of cane sugar and glucose syrup. The process is repeated until the strength reaches 60°Brix. At this stage, citric or tartaric acid is added at the rate of 1.25 g for every kg of peels. Alternatively, glucose or invert syrup may be added up to a maximum of 50.0% of the cane sugar used. The strength of the syrup is then raised to 75°Brix by 5°Brix every succeeding day. The peels are then left in this syrup for 2-3 weeks. Finally, they are taken out from the syrup and dried on wire mesh trays at room temperature until they are no longer sticky. They may also be dried at 49°C for 2-3 h in a drier.

1.3.4 Jam, jelly and Marmalades

The mandarin juice extract can be prepared by crushing or slicing the fruit and cooking with water. For jam, any fruits like banana, apple etc can be used in combination with orange juice. For jelly and marmalade, mandarin oranges can be used singly. The extract is boiled with suitable amount of sugar till the desired end point is achieved. For marmalades, prepared peel shreds are added. The product is filled in the packing containers and allowed to set while cooling.

1.4 Harvest& Post Harvest handling of Mandarin Orange

1.4.1 Harvesting

Mandarins are mostly hand plucked, using ladders rested on bamboo support, to prevent the tearing of branches bearing fruits. The quality of the produce is greatly affected by the damages/injuries during the harvesting. Therefore, great care should be taken during harvesting/plucking the fruits.

The plucking of fruits should not be carried out during wet weather or early morning when fruits are turgid and can easily be bruised, leading to decay during subsequent handling. Mandarin fruit tend to "plug" when snapped from the tree, i.e., a piece of the peel from the fruit remains attached to the stalk. It is preferable to use clippers to clip the fruit from the tree to avoid damage. The other cause of deterioration in the fruit quality is harvesting of immature or over mature fruits. Similarly, fruits are spoiled when they are harvested by pulling the fruit, causing rupturing of the peel of loose skin of the fruits. Harvested fruits need careful handling, till they reach the consumers.

1.4.2 Harvesting stage

Generally, the Mandarins are harvested in 32-36 weeks after the fruit is set. In Coorg district, the fruits are harvested in 36-38 weeks; otherwise there is every possibility of shrivelling of fruits and heavy drops.

However, the most commonly used measures to access maturity for harvesting the Mandarin is peel colour. Fruits are considered mature, if they have a yellow orange colour on 25% or more of the fruit surface. Fruit quality for harvesting depends upon SS (soluble solids contents, sugar) and acidity of the juice. The juice should have a SS of 8.5% or higher. SS content is determined by squeezing a few drops of juice on a hand-held refractometer.

Unlike climacteric fruits, Orange doesn't improve in taste after harvesting. Therefore, fruits should be harvested when they attain full size, develop attractive colour with optimum sugar.

1.4.3 Harvesting method

Suitable harvesting technique is very important to prevent the losses during post-harvest handling. Fruits should be clipped in such a way that the button remains intact with the fruits. Sometimes, longer stalk portion of the clipped fruits left during harvesting, pierces into other fruits and causes injuries in them resulting in attack of wound pathogen. Therefore, while

clipping the stalk should be cut close to the fruit, so as to preclude it from puncturing the rind of other fruit during harvest and handling.

Faulty harvesting and rough handling adversely affects the marketable quality of fruits. The common commercial practice of harvesting is to pull the fruits from the branches, which may rupture the skin near the stem end leading to fungal infection and subsequent rotting. This practice should be avoided. Therefore, fruits should neither be plucked nor turn off, but should be cut off with clipper, shears or secateurs.

1.4.4 Yield

Oranges start bearing from the fourth year, but substantial yield can be expected only from sixth year onwards. It produces 500-800 fruits after about 9-10 years. However, its plants attain the level of full bearing at the age of 10-12 years. The net productive life span of mandarin orchards after deducting the first 5 pre bearing years is only 15-20 years.

