Centenary publication-42

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ENTREPRENEURSHIP DRIVEN ICAR-CPCRI TECHNOLOGY FOR HEALTHY ALTERNATIVE NON-FRIED SNACK FOOD

ICAR - CENTRAL PLANTATION CROPS RESEARCH INSTITUTE & AICRP ON PHET
KASARAGOD – 671 124, KERALA

Technical Bulletin No: 107

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2016

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Centenary Publicaltion - 42

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Techical bulletin No. 107

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December 2016

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Printed at : St. Francis Press, Ernakulam

Content

1. INTRODUCTION

Most of the widely consumed snack foods are high in refined carbohydrates or added sugar and low in nutritional value. Non-diet soft drinks, cookies, candy, pastries, granola bars, chips, pretzels and crackers generally contain more calories and are less satiating than fruits, vegetables, whole grains, nuts and seeds. Consuming too many refined or sugar-rich foods tend to increase the blood triglyceride levels and decrease the levels of health-promoting HDL cholesterol and may contribute to inflammation and oxidative stress, according to the American Heart Association.

Researchers in Europe and the United States have found acrylamide in certain foods that were heated to a temperature above 120°C, but not in foods prepared below this temperature. Potato chips and French fries were found to contain 39 to 910 times higher levels of acrylamide compared with other foods. The World Health Organization and the Food and Agriculture Organization of the United Nations stated that the levels of acrylamide in foods pose a ☒ ajor concern☒ Hence, there is an urge to search alternative health promoting snack foods. One possible health promoting source of snack food is coconut.

Coconut palm (*Cocos nucifera L.*), a perennial horticultural crop, is a symbol of national and international integration involving more than 93 producing countries with an area of 11.98 million ha and production of 58.42 million tonnes and more than 140 consuming countries. India accounts for 22.34 per cent of the world☒ coconut production and is one of the major players in the world☒ coconut trade. The area under coconut cultivation is distributed in 18 states and three union territories under different agro-climatic conditions. Currently the crop is grown in 1.95 million ha with an annual production of nearly 15840 million nuts. Copra processing, coconut oil extraction and coir manufacturing are the traditional coconut based industries in the country.

This palm is a regular and consistent food supplier to mankind all through the year, a characteristic which no other tree crop could be said to possess. The fresh kernel of ripe coconut constitutes an essential ingredient in the recipe of diverse food preparations in the household as well as in the industries of different countries. In the household preparations, fresh kernel is extensively used as grated nut, paste and as milk. When the coconut gratings, as such or in the form of ground paste, are used in food preparation, there is no loss of nutrient present in the kernel or wastage of kernel.

Coconut has been part of diet and livelihoods in the tropical countries of Asia, the Pacific, South and Central America and Africa for thousands of years. It provides a nutritious source of kernel, water, milk, and oil that has fed and nourished populations around the world for generations. Coconut

kernel is a potent source of carbohydrate and rich source of plant protein with appreciable amount of fiber. It is naturally low in digestible carbohydrate, contains no gluten, cheaper than most other nut flours, loaded with health promoting fiber and important nutrients with good taste.

Coconut kernels undergo paring, slicing, blanching, osmotic dehydration and drying to become ready to eat chips. Frying is not undertaken in the chips making process. Using a new method of drying on the basis of osmosis, in which partial dehydration in sliced form is brought about by dipping the fresh kernel in sugar,salt or any osmotic solution followed by hot air drying. This is claimed to result in product with better flavor than freeze drying method at comparatively lesser cost. Hence, the resultant coconut chips give health promoting substances and do not pose any health hazard. Nutraceutical and medicated coconut chips can also be made by incorporating beet root, carrot, ginger and pepper. Central Plantation Crops Research Institute (CPCRI), a constituent of Indian Council of Agricultural Research (ICAR) and only coconut based research institution in India, has successfully developed a process protocol and machineries for the production of coconut chips. ICAR- CPCRI has already provided training to large number of women entrepreneurs and self help groups in coconut chips making. A few units have commenced commercial production. There is a good demand for this product in the domestic and international market.

2. PROCESS FOR THE PRODUCTION OF COCONUT CHIPS

Fresh kernel of 8-9 months old coconut is to be used for good quality chips production. Here, the index for selection of the nut is that the nut should be matured enough to be sliced. If it is too tender, slicing and testa removing is not possible. Important steps involved in the production of coconut chips are given in Fig. 1 as process flow chart and each process involved in chips making are discussed in detail.

2.1. Removal of husk

After harvest, the coconuts have to be dehusked using either manual coconut dehusker (Fig. 2) or ICAR-CPCRI modified power operated coconut dehusker (Fig. 3).

The capacity of the power operated dehusker is 350 coconuts/hour. The power requirement is 2 HP. The dehusker contains two sets of rollers for dehusking and tail fibre removing. For dehusking, there are two rollers with pins fixed on their surface. For tail fibre removing, two blade type rollers and one helical type roller are provided. The dehusking roller speed is maintained at 40 rpm and tail fibre removing roller speed is 60 rpm. The machine can automatically adjust clearance between rollers and input to accommodate the coconuts of different size. The deshusked coconuts are stored in

