MINISTRY OF FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

PMFME
सूक्ष्म उद्यमों का संबल

PM Formalisation of
Micro Food Processing Enterprises Scheme

Processing of Orange Jelly

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CHAPTER 1

INTRODUCTION

India ranks second for fruits and vegetables producer in the world followed by China. India, during 2017-18 has produced about 97.358 MT fruits and 184.98 MT vegetables in about 6.5 MHa and 10.29 MHa respectively (Horticulture statistics at a glance, 2018, MoA & FW Gol). In spite of this, the per capita availability of fruit in India is 107 gm/day which is below the recommended 120 gm/day. India's share of global exports of fresh fruits and processed fruit products is also quite meager compared to other major fruit producers of the world (Bung, 2012). Unfortunately, fruits and vegetables being perishable in nature get wasted to the tune of 20-30 % in the supply chain due to improper handling, transportation and poor post-harvest management; and only 2 % of them are processed in to value added products and the rest is consumed fresh. Orange is the third most important largest producer fruit following bananas and mangoes. Fruits of Orange are appreciated for their high content of flavonoids, vitamin C, citric acid and minerals.

Sweet orange (Citrus sinensis L.) is one of the most important subtropical fruits of India and belongs to the family Rutaceae. It is widely consumed fruit RTS by normal as well as sick people and is well known for its instant energy, pectins, vitamin C and potassium content. Sweet orange RTS is refreshing after any hectic activity or on a dry, hot day to quench thirst.

1.1 Origin, Distribution and Production of Orange

The orange is the fruit of various citrus species in the family Rutaceae; it primarily refers to Citrus sinensis, which is also called sweet orange, to distinguish it from the related Citrus aurantium, referred to as bitter orange. The orange is a hybrid between pomelo (Citrus maxima) and mandarin (Citrus reticulata). Oranges are the most popular of all citrus fruits, and behind apples are also one of the most popular fruits grown and consumed globally. The orange originated in a region encompassing Southern China, Northeast India, and Myanmar, and the earliest mention of the sweet orange was in Chinese literature in 314 BC.

Oranges are believed to be native to the tropical regions of Asia, along with other citrus species, they have been cultivated from remote ages. Pomelo originated in India while mandarins originated in China. Orange culture probably spread from its native habitat to India and the east coast of Africa and from there to the eastern Mediterranean region. By the time Christopher Columbus sailed, orange trees were common in the Canary Islands. Today oranges are cultivated in subtropical and tropical America, northern and eastern Mediterranean countries, Australia, and South Africa.

Prior to 1920, the orange was mainly considered a dessert fruit. The spread of orange-juice drinking and consumption of value added products of orange, in contrast with eating of the fresh fruit, significantly increased the per capita consumption of oranges. Also important was the growing appreciation of the dietary value of citrus fruits; oranges are rich in vitamin C and also provide some vitamin A.

The orange has become the most commonly grown tree fruit in the world. It is an important crop in the Far East, the Union of South Africa, Australia, throughout the Mediterranean area, and subtropical areas of South America and the Caribbean. The United States leads in world production, with Florida, alone, having an annual yield of more than 200 million boxes, except when freezes occur which may reduce the crop by 20 or even 40%. According to UN's Food and Agriculture Organization in 2010, India ranked third orange producing country after Brazil and United states. Combined these countries accounts to almost half of the world's production of 68 million tons. Other major producers are Spain, Japan, Mexico, Italy, Argentina and Egypt. Large quantities of fresh oranges and orange juice concentrate are exported to the United States and small shipments go to East Germany, Canada and Argentina.

India exports sweet oranges to countries like Sri Lanka, France, the UK, Belgium, and Bangladesh in large scale. In India, major orange producing states are Andhra Pradesh, Maharashtra, Karnataka, Punjab, Haryana and Rajasthan. The areas producing mandarins are Coorg, Vidarbha, Darjeeling, Meghalaya, Asaam, Nagpur, Akola and Punjab. Area producing sweet oranges are Haryana, Punjab, Rajasthan, Maharashtra, Andhra Pradesh, Nagpur and Akola.

1.2 Varieties

There are different varieties of oranges growing worldwide. Varieties of oranges growing worldwide are described below. Common Orange: Common oranges (also called "white", "round", or "blond" oranges) constitute about two-thirds of all the orange production. The majority of this crop is used mostly for juice extraction.

Navel: It is large but with a thick, easily removed rind; not very juicy; of excellent flavor, and seedless or nearly so. Ease of peeling and separation of segments makes this the most popular orange in the world for eating out-of-hand or in salads. Limonene content of the juice results in bitterness when pasteurized and therefore this cultivar is undesirable for processing. The tree needs a relatively cool climate and should not be grown below an elevation of 3,300 ft (1,000 in) in tropical countries. Today it is commercially grown, not only in Brazil and California, but also in Paraguay, Spain, South Africa, Australia and Japan.

