



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Jamun Candy



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CHAPTER 1

INTRODUCTION

1.1. Status and Market Size

Syzygium cumini belongs to family Myrtaceae and is also known as *Syzygium jabunum* is evergreen tropical and subtropical plant native to Indian subcontinent. It is commonly known as Jambul, Black Plum, Java Plum, Indian Blackberry, Jamblang, Jamun etc. The tree fruits once in a year and berries are purple during early stage, later they become black and taste bitter sweet. Being a tropical and subtropical plant but it also performs very well in lower ranges of Himalaya's upto an altitude of 1300 meter from mean sea level. It is distributed throughout India, Sri Lanka, Malaya, and Australia. Annually the trees produce oblong or ellipsoid fruits (berries). They are green when raw and purplish black when fully ripe. The ripe fruits are sweetish sour to taste.

It is commonly known as 'naaval' in Tamil and Black plum, Indian black berry, Java Plum in English. Leaves are opposite, simple, entire and elliptic to broadly oblong. Flowers are white, 7.5-13 mm across, in branched clusters at stem tips. Fruits are variable in size, up to 2.5 cm long, ellipsoid or oblong, black with juicy pulp. It is an animal dispersed species. It is found throughout India, from sea level to an altitude of 1,800m, usually along streams and often gregarious in Sal (*Shorea robusta*) and evergreen forests

Seasonally, it is available from the month of May to July in Indian conditions. Various parts of this plant such as leaves, seeds, bark has been reported for its medicinal properties. It is very effective in the treatment of diabetes mellitus, ulcer, antioxidant, antibacterial, anti- fungal, nitric oxide scavenging, free radical scavenging, antimicrobial, anti HIV and radio- protective measures. During an ancient era, the seeds, barks, flowers, leaves are all used in ayurveda. According to Namasivayam et al. (2008), the bark of the plant which mainly contains carbohydrates and tannins has been used to treat dysentery. Chaudhari et al. (1990) reported that the seeds jamun has anti-inflammatory effects in rat and antioxidant properties in diabetics. Besides from this jamun has been used to treat various diseases from ancient area till now. This review describes mainly on medicinal importance of jamun plants and their applications in the treatment of various diseases.

1.1.1. Commercially grown varieties

The common types of jamun in India are:

- 1) Ram Jamun, with large, oblong fruits, dark-purple or bluish, with pink, sweet pulp and small seeds;
- 2) Kaatha, with small, acid fruits.

Among named cultivars are, mainly, 'Early Wild', 'Late Wild', 'Pharenda'; and, secondarily, 'Small Jaman' and 'Dabka' ('Dubaka'). In Java, the small form is called Djoowetkreekil; a seedless form is Djoowetbooten. In southern Malaya, the trees are small-leaved with small flower clusters. Farther north, the variety called 'KrianDuat' has larger, thicker leaves and red inner bark. Fruits with purple flesh are more astringent than the white-fleshed types.

Improved varieties developed by the SAUs, KVKs and ICAR Institution

varieties	Institution developed
Narendra Jamun 6 Narendra	Dev University of Agriculture and Technology, Faizabad, U.P.
RajendraJamun 1	Bihar Agricultural College, Bhagalpur, Bihar. KonkanBahadoli Regional Fruit Research Station, Vengurla, Maharashtra.
GomaPriyanka	Central Horticultural Experiment Station (CHES), Godhra, Gujarat.
CISH J-42 (Seedless type)	Central Institute for Subtropical Horticulture (CISH), Lucknow,U.P.
CISH J-37	Central Institute for Subtropical Horticulture (CISH), Lucknow,U.P

1.1.2. Cultivation Scenario

In India, the maximum number of jamun trees are found scattered throughout the tropical and subtropical regions. It also occurs in the lower range of the Himalayas up to an elevation of 1,300 meters and in the Kumaon hills up to 1,600 meters. It is widely grown in the larger parts of India from the Indo-Gangetic plains in the North to Tamil Nadu in the South. The data about its total acreage in India are not available.

The jamun tree can be grown on a wide range of soils. However, for high yield potential and good plant growth, deep loam and a well-drained soil are needed. Jamun prefers to grow under tropical and subtropical climate. It is also found growing in lower ranges of the Himalayas up to an altitude of 1300 meters.

Jamun is prolific and regular bearer tree. It starts flowering from March-April followed by fruiting (berry), which appears in May-June. Fruits ripen in June-July or on the onset of rains and takes about 3-4 months to ripen after full bloom. Fruit color change from green to deep-red or bluish-black at full ripening stage. Berry appears oblong, ovoid and crimson black in color when fully ripe. Fruits from grafted tree are large and deliciously sweet but slightly sour in taste. This fruit is mostly considered as a minor dry land fruit crop but, because of its high nutritional value and excellent processing qualities, it is now gaining popularity in sub-tropics and arid region of the country.

1.1.3. Production status of Jamun

India is the second largest producer of the fruit in the world. World production of Jamun is estimated at 13.5 million tonnes out of which 15.4% is contributed by India. India ranks second in production of Jamun in the world. Maharashtra State is the largest Jamun producer followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam and others. The mainly “Konkan bahadoli” variety are famous. This variety cultivated especially in Konkan region.

