



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Desiccated Coconut



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CHAPTER 1

INTRODUCTION

1.1. Status and Market Size

Coconut, fruit of the coconut palm (*Cocos nucifera*), a tree of the palm family (Arecaceae). Coconuts probably originated in Indo-Malaya and are one of the most important crops of the tropics. *Cocos nucifera* belongs to the large Palmaceae family of palm trees. Coco palm grows well in the tropical climates. The palm requires moist, sandy, well-drained soil and flourishes well all along the saline-rich coastal regions. The palm coconut is an unbranched, erect, tall-growing tree that could reach more than 100 feet in height and has a lifetime of about 75 to 100 years. Once planted, it may take about 4-5 years to begin their first produce, and often, quite longer time in some varieties.

Several hundred cultivars of the coconut palms grown all over the tropics and so, their taste of meat (kernel) and flavor of water thus may vary according to the saline content of the soil, distance from the seashore, the amount of rainfall, etc. The coconut palm thrives on sandy soils with pH 5.0 to 8.0 and is highly tolerant of salinity. It prefers areas with abundant sunlight and regular rainfall (150 to 250 cm annually). Coconuts also need high humidity (70 to 80%) for optimum growth.

In a year, a single coconut palm may yield 20-150 mature nuts. The fruit is almost spherical to oval in shape and measure between 5-10 inches in width. Its rough outer husk is light green, which becomes dry and turns gray as the nut matures. The husk (exocarp) is about 1-2 inches in thickness and made of tough fibers. Underneath the husk, there is a woody shell enclosing inner edible meat (kernel-endosperm). Recently harvested mature fruits contain some amount of sweet water inside its central hollow cavity surrounded by the white meat (endosperm). The fruit with its shell, kernel (meat), and water together constitute a commercial "coconut" in the markets.

Found across much of the tropic and subtropic area, the coconut is known for its great versatility as seen in the many domestic, commercial, and industrial uses of its different parts. Coconuts are part of the daily diet of many people. When young, the entire fruits are used as melons. When mature, only the seeds are used as nuts. Its

endosperm is initially in its nuclear phase suspended within the coconut water. As development continues, cellular layers of endosperm deposit along the walls of the coconut, becoming the edible coconut "flesh. When dried, the coconut flesh is called copra. The oil and milk derived from it are commonly used in cooking and frying; coconut oil is also widely used in soaps and cosmetics. The clear liquid coconut water within is a refreshing drink and can be processed to create alcohol. The husks and leaves can be used as material to make a variety of products for furnishing and decorating. It also has cultural and religious significance in many societies that use it.

1.1.1. Socioeconomic significance

Coconut is known to have been cultivated for thousands of years in our country and is an inevitable part of our culture and tradition, religious and social practices, folklore, food and drink. In folklore, coconut is the fruit which provides nutrition and is our heritage and legacy. The tree is mankind's true friend. The coconut palm is unique among horticulture crops raised in India because of the diverse uses of the coconut products in everyday life. So far nearly 360 uses have been reported. Every part of the coconut tree is of great utility and hence it is rightly called as "Kalpaviruksha" or the "Tree of Heaven".

Coconut withstands conditions considered to be marginal for many other crops, and its considerable hardiness contributes as a stabilising factor in the farming systems of marginal and fragile environments.

About 96% of the crop is grown by resource-poor smallholder and sharecropper families, on smallholdings under 4 ha. It is estimated that about 12 million people in India are dependent on the coconut sector in areas of cultivation, processing and trading activities. The crop contributes Rs 34,100 crore to GDP.

In addition to the traditional products of copra, coconut oil and copra meal, coconut has the advantage of producing a wide variety of food and environment friendly non-food products which are used both domestically and for the export market.

1.1.2. Commercially grown varieties

Enhancing productivity through cultivation of improved varieties including hybrids is one of the major strategies suggested to make coconut farming more remunerative. The extensive research conducted on coconut improvement at ICAR - Central

Plantation Crops Research Institute (CPCRI) and State Agricultural/ Horticultural Universities has resulted in the release of 49 improved varieties having high yield potential and other desirable traits such as resistance to biotic and abiotic stress and suitability for tender nut purpose. Twenty - Nine improved varieties of coconut suitable for different agro -climatic zones have been developed through selection and released till date, which includes 18 tall and 11 dwarf varieties. Besides these, 20 hybrid varieties including 8 Dwarf x Tall and 11 Tall x Dwarf hybrid and one Tall x Tall hybrid have also been released for cultivation in different agro-climatic regions. The released hybrid varieties of coconut have a yield potential of 2.79 to 6.28 tonnes of copra per ha per year in comparison to 2 tonnes of copra yield realized by the tall cultivars which are predominantly cultivated by coconut farmers.

1. Tall cultivars

The tall cultivars are most commonly cultivated in all coconut growing regions of the world. The productive life span of tall cultivars is about 60 years. They grow to a height of 15 to 18m. They produce copra of good quantity and quality with fairly high oil content. It takes around 5 - 7 years for the first bearing after planting. The tall cultivars commonly grown in India are the West Coast Tall (WCT), Tiptur Tall (TPT) and East Coast Tall (ECT).