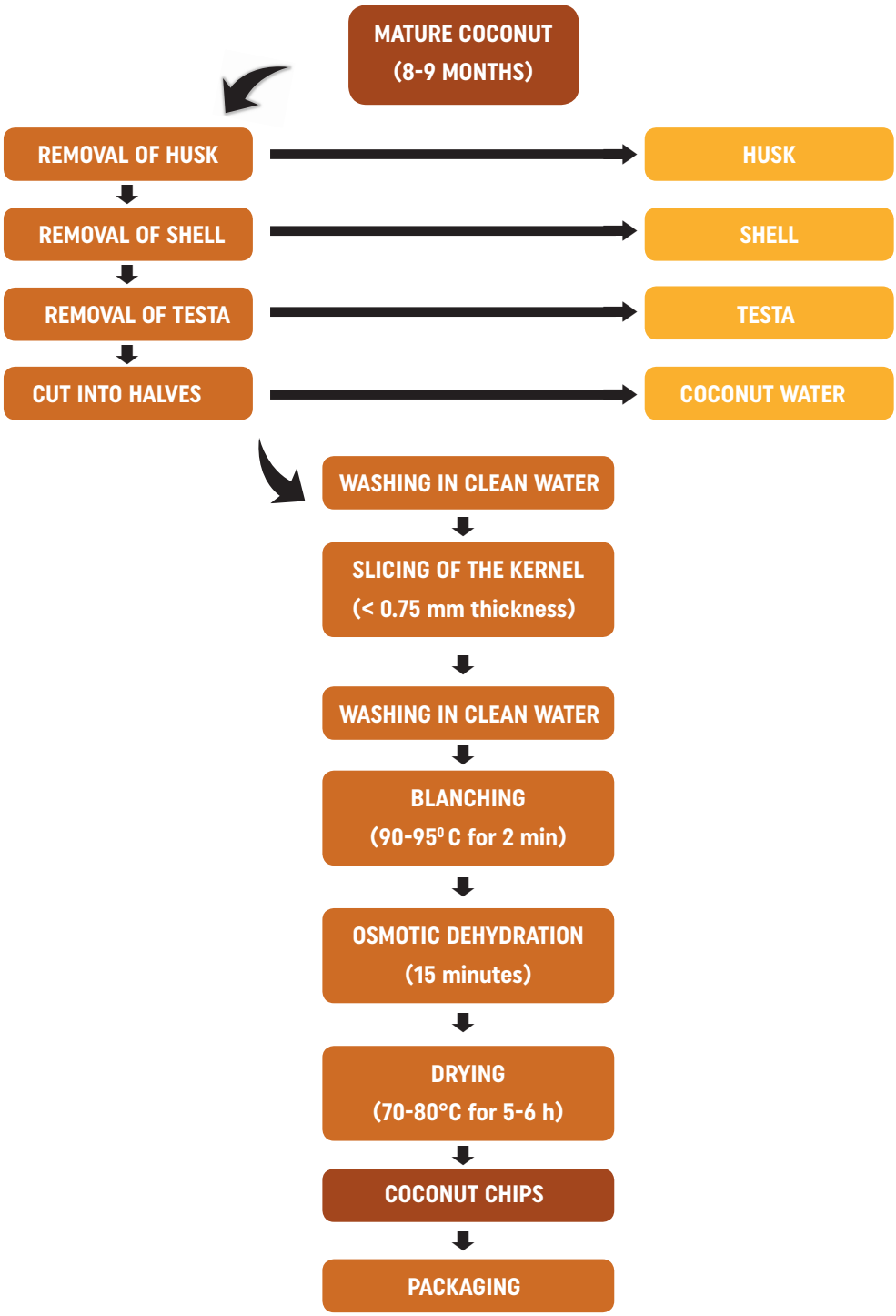

Fig. 1 Process flow chart for the production of coconut chips

Fig. 2 Manual coconut dehusker

Fig. 3 Power operated coconut dehusker

shade place for 3-4 days. This will help in easy removal of the shell.

2.2. Removal of shell

By using ICAR-CPCRI developed coconut deshelling machine (Fig. 4), the shell is removed without breaking the coconut kernel, which helps for easy removal of the testa. The shell can also be removed after breaking the coconut into halves and then scoop out the kernel pieces by knife

Fig. 4 Coconut deshelling machine

(Fig. 5). But, it will increase the time required for removing the testa.

Coconut deshelling machine is intended to reduce both time and drudgery involved in the manual deshelling process. Two concentrically rotating circular blade and a stationary shaft on which coconut is placed firmly are the major components of the deshelling machine. Coconut is pressed

Fig. 5 Manual deshelling of coconut

towards the rotating blades by firmly placing on the stationary shaft. Shell gets detached from the kernel due to the impact force of the rotating blade.

2.3. Removal of testa

The testa of the coconut kernel has to be removed for getting good appearance of the end product i.e. coconut chips. For the purpose, a peeler can be used and the testa can be removed manually (Fig. 6). Care should be taken to peel the testa only,

Fig. 6 Manual testa removing of coconut

without affecting the white kernel.

The testa can also be removed using the testa removing machine developed at ICAR-CPCRI, Kasaragod. The testa removing machine is shown in Fig. 7. The machine consists of a circular wheel covered with an emery cloth or water paper. This friction wheel is rotated using an electric motor. Coconut kernel is pressed to the surface of the rotating friction wheel either by hand or using a fork. Removed testa is collected at the bottom. The emery cloth/ water paper needs to be replaced periodically when the surface gets smoothened. One person can

Fig. 7 Testa removing machine

remove testa of about 75-100 coconuts per hour.

2.4. Cutting of kernel

White kernel is cut into pieces of triangular shape of about three inch size so that it can be held by hand for easy slicing.

