

Diversified Uses of Coconut

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Traditionally coconut is dried to produce copra which is then milled or solvent extracted to get the oil. The fresh kernel of ripe coconut constitutes an essential ingredient in the recipes of diverse food preparations in the households as well as in food industries of different countries. Coconut chips, desiccated coconut, virgin coconut oil, partially defatted coconut gratings, coconut cream, coconut milk powder are some of the edible products prepared from fresh kernel. Coconut water which is a byproduct in the copra industry, can be converted to vinegar and nata de coco and even used for biogas production. Technologies are available now to pack tendernut water in cans and pouches and preserve as cool drinks. Under non-edible products from coconut, shell is most important. Shell powder is used in plastic industries and in bakelite manufacturing as a filler material and is used in mosquito coils. Shell carbon and activated carbon are having industrial importance in that it is mainly utilised in purification of water, oil, etc. Coconut wastes such as petioles and bunch wastes are used as a substrate for mushroom cultivation and also be used for vermicomposting. Thus every part of the palm is beneficial to mankind and hence it is aptly described as "Kalpa Vriksha".

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Coconut is the only tropical crop commercially cultivated extensively in about 93 countries with an area of 12.8 million hectares and production of 10.9 million MT (copra equivalent) in 2001. In India, Kerala stands first in both the area under cultivation and under production. The coconut based economy can expect a revival from the negative impact of liberalised imports only when the profitability of coconut farming is delinked from the price behaviour of coconut oil. This is possible to achieve through efficient utilisation of the land under coconut and also the products at the on-farm and community levels. India has not made tangible progress in product diversification and byproduct utilisation of coconut except for the traditional activities such as oil milling and coir processing. As a result coconut oil continues to be the only major coconut product having influence on the farm level price of coconut. This situation can be transformed only when coconut based products, both edible and non-edible, gets priority over coconut oil. In the same way we have not achieved noticeable progress in the utilisation of the multiple products of coconut palm for value addition both at the farm households and on community levels. As compared to the tardy growth recorded by the country in the processing sector, most of the coconut growing countries are profit making from the production and exports of diverse coconut products. Philipines export over 40 non-traditional products of which coco chemicals,

coconut milk products, coconut water based products, and shell and coir products are of importance. From Sri Lanka shell based products, fresh coconuts, coir products, double distilled arrack and even leaf mid ribs are being exported. Likewise Fiji has started producing and exporting coconut cheese. Coconut is one of the export items from Indonesia and Thailand. Although possibilities are wide it is prudent for us to concentrate on selected products, which could compete pricewise and qualitywise, both in the domestic and export markets.

This paper deals with the various processes for the production of coconut based value added products.

Products derived from fresh kernel of matured coconut

Traditionally coconut is dried to produce copra which is then milled or solvent extracted to get the oil. Fresh coconut kernel contains about 4 to 4.5 percent protein. The major portion of the original protein passes on to the coconut cake which is the residual product after oil extraction. The oil has to be refined due to the development of free fatty acids produced during the drying stage which needs sophisticated equipments. The cake however is not considered suitable as a protein supplement because in the process of oil extraction the original protein gets discoloured and denatured due to the generation of very high temperature. Hence it is mainly used in ruminant feeding.

The fresh kernel of ripe coconut constitutes an essential ingredient in the recipes of diverse food preparations in the households as well as in food industries of different countries. In the household food preparation fresh kernel is used extensively in the grated, paste or milk form. The fresh kernel is of low acid nature, meaning extremely prone to microbial degradation, especially in tropical climate. The dairy industry with similar type of products has, by introducing hygienic processing of high standard, managed to control the quality of the end products. Therefore fresh kernel processing plants require the same level of hygiene as the dairies for safe and consistent production.

In the fresh kernel processing industries, shelling and removal of testa are the common labour intensive unit operation. As the existing machineries available are not satisfactory, further refinement is required.

Desiccated coconut

Desiccated coconut is the white kernel of the fruit, comminuted and desiccated to a moisture content of less than 3 percent. It is white in colour. It is a very important commercial product having demand all over the world in the confectionary and in other food industries, as one of the main subsidiary ingredients of fillings for chocolate, candies, etc. It is also used uncooked, as decoration for cakes, biscuits, ice cream and toasted for short eats.

Coconut chips

Coconut chips can be prepared by dehydrating the intermediate moisture coconut kernel. Intermediate moisture coconut kernel is the mature coconut kernel after removing the moisture content of the kernel partially by osmotic dehydration by using osmotic medium like sugar syrup. Coconut Chips is crispy and can be packaged and marketed in laminated aluminium pouches, which will have shelf life of 6 months. Since it is in ready-to-eat form, it could be used as snacks at any time. It could also be used just like fresh kernel after rehydration of the chips in hot water. Coconut chips with different flavour can be prepared by adding the required flavour essence in the osmotic medium. Instead of sweet, salted coconut chips and medicated coconut chips can also be prepared by suitable change in the osmotic medium.