1.4.5 Storing and Transporting

The initial sorting of marketable versus unmarketable fruits should be made in the field at the time of harvest. Severely damaged, decayed, over-ripe fruits, or unmarketable fruits should be put into a separate container and discarded.

Plastic crates or boxes are used for storing fruit. Oranges should be stored with only one or two layers per box as too many layers in one box may cause bruising of the fruit.

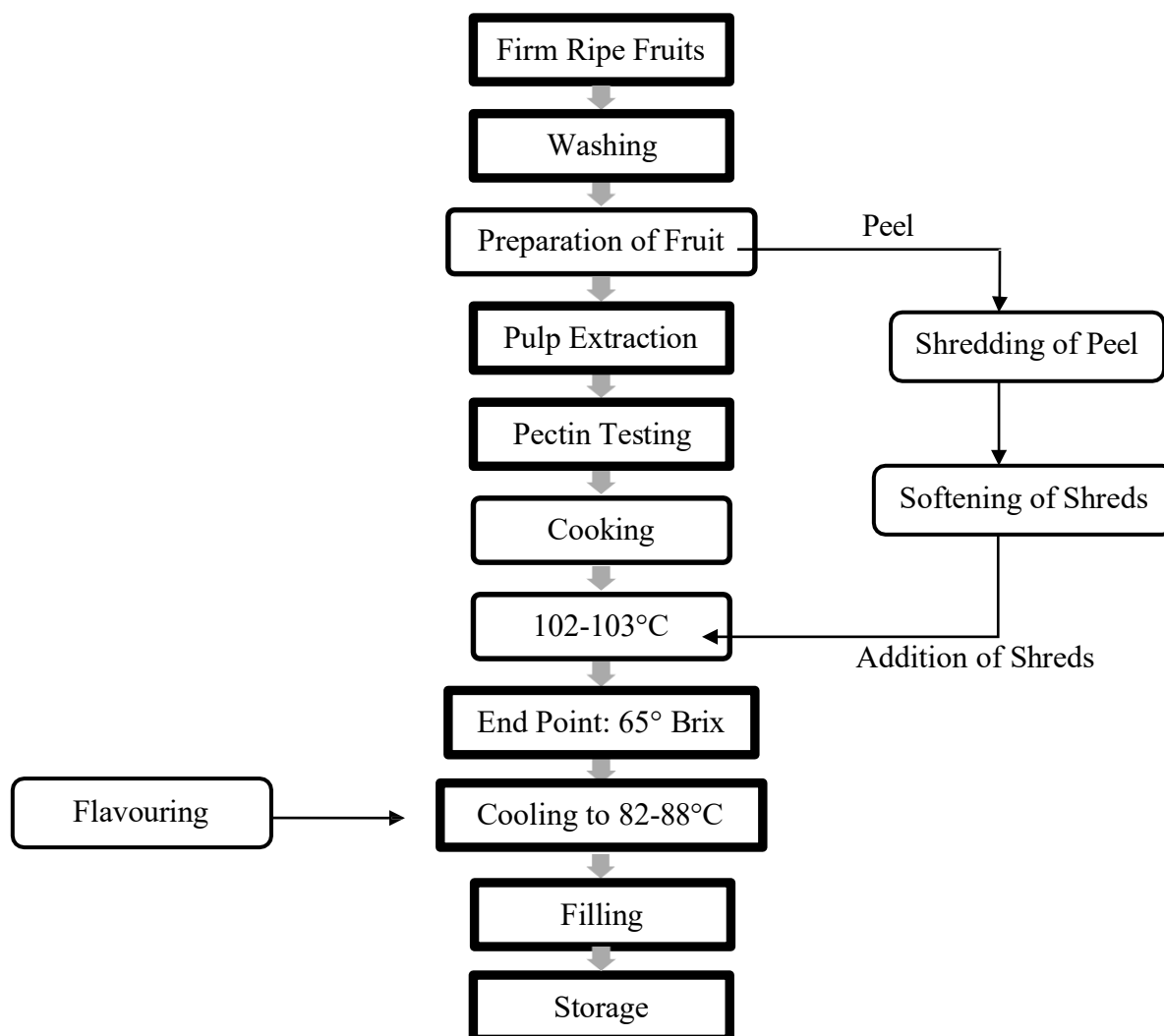
Since the shelf life of fruit is limited, adequate storage is very essential for extending the consumption period of fruits as well as for regulating their supply to the markets. Oranges can be stored at farm level for a period of 2 to 3 weeks in simple storage in wooden boxes, plastic crates, etc. It is possible to store the fruits for a period of 3 to 5 weeks in cold storage in boxes. Orange fruits can also be stored in evaporative cool chamber at 8-10°C & 90-95% relative humidity for a period of three weeks after post-harvest treatment with 1000 ppm Bavistin.