2. Dwarf cultivars

Dwarf varieties are shorter in both stature and life span. They grow to a height of 5- 7 m with an average economic life span of about 40 years. It takes around 3-4 years for the first bearing after planting. They are predominantly self pollinated. The nuts are smaller and the copra is thin, leathery and low in oil content. The dwarf cultivars are generally grown for tender nuts and also used for hybrid seed production. The common dwarfs available in India are Chowghat Orange Dwarf (COD), Chowghat Green Dwarf (CGD) and Gangabondam Green Dwarf(GBGD).

3. Hybrids

Hybrids are the intervarietal crosses of two morphological forms of coconut. They show earliness in flowering, higher nut yield as well as higher quantity and better

quality of copra when compared to the parents. Hybrids perform well under good management conditions including nutrient, irrigation and crop protection.

1.1.3. Cultivation Scenario

Coconut is one of the major plantation crops in India with a total cultivated area of 1975.81 thousand hectares with a production of 21,665 million nuts which makes India stand 3rd in the world. India occupies the premier position in the world with an annual production of 13 billion nuts, overtaking Indonesia and the Philippines, the other two prominent coconut-growing countries

1.1.4. Production status of Coconut

Table 1: Area, Production and Productivity of Coconut in India

Year	Area (^{'000} ha)	Production (Million nuts)	Productivity (Nuts per ha)
2000-2001	1823.91	12678.4	6951
2001-2002	1932.3	12962.9	6709
2002-2003	1921.8	12535.0	6523
2003-2004	1933.7	12178.2	6298
2004-2005	1935.0	12832.9	6632
2005-2006	1946.8	14811.1	7608
2006-2007	1936.8	15840.4	8179
2007-2008	1903.19	14743.56	7747
2008-2009	1894.57	15729.75	8303
2009-2010	1895.20	16918.40	8927
2010-2011	1895.90	16942.92	8937
2011-2012	2070.70	23351.22	11277
2012-2013	2136.67	22680.03	10615
2013-2014	2140.50	21665.19	10122
2014-2015	1975.81	20439.60	10345

Source: Horticulture Division, Dept. of Agriculture & Cooperation, Ministry of Agriculture & Farmers Welfare, Government of India.

**Table 2: State-wise Area, Production, and Productivity of Coconut in India
(2016-17)**

SI No.	States/ Union Territories	AREA (‘000 ha)	Production (Million Nuts)	Productivity (Nuts/Ha)
1	Andhra Pradesh	115.21	1,377.53	11,957
2	Assam	20.6	153.27	7,440
3	Bihar	14.9	141.09	9,469
4	Chhattisgarh	1.48	8.77	5,926
5	Gujarat	24.44	336.65	13,775
6	Karnataka	513.85	6,773.05	13,181
7	Kerala	770.79	7,448.65	9,664
8	Maharashtra	20.9	198.85	9,514
9	Nagaland	0.47	2.67	5,681
10	Odisha	50.91	341.68	6,711
11	Others	52.76	142.38	2,699
12	Tamil Nadu	461.06	6,570.63	14,251
13	Telengana	0.5	2.09	4,180
14	Tripura	4.61	32.23	6,991
15	West Bengal	29.63	374.56	12,641
	Total	2,082.11	23,904.10	11,481

Source: Horticulture Division, Dept. of Agriculture & Cooperation, Ministry of Agriculture & Farmers Welfare, Government of India.

1.1.5. Composition & Nutritive Value of Coconut

Table 3: Nutritive value of Coconut per 100 g of edible portions

Nutrients	Quantity per 100g
Energy	354 Kcal
Moisture	80.9 g
Protein	4.5 g
Fat	33.9 g
Ash	1.0 g
Dietary fibre	9 g
Carbohydrate	15.3 g
Sodium	20 mg
Pottassium	350 mg
Calcium	10 mg
Phosporous	240 mg
Iron	1.7 mg
Copper	0.435 mg
Magnesium	32 mg
Manganese	1.5 mg
Selenium	10.1 µg
Zinc	1.1 mg
Phytosterols	47 mg
Folates	26 µg
Niacin	0.540 mg
Pantothenic Acid	0.300 mg
Pyridoxine	0.054 mg
Riboflavin	0.02 mg
Thiamine	0.06 mg
Vit C	3.3 mg
Vit E	0.24 mg
Vit K	0.2 µg

Source: Nutritive value of Indian foods, NIN, 2019

1.1.6. Health benefits of Coconut

- 1.** Coconut is a very versatile and indispensable food item for most people under the tropical belt. It is some complete food rich in calories, vitamins, and minerals. A medium-sized nut carrying 400 g edible meat and some 30-150 ml of water may provide almost all the daily-required essential minerals, vitamins, and energy of an average-sized individual.
- 2.** 100 g kernel holds 354 calories. Much of this comes from the fats and protein. Although its meat is disproportionately high in saturated fats in comparison to other common edible nuts, coconut has many health promoting bioactive compounds.
- 3.** The important saturated fatty acid in the coconut is lauric acid (12 carbon fatty acid). Lauric acid increases good-HDL cholesterol levels in the blood. HDL is a high-density lipoprotein, which has beneficial effects on the coronary arteries by preventing vessel blockage (atherosclerosis). Physicians recommend high HDL to total cholesterol levels in the blood for the same reason.
- 4.** Coconut oil extracted from the dry kernel (copra) is an excellent emollient agent. It is used in cooking, applied over scalp as hair nourishment, employed in pharmacy and medicines.
- 5.** Research studies suggest that cytokinins (e.g., kinetin and trans-zeatin) in coconut water showed significant anti-ageing, anti-carcinogenic, and anti-thrombotic effects.
- 6.** The kernel is an excellent source of minerals such as copper, calcium, iron, manganese, magnesium, and zinc.
- 7.** It is also a very good source of B-complex vitamins such as folates, riboflavin, niacin, thiamin, and pyridoxine. These vitamins are essential in the sense that body requires them from external sources to replenish.
- 8.** Coconut meat and water contain a good amount of potassium. 100 g of fresh meat contains 356 mg or 7.5% of daily required levels of potassium.