1.1.4. Composition & Nutritive Value of Jamun

The Fruit contains 83.70 - 85.80 g moisture, 0.70 - 0.13 g protein, 0.15 - 0.30 g fat, 0.30 - 0.90g crude fibre, 14.00 g carbohydrate, 0.32 - 0.40 h ash, 8.30 - 15.00 mg calcium, 35.00 mg magnesium, 15.00-16.20 mg phosphorus, 1.20-1.62 mg iron, 26.20 mg sodium, 55.00

mg potassium, 0.23 mg copper, 13.00 mg sulfur, 8 I.U vitamin A, 0.01-0.03 mg thiamine, 0.009- 0.01 mg riboflavin, 0.20 - 0.29 mg niacin, 5.70 - 18.00 mg ascorbic acid, 7.00 mg chlorine and 3.00 mg folic acid per 100 g of edible portion.

Table 2: Nutritive value of Jamun per 100 g of edible portions

Sl. No	Nutrient	Percentage
1	Moisture	28.2
2	Protein	0.7
3	Fat	0.1
4	Mineral	0.4
5	Fibre	0.9
6	Carbohydrate	19.7
7	Calcium	0.02
8	Phosphorus	0.01
9	Iron	1.0
10	Calorific value	83/100 g

Source: Nutritive value of Indian foods, NIN,2019

1.1.5. Uses of Jamun

a. Food uses

- ✓ Good quality jamun juice is excellent for sherbet, syrup and “squash”. In India the latter is a bottled drink prepared by cooking the crushed fruits for 5 to 10 minutes at 140°F, pressing out the juice, combining it with sugar and water and adding citric acid and sodium benzoate as a preservative.
- ✓ Jamuns of good size and quality, having a sweet or sub acid flavor and a minimum of astringency, are enjoyable raw and may be made into tarts sauces and jam.
- ✓ Astringent fruits are improved in palatability by soaking them in salt water or

pricking them, rubbing them with a little salt, and letting them stand for an hour.

- ✓ All but decidedly inferior fruits can be utilized for juice which is often comparable to grape juice.
- ✓ When extracting juice from cooked jamuns, it is recommended that it be allowed to drain out without squeezing the fruit and it will thus be less astringent.
- ✓ The white-fleshed jamun has adequate pectin and makes a very stiff jelly unless cooking is brief (Miller et al.1955).
- ✓ The more common purple fleshed yields richly colored jelly but are deficient in pectin and require the addition of a commercial jelling agent or must be combined with pectin-rich fruits such as unripe or sour guavas.
- ✓ In Goa jamun are an important source of wine, resembling Port.
- ✓ Brandy and distilled liquor called “jambava” have also been made from the fermented fruit.
- ✓ Jamun vinegar, extensively made throughout India, is an attractive, clear purple, with a pleasant aroma and mild flavor.

b. Uses in Traditional Medicine

- ✓ Traditionally the jambul fruits, leaves, seeds, and bark are all used in ayurvedic medicine.
- ✓ The bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery
- ✓ A glycoside in the seed, jamun is considered to have antidiabetic properties.
- ✓ The seeds have also shown anti-inflammatory effects in rats and antioxidant properties in diabetics.
- ✓ Jamun fruit seeds and pulp have been reported to serve various purposes in diabetic patients, such as lowering blood glucose levels and delaying diabetic complications including neuropathy and cataracts.
- ✓ Jamun is most often recognized as an adjuvant therapy in type-2 diabetes.
- ✓ Jamun fruit reduces the sugar in the blood and is very good in the control of diabetes. Its seeds contain Glucoside, Jamboline and Ellagic acid, which are reported to have the ability to check the conversion of starch into sugar in case of excess production of glucose.
- ✓ All parts of the jamun can be used medicinally and it has a long tradition in

alternative medicine. The plant has been viewed as an antidiabetic plant since it became commercially available several decades ago.

c. Uses in Ayurveda

- ❖ Grahi – Absorbent, useful in malabsorption syndrome and diarrhea
- ❖ Vatakara – Increases Vata
- ❖ Shramahara – Relieves tiredness
- ❖ Pittahara, Dahahara – Balances Pitta and its symptoms like burning sensation.
- ❖ Kantartihara – Relieves throat pain
- ❖ Shosha – Emaciation
- ❖ Krimi – Worm infestation, infection
- ❖ Shwasa – Asthma, COPD (chronic obstructive pulmonary disease), wheezing, breathing difficulty
- ❖ Atisara – Diarrhoea, dysentery
- ❖ Kasa – Cough, cold
- ❖ Vishtambhini – Causes constipation, useful in diarrhea and dysentery
- ❖ Rochana – Improves taste, useful in anorexia Pachani – Improves digestion

According to Ayurveda, its bark is acrid, sweet, digestive, astringent to the bowels, anthelmintic and in good for sore throat, bronchitis, asthma, thirst, biliousness, dysentery, blood impurities and to cure ulcers

Syrup or vinegar prepared from the ripe fruit is useful in spleen enlargement and efficient astringent in chronic diarrhea. Hot water extract of dried fruits is used for stomach ulcers, reduce acidity and for diabetes. The ethanolic extract of *Syzygiumcumini* seeds decreased blood sugar level in alloxan induced diabetic rats also having antibacterial activity