2.5. Slicing of kernel

The slicer generally used to slice potato can be used for slicing the coconut. The thickness of the slice should be very thin and should not exceed 0.75 mm. Slicing should be done in such a way that the slices should fall directly in the tray half filled with water to avoid the contamination. The manual slicing is shown in Fig. 8.

In order to reduce the drudgery and increase

Fig. 8 Manual slicing of coconut

the capacity and efficiency, ICAR-CPCRI has developed women friendly sewing machine based coconut slicer (Fig. 9) and power operated multi commodity coconut slicing machine (Fig. 10).

The sewing machine based coconut slicer (Fig. 9) consists of a stainless steel slicing blade fixed on a circular disc, a specially designed curved feeder to insert coconut endosperm for slicing, an exit to guide the sliced coconut chips towards the outlet and a pedal operated mechanism similar to that of a sewing machine. Power is transferred from the pedal to the blade by belt and pulley. One can operate the machine by pedaling, allows the supporting disc gets rotated along with the blade. Coconut endosperm, the kernel is fed to the surface of the rotating blade through the slot provided in the feeder by the operator. When it comes in contact with the blade, coconut kernel gets sliced. The sliced kernel is guided towards the outlet by the guide and collected in a tray. Coconut chips of required thickness could be made by adjusting the clearance between the slicing blade and the blade supporting disc.

Fig. 9 Sewing machine based coconut slicer

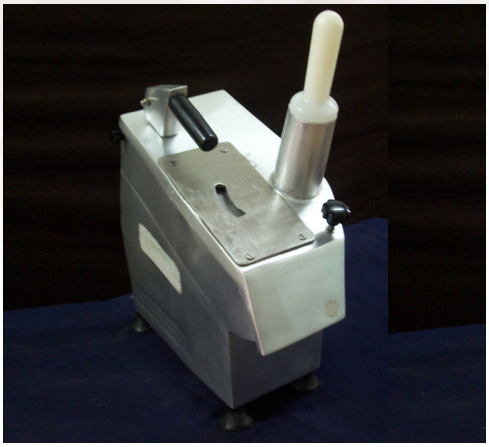

Fig. 10 Power operated multi commodity coconut slicing machine

Approximately 25-30 coconuts can be sliced in one hour using this machine.

The power operated multi commodity coconut slicing machine (Fig. 10) consists of

two stainless steel slicing blades fixed on a circular blade supporting disc, an exit guide to guide the sliced coconut chips towards the outlet and an electric motor as a prime mover. The piped feeder is also provided to slice other commodities namely potato, banana, tapioca etc. The electric motor rotates the blade supporting disc using a V-belt. Coconut endosperm is pressed to the surface of the rotating wheel through the slot provided on the feeder at the top of the machine. When it comes in to contact with the blade the coconut endosperm gets sliced and chips produced. The sliced coconut chips are then guided towards the outlet by the exit guide and are collected in a container. Coconut chips of uniform and required thickness could be produced using this machine. Capacity of the machine is 50-60 coconuts per hour.

2.6. Blanching

Thoroughly washed coconut slices are put in the muslin cloth and dipped in hot water at 90-95^{0}C for 2 minutes. This facilitates the removal of some amount of oil and arrest the enzymatic activity so that the final product will have more crispiness and taste. A blanching unit has been developed to make the process hygienic and efficient. The unit is fabricated using stainless steel and provision is made to heat the water inside to required temperature. A blanching unit developed at ICAR-CPCRI, Kasaragod for the blanching of coconut kernel is shown in Fig. 11.

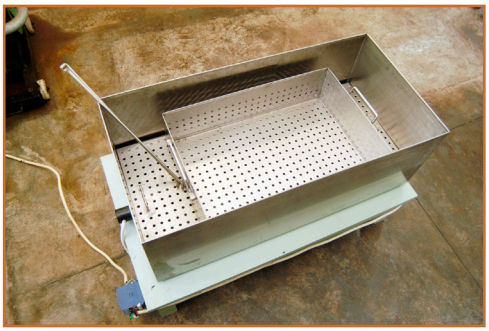

Fig. 11 Blanching unit for blanching of coconut slices

2.7. Osmotic dehydration

After blanching, the coconut slices are dipped in the osmotic medium for osmotic dehydration for 15 minutes. The osmotic medium differs according to the type of chips. The temperature of the medium should be at room temperature. For the small-scale industry, agitation of the syrup during osmotic dehydration is not required. For large-scale industry, agitation of the syrup during osmotic dehydration is required. The syrup may be stirred for every five minutes.

2.8. Preparation of osmotic medium

2.8.1. Sweet coconut chips

For the production of sweet coconut chips, 1 kg coconut slices are dipped in osmotic medium syrup containing 1 kg cane sugar of commercial grade and 20 g common salt in one litre clean water for 15 minutes. This medium can be reused with the addition of 150 g sugar and 5 g salt for every 1 kg coconut slices.

2.8.2. Sweet coconut chips with different flavours

Different flavours like vanilla, pineapple, lemon and orange can also be added along with the normal ingredients at 10 ml per litre syrup. This medium can be reused with the addition of 250 g sugar, 5 ml of flavour essence and 5 g salt for every 1 kg coconut slices.

2.8.3. Medicated sweet chips

For the preparation of medicated chips, ginger essence obtained from 150 g ginger is added along with the normal ingredients. Care should be taken that extract should not contain any dust or fibre. The osmotic medium can be reused by adding 250 g sugar, 5 g salt and ginger essence from 50 g ginger for every 1 kg coconut slices.