Valencia: It is smaller than the 'Washington Navel', with a thinner, tighter rind; is far juicier and richer in flavor; nearly seedless. It needs a warm climate. In fact, it is the most satisfactory orange for the tropics, even though it may not develop full color in warm regions. The fruits on the trees in spring will regreen, lose their orange color and turn green at the stem end, but the quality is not affected.

Hamlin: Hamlin, is small, smooth, not highly colored, seedless and juicy but the juice is pale. The fruit is of poor-to-medium quality but the tree is high-yielding and cold-tolerant. The fruit is harvested from October to December and this cultivar is now the leading early orange in Florida.

Other varieties of oranges growing worldwide are ‘Trovita’, 'Lue Gim Gong', ‘Rhode Red Valencia’, ‘Homosassa’, ‘Shamouti’, ‘Parson Brown’, ‘Pineapple’, ‘Queen’, ‘Blood Oranges’.

1.3 Varieties of oranges growing in India

Nagpur Orange: The fruit has a pockmarked exterior and sweet and juicy pulp. It gives the city of Nagpur its pseudonym Orange City. The Geographical Indication was applied for Nagpur orange with the registrar of GIs in India, and is effective as of April 2014. The Nagpur oranges blossom during the Monsoon season and are ready to be harvested from the month of December.

Coorg orange, also called Coorg mandarin, is a cultivar of orange from Kodagu in Karnataka. It was given the Geographical Indication status in 2006. Greenish-yellow in color, they have a tight skin and a sweet-sour taste, unlike Nagpur oranges which are known to have loose skin and sweet taste. Coorg oranges are said to have longer shelf life compared to other varieties.

Khasi Oranges trees are small, erect and evergreen. It is cultivator of orange from Meghalaya. They start bearing fruits in 3-5 years from planting, although full fruit yield happens only after eight years.

Darjeeling Mandarine is resembles to Khasi Mandarine

The 'Kinnow' is a high yield mandarin hybrid cultivated extensively in the wider Punjab region of India and Pakistan. In a hot climate, plants can grow up to 35 feet (11 m) high. 'Kinnow' trees are highly productive. The fruit matures in January or February. It peels easily and has a high juice content.

Other varieties of oranges growing in India are Mudkhed, Shrinagar, Butwal, Dancy, Kara and Seedless.

1.4 Health Benefits and Nutritional Information

Oranges are known for their vitamin C content, a powerful antioxidant that helps protect cells from damage. Oranges are also a good source of fibre, B vitamins, vitamin A, calcium and potassium. This popular citrus fruit is particularly known for its vitamin C content. However, oranges contain a range of other plant compounds and antioxidants that may reduce inflammation and work against disease. They also contain health-promoting compounds known as flavanones. Research suggests that these citrus phytochemicals help

support the body and protect us from conditions such as heart disease and cancer – they're also thought to have some anti-inflammatory, antiviral and antimicrobial benefits.

One medium orange will provide the NRV (nutrient reference value) of vitamin C for adults. Orange peel actually contains higher amounts of certain nutrients than the flesh, so using recipes that incorporate the zest of an orange will give your diet an extra boost.

Carbohydrates: Oranges are mainly composed of Carbohydrates and water, with very little protein and fat and few calories. Oranges have a low glycemic index (GI) of 31-51.

Fiber: Oranges are a good source of fiber. The main fibers found in oranges are pectin, cellulose, hemicellulose, and lignin. One large orange packs around 18% of the Reference Daily intake (RDI).

Vitamin C: Oranges are an excellent source of Vitamin C. One orange provides 100% of RDI.

Folate: Folate has many essential functions and is found in many plant foods.

Potassium: Oranges are good source of Potassium. High intake of potassium can lower blood pressure and may reduce risk of heart disease.

Oranges are rich in various bioactive plant compounds, which are beneficial to health.

1.5 The Bio Active Compounds in Oranges

- Citric acid: The most abundant organic acid in oranges, citric acid may help prevent the formation of kidney stones.
- Hesperidin: This antioxidant may strengthen your blood vessels and prevent atherosclerosis — the buildup of fatty deposits (plaque) inside your arteries.
- Anthocyanin: A class of antioxidant flavonoids, anthocyanin is responsible for the red flesh of blood oranges.
- Beta-cryptoxanthin. This is one of the most abundant carotenoid antioxidants in oranges. Your body converts it into vitamin A.

1.6 Nutritional properties of Sweet Orange

It is well-known that the orange is one of the most abundant sources of vitamin C however, it also contains considerable amounts of sugar, carotenoids, flavonoids essential oil and some minerals. Although there is great diversity among the cultivars of Citrus cinensis in terms of physical and chemical characteristics, each cultivar produces fruit within a short period of time, and does this consecutively throughout an extensive growing season. The nutritional properties of the orange are given in the below table.