1.1.6. Therapeutic properties of Jamun

The phytochemicals like oxalic acid, gallic acid, malic acid, tannins, oleanolic acid, cyanidin, flavonoids, betunilic acid, essential oils have been reported for significant saponins, terpenoids and quinines are confirmed by qualitative analysis. The bioactive compounds from different solvent extracts suspected of anti-diabetic properties. The leaves of *Syzygium cumini* is considered as an antibacterial and also used to strengthen the teeth and gums in folklore medicine

(i) Anti- Diarrhoea and Dysentery

The whole plant of Jamun such as seeds, fruit, leaves, flower, bark used in traditional medicine. Charaka used seeds and leaves decoctions for diarrhoea and the bark as an astringent. The fruit is treated for internally in obesity, in vaginal discharges and menstrual disorders, cold infusion in intrinsic haemorrhage. The bark is astringent; its juice is given doses in chronic diarrhoea, dysentery, and menorrhagia. Decoction of the bark is an efficacious mouth-wash and gargle for treating spongy gums, stomatitis, relaxed throat and other diseases of mouth. Bark also used for inflammation of skin.

(ii) Antimicrobial Effect

The antibacterial activity against *E. coli*, *B. subtilis*, *P. aeruginosa* and *S. aureus* and inhibitory effect on glucoamylase of ethanolic extracts from seeds of Jamun.

(iii) Antidiabetic

Jamun seeds are prescribed widely in many medicine systems for controlling diabetes. Anti-diabetic effect of jamun seed has also been substantiated by many pharmacological studies. Considerable reduction in blood glucose level is observed when treated with jamun seed.

(iv) Hepatoprotective

Effectuality of jamun peel extract as hepatoprotective agent against carbon tetrachloride (CCl₄) induced oxidative damage on hepatocytes.

(v) Immunomodulatory

It is now being recognized that immunomodulatory therapy could be practiced as an alternative to conventional chemotherapy towards variety of diseased conditions. The methanolic extract of jamun seeds possesses promising immunomodulatory activity.

(vi) Hypolipidemic

Alteration in lipid profile is one of the most common complications in diabetic mellitus and in that context hypolipidemicis effectively treated with jamun seed. Ethanolic extract of seeds is able to reduce the level of total serum cholesterol/high density lipoprotein cholesterol ratio, low density lipoproteins (LDL) and triglycerides. Elevated levels of cholesterol, phospholipids, triglycerides and free fatty acids in the plasma, liver and kidney tissues of streptozotocin induced diabetic were reverted back to normalcy on oral administration of

ethanolic extract of jamun kernel. According to them, the lowering effect was comparable to that of the treatment with standard drug (glibenclamide).

(vii) Chemopreventive

Hydro-alcoholic extract of jamun seed possesses chemopreventive properties in the DMBA-induced and croton oil promoted skin carcinogenesis. Croton oil treatment reduced the cumulative numbers of papillomas, the tumour incidence and increased the average latency period (carcinogen alone). Jamun seed has the potential to modulate biochemical and histopathological status during skin carcinogenesis. Researchers have identified antioxidant capacity of jamun seed as the probable mechanism of chemopreventive effect.

(viii) Anticancerous

Anticancerous effect of jamun pulp on human cervical carcinoma cell lines i.e. HeLa and SiHa using crude methanolic extract and breast cancer cells using hexane: acetone: methanolic extract. The extracts induced apoptosis in tumorous cells and the anti-proliferative effect was proportional to dose and exposure time. The extract exerted no apoptotic effect on non-tumorous breast cells.

(ix) Anti-allergic

Allergy is an abnormal reaction of the body to the allergen introduced by ingestion, injection, inhalation or skin contact. A novel, safe and effective remedy is required for this ailment. In an investigation, the aqueous extract of Jamun leaves (25-100mg/ kg, p.o.) inhibited the rat paw edema induced by 48/80 (allergenic compound), histamine and 5-HT. However, the extract could not produce any beneficial effects against the platelet aggregating factor- induced paw edema.

(x) Cardioprotective

Beneficial effects of methanolic extract of jamun seeds on cardioprotection against isoproterenol-induced myocardial infarction have been observed. The effect was probably related to strengthening of the myocardial membrane, induced by the phytochemicals like alkaloids, amino acids, flavonoids, glycosides, phytosterols, saponins, steroids, tannins and triterpenoids in the extract.

1.2. Indian Market Outlook

Jamun is an underutilized fruit crop, gaining popularity among the consumers due to its high nutraceutical values in rural as well as in urban masses. In addition, the ripe berries are good source of anthocyanins, vitamins, minerals, iron and pectin with fair amount of ascorbic acid. Though, there is maximum availability of raw material or Jamun fruits harvested, it cannot be fully utilized, consumed or processed due to lack of processing techniques and technical know-how. Being highly perishable fruit and its short life, it deteriorates at a faster rate if proper post-harvest handling practices and processing techniques are not adopted. The storage life of Jamun fruits restricted to only 24 hrs at room temperature and 12 days at cool temperature i.e. 3 to 4 °C.