1.2. Indian market outlook

Indians have been using coconuts in food and snack preparations since time immemorial. Today's young consumers depend heavily on conventional food. It is in this sector that coconut has a good chance to increase its use. Coconut as a tasty food adjunct is well recognized. To use coconut in preparations, the consumer has to break the nut transversely into two, shred into gratings and then process further. On the other hand, if coconut gratings, its rich milk and even prepared foods are available as such on the shelves of the market, surely consumers, especially the younger generation will be generated to encouraged to use them in preparations much more.

Fresh coconuts have limited availability as well as shelf life once their shells are removed. Hence, dried coconuts in the form of Copra or coconut powder have become mass consumption items due to their availability round the year across the country, longer shelf life, reduction 85 in wastage, convenient to transport and freedom to the consumers to buy the required quantity. Desiccated coconut is not used in large quantities in individual households but its main consumers are confectionary and biscuit industry. It is also used in the preparation of sweets, curry, many varieties of chutney, farsan and chikkies and many other food and snack preparations. Thus, restaurants, dhabas, canteens, sweet, farsan and chikki manufacturers, certain food processing units and caterers are bulk and regular consumers.

1.3. Value added products from Coconut

The important products of coconut in our country are whole coconut (tender and mature), copra, toddy, neera, gur, coconut palm candy, sugar, vinegar etc.

1.3.1. Coconut Kernel (or) White Meat:

The preservation and pickling of coconut was done by soaking the coconut kernels in brine solution maintained their colour, flavour, texture and taste and resembled like fresh coconut for 90 days. The salt and acid penetration in pickle is directly proportional to the concentration in the soak solution. The steeped coconut kernel was kept for 90 days under study, in which there was a remarkable reduction in reducing sugar, total sugar and free fatty acid content was increased gradually. The

moisture content after storage ranged between 38.05 and 38.61 per cent.

1.3.2. Desiccated coconut

Desiccated coconut, the edible dried-out shredded coconut meat is prepared from fresh kernel of fully matured coconut and it is available in coarse, medium and fine grades and also in special grades such as threads, strips, granules etc. Good desiccated coconut is crisp, snow white in colour with a sweet, pleasant and fresh taste of coconut kernel. Desiccated coconut, a commercial product was manufactured from the white part of the meat after removing the brown parings. The meat is shredded or disintegrated and dried in hot air driers at 140-170oF to 2 per cent moisture content (fat 65-68 % and Solids nonfat 30-32%) and used in the manufacture of cakes, pastries and chocolates. Desiccated coconut is the disintegrated, white kernel of coconut processed under strict hygienic conditions and dried to a moisture content of below 3.0 per cent. It is a food product which is ready and fit for direct human consumption.

1.3.3. Products from desiccated coconut

The matured coconut kernels were steam blanched and soaked in sugar syrup of 30° brix for a period of 48hrs. The drained pieces were sulphited for 20 min and dried in the cabinet drier at a temperature of 60°C for 8 h. Storage studies proved that sugar acts as an osmotic agent for the preservation of coconut. Osmotically dehydrated coconut was well suited for the preparation of products in the homes as well in commercial units.

1.3.4. Coconut Chips

Coconut chips, the thinly sliced crispy coconut meat which may be sweetened or salted and may come in handy as a ready -to- eat snack food. It was prepared by slicing the coconut meat of eleven to twelve month old nuts thinly into strands, soaked in syrup, drained and dried in a dryer or oven.

1.3.5. Coconut Crisps:

Coconut crisp is prepared from the young coconut endosperm of nine to ten month old nuts. It is white in colour, has pleasant coconut flavour and does not leave any

fibrous feeling after taste. It was processed by slicing the meat into 0.6-0.7mm thickness, blanched in boiling water, cooked in light syrup and then dried which is considered as a high energy food and of a good quality product.

1.3.6. Roasted young coconut:

Roasted young coconut was prepared by a process in order to sweeten its water and tender meat as well as to enhance their flavour. The process consisted of preliminary steps and the nuts were boiled in a solution (2% sodium meta bi- sulphite) for 20 min, dried and burnt for finishing touch and it was exposed to the fire for a minute or until the shell itself showed signs of burning. The fruit was kept at room temperature for 3 days or in the refrigerator for larger storage.

1.3.7. Dehydrated sweet coconut

Young coconut meat was used for preparation of dehydrated sweet coconut. The coconut meat was washed with water and then soaked in coconut water, again washed with clean water. The meat was cut into pieces mixed with refined sugar and water in the ratio of 6:3:1 and boiled for 1 h or until it is dried, cooled and packed.