Nutritional composition of orange fruit per 100 ml	
Energy (Kcal)	12.01
Dry matter (g/100 ml)	12.01
Water soluble dry matter (°Bx)	11.8
Vitamin C (mg/100 ml)	52.01
pH	3.19
Titratable acidity (g/100 ml)	1.37
Reducing sugar (g/100 ml)	4.02
Sucrose (g/100 ml)	4.12
Zn (mg/l)	1.7
Fe (mg/l)	0.86
Cu (mg/l)	0.54
K (mg/l)	1364
Mg (mg/l)	102.4
Mn (mg/l)	0.02
Na (mg/l)	7.7
Ca (mg/l)	95.2
P (mg/l)	150.1

(Ref: Topuz, et.al, 2005: Physical and nutritional properties of four orange varieties)

1.7 Constituents and Health Benefits of Oranges

Oranges also have many potential health benefits. Eating oranges may lower your risk of heart disease, cancer, and kidney stones.

1.8 Health Benefits

1. Heart health: Intake of fruits high in vitamin C is linked to reduced heart disease risk; Intake of isolated fibers from citrus fruits has been shown to decrease blood cholesterol levels, and the essential oils in oranges can protect LDL (bad) cholesterol particles from becoming oxidized. Flavonoids in citrus fruits (especially hesperidin) may help lower the risk of ischemic stroke in women and have protective effect against heart disease. Long term, regular consumption of foods that contain flavonoids might help protect against cancer and cardiovascular disease. Potassium may help lower the risk of stroke. Regular consumption of orange juice has a blood-thinning effect and lower risk of CVD.

2. Blood pressure: Consuming Orange can help reduce blood pressure.

3 Cancer prevention: Orange and orange juice are an excellent source of the antioxidant vitamin C. Antioxidants may help prevent free radicals from causing cell damage that can lead to cancer.

4 Prevent asthma: vitamin C also benefitted people with bronchial hypersensitivity when they also had a common cold and people with asthma.

5 Anemia prevention: Anemia is often caused by iron deficiency and most common in pre-menopausal women. Although Oranges are not good source of iron, but they are a great source of vitamin C and citric acid, which can increase the absorption of iron from other foods. It may help prevent anemia.

6. Prevention of kidney stones: The citric acid in Oranges may reduce your risk of kidney stones by diluting urine and increasing its citrate content. Potassium citrate is often prescribed to patients with the kidney stones. Citrates in oranges seem to have similar effects.

7. Boosting the immune system: Foods that are high in vitamin C and other antioxidants may help strengthen the immune system against the germs that cause the common cold and the flu.

8. Maintaining healthy complexion: Vitamin C plays a vital role in the formation of collagen, the support system of the skin. Sun exposure, pollution, age, and other factors can result in skin damage. By eating vitamin C in its natural form or applying it topically can help prevent this type of damage.

9. Scurvy: Scurvy is caused by deficiency of Vitamin C; connective tissues weaken due to the lack of vitamin C. Consumption of Orange prevent scurvy.

1.9 Cultivation, Bearing & Post Harvest Management

The orange tree, reaching 25 ft (7.5 m) or, with great age, up to 50 ft (15 m), has a rounded crown of slender branches. The twigs are twisted and angled when young and may bear slender, semi-flexible, bluntish spines in the leaf axils. Leaves are 3 to 6 in (6.5-15 cm) long, 1 to 4 in (2.5-9.5 cm) wide. Borne singly or in clusters of 2 to 6, the sweetly fragrant white flowers, about 2 in (5 cm) wide. The fruit is globose, subglobose, oblate or somewhat oval, 3 to 4 in (6.5-9.5 cm) wide. Dotted with minute glands containing an essential oil, the outer rind (epicarp) is orange or yellow when ripe, the inner rind (mesocarp) is white, spongy and non-aromatic. The pulp (endocarp), yellow, orange or more or less red, consists of tightly packed membranous juice sacs enclosed in 10 to 14 wedge-shaped compartments which are readily separated as individual segments. In each segment there may be 2 to 4 irregular seeds, white externally and internally, though some types of oranges are seedless. The sweet orange differs physically from the sour orange in having a solid center.

1.10 Cultivation and Bearing

Mandarin orange (*Citrus reticulata*) is most common among citrus fruits grown in India. It occupies nearly 40% of the total area under citrus cultivation in India. The most important commercial citrus species in India are the mandarin (*Citrus reticulata*), sweet orange (*Citrus sinensis*) and acid lime (*Citrus aurantifolia*) sharing 41, 23 and 23 % respectively of all citrus fruits produced in the country.

