COMMERCIAL PRODUCTION OF COCONUT CHIPS

NAIP ON VALUE CHAIN IN COCONUT

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
KASARAGOD- 671 124, KERALA

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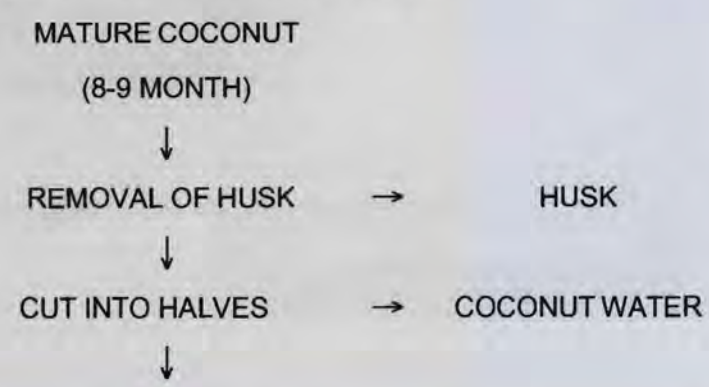
1. INTRODUCTION

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 12.8 million ha and production of 10.9 million tonnes of copra equivalent and more than 140 consuming countries. 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.

India accounts for 22.34 per cent of the world's coconut production and is one of the major players in the world's 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 1.91 million ha with an annual production of nearly 13000 million nuts. Copra processing, coconut oil extraction and coir manufacturing are the traditional coconut based industries in the country.

2. PROCESS FOR THE PRODUCTION OF SWEET COCONUT CHIPS

Fresh kernel of 8-9 month old coconut is to be used for this purpose. 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 sweet coconut chips are given in Figure 1 as process flow chart and each process involved in chips making are discussed in detail.



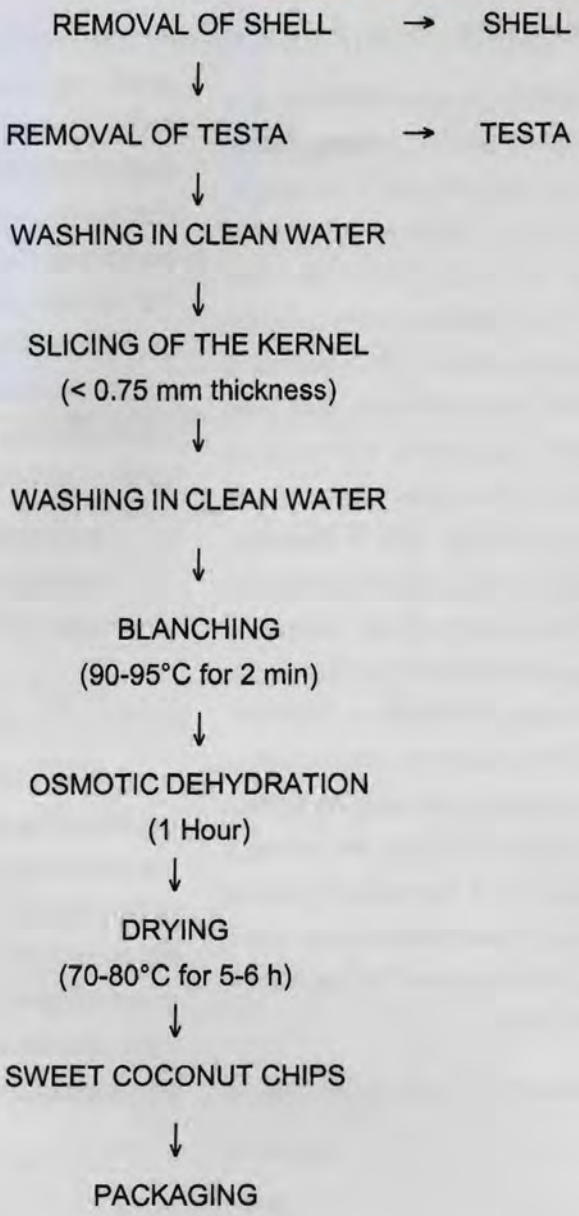


Fig. 1. Process flow chart for the production of sweet coconut chips

2.1. Mature coconut

After the harvest, the coconuts have to be dehusked using a tool called coconut dehusker (Fig. 2) and store the coconut without husk in shade place for 3-4 days. This will help to remove the shell easily. The dehusking process is shown in Figure 3.

