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II.E.2 – COCONUT

Milk Bottle on the Doorstep of Mankind

In prehistoric times, the water content of the immature coconut fruit was more important, as a drink, than was any part of the mature nut, as a food. Similarly, recent history also emphasises coconut's non-food use. The oil extracted from the kernel of the ripe coconut is an industrial raw material for products ranging from soap to explosives. In the intervening historical period, say the last three thousand years, coconut has served many human communities around the tropics in a variety of ways. King Manuel of Portugal itemised some uses, in 1501, at a time when the coconut first became well known in Europe ". . . and from these trees and their fruit are made the following things: sugar, honey, oil, wine, vinegar, charcoal and cordage . . ., and matting and it serves them for everything they need. And the aforesaid fruit, in addition to what is thus made of it, is their chief food, particularly at sea" (Harries, 1978).

Unfortunately, it is not possible to provide as much information as one might want on coconut in prehistory. This is because heat and humidity work against the preservation of fossils and there is a dearth of archaeological materials, coprolites or biological remains on tropical seashores where the coconut palm is native. Coconut residues do not accumulate because the palm grows and fruits the year round. This makes crop storage unnecessary, and, in fact, because of their high water content coconut seednuts cannot be stored, they either grow or rot. And the tender, or jelly coconut, is even less likely to survive in storage.

The sweet liquid in the immature fruit, however, is safe to drink where ground water may be saline or contaminated. It is a very pleasant drink and the coconuts are readily transported by land or sea. In short coconut is potable, palatable and portable! Unlike bottled, canned or otherwise packaged drinks, coconuts are sustainable and recyclable! It has been suggested that, as the "milk bottle on the door step of mankind" (Harries, 1981), the coconut could have influenced our human ancestors in the time before agriculture.

Leafy Vegetables, Fruits and Nuts

Millionaire's Salad

Although not strictly a green leafy vegetable, coconut heart of palm can be compared with blanched leafy vegetables such as endives, or with celery, or globe artichoke. It is called millionaire's salad on the assumption that only the very rich can afford to fell an entire palm, and have the leaf stalks cut away to expose the large bud, which is the part that is eaten. Palm hearts are best eaten fresh but they can be cooked, canned or pickled (Harries, 1993).

Other palms can be prepared in this way and there are palm species where this is a commercial operation. Palm heart production could easily be commercialised for coconut, especially in tropical coastal areas where tourism has replaced indigenous agriculture. One coconut heart can serve 40 side salads. Overaged palms, overgrown seedlings from coconut nurseries or those sprouting like weeds in neglected groves, could be used. It would even be practical to plant them at high density for sequential harvesting.

Farmers are reluctant to cut down coconut palms, even when these are over-aged. They do not thin-out palm stands that are too dense to be productive. They usually ignore overgrown seedlings. All this may be attributable to the period of domestication when the coconut palm might be the sole surviving food plant after a tidal wave or a hurricane. To cut down a coconut palm threatens future life support. In some communities, coconuts are planted to celebrate a birth. If the palm dies or is felled, the human life it commemorates may be jeopardised. A recent example of the extreme reluctance to cut down the trees occurred during Liberia's civil war when coconut palm hearts were eaten by the starving population only as a last resort.

Apple for the Teacher

Botanically, the coconut fruit is a drupe. Plums, peaches and cherries, which are also drupes, have edible outer parts to encourage dissemination by animals. Other palms, particularly the date, have soft, sweet and edible fruit. The coconut is different because the outer covering, the husk, is generally bitter and stringy when young and dry and fibrous when mature. Some rare individual coconut palms have an edible husk. It is less fibrous, spongier, easily cut, and sweet to chew like sugar cane (Harries, 1993).