2.8.4. Salted spicy coconut chips

For the preparation of salted spicy chips, osmotic medium containing 30 g common salt in one litre clean water is used. Further, for every additional dipping of 1 kg of slices, 10 g salt is added to the salt solution. After drying the slices, required quantity of chilli powder or black pepper powder or white pepper powder is sprinkled to get salted spicy coconut chips.

2.8.5. Nutraceutical coconut chips

Nutraceutical coconut chips (Fig. 12) can also be prepared by adding the juice obtained from 600 g carrot/beetroot or coconut inflorescence sap with the usual ingredients. By giving natural colour to the sweetened coconut chips, the nutritional quality in terms of phenolics, antioxidants, and other important nutrients as well as the attractiveness can be improved so that it can flourish in the domestic market.

Fig. 12 Nutraceutical chips

2.9. Drying of slices

Coconut slices after osmotic dehydration needs to be dried immediately. The slices are taken out from the osmotic solution and allowed to drain. After draining out, the slices are spread in a thin layer on filter paper kept inside the trays of a dryer. It is suggested to use solar dryer initially for one hour for surface moisture removal wherever it is possible. The slices are now ready for drying. Dryers using three different energy sources are available.

2.9.1. Electrical dryer

This dryer uses electrical energy to generate heat for drying coconut slices. Among the three types of dryers, this would be the easiest one to operate. Automatic and accurate temperature control, no operator required to operate etc. are the advantages of electrical dryer.

The osmotic dehydrated coconut slices can be dried in forced hot air electrical dryer

Fig. 13a Electrical dryer

Fig. 13b Drying of coconut slices in electrical dryer

at 70-80°C for 5-6 hours (Fig. 13a & b). The electrical dryer consists of a set of 10 trays with wire mesh screens for loading coconut slices. This batch type dryer uses four electric heaters and the heat is uniformly distributed using a blower. Temperature in the dryer is controlled automatically by a sensor and electronic control unit. Though the dryer is designed for 50 coconuts, the size could be enhanced to any desired capacity.

2.9.2. LPG/Biogas dryer

This dryer uses either LPG or biogas as fuel. Temperature is controlled manually by reducing the flame. However, cost of drying would be less than that of electrical dryer.

2.9.3. Bio-fuel dryer

This dryer (Fig. 14) can use any agricultural waste as source of energy. However, coconut shell is preferred since it burns without much smoke and the calorific value of it would be much higher than many other agricultural wastes.

The dryer is a batch type indirect heating one where only hot air comes in to contact

Fig. 14 Biofuel dryer for coconut chips drying (Drying chamber & Heating chamber)

with the coconut chips. Therefore, no smoke comes into contact with the coconut chips. It consists of a heating chamber that is kept in-door and a burning chamber, a furnace kept out door for convenience. The rectangular shaped heating chamber is made of mild steel sheet lined with fire bricks inside. Though any agricultural waste may be used as fuel, coconut shell is preferred. A chimney is provided for smoke to escape. Hot air from the heating chamber is conveyed to the drying chamber through insulated pipes using a blower. The drying chamber consists of a set of 10 trays with wire mesh screens for loading coconut slices. Temperature in the dryer is monitored by a sensor and is displayed outside. Though the dryer is designed for 50 coconuts, the size could be enhanced to any desired capacity. Drying cost would be the cheapest in this dryer. However, one operator is required to feed fuel to the chula.

3. PACKAGING OF CHIPS

The coconut chips are hygroscopic in nature. If the relative humidity in the atmosphere is more than 75 per cent, it will absorb moisture and loose its crispness. Hence, the chips must be packed in the metallised poly film or aluminum foil laminated with LDPE film pouches, which will maintain its flavor and crispness up to six months period without affecting its biochemical qualities (Fig. 15). To avoid the breakage of the chips during transportation, it may be packed as pillow packet using gases like nitrogen or carbon dioxide.

The protocol and machineries required for the production of coconut chips is given in the Fig. 16.

The prepared coconut chips has been analyzed for its nutritional quality at Defence Food Research Laboratory, Mysore and the nutritional characteristics of the coconut chips is given in Table 1.

Major part of the fat contains medium chain fatty acids such as lauric acid and capric acid which are beneficial for human health and nutrition. Lauric acid has the additional