Fig. 2. Coconut dehusker

Fig. 3. Dehusking of coconut

2.2. Removal of shell

By using a chisel, 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 scooping out the kernel pieces by knife (Fig. 4). But it will increase the time required for removing the testa.

Fig. 4. Deshelling of coconut

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. 5). Care should be taken to peel the testa only, without affecting the white kernel.

Fig. 5. Manual removal of testa

The testa can also be removed using a testa remover machine developed at CPCRI, Kasaragod. The testa remover machine is shown in Figure 6.


Fig. 6. Testa removal using testa remover

2.4. Cutting of kernel

Cut the white kernel into pieces of triangular shape of about three inch size to hold it by hand for easy slicing of the kernel.

2.5. Slicing of kernel

The slicer generally used to slice potato may 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. This is to avoid the contamination of sugar syrup. The manual slicing and mechanical slicing are shown in figures 7 and 8, respectively.

Fig. 7. Manual slicing of coconut kernel


Fig. 8. Mechanical slicing of coconut kernel

2.6. Blanching

Thoroughly washed coconut slices are put in the muslin cloth and dipped in hot water at 90-95°C for 2 minutes. This facilitates the removal of some amount of oil and milk so that the final product will have more crispiness and taste. A blanching unit developed at CPCRI, Kasaragod for the blanching of coconut kernel is shown in Figure 9.

Fig. 9. Blanching unit for blanching of coconut slices

2.7. Osmotic dehydration

After blanching, dip the coconut slices in the osmotic medium for osmotic dehydration for one hour. 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 every 10-15 minutes. In this case, the time of osmotic dehydration can be reduced to 40 minutes.

2.8. Preparation of osmotic medium

2.8.1. Sweet coconut chips

Mix 1 kg cane sugar of commercial grade and 20 g common salt in one liter of clean water to prepare the sugar syrup. This can be used for immersing about 600 g of coconut slices. Further, for dipping every 600 g of coconut slices, add 150 g sugar and 5 g salt to this syrup.

2.8.2. Sweet coconut with different flavours

For preparing sweet chips with different flavours like vanilla, pineapple, lemon, orange etc., add 10 ml of the required flavour essence to one liter of sugar syrup. Further, for dipping 1 kg of coconut slices, add 250 g of sugar, 5 g of salt and 5 ml of flavour essence.

2.8.3. Medicated sweet chips

For preparing medicated sweet chips, add ginger essence which is the extract obtained by grinding 150 g of ginger. Care should be taken that extract should not contain any dust or fibre. Further, for dipping every 1 kg of coconut slices, add 250 g of sugar, 5 g of salt and ginger essence obtained by grinding 50 g of ginger.

2.8.4. Salted spicy coconut chips

For preparing spicy coconut chips, mix 30 g of common salt in one litre of water. This salt solution can be used for immersing about 600 g of coconut slices. Further, for every additional dipping of 600 g of slices, add 10 g of salt to the salt solution. After drying the slices, sprinkle required quantity of chilli powder or black pepper powder or white pepper powder to get salted spicy coconut chips.

2.9. Drying of slices

Coconut slices after osmotic dehydration needs to be dried immediately. The slices are taken out from the sugar 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. The slices are now ready for drying. Dryers using three different fuels as its energy source are available.

2.9.1. Electrical dryer

The 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 at 70-80°C for 5-6 hours (Fig. 10).

2.9.2. LPG/Biogas dryer

The 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

The dryer 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 having two separate units namely drying chamber and burning chamber *(chula)*. Drying chamber is kept indoor. Burning chamber also can be kept indoor. However, burning chamber is generally kept outdoor for easy operation. The dryer is an indirect type of dryer. Therefore no smoke comes into contact with the coconut chips.

Drying cost would be the cheapest in this dryer. However, one operator is required to feed fuel to the *chula*.

Fig. 10. Drying of coconut slices

3. PACKAGING OF CHIPS

The sweet coconut chips is 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 upto six months without affecting its microbial and biochemical qualities (Fig. 11). To avoid the breakage of the chips during transportation, it may be packed as pillow packet using gases like nitrogen or carbon dioxide.