The oranges are generally shipped via truck to juice extraction facilities.

CHAPTER 2

Processing of Mandarin Orange Marmalade

2.1 Process Flow chart for Production of Mandarin Orange Marmalade



2.1.1 Washing

The fruits are washed to remove extraneous matter. Simultaneously, the fruits are inspected to remove any immature, spoiled, bruised or damaged ones.

2.1.2 Preparation of Fruit

The yellow portion of the peel is peeled off thinly from the fruit with a stainless steel knife. This peel goes to Shredding. The fruit goes to pulp extraction.

2.1.3 Shredding

The peel is cut into shreds that are 1.9-2.5 cm long and 0.08-0.12 cm thick. The shreds are softened by boiling before being added to the marmalade. If added directly the sugar solution and boiled without prior softening, the shreds become tough.

Three methods are employed for softening the shreds.

- Boiling for 10-15 minutes in water (changing the water many times). The bitter principles present in the peel are also removed in this process.
- Boiling in 0.25 percent solution of sodium carbonate or 0.1 percent ammonia solution.
- Autoclaving the shreds at 1160C to 1210C (70-105 k Pa).

The time required to soften shreds depends upon their size and shape.

2.1.4 Pulp extraction

The fruits can be crushed or cut into thin slices. The crushed fruit or the slices are boiled with water (2 kg water to 1 kg fruit). The boiling is done for around 40- 45 minutes, along with Citric acid at 2 g per kg of fruit

The extract is then strained using a muslin cloth (for jam marmalade) or filter press for a clear extract (for jelly marmalade). The extract is subjected to pectin test.

2.1.5 Pectin Test

This is done to estimate the amount of pectin present in the fruit extract. Depending on pectin strength, extra pectin is added if required.

One ml of boiled fruit extract is taken in a test tube and 3 ml alcohol (90%) is added. The test tube is left for few minutes till clotting is formed. If a single clot is formed, it indicates that the fruit extract contains rich pectin. If small unstable clot is formed, it indicates poor availability of pectin. If the pectin test shows poor pectin presence, fruit based pectin needs to be added.

Pectin is available commercially as a powder. It is stable if stored in cool, dry place and it will only lose about 2% of its gelling power per year. Powdered pectin should be added to fruit pulp at 3-6g per kg of final product, but it should first be mixed with about five times its weight of sugar to prevent lumps forming when it is added to the pulp or juice. For marmalades, slow setting pectin should be used so that the product sets slowly during the overnight cooling process.

2.1.6 Cooking

Required amount of sugar is added to the extract. Generally, sugar is added at the ratio 1:1 for the extract. The mix is boiled in a steam-jacketed kettle with low heat and continuous stirring. Impurities rising to the surface are removed.

When the temperature of the boiling mixture reaches 103°C, the shreds are added at the level of 62 g for each kg of the original extract. Boiling is continued at the same pace till end point is achieved

2.1.7 Judging the Endpoint

When the mixture starts to thicken, it is important to test for the end point at frequent intervals. Endpoint should be measured using a Refractometer for consistency. Temperature/ other tests can be used, but these are not consistent methods.