What is known as a coconut "apple" is botanically, the haustorium of the germinating seed. The haustorium begins to develop at the earliest stage of germination, even before the shoot or roots emerge through the husk. Coconuts harvested in this condition are suitable for domestic purposes or for second grade copra, but generally not for desiccated coconut. Often the apple is put aside to eat. It is slightly sweet, slightly oily with a cotton wool-like texture. As the endosperm lasts up to 15 months during germination, a large apple is found in well-developed seedlings. Children walking to school, grasp the leaves of a sprouted seednut and uproot it. Still holding it by the leaves they swing it against the trunk of the nearest mature palm to split the husk and crack open the shell.

Then they pick out and eat the apple (Harries, 1993).

An unusual form of the mature coconut has a jelly-like endosperm. This can be eaten with a spoon from the shell of the freshly cracked coconut. It is known as makapuno in the Philippines, where it is highly esteemed and as dikiri-pol, or similar names in India and Sri Lanka. It is known in other coconut growing countries such as Indonesia and has been reported from the Solomon Islands. The most interesting fact about it is that the embryo is normal but can only be germinated under the artificial conditions of a tissue culture laboratory.

A coconut with aromatic endosperm, favoured in Thailand for drinking and preparing a cooked dessert, is also known in Malaysia and Indonesia.

Lovely Bunch of Coconuts

The coconut has at times been treated as something of a joke to Europeans, as popularised in the music hall song "I've got a luverly bunch of coconuts". In history it was first introduced to Europe as *Nux indica*, or the nut from the Indies. It was possibly a generic name that covered shells of other palms that would survive the long overland journey and even nutmegs (Ridley, 1912). These would be kept as novelties and even be ornamented (Fritz, 1983).

Friar John of Montecorvino ca. 1292 described *Nux indica* as "big as melons, and in colour green, like gourds. Their leaves and branches are like those of the date palm" (Desmond, 1992). But it was not until after the Portuguese sailed to the Indian Ocean and brought back fresh samples in 1499, that the real nature of the coconut, other palm fruits and the nutmeg was distinguished in Europe (the people in the countries where these crops grow cannot imagine that such a confusion could exist).

When the fibrous husk is removed, the brown, hard-shelled nut is split to expose the kernel. In the same way, an almond has a fibrous outer-covering, a shell and a kernel. Unlike almonds and other nuts, the coconut is generally not used as such because of it large size. Health food and vegetarian shops often include slices of coconut kernel in packets of mixed nuts. In England, coconuts sold in greengrocers' shops (without husks) are usually split open and hung outside for birds to feed on in winter.

Oils, Fats and Foods

Fish and Chips

Coconut oil is certainly part of the diet in the countries where it grows. Equally importantly, in those countries, it may be an unguent for the hair, an emollient for the body, a rust inhibitor for iron or a fuel for lamps. Its first use in Europe was as a lubricant in textile mills. It subsequently became important to soap makers. Some of these are among today's industrial giants and they still import coconut oil for the excellent lathering properties it imparts. But, when soap manufacturers began using coconut oil they unintentionally fostered the fish and chip shop.

This famous institution, the forerunner of all fast-food take-aways, became part of the social fabric in Britain (Harries, 1988). Fish and chips date from just about the middle of the nineteenth century. Before that time, local "soap-boilers" accumulated animal fat as the major ingredient of laundry soap. Animal fat was chiefly available in the winter months when animals were slaughtered if they could not be fed. In contrast, coconut oil was available the year round from overseas colonial possessions where labour was cheap and the crop plentiful.

Whether for soap or for cooking, coconut oil was particularly acceptable because it was convenient to handle. For a start, in a temperate climate it does not look like oil. Below 20 to 26°C it becomes a greasy, somewhat crystalline white or yellowish solid fat. In other words, in cool climates coconut oil goes solid and resembles animal fat. It was a good substitute because there was no risk from infectious disease as there was with animal products.

The virtues of coconut oil were extolled at the beginning of the twentieth century in an advertisement for “Nut Lard” as:

". . . an absolutely pure vegetable fat, extracted from the coco-nut. It is sweeter than ordinary lard or butter, and cheaper than either. It is white, odourless, does not turn rancid and is infinitely superior to ordinary lard for all culinary purposes. It can be used with the most delicate dishes without altering the natural flavour of the dish."

