Glimpses on Coconut Processing

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Introduction

Coconut is an important source of vegetable oil used for both edible and industrial applications. It is estimated that nearly 50 per cent of coconuts in India are consumed raw, while the remaining quantity is converted to copra to obtain coconut oil. Coconut meat (kernel), the endosperm of the fruit contains 20 per cent carbohydrate, 36 per cent fat and 4 per cent protein at a moisture content of about 50 per cent. A number of products are derived from coconut of which copra is the most important one. Coconut oil can be extracted either from fresh kernel or from copra. Milled copra yields coconut oil which is extensively used for edible and cosmetic purposes, and copra cake is a valuable animal feed. Other products from coconut are the desiccated coconut, coconut cream, coconut milk powder, shell powder, activated carbon, etc..

Harvesting

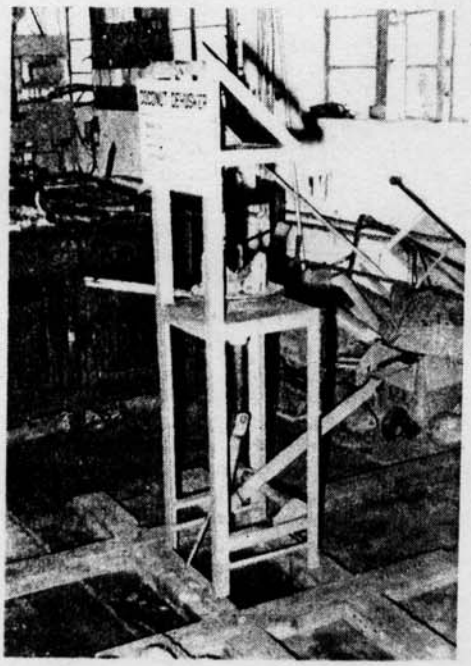
Coconuts are harvested at varying intervals in an year. The frequency differs in different areas depending upon the yield of the palms. In the West Coast of India, nuts are harvested 6 to 10 times in an year. In well maintained and high yeilding gardens, bunches are produced regularly and harvesting is done once in a month. Coconuts become mature in about 12 months. It is the ripe nut which is the source of major coconut products. Nuts which are 11 months old give fibre of good quality and can be harvested in the tracts where green husks are required for the manufacture of coir fibre. Therefore places where husks are required for retting, 10 to 12 harvests in an year are common in order to obtain husks in a perfect condition for retting.

Storage and Seasoning

It is a common practice to store or season the harvested nuts before they are further processed. The advantages of this procedure have been reported as (1) decrease in moisture content, (2) increase in thickness of copra, (3) increase in oil content , (4) greater meat resistance to bacterial sliming while sun drying, (5) easier husking, (6) cleaner and easier shelling, and (7) uniform quality of copra. (Grimwood, 1975)

Husking

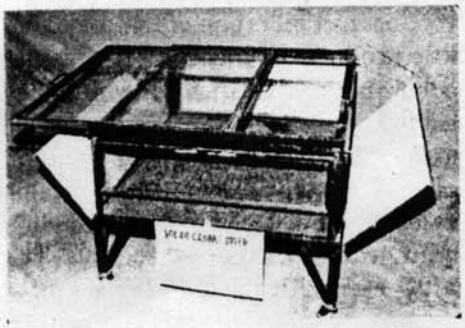
Traditionally husking is done manually by skilled workers with the aid of an iron spike driven to the ground. The work calls for skill and is strenuous. There has been long felt need for developing mechanical devices for husking coconut. CPCRI has developed a manually operated coconut dehusker. It consists of fixed and movable sets of blades to pierce and split the husks into parts. The nut is placed on three blades fixed to bottom frame and lifted by foot operated lever so that it gets pressed between lower and upper sets of blades . After complete piercing of blades the bottom plate with blades is rotated with hand lever . The dehusker can husk 110 nuts per hour (CPCRI, 1986). CPCRI has also developed a power operated dehusker which can dehusk about 600 nuts per hour (CPCRI,1996). The dehusker developed by Agricultural Engineering College, Thavanur (KAU) is a very handy one and is being used widely.