Arid and semiarid regions of the southwest to humid tropical regions of northeast are best suitable for orange cultivation in India. They are best suited for subtropical type of climates where the temperature is around 13-37˚C. High humidity and frost are extremely dangerous

for the plants. There could be a possible danger of fruit and flower drop due to hot winds during summer months. Some varieties can be grown at altitudes up to 2000 m above sea level. The soil that is best suited for orange plants should be light and well drained. Any soil such as sandy loam, alluvial, clay loam, lateritic etc. is favorable for orange plants. The pH of the soil may be around 4 to 9 but ideally deep soil with a pH of 5.5 to 7.5 is beneficial. The soil should not have high calcium carbonate content otherwise the feeder root zone may be badly affected.

The land for orange farming has to be ploughed thoroughly and properly levelled. Pits of dimensions 1 x 1 x 1 m are dug for planting. The best time for planting is from June till August. The normal spacing for planting the trees is 6 x 6 m such that one hectare of land can accommodate 277 plants.

The high density planting is practiced in hilly regions where planting is done on terraces against the slopes so as to accommodate more plants. These plants or trees are extremely sensitive to water logging and stagnation, so drainage channels of 3 to 4 ft depth along the slopes of the hilly regions are essential. The spacing for high density planting is 1.8 x 1.8 m between the plants such that one hectare of land can accommodate 2990 plants.

Fruit should be harvested when they attain full size, develop attractive orange color (Minimum 25%) with TSS (optimum sugar; acid blend) (8-10), since it is a non-climacteric fruit. Fully ripen fruits when turn to yellow color from green should be harvested. The common commercial practice of harvesting is to pull the fruits from the branch, which may rupture the skin near the stem and leading to fungal infection and subsequent rotting. Hence, fruit should neither be plucked nor torn off, but should be cut off preferably with clipper, shears or secateurs.

1.11 Post-Harvest Management

There are some fruit handling management after harvesting to avoid post-harvest losses. Following are Post-harvesting handling practices:

- Fruits are graded according to their size and color. All the diseased, deformed, bruised and unripe fruits are sorted out.

- Ethylene gas is used for treating the unripe green oranges such that they develop yellow or orange color.
- Oranges require a temperature of 7 to 8˚C and humidity of 85-90% such that they can be stored for 4 – 8 weeks.
- Do not leave harvested fruit out in the hot sun;
- Do not pick cold, wet fruit. When wet turgid fruit is handled the oil
- Glands can be ruptured. The released oil burns the fruit surface (oleocellosis) and also stimulates fungal spores to germinate. The burn Marks can take 2-3 days to develop;
- Wear cotton gloves when harvesting. This reduces puncture marks from fingernails and jewelry
- Use picking bags. This reduces damage as a result of abrasion on
- Wooden or metal picking bins and allows fruit to be gently lowered into
- Bulk harvesting bins;
- Do not leave stems on fruit or damage buttons by “plugging”;
- Use clean, smooth harvesting bins;
- Make sure packing line equipment is cleaned regularly. This reduces dirt and wax buildup which can cause fruit abrasion;
- Reduce packing line abrasion by using foam, rubber and smooth belts to Cushion fruit;
- Remove old and rotten fruit regularly from the packing shed and surrounds;
- Treat harvested fruit with a registered fungicide within 24hrs of harvest;

The general practice is to wash the harvested fruits with chlorine and coat them with a shine wax so that the fruits look fresh. They are dried at a temperature of 50-55˚C after coating. If the fruits have to be transported over longer distances, then they are packed in wooden boxes else baskets made of bamboo and mulberry are used for packing oranges. The boxes or baskets have to be ventilated and the fruits should be wrapped in tissue paper or newspaper for protection.

CHAPTER 2

PROCESSING AND VALUE ADDITION

2.1 Processing and Value Addition

Jellies are clear substances since they are made of fruit juice or a water extract of fruit. Jams, however, contain all or most of the insoluble solids of the fruit because whole, crushed, macerated, or pureed fruit is used in their manufacture. Technically, jams and preserves are identical, except the term preserves is used for products containing whole fruit.

Gelation of pectin is brought about by the addition of sugar in the presence of acid. Hydrogen bonding between hydroxyl groups and between hydroxyl and carboxyl groups (Whistler and Daniel, 1985) is responsible, at least in part, for the rigidity of fruit jellies. The relationships among the three essential ingredients, pectin, sugar, and acid, are important to the quality of the product. For example, insufficient pectin or acid may prevent gel formation and too little sugar results in a tough jelly (Woodroof, 1986).

Purified pectin is made from apple pomace and the white inner skin, or albedo, of citrus fruit. Pectins with high molecular weight and a relatively high proportion of methyl ester groups have the best jelly-forming ability. The quality of pectin is indicated by its ability to carry sugar when made into jelly and is expressed commercially by grade. Jelly grade is the proportion of sugar that one part of pectin is capable of turning, under prescribed conditions, into a jelly with suitable characteristics. If, for example, 1 lb of pectin will carry 150 lb of sugar to make a standard jelly, it is a 150-grade pectin.