1.3.8. Dehydrated coconut chutney

Dehydrated coconut chutney using simple hot air drying technique was developed. It reconstitutes well in cold water and had all the characteristics of fresh chutney. The product had a shelf life of 3 months at 37°C and 6 months at ambient temperature when packed in flexible pouches.

1.3.9. Coconut milk

Coconut milk refers to the milky fluid, freshly extracted from the coconut kernel with or without added water and coconut cream to the high-fat cream-like material obtained from the coconut milk by either gravitational separation or centrifugation.

1.3.10 Coconut cream

The concentrated milk extracted from fresh matured coconuts can either be used directly or diluted with water to make various curry preparation, sweets, desserts, puddings etc. Processed and packed coconut cream have a

shelf life of six months and once opened it should be stored in refrigerator for subsequent use. Coconut cream, a concentrated form of coconut milk, which is a convenient product prepared from mature and fresh.

1.3.11. Coconut syrup

Coconut syrup, a translucent, free-flowing liquid was prepared by cooking coconut milk with an equal amount of refined sugar and di-sodium-phosphate equivalent to 0.25 per cent of the volume of the milk, until the mixture attained a TSS content of 68-70 per cent. The hot mixture was poured in sterile containers and sealed hermetically. It was used as a topping for bakery products or as a mixer in alcoholic drinks or may be diluted in water and used in cooking rice cakes and other delicacies.

1.3.12. Sweetened condensed coconut milk

Coconut skim milk was used in the preparation of sweetened condensed coconut milk. Powdered dairy skim milk was added for protein fortification and other ingredients were corn oil, coconut cream and sugar. The skim milk was first pasteurized for 30 mins at 80-90°C and mixed with other ingredients. The mixture was blended or passed through a colloid mill, and heated in a steam jacketed kettle with constant stirring to a TSS content of 68%. It was packed hot in sterile tin cans and cooled immediately in cooling tanks.

1.3.13. Coconut candy

Coconut candy was prepared from grated coconut meat mixed with coconut milk. The grated coconut was moistened with a portion of the milk. The remaining milk and the molasses were poured in a cooking pan, and the mixture was heated to boiling. Refined sugar was added and the mixture was cooked until it gets hardened when dropped into cold water. It was then poured in butter-greased pans, allowed to cool slightly, cut into desired sizes and individually wrapped in cellophane sheets.

1.3.14. Coconut milk powder

Coconut milk powder was prepared by dehydrating the milk under controlled conditions. The composition of the milk was adjusted with fat percentage in the

range of 50-60 per cent of the total solids. The emulsifiers and stabilizers were also added to the formulation. The most crucial step was the dehydration stage for which spray drier was employed at high temperature (around 180°C). Instant dehydration takes place converting each tiny droplet into microcapsules with fine droplet of the oil inside.

1.3.15. Coconut flour

Coconut flour is a unique product prepared from coconut residue. Coconut flour, a by-product in the processing of coconut milk, can provide not only value-added income to the entrepreneurs but also a nutritious and a healthy source of dietary fiber for the consumers. It can be used as fillers, bulking agents and substitute for wheat flour, rice flour and potato flour at certain levels and incorporated into various food products like baked products, snack foods, steamed and extruded products. One by-product of coconut is the “sapal” from coconut meal, taken after extraction of the coconut milk. The “sapal” was made into coconut flour which contains dietary fibre. The utilization of coconut sapal may have some health benefits and may encourage the industry to produce value added products or functional foods which may help in the proper control and management of chronic diseases. This offers scope for utilization of coconut flour as a dietary component for diabetes. Low-fat, high fibre coconut flour, a unique product from sapal is a good source of dietary fiber. It is comparable with other cereal flour in terms of carbohydrate, fat and energy content and a good ingredient in nutraceuticals.

1.3.16. Tender coconut water

It is valued both for the refreshing drink and gelatinous kernel, which is a delicious food. The tender nut water is rich in potassium and minerals. Glucose content is maximum in seven months old nuts and hence the best stage for drinking. The dwarf coconut variety, Chowghat Orange Dwarf (COD) is a tender nut variety.

Tender coconut water is thermally processed and packed aseptically in PET bottles or tetra packs and sold. This is becoming a popular product.

1.3.17. Coconut jaggery

Sweet toddy if carefully collected in sterile glass vessels remains unfermented for a considerable time. It can be strained and boiled down to the crystallizing point, to obtain 12-15 percent jaggery with nutritional and medicinal value. The reducing sugars and minerals made it more nutritious and health friendly.

1.3.18. Coconut vinegar

Vinegar was produced from fermenting coconut toddy and was commonly used in the preparation of fish and meat dishes. If toddy was fermented for more than 24 hours and acidification was done for 10-14 weeks and the resultant was coconut vinegar.