Coconut dehusker

Copra Drying

Fresh coconut meat contains about 50 per cent moisture which is to be brought down to 5 - 6 per cent by drying. Drying must be carried out within 4 hours of splitting since coconut meat deteriorates very rapidly due to growth of mould and bacteria. Microbial activity in the form of slime is seen if temperature is only 30°C and relative humidity around 80 per cent The greasy surface continues to develop and within 48 hrs penetrating mould appears (Nathaneal, 1968). Microbial activity is reported to be more when moisture content is above 20 per cent (Nair,1984). The methods generally used for drying of copra are (1) sun drying, (2) smoke drying or kiln drying and (3) indirect hot air drying.



Solar dryer

Sun Drying

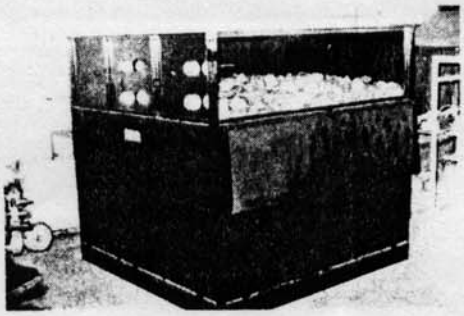
The conventional system of copra drying is by spreading the cups on any open surface for sun drying. This operation takes about 8 days and quality deterioration due to deposition of dirt and dust of wet meat is nearly unavoidable. Again if the atmosphere is cloudy and the temperature goes down during the initial days of drying, the copra will get infested with mould.

Solar Dryer

The drying time can be reduced to 3-4 days if proper solar dryers are used. If the dryer is an enclosed type, quality deterioration due to deposition of dirt can be avoided. A batch type solar cabinet dryer developed at CPCRI takes only 3 days for drying (Singh *et. al.* 1982, Patil, 1984). It consists of a cabinet made of jackwood with castor wheels. The drying surface is made of solar aluminium absorber sheet and the three aluminium reflectors fixed on three sides converge solar radiation into the drying chamber by which the temperature inside the drying chamber is brought to 20 to 25°C higher than the ambient temperature. The capacity of this solar dryer is 100 nuts and the cost of the dryer is Rs.3000 only.

Indirect Drying

Due to considerable capital investment and high rate of fuel used, indirect dryers were considered economical only in a relatively large scale. Hence the earlier reported dryers were all of building type with large capacity such as Samoa dryer, Camaro dryer, New College copra dryer, Iron hot table dryer, and Tonga hot air dryer (Grimwood, 1975). But in CPCRI, an indirect type copra dryer of 400 nuts per batch capacity using agricultural waste as fuel was developed. It consists of a drying chamber, plenum chamber, burning cum heat exchanging unit and a butterfly valve to control the rate of combustion and also the drying air



Smoke fire dryer having the capacity of 1000 nuts

temperature. The dryer requires only $3m^2$ area for housing and could be carried by 2-3 persons. The drying time required per batch is 36 hours spread over 4 days (Patil, 1984). So far, more than 200 units of this dryer have been sold to various copra makers and they are satisfied with its performance.

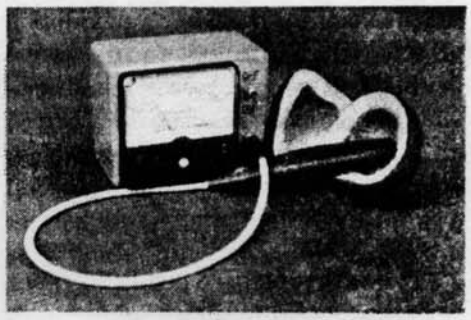
This dryer was further scaled up and suitably modified to raise its capacity to 3500 to 4000 nuts. This dryer is suitable for copra processing societies and for large holdings (CPCRI 1989).

An electrically operated dryer with forced hot air circulation was also developed at the Institute to dry 1000 coconuts per batch. It consists of 6 nos. of 1 KW strip heaters and a blower. The drying time taken is about 28 hours. (CPCRI 1989).