The amount of sugar in a jelly depends on the amount and quality of the pectin used. When the sugar content of a mixture is increased or the pectin content decreased, a weaker jelly will result. Tougher gels result with reduction in sugar or an excess of pectin. In a normal finished jelly, the concentration of sugar is about that of a saturated sugar solution. The third essential ingredient for jelly is acid. The amount of acid required depends not on total but active acidity or pH. Apparently the acid acts by neutralizing the charge on the carboxyl groups of pectin, thus increasing the tendency of the molecules to associate and hence to form a gel. The pH must be below 3.5 for gel formation. As it is decreased below 3.5, the firmness of the jelly

increases. Acids such as vinegar, lemon juice, lime juice, citric acid, lactic acid, malic acid, and tartaric acid often are added in making jellies and jams.

Water, a fourth ingredient in jelly, is taken for granted. In a natural fruit jelly, there are traces of other components, such as salts, proteins, and starches. Such components are not essential, as shown by a formula for test jelly: 450 ml distilled water, 5.2 g of 150-grade pectin, and 775 g of sucrose (Cox and Higby, 1944). These ingredients are cooked until the batch weighs 1200 g and poured into four glasses, each of which contains 2.0 ml of tartaric acid solution (22.4 g of acid/50 ml of solution). This product is sometimes called a "synthetic" jelly because only purified ingredients are used in making it. The formula could be used in an experiment for studying the effects of ingredient variation on gel strength of jellies.

To make jelly without added pectin, fruits with adequate pectin levels (crab-apples, grapes, apples, currants, sour blackberries, cherries, quinces, lemons, sour oranges, and grapefruit) are best used (Woodroof, 1986, p. 428). Adding one of these fruits to lower pectin fruits (strawberries and apricots) (Woodroof, 1986), using partly underripe fruit, which is higher in pectin (USDA, 1988), or adding a commercial pectin will contribute needed pectin. Pectin content of juice is indicated by its viscosity because large molecules increase viscosity.

To make jelly, fruit is heated, and the juice is extracted and filtered. The mixture of sugar and juice is cooked in a kettle until the desired concentration of sugar (usually 65–69%) is achieved. In commercial operations, a vacuum system may be used for heating; the resultant lower cooking temperature minimizes hydrolysis of the pectin and maintains color and flavor (Woodroof, 1986). Methods of determining when jelly has cooked long enough can be divided into two groups: measurement of gelation and measurement of soluble solids content. Gelation can be measured by chilling a small amount of boiling jelly in a refrigerator or by the sheeting off test, in which the mixture is allowed to drip from a large cool spoon. If the syrup separates into two streams of drops that sheet off together, the jelly is done. The success of these crude tests depends on the experience of the operator.

2.2 Raw Material Requirements

A sustainable food processing unit must ensure maximum capacity utilization and thus requires an operation of minimum 280-300 days per year to get reasonable profit. Therefore, ensuring uninterrupted raw materials supply requires maintenance of adequate raw material inventory. The processor must have linkage with producer organizations preferably FPCs through legal contract to get adequate quantity and quality of raw materials which otherwise get spoiled.

2.3 Manufacturing Process of the Orange Jelly

Important considerations in jelly making:

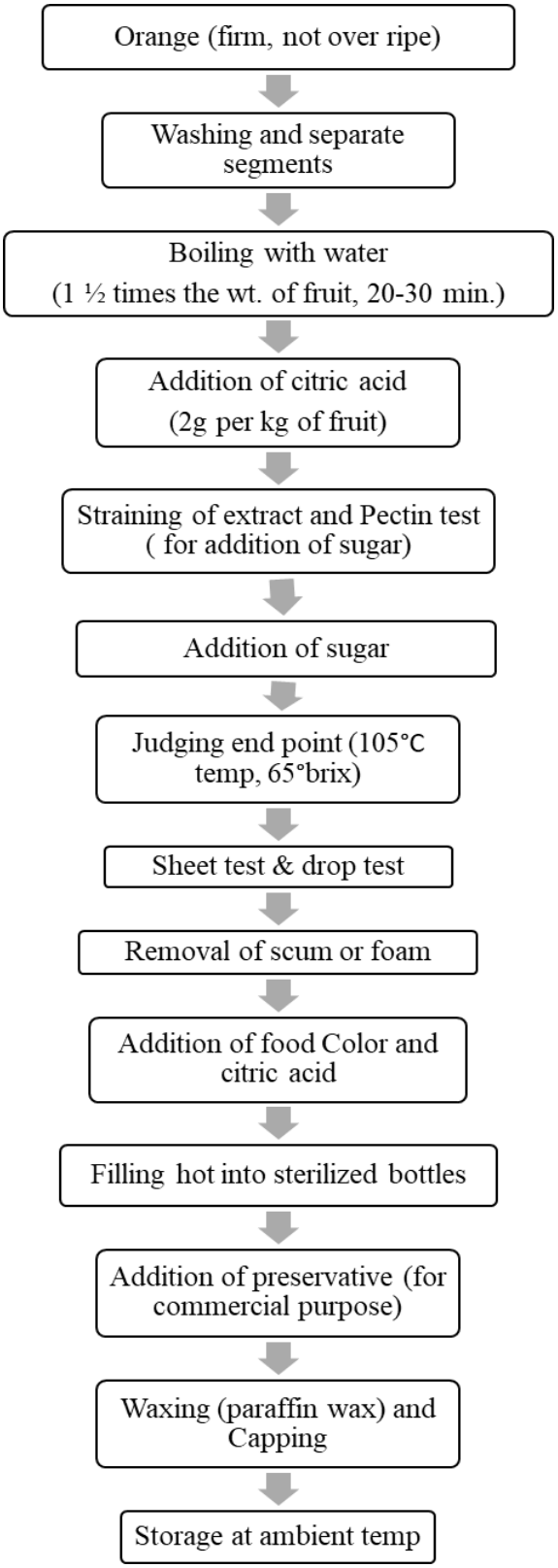
- ✓ Pectin, acid, sugar (65%) and water are the four essential ingredients
- ✓ Pectin test and determination of end-point of jelly formation are very important for the quality of the jelly.
- ✓ Pectin substances present in the form of calcium pectate are responsible for the firmness of fruits.
- ✓ Pectin is the most important constituent of jelly. It is a commercial term for water-soluble pectinic acid which under suitable conditions forms a gel with sugar and acid.