Jamun falls in underutilized fruit species which are neither cultivated in an organized farming system, nor processed by established commercial processing methods. Jamun has almost an exotic flavor and are known for their nutritional and therapeutic values. Jamun fruits, although produced in considerable quantities and consumed, but seldom processed. There is a great scope of the processed products not only because of their exotic flavor, but also due to their nutraceutical importance. Thus, processing of Jamun fruit into value-added products result in a wide variety of exotically flavored products with better nutritional and sensory qualities may unveil new market for export. Therefore, development, standardization and popularization of value-added products from Jamun fruit are essential.

1.3. Value added products from Jamun

1.3.1. Jamun juice

The Jamun fruits are washed and grated to separate pulp. After heating the pulp at 60°C, the juice is extracted through basket press. The juice is strained to remove unwanted particles. The juice is pasteurized the juice at 85°C with sodium benzoate as preservative. Then, the juice is bottled in clean and sterile glass bottles and stored at ambient temperature.

1.3.2. Jamun squash

The Jamun fruits are washed and cut and seeds are removed. Juice is extracted through basket press and straining is done to remove unwanted particles from juice. Sugar syrup is prepared by mixing 1.8 kg sugar, 1 L water and 15 g citric acid for 1 litre of juice. The syrup is strained to remove foreign particles and scum and the syrup is mixed with juice

homogeneously. Sodium benzoate at 3.0 g/L squash is added as preservative. The squash is bottled the juice in clean and sterile glass bottles and stored at ambient temperature.

1.3.3. Jamun RTS beverage

The Jamun fruit pulp is mixed with strained syrup solution (as per requirement). Then, the mixture is homogenized. The RTS is filled in glass bottles and corked tightly. The bottles are pasteurized at 85°C for 20 min, cooled to room temperature and stored at ambient temperature.

1.3.4. Jamun Jam

Jamun fruit pulp and sugar are taken in a stainless steel kettle and heated to about 110°C under constant stirring and turned low. Pectin is added at 2 g/kg or 0.2% and stirred constantly to prevent the pectin from clotting. When the pectin is dissolved, remaining sugar is added to dissolve completely in the mixture. The jam mixture is heated and stirred constantly till it starts boiling vigorously. Near the finishing point (approximately 221°C or at 68-70% TSS), acidifier (citric acid) is added at 4g kg⁻¹ emulsion to get the expected acidity. Also sodium benzoate is added as preservative at 1 g kg⁻¹ by weight. The jam is hot filled into jars and then the jars are cooled in running cold water until they reached a temperature slightly above room temperature.

1.3.5. Jamun Wine

The Jamun fruits are washed and then dipped in 5% NaCl salt solution for 72 hour. The seeds are separated from the fruit and the fruit pulp is crushed with water (1:1 ratio). The pulp is pressed to extract the juice and sodium metabisulphite is added. TSS is adjusted to 17 °Brix with cane sugar and the pH to 4.5 using 1N acetic acid. The must is inoculated with wine yeast starter culture (use 28-48 hour old starter culture at 2% v/v) and kept for Fermentation (at 32 ± 20C for 6 days). Racking and decantation are done (First racking when Brix reaches 2-30. Two to three more racking at 15 days intervals if sedimentation persists). The wine is clarified by chemical method (by adding 0.04% Bentonite). Final racking is done to clear the wine. The wine is filled in bottles and corked. Then the bottles are sealed with bees wax and stored at ambient temperature.

1.4. Harvest & Post Harvest handling of Jamun

1.4.1. Harvesting

The seedling jamun plants start bearing after 8 to 10 years of planting, while grafted ones bear after 6 to 7 years. However, commercial bearing starts after 8 to 10 years of planting and continues till the tree becomes 50 to 60 years old. The fruit ripens in the month of June -July. The main characteristic of ripe fruit at full size is deep purple or black colour. The fruit should be picked immediately when it is ripe, because it cannot be retained on the tree in ripe stage.

1.4.2. Harvesting method

The ripe fruits are handpicked singly by climbing the tree with bags slung on the shoulder. Care should be taken to avoid all possible damage to fruits.

Jamun Fruit harvester has been developed for safe harvesting of Jamun. The collecting nylon net is fixed in a revolving frame for collecting fruits without damage. The height of collecting net is 5 feet and collection area is 25 sq.m. Two pipes are fixed in concentric to reduce the size of machine during transportation. Two trees can be harvested per hour without any damage. The gadget costs around Rs. 7000.

1.4.3. Yield

The average yield of fruits from a full grown seedling tree is about 80 to 100 kg and from a grafted one 60 to 70 kg per year.

1.4.4. Storage and Marketing

The fruits are highly perishable in nature. They cannot be stored for more than 3 to 4 days under ordinary conditions. However, pre cooled fruits packed in polythene bags can be stored well up to three weeks at low temperatures of 8 to 10°C and 85 to 90% relative humidity.

Storage life of fruits can be extended up to three weeks by storing pre-cooled fruits in perforated polythene bags at 8-10°C temperature and 85-90% relative humidity. After harvest fruits are usually packed in bamboo baskets for transportation to local markets.

