

Coconut Processing—Problems and Prospects

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COCONUT is one of the important sources of vegetable oil. The copra, with an oil content of 70 per cent is perhaps the richest material for oil extraction. The coconut is grown over 1.12 million hectares in the country. A remarkable feature of its cultivation in Kerala is that it is a small holder's crop. Mostly it is grown in home-steads. Nearly 90 per cent of holdings in Kerala, 95 per cent in Tamil Nadu and Karnataka and more than 98 per cent in Andhra Pradesh are less than 1 hectare in size Jaswant Singh (1980). This establishes the fact that coconut is not a crop of owners of extensive plantations only.

The coconut processing industry in India is generally considered to be a large-scale industry, although it is desirable to be a small scale one. The conversion of coconut meat which is about 26 per cent of nuts total weight, into copra for extracting the oil is the most vital aspect of technology in the coconut industry Jaswant Singh et al. (1980). The coconut oil, in general, is extracted from copra by various methods ranging from primitive rotaries to low pressure expellers, using solvent extraction at a later stage. Irrespective of the method employed, the various stages in the processing of coconut such as dehusking,



Fig. 1. Coconut Hicking Machine developed by the author.

splitting and draining out coconut water, drying deshelling, cleaning and grading have always to be done before the extraction oil. All of these require labour and time, besides the equipment needed for the operation.

[1] Coconut husking

Traditionally, the coconut is husked manually with a spike and knife. Husking with the help of spike as well as knife requires considerable skill and wrist, chest and arm strength. It involves a certain amount of risk.

A coconut husker, utilising the principle of three spring action blades piercing the coconut husk vertically downward, has been designed and

developed (Fig. 1) at CPCRI, Kasaragod, Kerala to solve the problems of husking Jaswant Singh (1981). It has been found satisfactory in its operation and performance. The average capacity of this machine is 140 coconuts per hour. The total cost including the cost of materials worked out to be Rs. 210 (1978). This does not involve any risk of injury to the operator. It can be handled by anybody.

[2] Copra drying

Ordinarily to get dried copra the drying of coconut meat is done by exposing the split halves of the nut to the sun. The husked nuts are split into halves by striking with a heavy knife or small axe and drained free of the nut water. The halves are then

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dried in the open yard in sun, either near the roads or in coconut gardens, generally within four hours after splitting. A gap of more than four hours between the splitting and the commencement of drying encourages bacterial activity on the inner surface of the kernel (Table 1). The sliming due to bacteria become more pronounced during the first and second days of either open yard drying or kiln drying, if the sunshine is not bright in the day or the kiln overloaded. This leads to a reddish colouration of the kernel.

Another age-old practice of drying the split halves of coconut is by smoke where the split halves are spread over a platform of bamboo or wooden trays over a fire place and subjected to slow heat produced by burning coconut shells for 4 to 5 days.

Problems of Copra Drying

The traditional methods of sundrying widely used in rural

areas are crude, and unhygienic. Copra is usually contaminated with dust, mould and other organisms. It is also time consuming and labour intensive. There is loss of copra caused by rats, crows, and squirrels.

As the kernels are directly heated by hot gases from burning coconut husks and shells in the kiln, the resulting copra is badly tainted by the smoke and often not dried properly. The oil from such copra has smoky odour, often rendering it unfit for human consumption. The oil cake is also found to be of inferior quality. Though the smoked copra is less susceptible to spoilage by moulds and insects, it does not compensate for the loss in quality. Low grade copra as a raw material, leads to low oil production combined with the development of aflatoxin, a metabolic product of certain fungi, which is now proved to be potentially carcinogenic. The effect of mould action on the quality of oil produced from copra is given in Table 2.

There are several hot air driers available for copra drying. Studies have been conducted for comparative efficiency of improved kilns and hot air driers but it has been reported that because of the high installation costs and the added operational expenses involved therein, even the processors do not accept it.

Prospects

The designing of a small and economic type of copra drier for the small farmers, hence assumes importance in the light of problems outlined above. Such a drier should preferably be either one which uses a solar energy or a cheap fuel such as the coconut shell itself. Also the available kilns should be redesigned and modified to meet economic and quality improvements. An economic solar drier of simple design has been developed (Fig. 2) for capacity of 150 nuts *i.e.* 300 halves at CPCRI, Kasaragod, which has been tested and found satisfactory. It saves 44 per cent of the drying time as well as produces good quality copra as compared to traditional method of open yard drying.