This advertisement went on to state that “Nut Lard contains neither salt nor water . . . [and] [i]n cold weather, Nut Lard may become hard - it should then be shredded before using . . “. The most telling part of the advertisement was that "Nut Lard is unequalled for frying fish, it does not splutter, there is no smell, and it can afterwards be strained and kept for future use" (Anon, 1912).

It was in the 19th century that this sort of advertising became a significant factor in marketing. In particular, the industrial soap makers started large scale advertising of their products, with the prepackaged brand names that still survive today. This competition put the small, local soap-boilers out of business. When they could no longer sell soap, they looked for something else to do with their existing equipment - deep copper pans over open fires. They

had started to use coconut oil for soap. Now they began frying fish and chips.

Coconut oil

In coconut growing countries, coconut oil is largely used for edible purposes. It is prepared domestically by heating coconut milk when a clear oil separates. The extraction of oil from copra is one of the oldest seed crushing industries in the world. Copra processing methods range from simple village processes to modern high-pressure expellers and pre-press or solvent extraction plants. Throughput can be more than 500 tonne of copra per day. In Indonesia some processors cook chopped fresh kernel in previously extracted coconut oil before pressing. Various commercial methods exist for "wet" processing of edible grade oil and flour from fresh meat, but none are yet commercially viable (Harries, 1993).

Coconut oil is the most important of the small group of commercial fats that contain a high proportion of glycerides of lower fatty acids, in particularly lauric. The chief fatty acids are lauric 45 percent, myristic 18 percent, palmitic 9.5 percent, oleic 8.2 percent, caprylic 7.8 percent capric, 7.6 percent and stearic 5 percent. There is a minute amount of tocopherol (vitamin E). The natural volatile flavour components of fresh meat and oil are mostly delta-lactones. Lauric oils are characterized by high saponification value and have the lowest iodine value of vegetable oils in common industrial use. Coconut oil as it is ordinarily prepared in tropical countries is a colourless to pale brownish yellow oil. In temperate climates, or air conditioning, it appears as a greasy somewhat white or yellowish solid fat that has a melting point range between 20 and 26°C. Until refined it has a pronounced odour of coconut. Coconut oil is refined, bleached and deodorised using standard vegetable oil processing technology. If coconut oil is cooled until crystallization, part of the oil produces a semi-solid mass and is then separated under hydraulic pressure.

The solid fraction, coconut stearine, is a harder fat with a higher melting point. It finds use as a valuable confectionery fat and as a substitute for cocoa butter because of its brittleness and "snap" fracture. The liquid fraction, coconut oleine, has a correspondingly lower melting point and is used in margarine manufacture. Hydrogenation converts its unsaturated glycerides into stearic glycerides. The product has a melting point higher than coconut stearine and is used as a brittle confectionery fat, which even more resembles cocoa butter. When refined and deodorised, coconut oil mixed with non-fat milk is a replacement for whole milk for many purposes, including imitation dairy products, filled milk, coffee whiteners, soft-serve desserts, frozen desserts, whip toppings, milk shake mix, chocolate filled milk, etc.

Coconut oil is used for its bland flavour, resistance to oxidation, stability in storage and unique liquefying property that contributes to "mouth-feel" of the food of which it is a component. The main non-edible uses are for soaps, detergent foam boosters, lubricating oil additives, mineral floatation agents, shampoo products and corrosion inhibitors. Lauric oils enhance the lathering quality of soaps and this makes coconut oil particularly useful for hard water or marine soaps. A feature of soap making with coconut oil is the higher yield of glycerol, 14 percent compared with 10 percent for most oils. Other non-edible uses include, illuminating or fuel oil in rural areas or for lighting in ceremonial lamps. Coconut stearine is also used to advantage in candle manufacture. Coconut oil will directly fuel unmodified diesel engines.