Procedure for manufacturing of Orange Jelly is given in the below flowchart: Formulation includes 100 kg of Pulp, 75 kg of Sugar, 300 g of Citric acid and 100g of Pectin.

Gelling

Sugar is essential in the gelling process of jams and jellies to obtain the desired consistency andfirmness. Pectin, a natural component of fruits, has the ability to form gel only in the presence of sugarand acid. Sugar attracts and holds water during the gelling process

2.4 Process Flow for Production of Orange Jelly



Receiving of Orange fruits: Fruit goes through inspection lines for removal of bruised or damages fruits.

Washing and cleaning: The fruits are graded and washed and rinsed with clean water, and inspected again to remove the damaged ones.

Peeling: Orange fruits are peeled by peeler machine

Slicing: Peeled orange fruits are sliced into slicer machine.

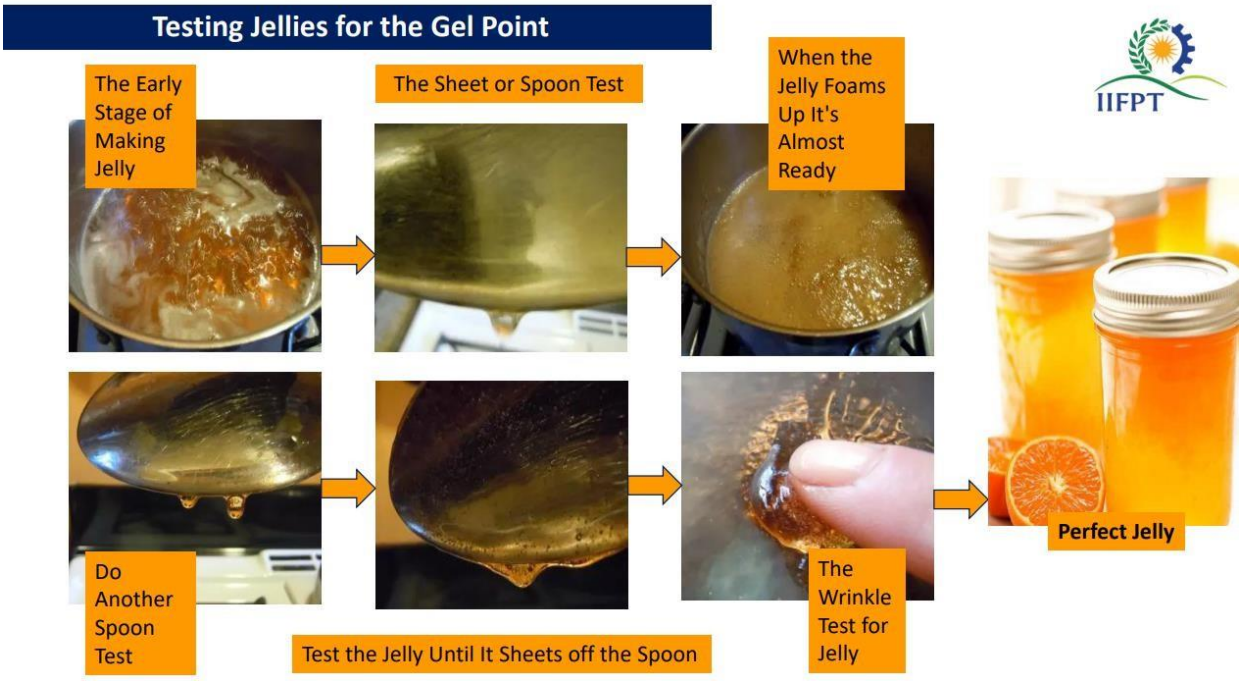
Boiling: Boiling of sliced oranges in water to extract juice or pulp.