Fig. 15 Coconut chips packed in attractive packing

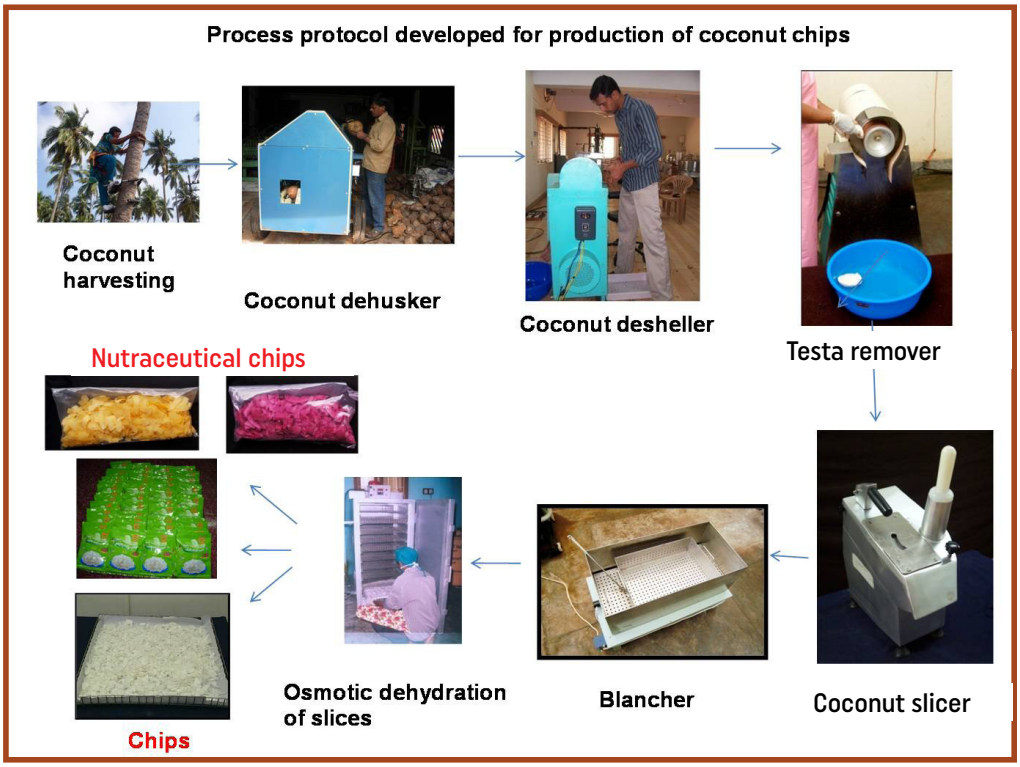

Fig. 16 Process protocol developed for the production of cococnut chips

Table 1. Nutritional quality of coconut chips

Property		Quantity
Moisture	(%)	2.17
Total fat	(%)	48.10
Protein	(%)	1.24
Total sugar	(%)	39.35
Crude fiber	(%)	6.13
Ash	(%)	1.36
Total carbohydrate	(%)	46.13
Energy	(Calories per 100 g)	622

(Source: DFRL, Mysore)

beneficial function of being formed into monolaurin in the human or animal body. Monolaurin is the antiviral, antibacterial, and antiprotozoal monoglyceride used by the human or animal. Further, it helps in reducing harmful LDL and total cholesterol and increasing beneficial HDL in human body.

4. REUSE OF SUGAR SOLUTION

The strength of the osmotic medium will decrease after the completion of the osmotic dehydration of the slices. It can be brought up by adding the necessary ingredients. After the repeated use of the medium, it can be concentrated by heating in water-jacketed vessel like milk cooker, steam jacketed vessel or vacuum jacketed vessel. By any of these methods, the off-flavour of the osmotic medium, developed

Table 2. Materials required for processing of 250 coconuts per day

Sl. No	Name of the material	Manual method		Mechanical method	
		Specification	Quantity	Specification	Quantity
1	Mature coconut	8-9 months old	250	8-9 months old	250
2	Coconut dehusker	Hand operated	5	Power operated	1
3	Coconut desheller	Stainless steel knife/chisel	5	Power operated	1
4	Coconut testa remover	Stainless steel peeler	5	Power operated	1
5	Coconut slicer	Stainless steel slicer Sewing machine sealer	5 1	Power operated	1
6	Blanching Unit	Stainless Steel	1	Stainless Steel	1
7	Plastic Basin	3 Litre Capacity 6 Litre Capacity	15 5	3 Litre Capacity 6 Litre Capacity	15 5
8	Filter	Stainless steel	5	Stainless steel	5
9	Muslin cloth	50 x 50 cm size	5	50 x 50 cm size	5
10	Vessel	Stainless steel 10 litre capacity	3	Stainless steel 10 litre capacity	3
11	Gas stove	LPG	1	LPG	1
12	Sugar	Commercial grade	54 kg	Commercial grade	54 kg
13	Salt	Commercial grade	1.5 kg	Commercial grade	1.5 kg
14	Stirrer	Stainless steel	3	Stainless steel	3
15	Solar dryer	MS Frame and LDPE cover	1	MS Frame and LDPE cover	1
16	Electric dryer	Forced hot air electric dryer	1	Forced hot air electric dryer	1
17	Packaging material	12 micron Aluminium foil laminated with 50 micron LDPE or 12 micron polyester film laminated with 25 micron metallised BOPP	1500	12 micron Aluminium foil laminated with 50 micron LDPE or 12 micron polyester film laminated with 25 micron metallised BOPP	1500
18	Heat sealing machine	Hand operated	2	Hand operated	2

Table 3. Conversion ratio from coconut to coconut chips

	Weight (%)					
	Kernel	Testa	White kernel	Slices	Osmosed slices	Chips
With respect to whole coconut	32.0	2.5	29.2	28.7	25.5	16.2
With respect to kernel	100	7.9	91.8	90.3	80.2	51.0

during the osmotic dehydration, can be eliminated. In water-jacketed vessel or water bath, the syrup is heated for about one hour. The temperature of the water in the water bath should be about 90^{0}C. Table 2 gives the information related to different input materials required for processing 250 coconuts daily for chips making by manual and mechanical means, respectively. The conversion ratio of coconut into coconut chips are given in Table 3.

The quantity of chips obtained is about 50 percent of the weight of the fresh kernel. On an average, about 150 g of chips can be obtained from one coconut.

5. USE OF COCONUT CHIPS

The coconut chips are crispy in nature and in ready-to-eat form. No frying is required before the consumption. It has its own coconut flavor as no oil is used for frying. It can be used as a snack food. After rehydration of the chips, it can also be used as fresh kernel. Rehydration of the chips may be done by soaking the chips in hot water at about 50°C for 30 minutes.