It would also be advisable that efforts should be made for either community level processing, like wheat grinding mills and oil expellers, or utilizing some of the available principles and techniques, medium sized units may be developed to serve the medium growers.

[3] Processing

(i) Traditional Methods

Grating of the fresh coconut meat is done by hand followed by hand pressing. Water is mixed after the first pressing and

Table 1
Effect of preliminary delays on quality of copra

Sl. No.	Delay period before kiln drying (hrs)	White %	Slightly discoloured or dirty %	Red or Red black %
1.	Nil	82	18	00
2.	02	80	20	00
3.	04	75	25	00
4.	06	70	29	01
5.	09	61	35	04
6.	12	36	42	22
7.	24	10	48	42
8.	48	00	17	83

Ref. Thampan, P. K. [1975]. The coconut palm and its products Greena Villa Publishing House pp. 234.

Table 2
Effect of mould action on quality of copra oil

Sl. No.	White mould [<i>Rhizopus</i> sp]		Black mould [<i>A. niger</i>]		Brown mould [<i>A. flavus</i>]		Green mould [<i>P. glaucum</i>]	
	Oil loss	FFA as oleic acid	Oil loss	FFA as oleic acid	Oil loss	FFA as oleic acid	Oil loss	FFA as oleic acid
	%	%	%	%	%	%	%	%
1.	43.1	21.0	51.3	9.5	30.7	6.8	6.2	1.2
2.	36.4	19.8	23.0	8.0	29.8	5.4	0.69	1.0
3.	41.0	26.	13.0	2.9	33.7	7.7	0.87	0.9
4.					37.2	7.2	0.54	0.8
5.					36.8	6.5		
6.					37.0	7.0		
7.					40.3	9.1		
Average :	40.2	22.5	29.1	6.8	35.1	7.1	0.6	1.0

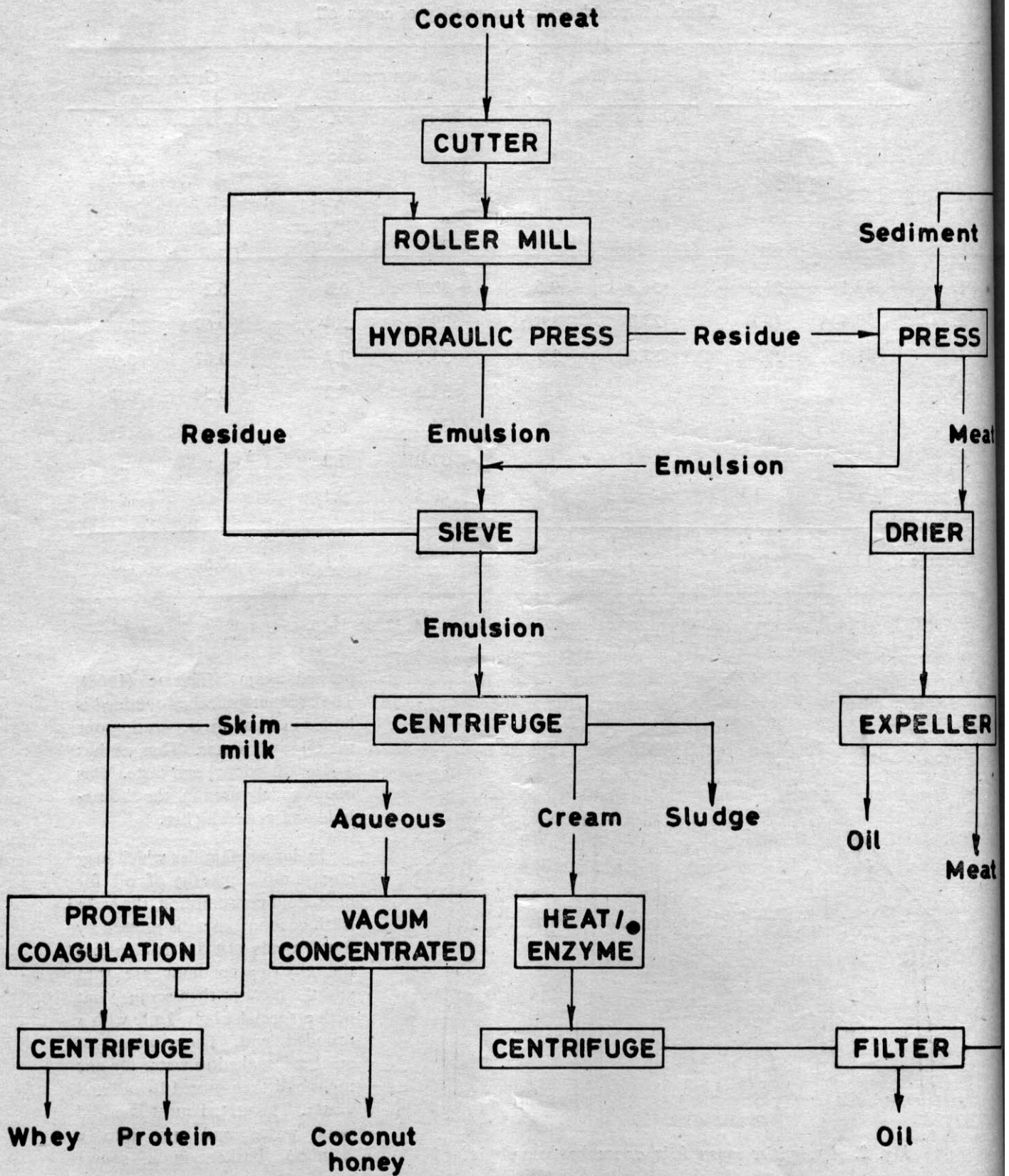
Brill, HC, Parker, HD and Yates, HS. Copra and coconut oil Phil. Jour. Sc. A, 12. pp. 55-86.