Filtration: Clarification is done to separate juice/pulp. After Juice extraction, the juice is clarified and separated from the seed.

Addition of Sugar, Citric acid, Pectin and Color and flavor are optional.

Hot Filling of jelly is done

Packaging: Different types of packaging including plastic bottles, glass bottles and containers are used for Packaging of Orange Jelly.



2.5 Market Demand and Supply for Orange Jelly

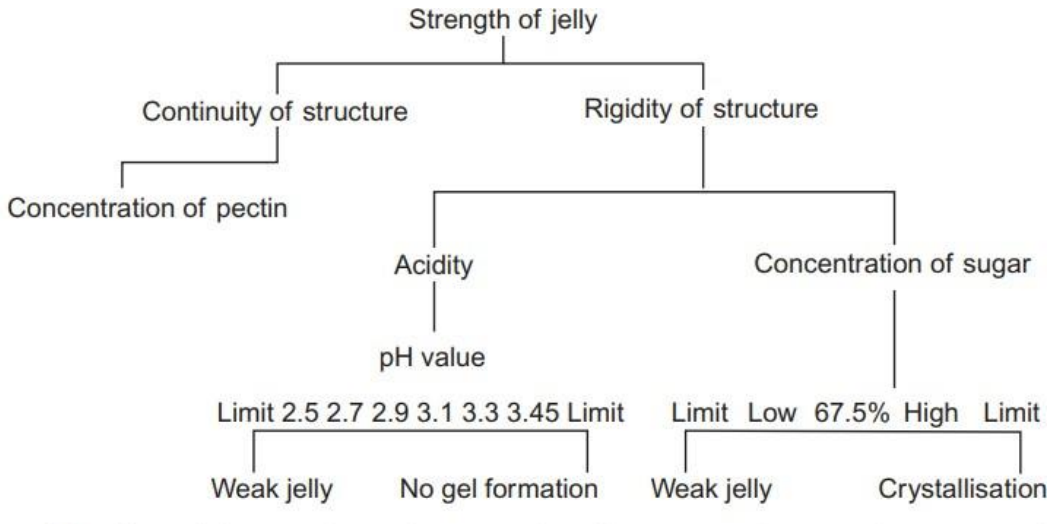
Orange Fruits and peel were processed into various value added products like Orange Squash, Orange Crush, Orange marmalade, Orange sherbets, Orange candied peel, Orange candied peel with chocolate, Orange candied fruit slices, Orange candied fruit slices with chocolate, Orange jelly, Orange jam, and Orange ice lollies. Orange peel also processes into essential oil

products. Due to sensitivity to chilling injury and limited shelf life of Orange fruit, it becomes important to process it in the form of value added products to reduce the surplus in the market in its peak season of production. Preservation of fruit in the form of value added products has turn out to be the business activity of great significance and countries with rich fruit resources with short harvesting season are emphasizing more for establishes storage to keep up quality of fruits, enhance shelf life and preserve fruit for availability in off-season. In recent past the consumption of fruit based products has increased at a fast rate.

2.6 pH and Gel Formation

pH and titratable acid are indicators for the quantity of organic acids and its salts contained in a fruit. Both factors affect gel formation. In the production of jams with high methoxyl pectins, the pH range is usually set at about 2.8–3.2 with citric acid because this pH range is very favorable to gelation, flavour, and shelf life. Gel formation and partial gel formation largely regulate the consistency or body of jams and jellies in their finished condition, and an understanding of these functions is helpful in the most efficient use of pectin. The pH of jams is usually in the region of 2.8–3.4 (depending on the fruit)

Effect of the pH value and sugar and pectin concentration on gel structure and strength.



CHAPTER 3

PACKAGING OF ORANGE JELLY

Food packing is the fundamental tool used by industries to appeal the customer responsiveness and educate the consumer about the welfare of the processed fruit product at the time of purchase. The nutritional, safety, and quality content of new packaging materials must be thoroughly studied before their use. The proved advantages, viz. improved safety, long shelf life, and better preserved quality attributes upon usage of appropri- ate packaging resulted in tremendous growth of food packaging industry. Health and welfare status of consumers are obliga- tory prime concerns for food technologists (Kohan-Nia, Pakbin, Mahmoudi, & Fakhri, 2016).