Copra

When the industrial demand for coconut oil developed in the nineteenth century sailing schooners, and later tramp steamers, sailed to Pacific islands where the palm was plentiful. Fresh coconuts are a bulky and perishable cargo because of the husk and high water content. The fruit contains about 50 percent husk, 12 percent shell, 10 percent water and only about 28 percent meat (kernel). The fresh coconut meat itself contains about 47 percent moisture. It was more convenient to ship copra, which the islanders could prepare in advance by sun drying the kernel, or over a fire at short notice once the boat had arrived.

Commercial copra plantations today still use sun drying, direct firing over a barbecue, or indirect hot air in various sorts of kiln. The moisture content reduces from 45-50 percent to 6-8 percent and the oil content increases from 35 percent to 60-65 percent. For safe storage, the moisture content of copra should be 6 percent. At first point of sale it often has a much higher level. It dries further during storage but moulds may attack under such conditions. One of these is *Aspergillus flavus*, which produces aflatoxin. The presence of this carcinogen is a stimulus to improve copra quality or to by-pass it and process the fresh fruit (Harries, 1993).

Edible (ball) copra

Copra may also form naturally inside the whole ripe nut. As early as the middle of the 6th century Cosmas Indicopleutes said of the coconut "If the fruit is gathered ripe and kept, then the water gradually turns solid on the shell, while the water left in the middle remains fluid, until of it also there is nothing left

over" (Desmond, 1992). This happens when nuts are kept in a store in dry environments and in those varieties that do not germinate quickly. The endosperm (kernel) eventually comes away from the shell and forms a ball of copra that rattles loosely inside the nut. The husk can remain on so that the shell will not crack and the process takes eight to twelve months. Fires may be lit to help drying but the heat and smoke do not contaminate the endosperm, which retains a very high quality (Harries, 1993).

Copra cake and copra meal

After the oil extraction from copra, a good quality residual cake will contain 6-8 percent oil, with a protein content of around 20 percent. Copra meal, the solvent extracted residue, contains 1-3 percent oil depending on the efficiency of the plant. Cattle or poultry feeds use both cake and meal. They are useful for dairy and for fattening and give firmer butter and harder body fat than other oil cakes. Cake with a high oil content is generally fed to pigs. The deficiency in certain amino acids, notably tryptophan, lysine, methionine and histidine limits the amounts used in animal feed. If aflatoxin is present in poorly prepared copra it can pass into the cake or meal (Harries, 1993).

Coconut flour

Coconut flour suitable for human consumption is produced when oil is extracted from fresh coconut kernels rather than from copra. It is used in bread making and other foods. However, it is not superior to other protein sources in the proportions of the various amino acids (Harries, 1993).

Coconut - Confectionery

Sugar and Honey

The coconut palm is a fine source of nectar. It begins to flower three to five years after planting, depending in growing conditions. Once started, it opens a new inflorescence regularly at twenty-five to thirty day intervals throughout the year. The palm goes on flowering for the remainder of it eighty year or longer life span. Every inflorescence contains hundreds of male flowers that open sequentially over a three week period. Each male flower contains one drop of nectar when first open. This attracts visits by honey bees and bumble bees in the early morning. Each inflorescence also carries female flowers, sometime more than one hundred. Altogether for about one week a month, these are each receptive for purposes of pollination. Individual female flowers open for a day or two. They produce an almost continuous flow of nectar droplets from three exposed and easily accessible nectaries. They are also visited by birds (honey-eaters) and even by lizards.

The activity of insects draws attention to the nectar whose sweetness is readily sampled by touching with a finger (easily reached in young palms). These may have been the clues that encouraged early domesticators and cultivators to find ways to increase the flow of nectar. This is known as tapping and it produces toddy as described in detail in the section “Water into Wine.”