1.4. Harvest & Post Harvest handling of Coconut

1.4.1. Harvesting

- Harvesting of coconuts is commonly done by climbing the tree with the help of a rope ring round the feet or ankles of the climber or by using a ladder.
- On reaching the top, the climber taps the nut in the lowermost bunch with its harvesting knife to test its maturity.
- If he is satisfied, he cuts the bunch at the base of the stalk when it drops down to the ground.
- If the ground is very hard or if tender nuts are to be harvested, the bunches are lowered by using a rope. The climber also cleans the crown and removes the dry leaves, sheaths and spathes.
- In the West Coast and certain other tracts where coconut leaves are required for thatching houses, one or two lowermost leaves are also cut down at the time of harvest.
- The cutting down of green leaves is considered undesirable as it affects the yield of trees to some extent.
- In some places where the trees are not tall, harvesting is done by cutting the bunches with a knife, attached to a long bamboo pole.
- Nuts which are to be stored for making ball copra are not harvested till they are completely ripe and dry.

1.4.2. Yield

The average yield is 80 – 100 coconuts/ tree/ year. 11-12 months old coconuts are harvested at an interval of 30-45 days. On an average, eight harvests can be done every year from a single tree. Coconut palms are productive throughout the year.

1.4.3. Storing and Transporting

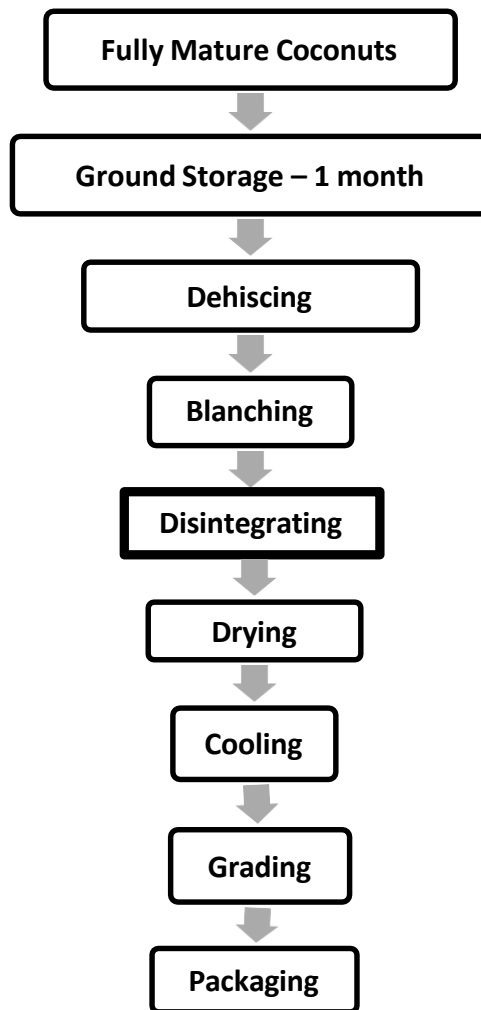
The harvested coconuts are seasoned by ground storage for one month. This improves the coconut kernel. This practice promotes desirable changes in the greener or somewhat less mature nuts. The coconut meat grows thicker and harder thus producing a more suitable material for desiccated coconut production. This causes the water inside the kernels to get absorbed. The kernels get separated easily from the shell wall. Also de-husking is easier.

After ground storage, coconuts can be transported to the processing centre. Coconuts in the husk are very bulky. They are dehusked first before being transported in trucks or carts.

CHAPTER 2

Processing of Desiccated Coconut

2.1 Process Flow chart for Production of Desiccated Coconut



2.1.1. Harvesting

The stage of maturity of harvest of coconuts for Desiccated Coconut production is very crucial. The quality of desiccated coconut depends upon the quality of coconuts used. Fully matured coconuts of about 11-12 months are used for the preparation of desiccated coconut. Immature nuts tend to produce rubbery kernel. Foul smelling nuts should not be selected.

2.1.2. Ground storage

Ground storage of coconuts should be done for a month period. During this process, the coconut water gets absorbed and the kernel grows thicker and harder thus producing a more suitable material for desiccated coconut production. The coconuts are then de-husked.

2.1.3. De-hiscing

The dehusked coconut undergoes dehiscing. Dehiscing process involves the following steps

- Deshelling without breaking the kernel - the outer shell is removed. This is done manually or mechanically.
- Paring - removing the brown testa. This is done by scraping it off manually using paring knives. Almost 15% of the kernels is lost as paring during this process. Mechanical paring can also be employed.
- Washing the kernels to remove any remaining testa particles adhering to the surface of the kernel. This should be done using clean potable water.
- Slicing the pared kernel into two halves to release the coconut water.

2.1.4. Blanching

The kernels are immersed in boiling water for 8-10 minutes in a blanching tank. Alternatively passing live steam at 88°C through the kernels for 5 minutes can also be done for blanching of the kernels. Blanching kills fungus and viruses. Blanching is a crucial step to make good quality desiccated coconut powder.

2.1.5. Disintegrating

The blanched coconuts are shredded into small pieces. This is done using a disintegrator, which is an impact pulverizer with hammer heads. The hammer heads crush and grind the coconut meat to powdered form.

Disintegrator is capable of producing different sizes from 1mm to 5mm

continuously. Different shapes and fancy cuts are also done.

2.1.6. Drying

The granules are then dried in a drier; the temperature in the drying chamber is maintained at about 80-90°C for 40-45 minutes. The maximum moisture content of the end product should be 3%; only at this moisture content, the product will have an increased shelf life. The following types of dryers can be employed.