The Institute has also developed a smoke free collapsible copra dryer of 1000 nuts capacity which can dry coconuts in 24 hours. It has got a unique furnace wherein the fuel used is only shell.

Copra Moisture Meter

For safe storage of copra, the optimum level of moisture content recommended is 6 per cent. In the field, moisture content of copra is often estimated subjectively by the texture of copra or by its inflamability. This method gives only a very approximate estimation. To estimate the moisture content in a scientific and accurate way, CPCRI has developed a moisture meter which works on the principle of electric conductivity. It is calibrated to read the moisture content from 5 per cent to 40 per cent so that the moisture at the different stages of drying can be found out (Madhavan 1986). This moisture meter is being used by various agencies in Kerala as a quality testing instrument in their copra procurement programme.



Copra moisture meter

Chemical Treatment of Wet Kernel

Preservation of fresh kernel becomes essential when drying is delayed due to uncertainty of weather conditions. Sreemulanathan *et. al.* (1979) reported that application of a thin coat of glacial acetic acid prevented microbial growth during open sundrying. A chemical treatment of dipping fresh kernels in 1000 ppm propionic acid for 60 min. to preserve it upto 49 days without

Small holders dryer

further drying had been developed at CPCRI. This was found to be useful and simple to overcome the spoilage of kernel due to sudden onset of inclement weather (Patil, 1991).

Copra Storage

The safe moisture level of 5-6 per cent cannot be maintained in copra if stored under conditions of high relative humidity and wide fluctuating temperature. The wet copra should not be mixed with dry copra and storage structure should be such that there is minimum fluctuation in temperature compared to ambient to avoid moisture migration effects in the structure. Studies conducted at CPCRI have shown that copra can be safely stored if kept in saturated atmosphere of either neem leaf gas, bio gas or SO_2. Painting of roof with mat white reflective paint has been reported to reduce temperature fluctuations within 10 degree centigrade, thus preventing serious condensation effect. The walls also should be provided with sufficient number of adjustable ventilators. The floor of the structure should be water proof, smooth and easy for cleaning. The cracks and crevices in the structure must be regularly cleaned out and filled in with mortar so as to eliminate residual population of insects. If the commodity is bagged, it should never be stored directly against the wall, and should be provided with proper tonnage. Marar and Padmanabhan (1960) reported that copra could be safely stored in plastic lined gunny bags even during rainy season.

Extraction of Oil From Copra

In the rural areas and villages copra is crushed in the primitive 'chakku' driven by bullocks. The power driven chakkus or rotaries are used in larger establishments and are driven by steam, diesel or electricity. In the organised sector, copra is crushed by expellers. A double crushing unit gives better extraction; hence, series of expellers are preferred. The clean copra is passed to disintegrator, where it is converted into a coarse meal. The meal is heated in the cooker by steam up to 88°C. The pulped copra is fed continuously to the expeller from which the oil and the cake are forced in different streams. The first expeller gives 50 per cent extraction and the second extracts the remaining, leaving about 10 per cent oil in the cake compared to 70 per cent in copra.

The oil can further be extracted from cake with hydraulic pressing but these presses have gone out of business due to higher cost of maintenance. For removing this oil, the solvent extraction method with hexane is followed or the cake as such is used as cattle feed.

Coconut oil is one of the major edible products of coconut. It posesses a very high saponification value (250 to 260) and a very low iodine value (7.5 to 9.5) where as other common oils and fats have saponification value ranging from 180 to 200 and iodine value ranging from 40 to 200. The high saponification value coupled with low iodine value gives it a very high hardness number. That is why, compared to other soaps, coconut oil based soaps are extremely hard and produces an excellant lather.

Storage of Coconut Oil

Unrefined coconut oil is susceptible to rancidity due to the presence of certain proportion of free fatty acids . This is accelerated by the presence of moisture , air, light and fat splitting enzymes leading to the formation of peroxidation products. These usually originate from the copra itself, if it is not properly processed. Further studies have shown that the shelf life of coconut oil can be improved by the addition of either antioxidants or preservatives. Thus addition of either common salt (1 per cent), tamarind (2 per cent) or citric acid (500ppm) to coconut oil enhance the shelf life to more than one year.