6. MAJOR POINTS TO BE CONSIDERED FOR GETTING QUALITY COCONUT CHIPS

The following important points need to be considered and followed strictly for the preparation of good quality coconut chips.

1. Pure water is to be used in the coconut chips making process. It is suggested to use a water purifier for getting good quality water.
2. The sugar syrup should be stored in the refrigerator to avoid contamination during night hours for further usage.
3. All tools and work place should be thoroughly cleaned.
4. Once coconut is opened to extract coconut kernel or to remove testa, it should be subjected to soaking in the sugar syrup within an hour.
5. The slices should be washed at least thrice before putting in the syrup.
6. After removing from the sugar syrup, coconut slices are to be dried as early as possible.
7. The dried coconut chips are to be packed immediately in air tight packs.

7. COST ANALYSIS OF THE COCONUT CHIPS BY MANUAL METHOD

7.1. Land and building

The coconut chips making unit shall be located in the vicinity of the coconut growing area to ensure the continuous supply of raw material. A land of about 5 cents is required to house the chips unit.

The investment on land @ Rs.1 lakh per Cent	: Rs. 5,00,000
Built up area of 1000 sq.ft will be required for housing as well as facilities	
Hence investment on building @ Rs. 1000/sq.ft	: Rs. 10,00,000
Total investment on land & building	: **Rs. 15,00,000**

7.2. Raw material

The raw material will be 8-9 month old coconuts. The coconut is dehusked and deshelled prior to be used as a raw material for coconut chips making. In one coconut, approximately 300 g kernel is obtained and approximately 50% of the weight of the kernel is converted into coconut chips. The proposed processing unit will be having the capacity of processing 250 nuts daily which costs about Rs. 2500/- and for working of 300 days in a year, the cost of the raw material comes to Rs. 7,50,000/-.

7.3. Miscellaneous expenses

Assets such as office furniture	: Rs. 40,000
Pre operative expenses such as registration, documentation, legal expenses, deposits such as for electricity, water etc., traveling and consultancy etc.,	: Rs. 80,000
Administrative expenses like stationery and traveling	: Rs. 40,000
Utility bills like electricity and water charges per year	: Rs. 90,000
Total miscellaneous expenses	**: Rs. 2,50,000**

7.4. Equipment and machinery required for processing 250 coconuts per day					
Sl. No	**Name of the material**	**Specification**	**Quantity**	**Unit price (Rs.)**	**Total cost (Rs.)**
1	Manual coconut dehusker	Mild steel (MS)	5	500	2,500
2	Knife/ chisel for deshelling	Stainless steel	5	100	500
3	Peeler for removal of testa	Stainless steel	5	100	500
4	Slicer	Stainless steel	5	100	500
5	Sewing machine based coconut slicer	MS frame and Stainless steel	1	15,000	15,000
6	Blanching unit	Stainless steel	1	10,000	10,000
7	Plastic basin	3 litre capacity 6 litre capacity	15 5	60 100	900 500
8	Filter	Stainless steel	5	100	500
9	Muslin cloth	50 x 50 cm size	5	120	600
10	Vessel	Stainless steel 10 litre capacity	3	500	1500
11	Gas stove	LPG	1	3,500	3,500
12	Stirrer	Stainless steel	3	100	300
13	Solar dryer	MS Frame and LDPE cover	1	20,000	20,000
14	Electric dryer	Forced hot air	1	1,00,000	1,00,000
15	Heat sealing machine	Hand operated	1	15,000	15,000
16	Miscellaneous items		-	-	28,200
				Total	**2,00,000**

7.5. Manpower required

Sl.No	Staff	No. of position	Salary / month (Rs.)	Salary / annum (Rs.)
1	Manager-cum-product supervisor	01	20,000	2,40,000
2	Unskilled labour	05	10,000	6,00,000
			Total	**8,40,000**

7.6. Working capital

Sl.No.	Item	Quantity	Rate per unit	Amount (Rs.)
1.	Coconut	75,000	Rs. 10 / coconut	7,50,000
2.	Sugar	16,200	Rs. 35 / kg	5,67,000
3.	Salt	4 50	Rs. 10 / kg	4,500
4.	Packaging material	4,50,000	Rs. 2 / packet	9,00,000
5.	Flavours	225	Rs. 600 / litre	1,35,000
6.	Miscellaneous items	-	-	**1,43,500**
			Total cost	**25,00,000**

7.7. Capital investment

a.	Investment on land for 5 cents @ Rs.1 lakhs / cent	Rs. 5,00,000
b.	Investment on building for 100 sq.ft@ Rs.1000/ sq.ft	Rs. 10,00,000
c.	Machinery and equipment	Rs. 2,00,000
d.	Miscellaneous assets	Rs. 2,50,000
	Total	**Rs. 19,50,000**

7.8. Source of finance

The fixed working capital is worked out to be Rs. 19,50,000. The amount shall be raised as given below.

a.	The entrepreneur (one third)	Rs. 6,50,000
b.	Loan from bank (two third)	Rs. 13,00,000
	Total	**Rs. 19,50,000**

7.9. Fixed cost		
a.	Depreciation on plant, machinery and equipment @ 10%	Rs. 20,000
b.	Depreciation on building @ 5%	Rs.50 ,000
c.	Interest on term loan @ 12.5%	Rs. 1,62,500
d.	Interest on working capital @ 11%	Rs. 2,75,000
e.	Repair and maintenance of machinery @ 5%	Rs. 10,000
f.	Salary	Rs. 8,40,000
g.	Administrative overheads	Rs. 60,000
h.	Insurance	Rs. 24,000
i.	Sales promotion and advertisement expenses	Rs. 60,000
	Total	**Rs. 15,01,500**