In case of jelly marmalade, for every kg of whole fruit extract, around 10 gm of ready-made fruit pectin & 7 gm of citric acid (to obtain pH 3.0-3.3) are sprinkled on the boiling mixture, while nearing endpoint.

The final Total Soluble Solids (TSS) content of marmalade should be 65° Brix. At this point the boiling is stopped

2.1.8 Cooling

The marmalade is cooled in a shallow pan or in a water-cooled pan. The shreds due to their low density tend to accumulate in the top layer; hence slow stirring is done to enable the uniform distribution of shreds in the marmalade. When the temperature falls to 82 to 88°C, a thin film begins to form on the surface of the marmalade. This layer becomes sufficiently thick and helps to prevent floating of the shreds onto the surface.

Most of the natural flavour volatilizes during the boiling and cooking processes. Hence, flavouring is added to compensate the flavor loss during cooking process. Generally, orange oil is added to the marmalade at the time of filling into jars or cans.

2.1.9 Packing

After cooling the marmalade can be filled into jelly glasses or glass jars, at about 82°C. The bottles/ jars are closed air-tight. The marmalade is allowed to set overnight. On cooling a thin

layer of molten paraffin wax is poured on the top. The packed marmalades are stored in a cool dry place.

Hermetically sealed cans can also be used for packing marmalades. The cans are inverted upside down to sterilize the lids

The jars should be warm to prevent them from cracking when the hot marmalade is poured in. If the marmalade is cooled too much it will be difficult to pour. The filled jars can be placed in water to cool down the marmalade so that it does not keep cooking in the jar. The gel starts to form as the temperature of the marmalade reduces (about 55°C) and continues until it is cold.

2.2 Critical points in Processing

The correct sugar content is critical for proper gel formation and for preservation.

- Monitoring of the final TSS content is very critical it influences the setting, texture and shelf life of the product
- The pan should be removed from the heat during testing as the Marmalade will continue to cook and may become over-cooked, which cannot be reversed.
- Addition of excess of acid results in the breakdown of jelly structure due to the hydrolysis or decomposition of pectin.
- If the acid is in excess, the pectin breaks down and forms syrup like jelly.
- It is important to stir the product at all times during heating, otherwise it may burn at the bottom of the pan, causing off-flavors and discoloration.
- When the product starts to thicken, it is important to test for the end point at frequent intervals
- A jelly may fail to set due to lack of acid or pectin in the fruit from which it is made. It may also fail to set due to insufficient cooking of the fruit resulting in inadequate extraction of pectin and acid.
- Fermentation usually takes place in those jellies in which syneresis has taken place.

2.3 Defects in processing

- ❖ If the cooking is stopped before the concentration of sugar reaches 65 percent, the product may fail to set and may remain syrupy and highly soft.
- ❖ If the TSS is higher than 68%, the product will be very stiff and the sugar might start to form crystals in the Marmalade.
- ❖ If sugar is added in excess of the required quantity, a syrupy or highly soft jelly or crystal jelly results. It can be corrected by adding fresh clarified juice rich in pectin.
- ❖ Too low concentration of sugar or soluble solids: This causes the network of pectin to hold more liquid than it possibly can do under normal conditions.
- ❖ Insufficient pectin: This results in the formation of a pectin network which is not sufficiently dense and rigid enough to hold the sugar syrup.
- ❖ If heating is continued beyond the end point, the jelly becomes tough due to over-concentration. This occurs when the juice is rich in both acid and pectin and enough sugar has not been added.
- ❖ Improper stirring may cause burning at the bottom of the pan, causing off-flavors and discoloration.
- ❖ If the jars are moved or shaken while they are cooling or the gel will not form and the marmalade will not set.
- ❖ Gelation is caused due to breakdown of pectin during pouring of jelly into the containers. The jelly becomes weak and remains broken.