Fig. 2. A primitive copra kiln, or smoke house offering protection from the rain.

pressed again Thieme (1968). The coconut milk thus obtained is boiled in a pan for separating out the oil and water. Thus oil has a pleasant odour and taste. This one is widely used in the household and priced higher.

In larger families which may require more quantity of oil for household consumption, the grated fresh coconut meat is pressed by foot Thieme (1968). In this case the fully ripe coconuts are split and the meat is then scraped out with a special blunt knife with a rounded end. These pieces of meat are soaked in water for one night and then grated by a hand grater. The grated meat is mixed with water and put into a bamboo basket in a square wooden trough or on a wooden



Krauss-Maffei/CFTRI Process : Flow Diagram

board with a raised rim. A man then presses the grated meat with his feet, holding a wooden support. Water is added to the pressed meat and pressed several times to obtain maximum milk. Coconut milk thus obtained is collected in a wooden vessel with a stoppered opening at the bottom and allowed to stand for several hours in it. The watery layer formed on the top is drained out from the stoppered opening. The remaining cream layer is put into a pan for final separation by boiling.

As a cottage industry, oil extraction is done in the 'Chekku' in the rural areas. Among the primitive mechanical presses, the Indian 'Chekku' is found to be quite efficient. It consists of a stone or wooden mortar 75-100 cm in height held firmly by a sunken rod in the ground. Two persons are required for operation—one for attending the oxen and the other the mortar in which dried meat is usually crushed. Thampan (1975). This method is presently going out of practice.

Problems of Traditional Method of Processing

The grating of meat by hand or foot is a very strenuous work. Though the oil thus obtained is of good quality with good odour, its high moisture content prevents storage for a long period. The cake obtained after final pressing either in a primitive hand press or in 'chekku' has a very high percentage of oil and moisture, which reduces the yield of oil and storability of cake. It consumes more time and labour.

Prospects for Improvement

Method of grating by hand or foot may be mechanized to

reduce the drudgery without replacing labourer. Indian 'chekku' may be redesigned in such a way that minimum oil is left behind in the cake and consumes less time. Simultaneous arrangement may also be made to remove all the moisture found in the oil, thus giving it a better storage life. The improvement should be technologically superior and economically viable for rural masses, such that producer becomes the primary processor also.

(ii) Modern Methods

[1] Dry Processing

Dried copra is fed into mechanical oil expellers. The crushing takes place in the chamber as a result of which oil expellation is done. During operation, material comes in contact of high temperature.

Problems of Dry Processing :

The quality of final product in dry processing is dependent on copra, a raw material over which the oil miller generally has no control. The by product (oil and cake) because of under-going the high temperature-treatment becomes unsuitable for human consumption and has to be used only as animal feed. The oil has to be given extensive purification treatments (refining and deodorization). From economic point of view also it does not seem suitable for rural coconut growers.