Coconut milk and related products

Coconut milk is an emulsion of its oil in water into which some of the soluble components of the fresh kernel have already been passed. It is milk like liquid obtained from the gratings of the fresh

kernel after they are mixed with some water, kneaded and pressed out. The milk is pleasant and sweet with an agreeable flavour. A comparison of the coconut milk with cow's milk has shown that coconut milk is richer in fat, poorer in protein and sugar content. Apart from household culinary uses, coconut milk is utilised as a substitute of dairy cream in beverage type milk, as evaporated and sweet condensed milk and in the preparation of white soft cheese, yoghurt and many other foodstuffs. Commercial production of these products has been promoted in the Philippines, Thailand, Indonesia, Western Samoa, Sri Lanka and Malaysia and to some extent in India.

Bottled coconut milk : The processing technology involves extraction of milk from coconut, straining the milk in a cheese cloth into an aluminium kettle with 0.1 percent benzoic acid before placing the kettle in an autoclave at 117°C for three minutes with steam injection. The temperature of the milk in the pot is then brought down to 80-85°C, by running tap water. The milk is then homogenised for about five minutes and bottled at 70°C to 80°C. The final product is as good as cow's milk and is highly nutritious.

Coconut cream : Coconut cream is a white, smooth, liquid cream with excellent coconut flavour and 20-30% fat, aseptically packed. The product is easily pourable and ready for direct serving or to be used in other food preparation. Coconut cream is essentially used as a fat source for the reconstitution of the skimmed dairy milk and as a component of infant milk powders.

Dehydrated coconut milk : This is produced on a commercial scale in the Philippines, Malaysia and India. In the Philippines, the fresh coconut milk is blended with small amounts of additives such as maltodextrin or casein and is spray dried. The final product is marketed in laminated foil bags. The powder easily dissolved in water to form a milky white liquid with the flavour and texture of coconut milk.

Virgin oil : Obviously, coconut oil has difficulty competing with other vegetable oils. However, by altering the manufacturing process, it is possible to produce a virgin oil of high quality with the following added values viz., coconut flavour, low free fatty acid (less 0.07% as lauric acid) without refining, maximum natural vitamin E content. No chemicals are added and it should be free from aflatoxin contamination. In this process, coconut milk is filtered and concentrated and then cream is separated by centrifugation. The cream is stirred

vigorously to get the virgin coconut oil by a process called phase inversion. The oil thus obtained is very clear, nutritious and has got a longer shelf life.

Edible coconut flour : After expelling the milk, the protein rich residue is dried and powdered to obtain a product called coconut flour. The flour so obtained typically contains 7-8 percent protein, 3-5 percent moisture and 17 percent oil. It can be used as an ingredient in weight control foods because of its high fibre content. The protein contained in the flour is identical to that contained in the original fresh kernel. After blanching the residue has to dry. The dried coconut residue is passed through a special type of screw press under a specified expeller setting to reduce oil content of the residue without too much change in colour which will increase the shelf-life of the flour. The defated flakes are redried to reduce its moisture content to 2.5 to 3.0 percent which is finally ground to reduce particle size to a fine mesh.

Products of tender coconut

Tender coconut water has a great potential as a health drink both in Indian and international market. It has a caloric value of 17.4 per 100 g of water. Now technology is available to pack tender nut water in pouches and it can be stored safely for 3 months.

Snowball tender coconut : The soft tender kernel or solid endosperm of tender coconut is a delicious dessert. But the traditional method of its extraction is difficult, time consuming, and risky. Thus the kernel of the tender coconut is sometimes eaten or else thrown away. Coconut of 8 month maturity is more suitable for making snowball tender coconut. Before scooping out the globular tender kernel with water, a groove is made in the shell by using a machine. By inserting the scooping tool, specially made for this purpose, in between the tender kernel and shell and then by rotation of the nut, the snowball is scooped out from the shell. It is nutritive and is a drink and snacks at the same time. Since the snowball tender nut can be individually packed and refrigerated under hygienic conditions, the shelf-life of this product is prolonged and therefore this ready-to-serve product is found to become popular.

Canning of tender coconut : The tender coconut kernel obtained from 7 to 8 month matured coconut, usually available in tender coconut water packaging industries, canning can be done with covering syrup of 30 to 40 Brix. For canning, the pressure processing may be avoided by adding 0.3 percent to 0.4 percent citric acid in the cover syrup. Addition of ascorbic acid and antioxidants will have beneficial effect.

Products derived from coconut water of matured fruits

In most of the countries coconut water is now a waste product of the coconut industries. As the nut matures, the composition of the water, especially the sugar content, also undergoes significant changes. During the early stages of development, the quantity of invert sugar present in the water increases and reaches a maximum at 220 days. After this stage, sucrose appears in the water and the concentration of total sugars falls. Similarly the concentration of total solids also declines and subsequently disappears during germination.

Bottled coconut water : Bottling of coconut water for use as a soft drink is gaining popularity. Coconut water can be marketed as natural soft drink if preserved and packed. Non-carbonated beverage can be produced from the coconut water of mature nuts. The process involves collection of water, upgradation and pasteurisation, filtration and bottling. Coconut vinegar and nata de coco are prepared from coconut water which has got industrial demand.