CHAPTER 3

Packaging of Mandarin Orange Marmalade

3.1 Criteria for packaging material

The primary packages for marmalades must have the following characteristics:

- It should allow heat transmission. Heat transmission i.e. heat transfer is very fast during heating and cooling.
- It should be heat-resistant i.e. it should have resistance towards high filling temperature.
- It must be able to achieve and maintain vacuum and thereby prevent contamination with 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 Marmalade

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

3.2.1. Metal Containers - Lacquered

Tin containers are also used namely, “Open Top Sanitary cans (OTS cans)”. The tinplate used for this is a low carbon mild steel base plate suitably coated with a thin layer of tin metal. Tin plate must have a very low sulphur, phosphorus and copper content. For preservation and processing, tin is an ideal container for marmalade packaging. It is hermetically sealed thereby avoiding contamination.

The only disadvantage with tin cans is that it slowly reacts with the contents over a period of time leading to “corrosion”. To overcome this, inside lacquered or resin-coated tin cans are used for food containing high acid content and sulphur content.

3.2.2. Glass Jars with Lug Caps

Basically, glass is better than other materials for packaging of marmalade for few reasons viz. it is very much chemically inert, aesthetic appealing glass is much better and the product has long shelf-life in glass than any other material.

But on the other hand, the major drawbacks associated with glass are that they are heavy in weight, fragile, and require sterilization before refilling of product thereby increasing the production cost.

3.2.3. Plastic Containers

Plastic jars are already into this market because of their light weight and resistance to breakage. High density polyethylene, polyvinyl chloride and some of the newer acrylics have been used for this purpose. HDPE has a linear structure. The promising properties of HDPE, which make it suitable for marmalade packaging, are its good moisture barrier properties, its excellent resistance to a wide range of chemical compounds, good tensile characteristics and good high temperature resistance. Injection moulded containers of PP or HIPS are also used for packing 200 grams of the product.

Unit servings of marmalades are packed in injection moulded plastic cups. They are closed with peelable membrane lids. Plastic cups are moulded from polystyrene, polyethylene, polypropylene or polyvinyl chloride. Closures can be foil laminates, clear plastic film or metallized plastic film. The type of plastic used must be capable of heat sealing or the membrane must have a suitable peelable adhesive or heat-seal coating, the selection of which will be governed by the material used to form the cup.

In the selection of a suitable heat-seal formulation, note must be taken of the temperature of marmalade fill. Marmalades are filled hot (82°C or higher) and the actual degree of peelable seal does not become evident until it has set for 24 hours. Problems around membrane formation i.e. heat-seal coating separating from the inner foil ply, are a frequent plague to the material supplier. The foil used must be clean and free from oily residues to prevent separation of the laminate plies.

3.2.4. Flexible Packs

Marmalades can also be packed in 2-3 layered co-extruded polyolefinic pouches of 200 and 400/500g capacities. The individual pouches are further placed in printed paperboard or E-fluted corrugated cartons.

The current changing trend in packaging indicates that products such as marmalades, which were earlier packed using conventional materials like metal and glass have now gradually moved to plastics packaging. The plastics offer advantages of lighter weight, cost competitiveness, ease of handling and variety of shapes and sizes as compared to the conventional packs. This trend of plastics packaging is on the rise and is likely to continue.