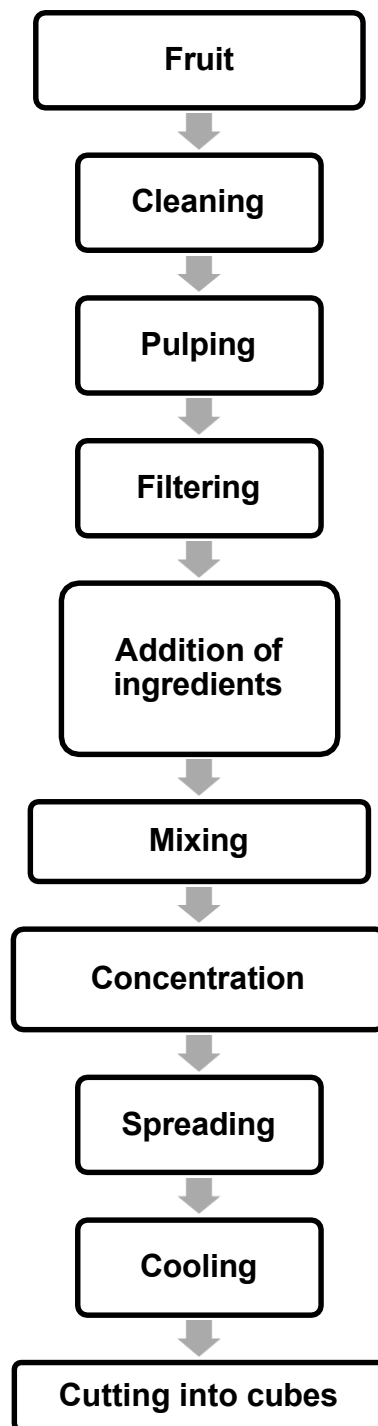
The fruit is packed and needs to be sent to the market almost daily. For marketing, well ripe and healthy fruits are selected. Damaged, diseased and unripe fruits are discarded. These

selected fruits are then carefully packed in wooden baskets and sent to the local markets. Practice of prepacking fruits in leaf-cups covered with perforated polythene bags reduces damage in transit and during handling in markets.

CHAPTER 2

Processing of Jamun Candy

2.1 Process Flow chart for Production of Jamun Candy



2.1.1. Sorting

Immature fruits and damaged fruits are manually removed. Sound fruits are selected for processing.

2.1.2. Washing

Primary washing of fruit with in potable water, final rinsing by chlorinated water, draining of surface water is carried out. Jamun fruits may be washed by using fruit washers also. Dirt, mud, soil are removed during washing.

2.1.3. Pulping

Fruit pulper can be used for Jamun pulp extraction. For the extraction of pulp, the jamun fruits are heated to 60°C along with small quantity of water (10%). This allows separation of pulp from seeds and then the fruits are passed through the pulper.

- ✓ Passing heated mass through a basket press/ pulper.

The method was optimized for pulp extraction from jamun fruits. The capacity of the pulper is 100 kg/h, pulp recovery of 50%, peel and seed 41%, 9% wastage.



Basket press



Hydraulic press

2.1.4. Concentration

Sugar and milk powder were added first to the boiling pulp. Addition and mixing of sugar crystals and skim milk powder was done at temperature above 60°C. After thorough mixing the mix was heated at 80-90° C for about 1 h. Addition of butter to jamun pulp mix gave smoothing effect in the mouth while chewing the candies. Glucose powder is also added to fortify the candies. Continuous stirring was done during the period of heating until the mix attained consistency. Pulp is heated until it reaches 70° Brix. For determining optimum degree of consistency, spec test was conducted. In this test, a speck of mix was put in water, at normal temperature (25-30°C). Speck forming a solid mass indicates attainment of optimal degree of consistency.

2.1.5. Spreading & Cutting

Mix is then spread on clean stainless trays to a thickness of 10 cm. Before spreading, a thin layer of milk butter is smeared to avoid sticking of mix on trays. A thin film of butter can be applied on the top surface of the spread to get a smooth surfaced jamun candies. The spread is then kept aside for 2 hours for setting. Once it attains room temperature, spread can be cut into appropriate sized candies. Candies can be then wrapped in butter paper or appropriate packaging. Candies can be stored safely for 2 months under ambient conditions (20-30°C) while at refrigeration temperature, the shelf-life will be around 4 months.

2.2 Formulation for Toffee

The following ingredients are usually present in fruit based toffees. The recipe can be customised and standardized.