Process for the production of copra and coconut oil

The dried coconut endosperm is called *copra*. The *copra* and the oil it contains are the principal products of coconut palm. With oil content of 65-70 percent, *copra* is the richest source of fat. The essential requirement of *copra* drying is to bring down the moisture content of the wet fresh kernel from 45-55 percent to 5-6 percent. There are two types of *copra* - edible *copra* and milling *copra*. Edible *copra* is available in two forms - ball *copra* and cup *copra*. The production of edible *copra* in India is around 50,000 tonne per annum and the produce is utilised for sweet snacks preparations in households and as an ingredient in the processed foods.

Milling copra : The conversion of fully matured coconuts into *copra* for milling purpose is the most common processing activity in the major coconut producing countries. Drying is an important post-harvest operation in the production of *copra* for the extraction of good quality oil. To obtain good quality white *copra*, particularly during rainy season, a suitable dryer using indirect heating is essential.

Coconut oil from copra : In most of the coconut producing countries, *copra* crushing has become a traditional industry. Power driven 'Chekkus' or rotary mills, expellers and hydraulic presses are used for crushing on a commercial scale. The quality

of *copra* is related to the quality of coconut oil. *Copra* is cut into small chips in a *copra* cutter. The chips are fed into steam jacketed kettles and cooked mildly at a temperature of 70°C for 30 minutes. After proper cooking, the cooked material is fed into the expeller continuously to extract oil. This oil is filtered by means of a filter press and stored in MS tanks. Bulk packaging is done in tin containers. HDPE containers and polymeric nylon barrier pouches are used for small consumer packing.

Similarly many nonfood products can also be prepared from coconut. Among the nonfood products of coconut, coir or coconut fibre, coconut pith and shell assume commercial importance. Other parts of the palm especially coconut wood and leaves are recently gaining attention.

Coir fibre : The coir fibre is extracted from coconut husk. The husk of an average coconut weighs about 0.4 kg of which 30 percent constitutes coir fibre and the balance 70 percent is pith, outer skin etc. There are two types of coir fibre: white fibre and brown fibre. The world production of coir fibre is estimated at 0.330 million tonnes per annum of which the contribution of India and Sri Lanka is about 65% and 32% respectively.

Structure and properties of coir fibre : The chemical constituents of pure coir are cellulose (32-43 percent), lignin (40-45 percent), hemicellulose (0.15-0.25 percent), and pectin which makes it more extensible compared to other natural fibres. The fibre is weather-resistant and also resistant to fungal and bacterial decomposition which are attributed to the high lignin content. Lignin is the main constituent responsible for the stiffness of the coir and also partly responsible for the natural colour of the fibre.

Coir pith : Coir pith constitutes as much as 70 percent of the husk and is now a waste product of the coir industry. Accumulation of this waste in industrial yards causes environmental pollution and fire hazard. Coir pith absorbs over eight times its weight of water and parts with it slowly. It is also excellent organic mulch in all kinds of soil. Pith in combination with cowdung is used for biogas production.

Coconut shell : Coconut shell, is another important commercial product. The major use is as a fuel. To a lesser extent, it is used as a raw material for the manufacture of *hookah* shells, various domestic utensils, curious, fancy items, etc. The

commercial utilization of coconut shell for the production of shell charcoal, activated carbon, shell flour etc is now gaining importance in the producing countries with an expanding market demand.

Major shell products : Shell charcoal, activated carbon, and shell flour are the main commercial products obtained from the shell. Good charcoal is uniformly dark and produces a metallic sound when dropped on hard ground. The charcoal has a high adsorption capacity for gases and colouring matter and can, therefore, be used as a refining agent both as a deodoriser and as a decolouriser. The shell charcoal also finds way to laundries, smitheries, etc. The commercial value of shell charcoal lies in its use as the primary raw material for the production of activated carbon.

Activated carbon is a by-product extensively used as agents for purifying, refining and bleaching of volatile oils and chemical solutions. They are also in demand as an adsorbent of gases. Of late, a large number of plants based entirely on coconut shell charcoal have come up in the major coconut growing countries. In India, the use of coconut shells for the manufacture of activated carbon is covered by the Indian Patent No.109082.

Coconut shell flour is the pulverized form of shell known as 'Coconut shell flour'. This is manufactured from shells of fully matured nuts. Coconut shell flour gives a smooth and lustrous finish to moulded articles and also improves their resistance to moisture and heat. It is used in plastic industries as a filler material, and in the manufacture of bakelite and mosquito coils and agarbathis.

Coconut wood

Coconut wood is not naturally durable and it should be properly treated to protect it from wood destroying organisms like termites and decay fungi. The non-pressure methods, which involves brushing, spraying, dipping, steeping, dip diffusion, double diffusion and hot and cold bath appear to be promising. The preservatives used are either oil borne such as, creosote, pentachlorophenol and cuprinol, or waterborne salts like the standard chromated copper arsenate (CCA) under different trade names. The service life of treated wood is two to six times more than the untreated material. Coconut wood is also found useful in the manufacture of particle boards. Thus every part of the palm is beneficial to mankind and hence it is aptly described as "Kalpa Vriksha".