[2] Wet Processing

Considerable research work has been done for the development of an economically viable process to convert wet coconut meat into protein, oil and other edible products in [i] Central Food Technological Research

Institute, Mysore, India [ii] Tropical Products Institute, London and [iii] Texas A and M University. The process tried and developed at CFTRI, Mysore is dealt in brief. Messrs Krauss,—Maffei of West Germany developed a process for wet processing of coconut Gregory (1961). One unit of this process (Fig 4) was gifted to India in 1961 which was subsequently installed in CFTRI at Mysore Bhatia (1963). In this process the harvested matured coconuts are autoclaved at a pressure of 3 kg/cm² for 10 minutes. Nuts are then cut and the meat is scooped out. This meat is passed through a roller mill, followed by hydraulic pressing. The emulsion obtained is centrifuged to yield cream and skim milk. Further separation of cream yields oil and an aqueous sludge, which is recycled. The process (Fig. 3) is much more complex, yielding five possible products : oil, meal, whey, protein concentrate and honey.

The yield of oil is about 90 per cent and protein yield is about 71 per cent. In one of the

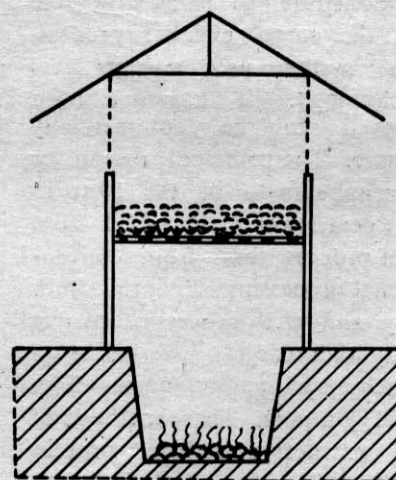


Fig. 3. Cross section of A type of copra smoke kiln used in many regions. Van Hall and Van De Koppel 1948.

Table 3
Composition of products from K.M./CFTRI process

Sl. No.	Material	Percentage				
		Moisture	Protein	Fat	Minerals	Carbohydrates
1.	Coconut honey [60° Brix]	40.0	15.6	2.0	6.8	35.6
2.	Acid coagulated proteins [by centrifugation at pH 3 to 4.0]	6.0	74.3	3.1	6.1	10.5
3.	Heat coagulated protein [at 82°C]	8.4	66.1	3.4	8.2	13.9
4.	Residual meal	9.7	5.2	8.7	1.6 (ash)	25.1 (crude fibre)

trials conducted with the plant at CFTRI, Mysore, 1000 kg of coconut kernel yielded 330 kg of oil, 60 kg of protein carbohydrate flour and 96 kg of meal Thampan (1975). The composition of the various products obtained in the process is reported in Table 3.

Problems of Wet Processing

The process has not yet been demonstrated to be as profitable as the copra expeller process. The system uses a high level technology. It has not been proved to be commercially viable. The principal reason for this appears to be the 10 to 15 per cent lower yield of oil from wet process than from conventional processing of copra. Both dry and wet processes involve very high capital investment on machinery and require high energy inputs. These methods of oil extraction reduce protein content in cake or flour due to

excessive heat developed and consequent denaturation.

Prospects of Dry and Wet Methods

Thus instead of wasting time on complicated processes, if the available expeller units and rotary units could be made more efficient, it would perhaps solve the problems to some extent. Greater attention must be paid towards development of small scale industries in villages. Actually, industrialisation should not mean always the large million-rupee factories located in or near cities. It is unlikely that the big business will be hurt by these small ones. The small industries would provide work, discourage migration to cities and in a way improve skills in far flung settlements. It would also be one way to return to near self-sufficiency and self-reliance.

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References

1. Bhatia, D. S. (1963). Modified Krauss—Maffei process for wet processing of coconut. *Coconut Bull.* 17 : 153-60.
2. Gregory, P. J. (1961). Coconut oil extraction and processing plant (machine). *Coconut Bull.* 15 : 41-48.
3. Singh, Jaswant (1980). Some aspects of post harvest technology in coconut. *Agril. Engg. Today.* 4 (5) : 20.
4. Singh, Jaswant (1981). Coconut husking machine. *Invention Intelligence*, 80-81.
5. Singh, Jaswant, Nambiar, K. K. and Nambiar, C.K.B. (1980). Design and development of a solar copra dryer. Paper presented at XVII Annual Convention of the ISAE held at IARI New Delhi.
6. Thampan, P. K. (1975). The coconut palm and its products. Green Villa Publishing House, 208-209.
7. Thieme, J. G. (1968). Coconut oil processing. FAO Agricultural Development Paper No. 89, pp. 11.