CHAPTER 4

Food Safety Regulations & Standards

(Food Safety Standard and Additives Regulation, 2011), 2.3 Fruits and Vegetable Products

Regulation 2.3.31 Jam, Jellies & Marmalades

- Marmalade means a mixture brought to a suitable gelled consistency of sugars and one or more of the products obtained from fruit including pulp, puree, juice, aqueous extracts and peel.
- Jelly marmalade means product from which all the insoluble solids, or all insoluble solids except for a small proportion of thinly cut peel, have been removed during the process of manufacture.
- Marmalades shall be prepared from any fruit ingredient singly or in combination.
- The prepared fruit content in marmalades shall be not less than 45 percent by weight.
- The total soluble solids content shall be not less than 60 per cent by weight in the case of marmalades.
- The other substances that may be added to the products are cane sugar, sucrose, dextrose, and invert sugar, liquid glucose, honey, salt, herbs, spices, condiments and their extracts and other ingredients appropriate to the product whose standards are prescribed in these regulations.
- Pectin derived from any fruit may be used at GMP level.
- The product shall conform to the following quality factors, namely:-
 - in case of marmalades, the finished product shall be reasonably uniform and shall be of good keeping quality and attractive colour.
 - Fruit jellies shall be of gelatinous consistency. It shall be clear, sparkling of attractive colour.
 - It shall not be syrupy, sticky or gummy and should retain the flavour or aroma of original fruit.
 - The product shall be free from burnt or objectionable flavors, weeping, and crystallization.
 - Marmalades shall have a uniform suspension of peel.
- The product shall be free from extraneous matter normally associated with the fruits such as skin, pits, pit fragments and seeds.

- Containers shall be well filled with the product which shall occupy not less than 90 per cent of the water capacity of the container.

(The water capacity of the container is the volume of distilled water at 27°C which the sealed container will hold when completely filled. When product is packed in glass containers, the water capacity shall be reduced by 20 ml.)

Standards specified in this sub-regulation shall not apply to—

- (a) the products when indicated as being intended for further processing including as those intended for use in the manufacture of fine bakery wares, pastries or biscuits;
- (b) the products which are clearly intended or labeled as intended for special dietary uses;
- (c) the reduced sugar products or those with very low sugar content;
- (d) the products where the foodstuffs with sweetening properties have been replaced wholly or partially by food additive sweeteners.

A. Permitted Additives for marmalades

a. Regulation 3.2.11

Pectin

(1) Pectin shall be white, yellowish, light greyish or light brownish powder and as described below, namely:-

- Common Name: Pectin
- INS No.: 440
- C.A.S No.: 9000-69-5
- Chemical Name: Pectin

(2) Pectin shall conform to the requirements specified in the table below, namely:-

Characteristic	Requirements	Characteristic	Requirements
Loss on drying, percent. by mass, Max	2	Total insolubles, per cent. by mass, Max	3
Sulphur dioxide, mg/kg, Max	50	Nitrogen, per cent. by mass, Max	2.5
Methanol, per cent. by mass, Max	1	Galacturonic acid, per cent. by mass on ash-free and	65

		dried basis, Min	
Ethanol, per cent. by mass, Max	1	Degree of amidation, percent. by mass of total carboxyl groups of pectin, Max	25
2-propanol, per cent. by mass, Max	1	Lead, mg/kg, Max	2.0
Methanol, ethanol & 2-propanol, per cent. by mass, Max	1	Copper, mg/ kg, Max	300
Acid insoluble ash, %by mass, Max	1	Arsenic, mg/ kg, Max	5.0

b. Regulation 3.3.4

Trehalose may be added as an ingredient in the following foods, subject to label declaration under sub-regulation 49 of Regulation 2.4.5 of the Food Safety and Standards (Packaging and Labelling) Regulations, 2011: **Marmalade: 0.5 - 20.0 per cent**

c. Permitted additives (Appendix A)

Additive	Limit	Additive	Limit
Acesulfame potassium	1,000 mg/kg	Canthaxanthin	200 mg/kg
Alitame	100 mg /kg	Caramel III - ammonia caramel	200 mg/kg
Allura red AC	100 mg/kg	Caramel IV – sulfite ammonia caramel	1500 mg/kg
Annatto	GMP	Carmoisine	200 mg/kg
Aspartame	1,000 mg/kg	Carnauba wax	400 mg/kg
Aspartame-acesulfame salt	1,000 mg/kg	beta-Carotenes, vegetable	1,000 mg/kg