Ingredients per kg of fruit pulp	
Sugar	600 grams
Commercial glucose	100 grams
Skim Milk Powder	100-150 grams
Butter	100 grams
Salt	5 grams
Citric acid	4 grams

a. Role of the different ingredients

- ❖ Proper level of sugar ensures a proper setting and taste of the product
- ❖ Addition of butter provides a nice and smooth mouth-feel, thereby enhancing product taste. It also impacts the product texture
- ❖ Addition of skim milk powder improves the taste of the toffee. It helps in the shape set of the product
- ❖ Salt enhances the taste of the different ingredients.
- ❖ Citric acid with its slight sourness enhances taste and texture
- ❖ The glucose powder is added to fortify the candies. It gives a very good texture

2.3. Possible defects in processing

- Formulation and standardization are very crucial as these affect the final outcome.
- More sugar than the required levels will cause unset/ sticky product
- Lesser than required sugar will cause poor binding and reduced taste
- More than required salt and citric acid will spoil the taste of the product
- Lesser fat and SMP levels will result in a dry product and pronounced astringent taste. Shape will also be impacted.
- End-point
- Lower brix value may result in reduced shelf life of the product
- When aiming at a higher brix, over boiling of the mix will cause burnt/ chewy/ hard product

CHAPTER 3

Packaging of Jamun Candy

3.1 Defects in Packaging

a. Oxidation

If the candy contains fat, then rancidity can occur as a result of oxidation. Fat containing candy will also react with moisture to produce fatty acids and their degradation products. Oxidation of fats in candies is a minor problem as fat contains natural antioxidants. Being high in fat, however, candy is likely to absorb odours from the surrounding atmosphere.

b. Fat Bloom

It is a surface defect in candy, which occurs during storage, whereby the initial gloss of the candy is first lost and then replaced by a white or grayish haze. This defect, occurring more frequently in summer, is deleterious to the aesthetic appearance of many candy products. The defect, however, does no harm to the eating quality of the candy, unless it brings along with it other defects such as staleness or mould growth.

c. Sugar Bloom

Candies can be affected by condensation giving sugar bloom, in which a fine layer of sugar crystals form on the surface of the product. This renders it unsaleable and if left unchecked can lead to mould growth.

d. Odour Absorption

Odour absorption by oils and fats can also be a problem. Odourous compounds are often very soluble in oils and fats and can be readily absorbed from materials such as paints, printing inks, petroleum oils and disinfectants. When the product is eaten, the odours are released in the mouth producing objectionable flavours.

Candy can also deteriorate in other ways including exposure to heat, light, moulds, yeast, foreign odours and mechanical damage.

3.2. Criteria for packaging material

In selection of packaging materials for candy the following need to be considered:

a. Water Vapour Transmission Rate (WVTR)

Knowledge of WVTR of packaging materials and the effect of folding, creasing, crumpling of materials on papers and aluminium foil show considerable effect. However, thermoplastic materials are not much affected.

Effect of Folding and Crumpling on the WVTR

	WVTR, g/m ² , 24 hr. 38°C & 90% RH.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	0.9	1.7	3.4	18
Met PET / LDPE (50μ)	0.5	0.6	0.7	0.6
2-sides PVDC coated PET	4.2	3.7	5.9	4.8
2-sides PVDC coated PET/LDPE	2.9	3.6	3.3	3.1

b. Gas Transmission Rate

Permeability to gases like oxygen decides the shelf-life of oxygen sensitive candy items. The oxygen transmission rates (OTR) of some plastic materials and the effect of folding and crumpling is shown in Table

Effect of Folding and Crumpling on the OTR

	Oxygen transmission rate, ml /m ² , 24 hr. Atm. at 25°C.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	< 1	5.5	16	59
Met PET / LDPE (50μ)	< 1	< 1	2	3.5
2-sides PVDC coated PET	6	6	8	7
2-sides PVDC coated PET/LDPE	7	7	9	11

Besides OTR, permeability to volatiles and flavours is important in candy packaging. Polyolefins have high values, whereas plastics such as polyester, nylons, ethylene vinyl alcohol (EVOH) have good barrier properties for transmission of volatiles. The odour permeabilities (for volatiles used in candy) of some materials is compared in the table.

Odour Transmission of Packaging Materials

Packaging Material	Thickness (μ)	Days to Aroma Leakage			
		Vanillin	Menthol	Piperonal	Camphor
BOPP / PE	17/50	6	2	1	13
PET / PE	12/50	2	16	5	< 30
PET / EVOH	12/15	< 30	< 30	30	< 30
OPP / EVOH / PE	18/15/50	30	< 30	27	< 30
PET / EVOH / PE	12/15/50	15	25	27	< 30

c. Grease Resistance

Grease Resistance of the packaging material is important to avoid seepage of oils and fats and smudging of the print.

d. Tensile Strength & Elongation

Tensile Strength and Elongation properties of materials need to be studied as their running on high-speed machines should be suitable.

e. Tear Strength

For a candy film, tear strength is of importance as low tear values are necessary and useful for opening packages by hands.

f. Heat Seal Strength

The performance of a finished package is determined by the effectiveness of the package seal i.e. the permeabilities to water vapour, gases and volatiles increase if the seal is not perfect. Thermoplastic films such as polyethylene give excellent heat seals.

g. Performance Properties

Apart from the above mentioned important properties, a material has to perform well on machines; therefore, knowledge of physical properties like slip, stiffness, blocking resistance is also necessary. Twist retention for twist wrap is also of importance.

The primary function of packaging is to protect. However, the emotional role played by packaging is also of importance, especially when the confection is a gift. A sophisticated packaging using deluxe materials is often used as a way of expressing feelings. Candy

packaging must also be specialised for specific target groups. Children's sweets are to be packed differently from adult sweets and candy bars for adolescents should look different from expensive candies for discerning consumers. A different pack size is required for quick impulse buys at petrol stations and roadside shops than for the super markets selling predominantly family sized packs.