7.10. Variable cost		
a.	Working capital including raw materials	Rs. 25,00,000
b.	Other variable costs like electricity, LPG, watch and ward and other factory overheads	Rs. 1,00,000
	Total	**Rs. 26,00,000**

7.11. Profitability projections

Total cost of production (Fixed cost + variable cost)		**: Rs. 41,01,500**
Cost of production	(41,01,500 / 4,50,000)	: Rs. 9.11 per packet of 25 g
Total cost of selling (4,50,000 packets at Rs.20/ packet)		: Rs. 90,00,000
Profit		**: Rs. 48,98,500**

Break even point = Fixed cost / [selling cost – (variable cost / No. of units)]

= 15,01,500 / [20 – (26,00,000 / 4,50,000)]

= 15,01,500 / [20 – 5.78]

= 15,01,500/ 14.22

= **1,05,590 packets of coconut chips**

Break even sales = 1,05,590 x 20

= **Rs. 21,11,800**

Break even period = 1,05,590 / 1500

= **71 days**

7.12. Benefit cost analysis

Capital productivity analysis is the most important tool for evaluating the financial feasibility of any project. The *ex-ante* concept of cost benefit analysis is adopted to evaluate the present project. The study was confined to the direct costs and benefits, the social cost-benefit aspects are not accounted.

Feasibility analysis of the project on commercial production of coconut chips revealed a benefit cost ratio of 2.11 and an internal rate of return of 251.20 per cent. General theory as well as empirical studies on project feasibility analysis indicates that, a project with BCR value above 1 is always feasible. As far as IRR is concerned, it is advisable to compare the value with the prevailing returns we may obtain, had we invested the amount in other ventures. In the present study, the IRR is found to be 251.20 percent, which is well above that of any other prevailing market rate of return. Thus, we may conclude that the commercial production of coconut chips could turn out to be a profitable venture.

The break even period for the coconut chips making unit is calculated to be 71 days which corresponds to a sales volume of Rs. 21,11,800 equivalent to 2640 kg of coconut chips.

Discounted cash flow of coconut chips production							
Year (n)	Fixed cost(Rs)	Variable cost(Rs)	Total cost	Total returns	Discount-ing factor	Discounted cost	Discounted benefits
0	1950000	-	1950000	-	1	-	1950000
1	1501500	2600000	4101500	9000000	0.889	3645778	8000000
2	1501500	2600000	4101500	9000000	0.790	3240691	7111111
3	1501500	2600000	4101500	9000000	0.702	2880615	6320988
4	1501500	2600000	4101500	9000000	0.624	2560546	5618656
5	1501500	2600000	4101500	9000000	0.555	2276041	4994361
6	1501500	2600000	4101500	9000000	0.493	2023148	4439432
7	1501500	2600000	4101500	9000000	0.438	1798353	3946161
8	1501500	2600000	4101500	9000000	0.390	1598536	3507699
9	1501500	2600000	4101500	9000000	0.346	1420921	3117955
10	1501500	2600000	4101500	9000000	0.308	1263041	2771515
Benefit Cost Ratio (BCR)= 2.11							
Internal Rate of Return (IRR)= 251.20%							

8. COST ANALYSIS OF THE COCONUT CHIPS BY MECHANICAL METHOD

The cost of land, building and raw material are same as mentioned in section 7.1 and 7.2.

8.1. Miscellaneous expenses

Assets such as office furniture	: Rs. 50,000
Pre operative expenses such as registration, documentation, legal expenses, deposits such as for electricity, water, traveling and consultancy etc.,	: Rs. 1,00,000
Administrative expenses like stationery and traveling	: Rs. 40,000
Utility bills like electricity and water charges per year	: Rs. 1,10,000
Total miscellaneous expenses	**: Rs. 3,00,000**

8.2. Equipment and machinery required for processing 250 coconuts per day

Sl. No.	Name of the material	Specification	Quantity (No.)	Unit price (Rs.)	Total cost (Rs.)
1	Coconut dehusker	Power operated	1	2,00,000	2,00,000
2	Coconut desheller	Power operated	1	50,000	50,000
3	Coconut testa removing machine	Power operated	1	50,000	50,000
4	Multi commodity coconut slicer	Power operated	1	70,000	70,000
5	Blanching unit	Stainless steel	1	10,000	10,000
6	Plastic basin	3 litre capacity 6 litre capacity	15 5	60 100	900 500
7	Filter	Stainless steel	5	100	500
8	Muslin cloth	50 x 50 cm size	5	120	600
9	Vessel (10 litres)	Stainless steel	3	500	1,500
10	Gas stove	LPG	1	3,500	3,500
11	Stirrer	Stainless steel	3	100	300
12	Solar dryer	MS Frame and LDPE cover	1	20,000	20,000
13	Electric dryer	Forced hot air electrical Dryer	1	1,00,000	1,00,000
14	Heat sealing machine	Hand operated	1	15,000	15,000
15	Miscellaneous items				27,200
				Total	**5,50,000**

8.3. Manpower required

Sl. No.	Staff	No. of position	Salary / month (Rs.)	Salary / annum (Rs.)
1	Manager-cum-product supervisor	01	20,000	2,40,000
2	Unskilled labour	02	10,000	2,40,000
			Total	**4,80,000**