- **Tray dryer**

The granules are spread out uniformly in trays. The granules are stirred occasionally during the process to ensure uniform drying. During this process the trays are moved twice and the content raked over in order to ensure uniform drying and to break up any lumps that might have formed.

- **Rotary dryer**

The arrangement consists of a cylindrical rotating drum into which the coconut powder is fed using a hopper.

- **Vibro fluid bed dryer**

This is an extension of fluidised bed techniques, by using vibrations as an external aid to fluidisation. Vibrations breakup the inter-particle forces of attraction and improve quality of fluidization.

2.1.7. Cooling & Grading

The dried product is allowed to cool to ambient temperature on stainless steel tables, and then sifted into coarse, medium, fine (macaroon) and extra fine grades. Grading happens in a vibratory screen with different screens such as 12, 14 and 16 mesh. The graded desiccated coconut goes to packing.

In fully mechanised plants, the cooling system is integrated into the drying system.

2.1.8. Packaging

The desiccated coconut is packed semi-automatically for bulk packages and automatic form fill seal machines for retail packages.

2.2. Critical points in Processing

- Only good quality harvested nuts should be used (not fallen ones).
- Usage of unhygienic wash water may result in spoilage of the product due to spoilage microbes.
- Poisoning by pathogens such as *Salmonella* also becomes possible if the wash water is unhygienic.
- The presence of any chemical residues in the water is bound to show up in the final product
- Proper control of blanching temperature is essential to inactivate the spoilage organisms as well as enhance the final product colour.
- Drying temperature control is highly significant in influencing the product shelf life as well as organoleptic properties such as color and flavor.
- The sieves and disintegrator, if not well maintained, may result in small pieces of metal in the coconut.
- The bags used should be sound and dry.
- Dampened coconut quickly develops mould spoilage which turns it yellow or black.
- Damp coconut also tends to become rancid, this rancidity is mostly hydrolytic resulting from the enzymes produced by the moulds, rather than oxidative, so the fats become soapy smelling and tasting.
- Hence storage in good conditions, about 10-15 °C at a relative humidity of 50% is essential to allow coconut to be kept for many months.

2.3 Hazards in Processing

- Biological hazards include contamination by
 - Pathogens like *Salmonella*, *Listeria monocytogenes*, *Eschericia coli*
 - Spoilage causing and toxin producing yeast and mould
- Chemical hazards like pesticides and residues - unapproved chemicals and unapproved levels
- Physical hazards like extraneous matter and metal fragments from shredding/ grading operations.

CHAPTER 3

Packaging of Desiccated Coconut

3.1. Deteriorating factors

In order to select a suitable packaging material/ type of package for Desiccated coconuts, it is essential to know the factors which affect the quality of Desiccated coconut.

3.1.1. Moisture Content

Desiccated coconut is hygroscopic in nature and picks-up moisture from the atmosphere. The material having good moisture barrier properties are required for this product.

3.1.2 Loss of Aroma / Flavour

Desiccated coconut contains significantly high level of fat. This will leads to hydrolytic rancidity. Rancid product loss its natural aroma.

3.1.2. Insect Infestation

Desiccated coconut is prone to spoilage due to insect infestation, which can be further accelerated due to high humidity, heat and oxygen.

3.1.3. Microbial Contamination

In high humidity condition of 65% and above, moisture absorption occurs. Beyond a certain level of moisture content, spoilage due to microbial growth sets in.

3.2. Packaging requirements of Desiccated coconut

In order to maintain the quality of the Desiccated coconut during handling, transportation, storage and distribution, the packaging material to be used is to be selected with care, keeping in mind the functional as well as the marketing requirements.

The packaging requirements for Desiccated coconut, in general, are listed below:

- To protect the product from spillage and spoilage.
- To provide protection against atmospheric factors such as light, heat, humidity and oxygen. The selected packaging materials should have high water vapour and oxygen barriers.
- The packaging material should have a high barrier property to prevent aroma/flavour losses and ingress of external odour.
- Besides the above functional requirements, the packaging material should have good machinability, printability and it should be easily available and disposable.

3.3. Packaging materials for Desiccated coconut

3.3.1. Bulk packaging

In bulk packaging, the current trend is to use Flexible Intermediate Bulk Containers (FIBCs) commonly known as Jumbo bags. These bags have a capacity of up to 1 tonne. In general these bags are made from cloth, but at present mainly from plastic (PP) fabric, which can be laminated or provided with an inner plastic liner bag. The PP fabric is stabilized against UV degradation. The bags are provided with filling and discharge spouts and slings for hanging during loading/ unloading operations.

The FIBCs offer various advantages such as:

- Bags are flexible, collapsible and durable
- Can be used for packaging of granules, powder, flakes and any free flowing material
- Product wastage / spillage and tampering can be avoided
- Since the handling is mechanised, less labour is required
- Saving in time for loading and unloading
- Bags are light in weight and, therefore, freight costs are reduced

3.3.2. Institutional packages

Institutional packs of capacities ranging from 2kg to 10kg are also used. The traditional materials that were used such as tinplate containers and jute bags are currently being replaced by materials such as laminated flexible pouches and plastic woven sacks. The sacks are usually BOPP multicolor Printed laminated PP Woven bags. These bags may be gusseted and have window and micro perforation.