3.3. Packaging Materials used for Candy products

A very high quantum of polymeric materials, besides cellulose and aluminium foil are used for candy items. Paper board and metal containers are also used for certain applications. Although a variety of packaging materials are available, the ultimate choice of the wrapper depends upon the required shelf-life, performance on the wrapping machine and the cost which is purely based on the segment of the market targeted by the manufacturer.

The most common choice of packaging medium is plastic (generally flexible) as it provides the required protection and preservation, grease resistance, physical strength, machinability and printability. Plastics being lighter in weight are, therefore, the most preferred material for packaging of candy.

There are many changing trends in the packaging of candy. Plastic films and their laminates are increasingly replacing waxed papers due to better properties and aluminium foil laminates due to price and better flex crack property.

Depending on the type of package i.e. twist wrap, pillow pack and vertical flow pack or roll pack, the plastic based packaging films used for candy are listed below.

a. Polyethylene (PE)

It is considered to be the backbone of packaging films. Since one of the greatest threats to the integrity of candy products comes from moisture, polyethylene with its low water vapour transmission is of definite interest. Polyethylene films are fairly free of plasticizers and other additives and are quite extensively used as a part of lamination. Its ability to heat seal increases its value.

Low Density Polyethylene (LDPE) is an economical material with low WVTR, however, it has high permeabilities to flavours/volatiles, poor grease resistance and are limp. High-density polyethylene (HDPE) is stiffer, more translucent and has better barrier properties but needs higher temperature for sealing.

Later additions include high molecular weight high-density polyethylene (HM HDPE) and linear low-density polyethylene (LLDPE). HM HDPE is a paper like film with high physical strength and barrier properties, but is less transparent than ordinary polyethylenes. HM HDPE is available in twist-wrap grades. Polyethylene films are also suitable for making bags and pouches. A copolymer of polyethylene and poly vinyl alcohol, and EVOH has outstanding gas barrier properties especially when dry.

b. Polypropylene (PP)

Polypropylene films are undergoing a growth trend in the candy industry. They have better clarity than polyethylenes and enjoy superior machineability due to stiffness. Lack of good sealability has been a problem, however, PVDC and vinyl coating have been used to overcome this problem. Some varieties of PP have been specially developed for twist-wrap applications as they have the ability to lock in position after twisting.

Pearlised polypropylene with an opal finish and attractive gloss is also used. Both as laminates and overwraps, PP film is now widely used for all types of candy packaging applications.

c. Poly Vinyl Chloride (PVC)

PVC is a stiff and clear film having low gas transmission rate. PVC can be used as small wraps, bags and pouches. PVC when co-polymerised with polyvinylidene chloride is known as Saran. Since it is a costly material, it is only used as a coating to obtain barrier properties and heat sealability. PVC film is also used for twist wraps, as it has twist retention properties and is excellent on high-speed machines.

d. Polyesters (PET) and Polyamide (PA)

Polyethylene terephthalate film has high tensile strength, gloss and stiffness as well as puncture resistance. It has moderate WVTR, but is a good barrier to volatiles and gases. To provide heat seal property, PET is normally laminated to other substrates. Nylons or polyamides are similar to PET, but have high WVTR.

e. Metallised Films

When polymeric films are metallised there is an improvement in their barrier properties. Metallisation is also used for decorative purposes and aesthetics. The films, which are used for metallisation are PVC, PET, PP and polyamides. The traditional wrapping for the candy slab is aluminium foil for the inner layer (0.012 mm) with the dull side inside, a glassine layer over the foil to protect it and a printed coated bleached kraft sleeve.

A modification of this style of candy bar wrap is to use a heat seal coated foil inside the paper sleeve. Securing of the paper sleeve is by hot melt adhesive. Another popular method of wrapping candy slabs is on the horizontal form-fill-seal (HFFS) machines, when the reel of laminate is wrapped around the slab, cut and heat sealed at both the ends and along a fin-style back seam.

Typical constructions are:

- 12 μ Polyester / 9 μ Al foil / heat seal lacquer
- 40 gsm coated bleached kraft / 9 μ Al foil / LDPE plus cold seal coating

Candy bar lines are mostly individually wrapped on the horizontal form-fill-seal (HFFS) machine. The typical wrapping materials are Polyester, OPP - pearled or metallised. The Indian Standard stipulates that candy shall be wrapped in plain or printed cellulose film, waxed paper, aluminium foil, polyethylene or other flexible packaging materials. In the case of printed packaging materials, it is specified that the printing ink shall not come in direct contact with the product.

To safeguard the interest of the consumer, the Standards of Weights & Measures (Packaged Commodities) Rules, have imposed a limit on the weight of the wrapper. Under this, it is essential that in the case of twist wrap and pillow wrap candy, where the weight of the individual pieces is less than 10 grams, the size of the wrapper and the type of wrapping material selected is such that it meets the limit on weight of wrapper, under the above rules.

3.4. Future Trends

The candy market is one of the most competitive in the FMCG area. Major companies continuously battle to entice sweet-toothed consumers from competing brands. A strong

brand identity is complimented by innovative packaging designs to deliver a product capable of meeting the consumer demands.