Sweet toddy boiled in shallow pans, after straining, to crystallizing point gives a 12-15 percent yield of jaggery. This rough sugar is hard, semi-crystalline and golden brown in colour. A lesser degree of concentration gives treacle (or syrup). Syrup and sugar produced for the local market or for domestic purposes are unlikely ever to compete economically with cane or beet sugar. Bee hives are often kept in coconut groves to enhance fruit set. The year round flowering in a coconut plantation assures a perpetual supply of nectar. The hives can also serve as a source of pollen.

Desiccated coconut

The characteristic coconut flavour when mature, and to a certain extent the texture when grated and dried (desiccated), are important features. In the UK, television advertisements for a chocolate-covered, coconut-filled confectionery give an entertaining, but wrong, impression that the coconut falls from the palm already peeled and neatly split in half. In reality, the manual labour involved in harvesting, peeling, cracking deshelling and shredding to make desiccated coconut is far from amusing. Australians like their favourite cake dipped in chocolate icing and covered with desiccated coconut. This makes Australia a large importer of desiccated coconut but farmers on the neighbouring Pacific islands, who cannot grow much else than coconuts, neglect the crop because of low world market prices for their product.

Desiccated coconut was first manufactured in the early 1880s. It is an important product, sensitive to changes in production costs and easily susceptible to over production. Nuts are stored for three or four weeks before being dehusked in the field and carried to the factory. When the shell is chipped off the kernel comes away easily. Damaged or germinated nuts are rejected to make low grade copra. The brown testa is removed. This is usually pared off by hand though machines are available. Kernels are then washed and sterilized, to avoid risk of salmonella. After sterilisation, disintegrators reduce them to a wet meal or cutters produce fancy cuts such as threads or chips. Drying is by indirect drier at 75-80°C or by direct firing at 120°C. The dried product is cooled and

graded before being packed. Parings oil and drain oil are by-products.

Desiccated coconut should be pure white, crisp with a fresh taste. It should have less than 2.5 percent moisture, 68-72 percent oil (on dry weight), less than 0.1 percent free fatty acid (as lauric) and about 6 percent protein. If there is more than 6-7 percent sucrose then sugar has been added. Unavailable carbohydrate is about 18 percent, crude fibre about 4 percent and there is some mineral content. Desiccated coconut is widely used in sweets, biscuits, cakes and cake fillings (Harries, 1993).

Coconut – Milk, Water And Wine

The "Cocoa's Milky Bowl"

Dr Samuel Johnson's *Dictionary* of 1755 ran together articles on coco (the nut) and cocoa (the source of chocolate). As a result, spelling became confused. For some time the word coconut was misspelled cocoa-nut. Thus the poetic allusion to the "cocoa's milky bowl" refers to the coconut, *Cocos nucifera*, and not to cocoa, *Theobroma cacao*, (Child, 1974). Yet even explaining this, commits a further solecism because coconut "milk" is a manufactured product. Unfortunately the distinction between coconut water and coconut milk is not always kept clear in research publications by coconut scientists. Coconut milk and coconut cream are oil-water emulsions. Coconut milk is prepared by squeezing freshly grated endosperm, usually with a little added water, through cloth. On storing, coconut cream forms an upper layer. On heating either emulsion, a clear oil separates. This is the basis of the village method of oil extraction used for generations. Coconut cream is also produced industrially in both liquid and spray-dried forms. The national cuisines of coconut growing countries use it extensively (Harries, 1993).

Water into Wine

Both alcoholic and non-alcoholic beverages that are products of the coconut palm depend on the technique known as toddy tapping. As with other fruit juices, the watery sap that is the toddy can be converted to wine and other products by fermentation and distillation. The sugar content of coconut water would allow it to be fermented, but this is not usually done. Many types of palms are tapped and the historical background in southeast Asia is traced to the seventh century at least (Burkill, 1935).