3.3.3. Consumer Packages

The options available to the traders/exporters of Desiccated coconut in the selection of a consumer pack for domestic and export market are quite wide. However, the selection/choice of the packaging material/ system depends upon a number of factors, which are broadly listed below:

- Shelf-life period i.e. the degree of protection required by the product against moisture pick-up, aroma retention, discolouration etc. (this is more critical in case of powdered Desiccated coconut)
- Climatic conditions during storage, transportation and distribution
- Type/ sector of market
- Consumer preferences
- Printability and aesthetic appeal

The package types generally used as consumer packs are:

- Glass bottles of various sizes and shapes with labels and provided with metal or plastic caps. The plastic caps have added inbuilt features of tamper evidence, dispensing, grinding etc.
- Printed tinplate container with/without dispensing systems
- Plastic containers with plugs and caps with dispensing and tamper evidence features
- Printed flexible pouches - pillow pouch, gusseted pouch, stand-up pouch.
- Lined cartons

The printed flexible pouches have recently become very popular due to their easy availability, excellent printability, light weight, machinability and cost-effectiveness. Also, depending upon the functional and marketing requirements, the laminate/ film can be tailor made to serve a specific need.

The printed flexible pouches are generally laminates of various compositions. Some of the commonly used laminates are:

- Polyester/ metallised polyester/ LDPE
- BOPP/ LDPE
- BOPP/ metallised polyester/ LDPE
- Polyester/ Al foil/ LDPE

3 ply laminates such as 12 μ PET/ Print/ 12 μ Met. PET/ PE can avoid delamination and prevents smudging and de-figuring of the print.

Polyester and BOPP based laminates are generally more popular for spice packaging due to certain advantageous characteristics of each of these two films.

Polyester used for lamination is generally 10 or 12 μ thick. The film is highly transparent with excellent clarity, gloss and printability thus enhancing the sales appeal. The film has very low moisture and gas permeability and, therefore, ensures prolonged shelf life of the contents with aroma, flavour and taste retention. The very high mechanical strength (tear, puncture, burst and flex) minimises damage to the contents during handling and transportation. The film has good machinability as well as printability. The latest printing technologies help in improving sales promotions. The film is free from additives and, therefore, does not impart any odour or taint to the sensitive spice product that is packed.

BOPP films may be heat sealable or non heat sealable. The film has high yields, is stable under climatic changes and has excellent moisture barrier. This film is smooth, glossy, crystal clear and has high mechanical strength and non-contamination property for food contact applications.

The types of sealing of pouches from flexible plastic based materials could be variable:

- Centre seal formation

- Three sides seal formation
- Four sides seal formation
- Strip pack formation

The vital link in the performance of the pouch is the seal integrity. The performance of the heat seal layer is very important. Even if the film structure has been designed with exceptional properties, with excellence in interlayer lamination, if the sealing of the pouch fails, the product may get contaminated and in some cases become unfit for consumption.

CHAPTER 4

Food Safety Regulations & Standards

2.3 Fruits and Vegetable Products

a. Regulation 2.3.45 Grated Desiccated Coconut

- Grated Desiccated Coconut means the product obtained by peeling, milling and drying the kernel of coconut (*Cocos nucifera*).
- The product may be in the form of thin flakes, chips or shreds.
- The product shall be white in colour free from foreign matter, living insects, mould, dead insects, insect fragments and rodent contamination.
- The product shall have pleasant taste and flavour, free from rancidity and evidence of fermentation.
- The product may contain food additives permitted in these regulations including Appendix A (as follows).

Permissible Food Additive	Limit
Sulphur dioxide, Sodium/ Potassium/ Calcium Sulphite/ Bisulphate/ Metasulphite expressed as SO ₂	50mg/ kg maximum

- The products shall conform to the microbiological requirements given in Appendix B (as follows).

Parameter	Limit
Total Plate Count	Not more than 40,000 per gm

- The product shall conform to the following requirements: –

Parameter	Value
i. Extraneous Vegetable matter *	Not more than 15 units/100 gm
ii. Moisture (m/m)	Not more than 3.0 percent

iii. Total Ash (m/m)	Not more than 2.5 percent
iv. Oil Content (m/m)	Not less than 55.0 percent
v. Acidity of extracted fat expressed as	Not more than 0.3 percent Lauric Acid (m/m)
vi. Sulphur Dioxide	Not more than 50.0 mg/kg

*- Extraneous vegetable matter means fragments of shell, fibre, peel and burnt particles

b. 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).

c. 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
- 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);
- i. IS: 12252 - Specification for Polyalkylene terephthalates

Regulation 2.2: Labelling

Regulation 2.2.1: General Requirements

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

2. The particulars of declaration to be specified on the label shall be in English or Hindi in Devnagri script: Provided that nothing herein contained shall prevent the

use of any other language in addition to the language required under this regulation.