Benzoates	1,000 mg/kg	Curcumin	GMP
Brilliant blue FCF	200 mg/kg	Dimethylpolysiloxane	10 mg/kg
Carotenoids	500 mg/kg	Ethylene Diamine Tetra Acetates (EDTA)	130 mg/kg
Chlorophylls and chlorophyllins& Copper complexes	200 mg/kg	Erythrosine	100 mg/kg
Fast green FCF	200 mg/kg	Saccharins	200 mg/kg
Grape skin extract	500 mg/kg	Sorbates	1,000 mg/kg
Hydroxybenzoatespara	250 mg/kg	Riboflavins	200 mg/kg
Iron oxides	200 mg/kg	Steviol glycosides	360 mg/kg
Indigotine (Indigo carmine)	200 mg/kg	Sucralose (Trichlorogalactosucrose)	400 mg/kg
Neotame	70 mg/kg	Tartaric acid, L (+)	GMP
Polydimethylsiloxane	30 mg/kg	Tartrazine	200 mg/kg
Ponceau 4R	200 mg/kg	Sunset yellow FCF	200 mg/kg

B. 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	$1 \times 10^2/\text{g}$	$1 \times 10^3/\text{g}$
Yeast and Mold Count	5	1	50/ g	$1 \times 10^2/\text{g}$
Enterobacteriaceae	5	0	Not detectable as per prescribed method	
Staphylococcus aureus (Coagulase +	5	0	Absent/25 g	

ve)			
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

C. Food hygiene:

(a) The product shall be prepared and handled in accordance with the guidance provided in the Schedule 4 of the Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011 and any other such guidance provided from time to time under the provisions of the Food Safety and Standards Act, 2006 (34 of 2006).

D. 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.

Chapter 1 - General

1.2: Definitions

1.2.1 : 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 numerals 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).

Regulation 2.1: Packaging

Regulation 2.1.1: General Requirements

2. 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)

Regulation 2.2: Labelling

Regulation 2.2.1: 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.

Regulation 2.2.2 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.

5. 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

6. 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.
7. Net quantity by weight shall be declared on every package of food.
8. Lot/Code/Batch identification shall be given on the label.
9. 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.

10. 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.

e. Schedule H of FoSCoS: 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.

Manufacturers List of Food Processing Machineries

	Name of the company	Machineries
1	Eastend Engineering Company 173/1 GopalLal Thakur Road Calcutta 700 035 India Tel: +91 33 2553 6397	Cutting machinery
2	Gardners Corporation 158 Golf Links New Delhi 110003 India Tel: +91 11 2334 4287/2336 3640 Fax: +91 11 2371 7179	Cutting machinery, Juice filters, weighing machinery, Boiling equipment
3	Narangs Corporation P-25 Connaught Place New Delhi 110001 India Tel: +91 11 2336 3547 Fax: +91 11 2374 6705	Cutting machinery
4	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
5	Delhi Industries 4 Paharganj Lane, New Delhi 110055 India Tel: +91 11 2529720, 27525200, 27536888 Fax: +91 11 25791291	Juice extractors and Pulpers
6	Food Packs Indiana Thrikkariyoor, Kothamangalam, Ernakulam Kerala 686692 India	Juice extractors and Pulpers
7	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	
8	Sri Rajalakshmi Commercial Kitchen Equipment No.57, (old No. 30/1) Silver Jubilee Park Road, Bangalore - 560 002 India Tel: +91 (0)812 2222 1054/223 9738 Fax: +91 (0)812 2222 2047	Boiling equipment
9	Raylons Metal Works Kondivita Lane J. B. Nagar Post Office Post Box No. 17426 Andheri (E) Andheri - Kurla Road, Mumbai - 400 059 India Tel: +91 22 26323288 / 6325932	Boiling equipment
10	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
11	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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