Unlike maple or rubber trees, which are dicotyledons where the layer of cambium below the bark is tapped, palms are monocotyledons and the vascular strands are scattered through the tissue. Casual observers sometimes think that it is the coconut leaf stalks that are tapped. In reality, tapping uses the unopened flowering inflorescence. This is a large structure and when cut in the tapping process could indeed resemble the cut leaf stalk. There are many flowering stalks within an inflorescence, each able to exude sap. They are packed tightly into an enveloping spathe that would normally split to allow pollination. Binding the spathe tightly prevents it from splitting naturally. It may also be lightly beaten and flexed to stimulate sap flow. Once ready, the end is cut off to allow the sap to drip into a receptacle. The toddy tapper visits the palm, morning and evening, to decant the accumulated sap from the container before fermentation gets too active. Sap flow continues for many days, and each day a sliver is removed to reopen blocked vascular elements and increase flow. This continues until only a stump remains and the next inflorescence in sequence is prepared.

Obviously tapped bunches do not flower normally and the palm ceases to set fruit. If the sap flow reduces, the palm is allowed to rest. The palm may respond to this with particularly high yields of fruit on the next normal bunches. Excessive tapping followed by high fruit set could shorten the life of the palm. However, the financial return to the farmer would more than compensate for this (Harries, 1993).

Toddy is initially sweet and watery, the containers used to collect it are rinsed but not sterilised between uses. The weather is warm and collection is slow because the palms have to be climbed. Under these circumstances, fermentation to alcohol is practically unavoidable.

Toddy produced overnight and collected first thing in the morning contains about 3 percent alcohol and 10 percent fermentable sugar. Certain additives may slow or stop fermentation. Otherwise, fermentation continuing for 33 hours produces palm wine with an 8 percent alcoholic content. Sweet, unfermented toddy contains 16-30mg of ascorbic acid per 100g and the content changes little during fermentation The yeast in fermented toddy adds vitamin B (Harries, 1993).

Arrack is the product of distilling fermented toddy. Doubly distilled arrack is the basis of local gin, rum etc., by the addition of appropriate flavours.

As with other wine-making substances, coconut toddy can also become vinegar. Fermenting toddy with free access to air produces 45 percent acetic acid in 10 to 14 weeks. It is matured in closed casks for up to six months, and perhaps flavoured with spices and coloured with caramel.

Coconut Water

The entertainer Harry Belafonte may not have been completely accurate when he sang that coconut water

was "good for your daughter" and "full of iron" or that it could "make you strong like a lion." But he was praising the one thing about coconut that makes it different from all other plants - the large amount of water in the immature fruit.

Modern texts on coconut underrate the value of coconut water or overlook the part it played in the domestication of the coconut. Earlier writers had no such reservations. Thus in 1510, Ludovici de Varthema wrote, "When the nut begins to grow, water begins to be produced within; and when the nut has arrived at perfection, it is full of water, so that there are some nuts which will contain four and five goblets of water, which water is a most excellent thing to drink . . ." (cited in Harries, 1978) . As pointed out elsewhere, coconut water is often, but wrongly, called milk. As early as 1583, by which time coconut had become well known, Father Thomas Stevens praised the ubiquitous coconut and its refreshing milk [sic], "this is so abundant that after drinking the contents of one nut, you scarcely feel the need of another" (Desmond, 1992).

The immature fruit, used for drinking, will not fall naturally but must be cut from the palm. Bunches are selected just as they reach maximum size, when a jelly-like endosperm begins to line the cavity of the still thin and soft shell. At this stage each nut is full size, full of water with no airspace (it does not splash when shaken) and is very heavy. Usually, the harvester cuts one or two entire bunches of nuts and lowers them to the ground on a rope. If they fall, the weight of water would crack or even burst the soft shell inside the soft husk. The water would drain away and the fruit rot and spoil (Harries, 1993).

The coconut that is freshly harvested from a bunch that has been in the sun has a natural effervescence and will hiss with released gas when opened. Nevertheless, the "packaging" of this "product" leaves it at a disadvantage against internationally trade-marked colas and mineral waters. Young coconuts deteriorate over a few days unless kept cool. Cutting away some husk reduces the size so they can be kept in a refrigerated cool store. This extends "shelf-life" considerably. There are instances where drinking coconuts are transported hundreds of kilometres in refrigerated trucks. This occurs only where such a vehicle would otherwise return empty, where the roads are good and where an affluent urban market has no other access to coconut. The use of the coconut as a drink, is marginalised by most conventional agricultural treatments. It is seen as reducing the crop of copra (the dried kernel of the mature coconut) from which oil is extracted.