Coconut Products and Byproducts

These can be classified as food and non-food products depending upon their end use. The products which are utilised as food in the natural form or after processing into various products include the wet meat or kernel ,coconut water, coconut milk and milk products, desiccated coconut and coconut flour. Among non food products, also known as byproducts, coir, coconut pith and shell assume commercial importance.

Coconut Water

The products that can be prepared from matured coconut water are

nata-de-coco, a gelatinous delicacy formed by the action of micro organisms and coconut vinegar. Bottling of coconut water for use as a soft drink is also gaining popularity. Preservation of tender coconut water in pouches / cans offers enormous scope as a natural beverage without any artificial colour and flavour. Of late the consumer is well aware of the possible health hazards of the artificial beverages and soft drinks and so prefers tendernut water to other soft drinks. Fresh and sweet coconut toddy is also having very good market potential. Toddy tapping is a highly remunerative venture, which can be popularised, in the next century. Fresh coconut toddy without fermentation can be promoted as a sweet natural drink.

Coconut milk and milk products are prepared from fresh matured coconuts. In this process the white coconut meat is ground into a slurry from which coconut milk is seperated by pressing. This is centrifuged and further processed to get coconut cream, milk powder, etc.

Desiccated Coconut

Desiccated coconut is the white kernel of the coconut, comminuted and desiccated to moisture content of less than 3 percent. This is a very important commercial product having demand all over the world in the confectionery and other food industries, as well as an ingredient in the fillings of chocolate and candies.

Sri Lanka and Philippines are the major desiccated coconut producing countries. In India, only small units of production are available and the annual production is only around 30,000 tonnes. The small production units, however, do not utilize modern processing technologies, particularly in the drying and related areas. On an average, 7000-8000 nuts give one tonne of desiccated coconut. The oil content ranges from 68 to 72 percent, but should not contain more than 0.1 percent free fatty acids.

Coconut Byproducts

The major coconut byproducts like husk and shell can be converted to value added products like activated carbon, shell charcoal, shell flour and shell based handicrafts. Lack of efficient technologies and unorganized set up are the main reasons for the slow pace of development in this area.

The husk usually forms 35 to 45 per cent of the weight of the whole nut when ripe. About 30 per cent of the husk is fibre and 70 per cent is coir dust. Apart from the usual coir and coir products, coir pith finds varied uses as manure, as a mulch material and for making briquettes, with a good export potential. The briquettes can be used as a substitute fuel in place of firewood used in tile and brick industries and for other industrial heating purposes. Coir pith has also been put into trial for the production of biogas, light weight building bricks and also as a soil conditioner for moisture retentivity.

Coconut Shell Based Products

Coconut shell powder is preferred to many other similar materials like wood bark powder, peanut shell powder etc. because of its uniformity in size and chemical composition. Shell charcoal is also another product having extensive demand in the manufacture of activated carbon. Shell charcoal is prepared by burning the shell in a limited supply of air, so that the shells are only carbonized and not burnt to ash. The most modern method of manufacturing shell charcoal is using the Waste Heat Recovery Technology. Here, the flue gases evolved during carbonization is burnt in a furnace to produce process heat for application in the coconut processing industry like copra making and desiccated coconut.

Another product which is gaining attention is the activated carbon. Coconut shell based activated carbon is the most superior material for gas adsorption because of its small pore size and also due its high mechanical strength. This is an energy intensive process and hence technologies for minimizing the operating cost by cutting down the energy utilization should be devised.