The packaging material is a tool in which food product is pre- sented. It has ultimately a strong impact on physiochemical and microbial safety status of the food product. Packaging of food influ- ence the evaluation, attention, and purchase decision of consumers (Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013). In the modern era, numerous packaging materials are used including glass jars, plastic bottles, polythene bags, and so on for minimizing the environmental effects that mainly influenced the safety and quality kinetics of commercially available food products. Previous studies showed that glass packaging of various processed products is better than plastic bottles because of high protection against oxi- dative degradation.

3.1 Purpose of Packaging

Shelf life: To maintain the organoleptic properties over a long period

Preservation: Prevent temperature fluctuations, bacterial ingress, dust, etc.

Barrier protection: Prevent migration of oxygen, water vapor, UV light, etc.

Physical protection: Protection from shock, vibration, compression, etc.

Security: Prevent pilferage and/or tampering. Also for assuring authenticity

Portion control: Single serving packaging has a precise amount of contents to control usage.

3.2 Various Packaging Material Used for Orange Jelly

1. Glass Jars:

The use of glass bottles for the packaging of fruit jelly and jams 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.

Previous studies showed that glass packaging of various processed products is better than plastic bottles because of high protection against oxi-dative degradation (Aslam et. al. 2019).

Glass is a popular packaging option for jams and jellies, as it displays the product well, as well as having a good shelf life once opened (below Figure).

The filling and capping operations for jellies are so closely related that they will be treated as one subject. Filling requires that the proper weight of finished product be placed in the container and that the material so placed in the container be truly representative of the batch

2. PET Plastic Jars:

The abbreviation PET stands for polyethylene terephthalate, a substance that, from a chemical point of view, is a polyester. Polyesters were first manufactured in the 1930's, for use as synthetic fibres. Much of the PET produced today is still used to produce fibre. Fleece

sweaters, for example, are made of PET. In single stage primary packaging, the Jelly products are packed in one or two packaging materials in single operation.

3. Polythene Zipper Bag:

A plastic bag, poly bag, or pouch is a type of container made of thin, flexible, plastic film, nonwoven fabric, or plastic textile. Plastic bags are used for containing and transporting goods such as foods, produce, powders, ice, magazines, chemicals, and waste. It is a common form of packaging. Most plastic bags are heat sealed at the seams, while some are bonded with adhesives or are stitched.

4. Secondary Packaging of Jelly

At the secondary packaging stage, the Jelly products in primary packaging are overwrapped in a second packaging materials such as

Cellophane

PP or OPP film

cardboard label

Paper wrap either as monopacks or multipacks

5. Metal Containers Lacquered

Metal packaging plays an important role in the process of food preservation. The common expression used to describe such a process is “canning”. Canned food has become an important part of the human diet in developed countries during the past century. It is of particular value in those parts of the world where no or limited refrigeration exists for storing food. It is a means of safely preserving foodstuffs without microbiological deterioration

- Tin containers are also used - “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 jelly packaging.
- It is hermetically sealed thereby avoiding contamination.

CHAPTER 4

FOOD SAFETY REGULATIONS AND STANDARDS

4.1 Overview: Food Safety and Standards (Food Products Standards and Food Additives), Regulations, 2011

Regulation 2.3.31: JAMS, FRUIT JELLIES AND MARMALADES

Fruit jelly means product prepared by boiling fruit juice or fruit(s) or aqueous extracts of one or more fruits of sound quality, with or without water, expressing and straining the juice, adding nutritive sweeteners, and concentrating to such a consistency that gel formation takes place on cooling. The product shall be clear, sparkling and translucent. It may also contain any other ingredient suitable to the products including derivatives like fibre, extracts, spices and condiments.

The prepared fruit content in jams, jellies and marmalades shall be not less than **45 per cent. by weight**, except in strawberry, raspberry and ginger jams when the minimum fruit content shall be **not less than 25 per cent. by weight**. The minimum fruit content for cashew apples shall be 23 per cent. and 8 per cent. for passion fruit.

The total soluble solids content fruit jelly shall be not less than **60 per cent. by weight**

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.

A. Permitted Additives for Jelly

a. Regulation 3.2.11

15. 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 dried basis, Min	65
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

a. 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: **Jelly: 0.5 - 20.0%**

b. 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	1×10^2/g	1×10^3/g
Yeast and Mold Count	5	1	50/ g	1×10^2/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	

4.2 Food Safety and 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).

- **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 numericals 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

4. "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

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

4.3 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 :-

IS : 10146 (Specification for Polyethylene in contact with foodstuffs);

IS : 10142 (Specification for Styrene Polymers in contact with foodstuffs)

IS : 10151 (Specification for Polyvinyl Chloride (PVC) in contact with foodstuffs);

IS : 10910 (Specification for Polypropylene in contact with foodstuffs);

IS: 12252 - Specification for Polyalkyleneterephathalates (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 –

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

4. 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)

Sl. 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-

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

11. 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.

❖ 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.
6. Continuous supply of potable water shall be ensured in the premises.

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 equipment 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 equipment 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.

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