At the proper stage, the water contains about 5 percent sugar. A large nut may have 25g sugar. It also contains minerals, amino acids and vitamin C. It ferments easily, giving alcohol and vinegar. Coconut water has auxinic and plant growth promoting properties when used in plant tissue culture. Historically, various medicinal values are attributed to it. There is no doubt that it is a perfect oral rehydration fluid for severe diarrhoea in cholera cases and similar situations. Being naturally sterile, it may be injected intravenously to substitute for blood plasma in emergency surgery. It provides fluid plus minerals, sugar, and protein. In combination with egg yolk it finds use as a diluent in artificial insemination.

Coconut - The Tree of Life

Depending on variety, coconut fruit takes from eleven to fifteen months to reach maturity and the palm produces a new inflorescence every three to four weeks. This means that every stage of fruit development, from youngest to oldest, is present on any palm any time of the year. Jordanus of Séveras in the 14th century, thought the coconut was truly a marvel "which tree every month in the year sends out a beautiful frond . . . produces very large fruit, as big as a man's head . . . and both flowers and fruit are produced at the same time, beginning with the first month and going up gradually to the twelfth" (Desmond, 1992). In this respect it meets the specifications of the Biblical Tree of Life " which bare twelve manner of fruits, and yieldeth her fruit every month" (Revelations 22:2).

According to Peter Martyr d'Anghiera, writing circa 1552 "Some people believe that the germs of these trees were brought by the waves from unknown regions" (Harries, 1978). Four hundred years or so later it is still a matter of speculation that coconut may have originated on the coasts and islands of Gondwanaland. A wild form of coconut then floated into the Indian and Pacific Oceans, but not the Atlantic. Domestication occurred in the Malesian region (southeast Asia and the western Pacific). The wild and domestic forms were both taken into cultivation and introgressive hybridisation between them produced the wide range of varieties recognised today (Harries, 1990).

The original importance of the coconut palm was to coastal communities. With fish and shellfish to eat, coconut provides refreshing, sweet and uncontaminated drinking water in an otherwise saline environment. No tools are needed to get it and daily consumption of the water contained in one or two coconuts is enough to ensure good kidney function. The wild type coconut spread without human interference. Domestication of the coconut enhanced

the drinking qualities in particular. The domestic type depends on human activity for survival and dissemination (Harries, 1979).

Coconuts preceded the Polynesians into those parts of the Pacific region to which it could float and the Polynesians took domesticated forms to the islands that they settled (Lepofsky *et al*, 1992). Before the development of the copra industry it was a multi-purpose plant on small Pacific islands and the food potential was no more or no less important than any other use. As the islanders in the Indian and Pacific Oceans had found earlier, coconut husk fibres were important in building and rigging sailing ships. The took young fruit on board at the start of a voyage as self-contained individual servings of uncontaminated drinking water.

To Europeans, the coconut palm, was first grown as a plantation crop in the 1840's. But this was not for food. The industrial process for making soap, patented in 1841, required a cheap source of oil. Coconut oil, from copra (the dried endosperm of the nut), provided it. The development of dynamite from nitroglycerine between 1846 and 1867 had the remarkable effect of turning a once discarded by-product of soap manufacture, glycerine, into the more profitable side of the business (Harries, 1978).

To the industrial and political empire builders coconut was a cheap source of raw material and of war material. The "coconut cult" and "coconut boom" were features of the stock market in the early years of the 20th century. Coconut plantations were established throughout the tropics, wherever conditions were suitable, and often where they were not.