The developing trends in candy packaging are:

1. Widespread and increasing use of cold seal
2. Use of laminated structures and cold seals for premium products
3. Increasing use of opaque multi-packs for grocery outlets
4. Switch over to higher yield opaque films for cost reduction
5. Replacement of Al foil / paper wraps by OPP laminates
6. Developments in low temperature heat seal packs

CHAPTER 4

Food Safety Regulations & Standards

2.3 Fruits and Vegetable Products

a. Regulation 2.3.19. Fruit Bar/ Toffee/ Candy

1. Fruit Bar/ Toffee means the product prepared by blending Pulp/Puree from sound ripe fruit, fresh or previously preserved, nutritive sweeteners, butter or other edible vegetable fat or milk solids and other ingredients appropriate to the product & dehydrated to form sheet which can be cut to desired shape or size.
2. The product may contain food additives permitted in these regulations including Appendix A. The product shall conform to the microbiological requirements given in Appendix B. The product shall comply with the following requirements: —
 - (i) Moisture (m/m) – Not more than 20.0 percent
 - (ii) Total soluble solids (m/m) – Not less than 75.0 percent
 - (iii) Fruit content (m/m) – Not less than 25.0 percent

b. Permitted Additives

✓ 6. Use of permitted synthetic food colours prohibited

- (iv)(d) Non-alcoholic carbonated and non-carbonated ready to serve synthetic beverages including synthetic syrups, sharbats, **fruit bar**, fruit beverages, fruit drinks, synthetic soft-drink concentrates

✓ Permitted list and levels of Additives

Acesulfame potassium	1,000 mg/kg	Saccharins	160 mg/kg
Aspartame	350 mg /kg	Sulfites	300 mg/kg
Indigotine (indigo carmine)	100 mg/kg	Sucralose (Trichlorogalactosucrose)	450 mg/kg
Allura red AC	100 mg/kg	Sucroglycerides	10,000 mg/kg
Butylatedhydroxyanisole (BHA)	200 mg/kg	Sunset yellow FCF	100 mg/kg
Butylatedhydroxytoluene (BHT)	100 mg/kg	Tertiary butylhydroquinone (TBHQ)	200 mg/kg
Benzoates	1,000 mg/kg	L-Tartaric acid	GMP
Brilliant blue FCF	100 mg/kg	Dimethyl polysiloxane	GMP
Carotenoids	500 mg/kg	Propylene glycol alginate	200 mg/kg

Chlorophylls and chlorophylli NS,		Ascorbyl Esters	500 mg/kg
Copper complexes	100 mg/kg	Beta-Carotenes vegetable	2,000 mg/kg
Canthaxanthin	30 mg/kg	Ethylene Diamine Tetra Acetates (EDTA)	75 mg/kg
Caramel III - ammonia caramel	50,000 mg/kg	Grape skin extract	300 mg/kg
Caramel IV – sulfite ammonia caramel	30,000 mg/kg	Annatto	GMP
Guaiac resin	600 mg/kg	Steviol glycosides	350 mg/kg
Hydroxybenz OATES, PARA	1,000 mg/kg	Paprika oleoresin	GMP
Iron oxides	75 mg/kg	Lauricarginate ethyl ester	200 mg/kg
Phosphates	300 mg/kg	Neotame	70 mg/kg
Ponceau 4R	50 mg/kg	Phosphates	2,200 mg/kg
Propyl gallate	200 mg/kg	Polysorbates	5,000 mg/kg
Riboflavins	350 mg/kg	Sorbates	1,000 mg/kg

c. Microbiological standards for Thermally processed fruit products

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

d. 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).

e. 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 Polyalkylene terephthalates (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 labelling) 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)

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 up to 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.

f. 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. 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

So	Name of the company	Machineries
1.	Economy Engineering Company Kirti Building Dr V B Gandhi Marg, Fort, Mumbai-400001, Maharashtra, India	Pulper, pumps
2.	Gardners Corporation 158 Golf Links New Delhi 110003 India Tel: +91 11 2334 4287/2336 3640 Fax: +91 11 2371 7179	Filters, weighing machinery, Boiling equipment
3.	Universal Engineers Rajendra Nagar, Ghaziabad, Uttar Pradesh	Pulper
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.	Mehta Kitchen Equipments 3M-217, Street Number-13, Shastri Nagar, Behind Inderlok Metro Station, Delhi-110052, India	Processing vat
6.	Delhi Industries 4 Paharganj Lane, New Delhi 110055 India Tel: +91 11 2529720, 27525200, 27536888 Fax: +91 11 25791291	Juice extractors and Pulpers
7.	Food Packs Indiana Thrikkariyoor, Kothamangalam, Ernakulam Kerala 686692 India	Juice extractors and Pulpers
8.	Geeta Food Engineering Plot No C-7/1 TTC Area Pawana MIDC Thane Belapur Road Behind Davita Chemicals Ltd	Juice extractors and Pulpers

	Navi Mumbai 400 705 India Tel: +91 22 2782 6626/2766 2098 Fax: +91 22 2782 6337	
9.	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
10.	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
11.	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	Packaging equipment
12.	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.vsmil.net.in Website: www.autopackmachines.com	Packaging equipment



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