8.4. Working capital				
S.No.	**Item**	**Quantity**	**Rate per unit**	**Amount (Rs.)**
1	Coconut	75,000	Rs. 10 / coconut	7,50,000
2	Sugar	16,200	Rs. 35 / Kg	5,67,000
3	Salt	450	Rs. 10 / Kg	4,500
4	Packaging material	4,50,000	Rs. 2 / Packet	9,00,000
5	Flavours	225	Rs. 600 / Litre	1,35,000
6	Miscellaneous Items			1,43,500
			Total	**25,00,000**

8.5. Capital investment		
a.	Investment on land for 5 cents @ Rs.1 lakhs / cent	Rs. 5,00,000
b.	Investment on building for 100 sq.ft@ Rs. 500/sq.ft	Rs. 10,00,000
c.	Machinery and equipment	Rs. 5,50,000
d.	Miscellaneous assets	Rs. 3,00,000
	Total	**Rs. 23,50,000**

8.6. Source of finance

The fixed working capital is worked out to be Rs. 23,50,000. The amount shall be raised as given below.

a. The entrepreneur (one third) : Rs. 8,50,000
b. Loan from bank (two third) : Rs. 15,00,000

Total : Rs. 23,50,000

8.7. Fixed cost

a.	Depreciation on plant, machinery and equipment @ 10%	: Rs. 55,000
b.	Depreciation on building @ 5%	: Rs. 50,000
c.	Interest on term loan @ 12.5%	: Rs. 1,87,500
d.	Interest on working capital @ 11%	: Rs. 2,75,000
e.	Repair and maintenance of machinery @ 5%	: Rs. 27,500
f.	Salary	: Rs. 4,80,000
g.	Administrative overheads	: Rs. 60,000
h.	Insurance	: Rs. 24,000
i.	Sales promotion and advertisement expenses	: Rs. 60,000
	Total	**Rs. 12,19,000**

8.8. Variable cost

a.	Working capital including raw materials	: Rs. 25,00,000
b.	Other variable costs like electricity, LPG, watch and ward and other factory overheads	: Rs. 1,00,000
	Total	**Rs.26,00,000**

8.9. Profitability projections

Total cost of production (Fixed cost + variable cost)	**: Rs. 38,19,000**
Cost of production(38,19,000 / 4,50,000)	: Rs. 8.49 per packet of 25 g
Total cost of selling (4,50,000 packets at Rs.20/ packet)	: Rs. 90,00,000
Profit	**: Rs. 51,81,000**

Break even point = Fixed cost / [selling cost – (variable cost / No. of units)]
= 12,19,000 / [20 – (26,00,000 / 4,50,000)]
= 12,19,000 / [20 – 5.78]
= 12,19,000 / 14.22
= **85,725 packets of coconut chips**

Break even sales = 85,725 x 20= **Rs. 17,14,500**

Break even period = 85,725 / 1500 = **57 days**

8.10. Benefit cost analysis

Capital productivity analysis is the most important tool for evaluating the financial feasibility of any project. The *ex-ante* concept of cost benefit analysis is adopted to evaluate the present project. The study was confined to the direct costs and benefits, the social cost-benefit aspects are not accounted .

Discounted cash flow of coconut chips production

Year(n)	Fixed cost(Rs)	Variable cost(Rs)	Total cost	Total returns	Discounting factor	Discounted cost	Discounted benefits
0	2350000				1		-2350000
1	1219000	2600000	3819000	9000000	0.889	3394667	8000000
2	1219000	2600000	3819000	9000000	0.790	3017481	7111111
3	1219000	2600000	3819000	9000000	0.702	2682206	6320988
4	1219000	2600000	3819000	9000000	0.624	2384183	5618656
5	1219000	2600000	3819000	9000000	0.555	2119274	4994361
6	1219000	2600000	3819000	9000000	0.493	1883799	4439432
7	1219000	2600000	3819000	9000000	0.438	1674488	3946161
8	1219000	2600000	3819000	9000000	0.390	1488434	3507699
9	1219000	2600000	3819000	9000000	0.346	1323052	3117955
10	1219000	2600000	3819000	9000000	0.308	1176046	2771515
Benefit Cost Ratio (BCR)= 2.25							
Internal Rate of Return (IRR)= 220.47%							

Feasibility analysis of the project on commercial production of coconut chips revealed a benefit cost ratio of 2.25 and an internal rate of return of 220.47 per cent. General theory as well as empirical studies on project feasibility analysis indicates that, a project with BCR value above 1 is always feasible. As far as IRR is concerned, it is advisable to compare the value with the prevailing returns we may obtain, had we invested the amount in other ventures. In the present study, the IRR is found to be 220.47 percent, which is well above that of any other prevailing market rate of return. Moreover, production of coconut chips by using machinery was found to be more profitable than by manual method due to the fixed cost of additional manpower. Thus, we may conclude that the commercial production of coconut chips by mechanical means could turn out to be a profitable venture.

During coconut chips production from 75,000 coconuts / year, 30,000 kg husk, 10,000 kg shell, 7,500 litres water, and 500 kg

testa are obtained. The additional benefit of selling these co-products is not accounted in this analysis. Additionally, by selling the co-products like coconut husk, shell, testa and water, entrepreneur can earn more income.

The break even period for the coconut chips making unit is calculated to be 57 days which corresponds to a sales volume of Rs. 17,14,500 equivalent to 2,145 kg of coconut chips. Thus, coconuts chips based venture can contribute a modest increase in the income and livelihood of the entrepreneur. Apart from the profitability, this venture can result into a suitable healthy snack food for children and adults.


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