POST HARVEST TECHNOLOGY OF COCONUT

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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% of coconut in India are consumed raw, while the remaining quantity is converted as copra to obtain coconut oil. Coconut meat (kernel), the endosperm of the fruit contains carbohydrate 20%, fat 36% and protein 4% at moisture content of 50%. Coconut oil can be extracted either from fresh kernel or from dried kernel known as copra.

A number of products are derived from coconut and among them copra is the major one. When milled copra yields coconut oil which is extensively used for edible and cosmetic purposes, copra cake is a valuable animal feed. Other products from cocohut are the desiccated coconut, coconut cream, coconut milk powder, shell powder, activated carbon etc..

HARVESTING

Coconuts are harvested at varying intervals in a year. The frequency differs in different areas depending upon the yield of the trees. In the West Coast of India, nuts are harvested 6 to 12 times in a year. In well maintained and high yielding gardens, bunches are produced regularly and harvesting is done once in a month. In poor plantations there may be only six harvest in a year. In places where husks are used for retting, 10 to 12 harvests in a year are common in order to obtain husks in a perfect condition. Coconuts become mature in about 12 months. It is the ripe nuts 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.

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 are (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 (7) and uniform quality of copra.

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 three parts. The dehusker can husk 110 nuts per hour. Later CPCRI has developed a power operated dehusker which can dehusk about 600 nuts per hour. The dehusker developed by Agricultural Engineering College, Thavanur (KAU) is very handy and is being used widely.

COPRA DRYING

Fresh coconut meat contains 50 -55% moisture which is to be brought down to 5 - 6% 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 30°C and relative humidity around 80%. The surface shine continues to develop and within 48hrs penetrating mould appears (Nathaneal, 1968). Microbial activity is reported to be more when the moisture is above 20 % (Nair, 1984). The methods generally used for drying of copra are (1) solar drying, (2) smoke drying or kiln drying and (3) indirect hot air drying.

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 atmosphere is cloudy and 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). Solar dryers are classified based on the following criteria: 1) Whether or not the drying commodity is exposed to insolation; 2) The mode of air flow through the dryer; 3) The temperature of the air circulated to the drying chamber. Accordingly, solar dryers can be termed as either direct or indirect. Direct dryers are those in which the copra is exposed to the sun and in indirect dryers it is placed in an enclosed drying chamber and thereby shielded from insolation. In direct drying chambers heat transfer to the drying copra is by convection or radiation and so the rate of drying is greater than that for indirect dryers.

Due to considerable capital investment and high rate of fuel used it is considered earlier that indirect dryers are economical only in large scale. Hence the earlier reported dryers such as Samoa dryer, Camaro dryer, New College copra dryer, Iron hot table dryer, Tonga hot air dryer (Grimwood, 1975) are having larger capacity. But in CPCRI, an indirect type copra dryer of 400 nuts per batch capacity using agricultural waste as fuel is 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 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 100 units of this dryer have been sold to various copra makers and they are satisfied with its performance. This dryer is further scaled up and suitably modified at CPCRI to raise its capacity to 3500 to 4000 nuts and is suitable for copra processing societies and for large holdings.

An electrically operated dryer with forced hot air circulation is also developed at CPCRI 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 hrs.

Copra Moisture Meter: The Indian central

coconut committee had prepared standards for grading copra. The grading is mainly based on moisture content (Table 1).

Table 1. Grading of copra as per moisture content.

Description	Approx. moisture content (%)
Wet coconut meat, fresh coconut kernel	50
Wet or half dried copra	20 - 30
Mixed copra, undried copra	10 - 20
Fairly dry copra	8 - 10
Commercially dry copra	6 - 8
Well dried copra	5 - 7
Warehouse dried copra	5 - 6

The optimum level of moisture for safe storage of copra is recommended as 6%. In the field, moisture content of copra is often estimated subjectively by the texture of copra or by seeing its inflammability. This method is only approximate. 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% to 40% so that the moisture at the different stages of drying can be found out. This moisture meter is being used by various agencies in Kerala as a quality testing instrument in their copra procurement programmes.

Chemical Treatment to Wet Kernel: Preservation of fresh kernel becomes essential when drying is delayed due to uncertainty in weather conditions. Sreemulanathan et. al. (1979) reported that application of 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 4 days without further drying has been developed at CPCRI. This is found to be useful and simple to overcome the spoilage of kernel due to sudden onset of inclement weather.

Copra Storage: The safe moisture level of 5-6% 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 the 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 has 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°C, thus preventing serious condensation effect.

The walls 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 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 dunnage. Marar and Padmanabhan (1960) reported that copra could be safely stored in plastic lined gunny bags even during rainy season.

EXTRACTION OF OIL

In rural areas 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 and 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% extraction and the second extracts the remaining, leaving about 10% oil in the cake compared to 70% 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. This is referred to as lauric oil in the world market because of its high lauric acid content. Coconut oil is used in India (a) for culinary/ edible purposes (b) for toiletry purposes (c) for soap making and (d) as an illuminant and lubricant. The industrial application of coconut oil is mainly attributed to the presence of maximum lauric acid and glycerides which are not present in other vegetable oils.

(a) Edible purposes: The oil is largely used for culinary purposes in Kerala and some parts of Karnataka and Tamil Nadu. Because of the high content of saturated fatty acids, coconut oil is highly resistant to oxidative rancidity and retains a pleasing flavour. Hence coconut oil bearing food have a long shelf life.

(b) Toiletary purposes: Coconut oil is used as body massage oil , as hair oil , and for the preparation of hair tonics for which the crude oil is often subjected to one or more processes such as bleaching, refining, deodourising, and colouring. Coconut oil forms an important ingredient in the preparation of cosmetics such as face creams, shampoos, etc.

(c) Soap making: While most oils and fats consist of mostly glycerides of fatty acids viz., palmitic, stearic and oleic, the principal fatty acids of coconut oil are lauric and myristic which are of lower molecular weights. Hence the oil is easily saponifiable even under cold conditions. This property, viz., the ability of coconut oil to combine with alkalies such as caustic soda (in solutions of proper concentrations) even under cold conditions has made it the most widely used oil for the manufacture of cold process soaps on a cottage basis.

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%), tamarind (2%) or citric acid (500ppm) to coconut oil enhance the shelf life to more than 1 year.

COCONUT PRODUCTS AND BYPRODUCTS

This 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. Some of the byproducts from coconut can also be converted to value added products such as activated carbon, shell charcoal, shell flour and shell based handicrafts.

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 an ingredient in the fillings of chocolate and candies. Sri Lanka and the Philippines are the major desiccated coconut producing countries. In India, only small units of production are available and the annual production is only around 10,000 tonnes. These 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 %, but should not contain more than 0.1 % free fatty acids.

Husk: The husk usually forms 35 to 45% of the weight of the whole nut when ripe. About 30% of the husk is fibre and 70% 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 in 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 absorption because of its small pore size and also 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. Research work is in progress at CPCRI in this field. Philippines has already 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 to make furniture, window and door frames.

CONCLUSION

The coconut based economy should be developed not only on coconut oil and copra, but also on coconut byproducts with a view to integrate the whole processing for fuller utilization. Consumer awareness and acceptance of the products should go hand in hand with this. This will definitely combat the existing situation of confining to the traditional processing technologies in coconut.

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