Fig. 11. Coconut chips packed in attractive packing

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.

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 (Cal per 100 g)	622

(Source: DFRL, Mysore)

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 during the osmotic dehydration, can be eliminated. In water-jacketed vessel or water bath, heat the syrup for about one hour at about 90°C. The conversion ratio of coconut into coconut chips are given in Table 2.

Table 2. Conversion ratio from coconut to coconut chips

	Weight (%)					
	Kernal	**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	-	7.9	91.8	90.3	80.2	51.0

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

Table 3 gives the information related to different input materials required for processing 250 coconuts daily for chips making.

Table 3. Materials required for processing 250 coconut per day by 7 labourers

Sl.No	Name of the material	Specification	Quantity
1	Mature coconut	8-9 months old	250
2	Knife	Stainless steel	7
3	Testa remover (peeling tool) Testa Remover machine	Stainless steel CPCRI Model	7 1
4	Slicer Mechanical slicer	Stainless steel CPCRI model	7 1
5	Plastic basin	3 litre capacity 6 litre capacity	14 2
6	Filter	Stainless steel	7
7	Muslin cloth	50 x 50 cm size	7
8	Vessel	Stainless steel 5 litre capacity	1
9	Gas stove	LPG	1
10	Sugar	Commercial grade	15 kg
11	Salt	Commercial grade	1.5 kg
12	Stirrer	Stainless steel	1
13	Electric dryer	Forced hot air electric drier	1
14	Packaging material	12 micron Aluminium foil laminated with 50 micron LDPE or 12 micron polyester film laminated with 25 micron metallised BOPP	750
15	Heat sealing machine	Hand operated	1
16	Coconut dehusking machine	Hand operated	1

5. USE OF SWEET COCONUT CHIPS

The sweet coconut chips is 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. IMPORTANT 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 of coconut chips.

- 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.
- The sugar syrup should be stored in the refrigerator to avoid contamination during night hours for further usage.
- All tools and work place should be thoroughly cleaned.
- 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.
- The slices should be washed at least thrice before putting in the syrup.
- After removing from the sugar syrup, coconut slices are to be dried as early as possible.

7. COST ANALYSIS OF THE COCONUT CHIPS PROJECT

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. 5,00,000
@ Rs.1 lakh per Cent

Built up area of 1000 sq.ft will be required for housing as well as facilities

Hence investment on building @ Rs. 500/sq.ft : Rs. 5,00,000

Total investment on land & building : Rs. 10,00,000

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. From 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. 1000/- and for working of 300 days in a year, the cost of the raw material comes to Rs. 3,00,000/-.

7.3. Miscellaneous expenses

Assets such as office furniture	: Rs. 15,000
Pre operative expenses such as Registration, documentation, legal expenses, deposits such as for electricity, water etc., traveling and consultancy etc.,	: Rs. 1,00,000
Administrative expenses like stationary and traveling	: Rs. 10,000
Utility bills like electricity and water charges per year	: Rs. 25,000
Total miscellaneous expenses	: Rs. 1,50,000

7.4. Equipment and Machinery required for processing 250 coconut per day

Sl.No	Name of the material	Specification	Quantity	Unit price (Rs.)	Total cost (Rs.)
1	Knife	Stainless steel	7	25	175
2	Testa remover	Stainless steel	7	25	175
3	Slicer	Stainless steel	7	50	350
4	Plastic basin	3 litre capacity 6 litre capacity	14 2	20 30	280 60
5	Filter	Stainless steel	7	25	175
6	Muslin cloth	50 x 50 cm size	7	20	140
7	Vessel	Stainless steel 5 litre capacity	 1	 100	 100
8	Gas stove	LPG	1	3500	3500
9	Coconut dehusker	MS	1	150	150
10	Stirrer	Stainless steel	1	50	50
11	Electric dryer	Forced hot air electric drier	1	1,00,000	1,00,000
12	Heat sealing machine	Hand operated	1	15,000	15,000
				Total	**1,20,155**

7.5. Staff and Labour required

Sl.No	Staff	No. of position	Salary / month (Rs.)	Salary / annum (Rs.)
1	Manager-cum-product supervisor	01	12,000	1,44,000
2	Unskilled labour	07	5,000	4,20,000
			Total	**5,64,000**