Coconut Wood Processing

Freshly cut coconut trunks from senile coconut trees can be used as timber if treated with preservatives, to increase its shelf life. CPCRI has established treatment procedures for coconut timber processing (Mathew,1998). Accodring to this, 4-6% CCA, 70-30 mixture of creosote and bunker oil are good preservatives for coconut. The trunks can be either dipped in these chemicals or these chemicals can be brushed on the trunks. Philippines has developed a technology known as HPSD (high pressure sap displacement) treatment. It is a process of preserving the strength and durability of freshly felled trees by forcing out the sap from the trunk using a waterborne preservative solution. This process uses a high pressure sap displacement apparatus. Treated coconut timber can be used as electric poles, telecom poles and for interior uses such as furniture, window and door frames.

Conclusion

The economy of coconut processing is presently dependent upon the price behaviour of coconut oil which is highly unstable and

linked to that of other major oils and their overall availability in the country. The coconut based economy can be stabilised only when such dependance on a single product is minimised through the promotion of farm, household and community level processing of the multiple products and byproducts of the coconut palm. In the fast changing global scenario where liberalisation is pushed up coconut industry may not be able to survive unless the cost of production is reduced and the productivity increased. This will definitely combat the existing situation of confining to the traditional processing technologies in coconut.

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The CIIF Group

The Coconut Industry investment Fund (CIIF) Group is one of the most diversified conglomerates in the Philippines toady. The Group's mandate is to develop a vertically integrated set of operations that would best add value to coco-based products, working up the coco chemical chain, and thereby contributing substantially to Philippine economic development.

Managed by the CIF Management Company, Inc. and led by its Chairman and Chief Executive Officer, the group is engaged in several coconut-based businesses which characterize its diverse nature.

The CIIF has a Coconut Oil Milling Group which is a conglomerate of coconut oil milling and trading companies based in the Philippines, the world's largest exporter of coconut oil. In addition, the group has trading offices in the United States and Europe.

Controlling 21% of Philippine Oil Milling capacity, the CIIF Coconut Oil Milling Group has the capability to refine and produce a number of high grade and excellent quality coconut oils. This is the type of value-added activity that the Group intends to pursue over the long term.

Among the different products that are processed in the five (5) oil mills and refineries of the Group are: crude coconut oil, low acid oil, neutralized and bleached oil called cochin oil, neutralized, bleached and deodorized oil, acidulated oil, shortening, pork lard substitute, blend oil, copra expeller meal and copra extraction meal. The Group is also capable of producing other coconut oil products based on the specification of a particular buyer.

Another subsidiary of the CIIF Group of companies is Cocochem. Founded in 1981, Cocohem started commercial operations in 1986. It has become a reliable quality supplier of oleochemicals that has penetrated both the domestic market and the overseas markets of the Americas, Europe and Asia.

The Cocochem plant is one of the largest cochemical complex in Southeast Asia. From a feedstock of about 70,000 metric tons of coconut oil a year, the plant yields 36,000 metric tons of fatty alcohols, 29,000 metric tons of fatty acid products, and 8,500 metric tons of glycerine.

The market for Cocochem's products is expected to grow proportionally as more local industries realize the true advantage of locally derived cocochemicals in the production of consumer and industrial products. Presently, the soap and detergent industries consume a substantial portion of the plant's output. However, the pharmaceutical and nutrition industries offer opportunities that have not yet been tapped.

Still another subsidiary of the CIIF Group is the United Coconut Planters Bank (UCPB), one of the five largest private domestic banks in the Philipp-ines. It has been granted a universal bank status of the Philippine Central Bank, and is also a trustee of the Coconut Industry Investment Fund.

Other companies under the CIIF Group include the Minola Corporation, Silahis Marketing Corporation and the Cocolife and UCPB General Insurance Corp. (UGIC). The Minola Corporation is a refiner of coconut oil and an importer of corn oil. Its products are mainly used for frying and as salad oil. Silahis is mainly a marketing arm of the Group, while Cocolife provides life insurance services, including those of the coconut farmers through the farmers' reserve fund. UGIC is a subsidiary of Cocolife which provides non-life insurance services.

For further information about the CIIF Group, please contact: the Chairman and CEO, CIIF Management Co., Inc. 16th Floor, UCPB Building, Makati Avenue, Makati, Metro Manila, Philippines; Tel: (632) 818-8361; Fax: (632) 815-8370.

The Co-comunity