3. Pre-packaged food shall not be described or presented on any label or in any labelling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect;
4. Label in pre-packaged foods shall be applied in such a manner that they will not become separated from the container;
5. Contents on the label shall be clear, prominent, indelible and readily legible by the consumer under normal conditions of purchase and use;
6. Where the container is covered by a wrapper, the wrapper shall carry the necessary information or the label on the container shall be readily legible through the outer wrapper and not obscured by it;
7. License number shall be displayed on the principal display panel in the following format, namely:-



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

Regulation 2.2.2 Labelling of Pre-packaged Foods

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

1. The Name of Food: The trade name or description of food contained in the package.
2. Ingredient: *(For a single ingredient product, it can be mentioned as such.)*
3. Nutritional information -
4. Nutritional Information or nutritional facts per 100 gm or 100ml or per serving of

the product shall be given on the label containing the following:–

energy value in kcal;

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

5. Declaration regarding Veg or Non veg

Every package of Vegetarian Food shall bear a declaration to this effect by a symbol and colour code as stipulated below for this purpose to indicate that the product is Vegetarian Food. The symbol shall consist of a green colour filled circle, having a diameter not less than the minimum size specified in the Table below, inside the square with green outline having size double the diameter of the circle, as indicated:



iv. Size of the logo (vegetarian)

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

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

5. Declaration regarding Food Additives-

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

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

6. Name and complete address of the manufacturer

- i. The name and complete address of the manufacturer and the manufacturing unit if these are located at different places; in case the manufacturer is not the packer, the name and complete address of the packing unit shall be declared on every package of food;
- ii. Where an article of food is manufactured or packed by a person or a company under the written authority of some other manufacturer or company, under its brand name, the label shall carry the name and complete address of the manufacturing or packing, the name and complete address of the manufacturer or the company and on whose behalf it is manufactured or packed or bottled.

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

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

9. Date of manufacture or packing.

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

If the 'Best before Date' of the products is

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

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

“BEST BEFORE..... MONTHS AND YEAR

OR

“BEST BEFOREMONTHS FROM PACKAGING

OR

“BEST BEFOREMONTHS 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.

d. 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

12	Name of the company	Machineries
1.	Marshall-Flower Engineers India (P) Ltd Marshall Sons & Co. Tea Pvt Ltd, Harrington Court, Flat No 16, Kolkatta 700071 2282-9363,9367 mail@cal3.vsnl.net.in www.marshallflower.com	Deshellers, Washers, Dryers, Rotary washer cum blancher; VFB Dryers; Siever, Cutter, Cooling table, Lump breaker
2.	L&F Machineries, Chemmanda, Near Inrinjakkuda, Karalam, PO, Thrissur – 680711 www.lfmachineries.com Ph: 0484 2889549/ 9847293050 / 9495917378	Desheller, Precutter, Disintegrator, Screw elevator
3.	GEM Allied Industries Pvt Ltd GEM Group of Companies, 10/C Middleton Row, 3rd Floor, Kolkata - 700 071 India http://www.gemforgings.com/ gem.forgings@vsnl.com	Deshellers, Washers, Dryers, Blancher; VFB Dryers; Siever, Cutter, Cooling tables, Cutting machinery, Grading machine, Screw conveyor
4.	T & I Global Ltd, 11, Jassal House, 4-A Auckland Square, Kolkata- 700 017 sales@tiglobal.com Kolkata 03322833613/ 30283626 www.tiglobal.com 18, SIDCO Industrial Estate, Kurichi, Coimbatore 641 021, India, Phones:- 0422- 2674814/2674815 9443708418 (Mr Kumar Suresh) Mr Sangeet Bagaria 9443318408 at Coimbatore tk@tiglobal.com	Deshelling, Precutters, Automatic paring machine, Cutters, Dryers, Blancher, Graders, Coolers, Washing System
5.	Vikram India Limited Head Office Tobacco House, 1, Old Court House Corner, Kolkata – 700 001 Ph: 033 22307299; 09674344443	Dryers
6.	Tea Mech (India) Registered Office:- 96D,	Dryers

	Karaya Road, 4th Floor, Kolkata - 700 019 033-22812912 / 033- 22812913	
7.	Anpharma Equipments Anpharma Equipment IX/417-B, Near Apollo Tyres, Perambra P.o., Thrissur (Dt). Kerala. Pin - 680 689 0480 2723887 / 4	Tray dryer
8.	Lakshmi Industrial Equipments No. 22/10, Kollan Thottam, Nallampalayam, Ganapthy, Coimbatore - 641 006	Coconut de-sheller, Shredder, Dryers
9.	Vista Equipments and Machines P ltd 21 A,Chetipalayam Main Road, Eachanari Post, Coimbatore – 641021. Tamilnadu, INDIA. Mobile: +91 98431 77300 / +254 737 066 145., Email: info@vistaequipments.com / sales@vistaequipments.com	Dryers
10.	Essar Engineers, 519/1 ^a -Athipalayam Road, Chinnavedampatti, Coimbatore- 641006 Mail: essareng@yahoo.com Ph: 04222012617 Mob: 9843099054 Mail: essareng@yahoo.com Web:www.essarengineer.com	Deshellers
11.	Nirmal prem creations Crushing & Pulverising equipments Coimbatore 0422-2543736 9443342236 npcskumar@yahoo.com	Shredder
12.	Kilburn Engineering Ltd. 6, MIDC Saravali, Kalyan Bhiwandi Road, Bhiwandi Dist. Thane - 421 311, Maharashtra India. Tel: (+91-2522) 283000 E-mail: marketing@kilburnengg.com	Dryers