7.6. Working Capital

Sl.No.	Item	Quantity	Rate per unit	Amount
1.	Coconut	75,000	Rs.4 /coconut	3,00,000
2.	Sugar	4,500	Rs.35 /kg	1,57,500
3.	Salt	450	Rs.10 /kg	4,500
4.	Packaging material	4,50,000	Rs. 2/packet	9,00,000
5.	Flavours and other miscellaneous items	-	-	8,000
	Total cost			13,70,000

7.7. Capital investment

a.	Investment on land for 5 cents @ Rs.1 lakhs per Cent	: Rs. 5,00,000
b.	Investment on building for 100 sq.ft@ Rs. 500/sq.ft	: Rs. 5,00,000
c.	Machinery and equipment	: Rs. 1,20,155
d.	Miscellaneous assets	: Rs. 1,50,000
	Total	12,70,155

7.8. Source of Finance

The fixed working capital is worked out to be Rs. 12,70,155. The amount shall be raised as given below.

a.	The entrepreneur	(1/3rd)	: Rs. 4,23,385
b.	Loan from bank	(2/3rd)	: Rs. 8,46,770
	Total		12,70,155

7.9. Fixed cost

a.	Depreciation on plant, machinery and equipment @ 10%	: Rs. 12,015
b.	Depreciation on building @ 5%	: Rs. 25,000
c.	Interest on term loan @ 12.5%	: Rs. 1,05,846
d.	Interest on working capital @ 11%	: Rs. 1,50,700
e.	Repair and maintenance of machinery @ 5%	: Rs. 6,008
f.	Salary	: Rs. 5,64,000
g.	Administrative overheads	: Rs. 10,155
h.	Insurance	: Rs. 5,000
i.	Sales promotion and advertisement expenses	: Rs. 10,000
	Total	8,88,724

7.10. Variable cost

a.	Working capital including raw materials	: Rs. 13,70,000
b.	Other variable costs like electricity, LPG, watch and ward and other factory overheads	: Rs. 30,000
	Total	14,00,000

7.11. Profitability projections

Total cost of production (Fixed cost + variable cost) : Rs. 22,88,724

Cost of production (22,88,724 / 4,50,000) : Rs. 5.09 per packet of 25 g

Total cost of selling (4,50,000 packets at Rs.10/ packet) : Rs. 45,00,000

Profit : Rs. 22,11,276

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

= 8,88,724 / [10 - (14,00,000 / 4,50,000)]

= 1,29,175 packets of coconut chips

Break even sales = 1,29,175 x 10

= Rs. 12,91,750

Break even period = 1,29,175 / 1500

= 87 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.

Discounted cash flow of coconut chips production

Year (n)	fixed cost (Rs)	variable cost (Rs)	Total cost (Rs)	Total returns	Discounting factor	Discounted cost	Discounted benefits
0	1270155		1270155		1		-1270155
1	888724	1400000	2288724	4500000	0.889	2034421	4000000
2	888724	1400000	2288724	4500000	0.790	1808375	3555556
3	888724	1400000	2288724	4500000	0.702	1607444	3160494
4	888724	1400000	2288724	4500000	0.624	1428839	2809328
5	888724	1400000	2288724	4500000	0.555	1270079	2497180
6	888724	1400000	2288724	4500000	0.493	1128959	2219716
7	888724	1400000	2288724	4500000	0.438	1003519	1973081
8	888724	1400000	2288724	4500000	0.390	892017.2	1753850
9	888724	1400000	2288724	4500000	0.346	792904.2	1558977
10	888724	1400000	2288724	4500000	0.308	704803.7	1385758
Benefit Cost Ratio (BCR)= 1.87							
Internal Rate of Return (IRR)= 47.3%							

Feasibility analysis of the project on commercial production of coconut chips revealed a Benefit Cost Ratio of 1.87 and an Internal Rate of Return of 47.3 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 47.3 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 87 days which corresponds to a sales volume of Rs. 12,91,750 equivalent to 3230 kg of coconut chips.

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The Milky White COCONUT CHIPS
as a Crispy direct Health SNACK !
or Magic TASTE MAKER !!
Coconut
Chips