The importance of the coconut at the time of the First World War was clearly demonstrated when the German territories in Africa and the Pacific with their extensive plantations, were taken as reparation. As a result, Japan administered the Caroline, Marianna and Marshall islands. To these they added, in 1942, other important coconut growing countries. Indonesia and the Philippines together accounted for more than fifty percent of the world supply of copra; Indo-China, Malaya, Borneo, New Guinea, the Solomons and the Gilbert Islands for a further twenty-five percent.

By the end of the Second World War, when nuclear weapons displaced high explosives, the strategic importance of the coconut had passed to other oil crops. For instance, the high palmitic acid content of palm oil and cotton seed oil was preferred for the new "conventional" weapon, napalm. Industrially, coconut oil soap, excellent for lathering in hard or saline water, and coconut fibre (coir), valued for resilient, water-resistant rope, were ousted by petroleum-based detergents and synthetic fibre (Harries, 1978).

Besides man, other animal life from pollinating insects to pests, became associated with the coconut. Two are of cultural interest in relation to coconut as well as being foods in their own right. These are the coconut crab and the palm weevil. The coconut, or robber crab, (*Birgus latro*) is a massive land-living crab that can climbs coconut palm stems and is reputed to cut off nuts before returning to the ground to eat them. Its association with the coconut is not purely fortuitous. The coconut spreads long distances between the Indian and Pacific Oceans by inter-island floating. It can easily carry the small post-larval stages of the crab. This would account for the equally widespread distribution of an otherwise terrestrial crab, which only spends about thirty days of its larval life in coastal waters. On many islands where it was once found the crab has been eaten to extinction. As Darwin said, the crab "grows to a monstrous size" and "is very good to eat" (Harries, 1983).

Palm weevils (*Rhynchophorus spp.*) are a serious pest of coconut groves, killing palms directly by burrowing in the stem or indirectly as a vector of the red ring nematode. The palm weevil grub grows as large as a man's thumb, and subsistence cultivators can collect hundreds of palm weevil grubs from fallen or felled palm stems. When fried in their own fat and eaten, the larvae ensure an energy rich diet.

Another insect activity related to food is the gathering of pollen by honey bees. Health food shops sell coconut pollen. As with other pollens, it is collected by incorporating a trap in the hive entrance, which removes the pollen pellets as the bees return from foraging. Coconut pollen for this purpose could also be collected directly from male flowers. Coconut breeders routinely harvest and process male flowers for kilogram quantities of pollen used in artificial pollination for F_1 hybrid seed production (Harries, 1973). Here again, the year round flowering of the coconut means that regular supplies of pollen are easy to maintain.

When coconut oil was first available in Europe, it was advertised as healthy, whereas animal fats or dairy products were associated with communicable diseases. Now non-communicable diseases such as heart diseases and cancer are of more concern. The routine use of coconut oil for frying fish or for making margarine has long been discontinued in western societies, mainly as a matter of economic supply and demand, long before the diet conscious substitution of butter by artificially hydrogenated fats from soybean, rapeseed, etc. Coconut oil continues to be used directly in the tropical diets, for vegetable ghee in India.

Coconut oil is easily digested and absorbed into the system to the extent of 95-98 percent as rapidly as

butter fat. This is attributed to the low molecular weight of the fatty acids. In common with other vegetable oils, coconut oil contains virtually no cholesterol but there are objections to its food use due to the high saturation of the fatty acids. In the USA "tropical oils" have come under attack from pressure groups. Their criticisms overlook the fact that most coconut oil is used for non-edible purposes, which other domestic sources of oils and fats have replaced it for deep frying and that much of the food uses now are to improve the quality of factory prepared products. Only in the countries where the coconut grows is it still used extensively for cooking, where it makes lower quality protein and carbohydrates more acceptable and more digestible. In fact naturally saturated medium chain coconut oil may be healthier than artificially hydrogenated short chain vegetable oils.

Finally, what more needs to be said about coconut than was given in the Account of Priest Joseph, circa 1505, "In conclusion, it is the most perfect tree that is found, to our knowledge" (Harries, 1978).

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