

ALTERNATE USES OF ARECANUT

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India is the largest producer of arecanut. It is estimated that around 1,77,000 ha of land is under this crop. The annual production of arecanut is estimated as 2,10,000 tonnes of all marketed grades put together. Of this, about 1,30,000 tonnes are from Karnataka and Kerala States, valued at about 2,600 million rupees.

In terms of trade, arecanut is not considered as an essential commodity. So when the market price slumps, there is no support price. But with the fall in price, the producer who depends on this crop suffer and also to a certain extent the general economy of this region suffers a setback. To avoid such fall in price and hardship, it is necessary to divert the small quantity, which causes glut in the market, to other uses. Even if it does not give good return, it serves the purpose as rest of the quantity that is brought to market fetches remunerative price. Added to this, the masticatory habit is also slowly declining since the last three decades. Hence studies on developing alternate and better uses of arecanut were taken up by the erstwhile Indian Central Arecanut Committee in the fifties and Indian Council of Agricultural Research under the auspices of CPCRI, Regional Station, Vittal since the early seventies. As CPCRI did not have necessary expertise in such disciplines, research schemes in the alternate uses of arecanut were implemented through collaboration with various organizations/Research Institutes like Central Leather Research Institute, Madras; Indian Drugs Research Association, Pune; Central Food Technological Research Institute, Mysore;

Department of Chemical Technology, University of Bombay; Oil Technological Research Institute, Anantapur; Punalur Paper Mills Limited, Kerala. The funds were provided by the Arecanut Marketing Federation which were channelised through CPCRI. An attempt is made here to summarize the results of various research projects undertaken on alternate uses of arecanut.

Chemical Composition

Major part of work has been carried out by CFTRI, Mysore. The main constituents of arecanut are polyphenols, fat, polysaccharides, fibre and protein (Shivashankar, *et. al.*, 1976) (Table 1). The mineral matter contains calcium (0.05%), phosphorus (0.13%) and iron (1.5 mg/100g) (Anonymous, 1948). It also contains vitamin B6 (286.92 mg%) and Vitamin C (416.20 mg%). The polyphenols mostly flavonols include about 10 per cent of (+) catechin, 2.5 per cent epicatechin, 12 per cent of (+) leucocyanidin, the remaining portion being complex flavonoids in varying degrees of polymerisation (Natarajan and Seshadri, 1961; Banerjee, *et. al.*, 1961; CFTRI, 1961; Govindarajan and Mathew, 1963 and Mathew, *et. al.*, 1969).

Among the alkaloids present in arecanut, arecoline ($C_7H_{13}O_2N$) is the main and physiologically most active one, varying from 0.1 to 0.67 per cent (Anonymous, 1948; Raghavan and Baruah, 1958; Dutta and Dutta, 1959). Other alkaloids present in trace amounts are arecaidine

Table 1. Range of variations of the chemical constituents of green and ripe arecanuts

Constituents*	Green nut (Kalipak stage)	Ripe nut
Moisture	69.4-74.1	38.9-56.7
Total water extractives	32.9-56.5	23.3-29.9
Polyphenols	17.2-29.8	11.1-17.8
Arecoline (extraction method)	0.11-14	0.12-0.24
Fat	8.1-12.0	9.5-15.1
Crude fibre	8.2-8.8	11.4-15.4
Total polysaccharids	17.3-23.0	17.8-15.4
Crude protein	6.7-9.4	6.2-7.5
Ash	1.2-2.5	1.1-1.5

*Expressed as percentage values calculated on dry weight basis.

(C₇H₁₁O₂N), guvacoline (C₆H₁₁O₂N) and guvacine C₆H₉O₂N).

Changes in Chemical Composition with Fruit Development

The changes in chemical constituents of

arecanut with different stages of maturity were studied by Mathew *et al.* (1964) (Table 2). Polyphenols decreases with maturity and large concentration at the tender stages may help against infection. With maturation, the

Table 2. Composition of arecanut (South Kanara type) at different maturity stages (values except moisture are expressed on dry basis).

Composition	Stages of maturity of nuts				
	Very tender	Tender	Mature green	Semi ripe	Ripe
Average weight of fruit (wet, g.)	4.71	11.97	26.40	35.16	35.05
Moisture content of husk (%)	91.68	70.78	79.77	75.46	74.70
Av. weight of husk (dry, g)	0.22	2.43	3.38	5.25	5.40
Av. percentage of husk (on total dry weight)	75.86	80.72	54.25	43.08	39.40
Moisture content nut (%)	88.34	84.00	70.60	49.52	39.40
Av. weight of nut (dry, g)	0.07	0.58	2.85	6.94	8.31
Av. percentage of nut (on total dry weight)	24.14	19.28	45.75	56.92	60.60
Total water extractive (%)	65.60	73.72	56.49	34.80	27.89
Polyphenols (tannins, %)	43.85	47.94	29.44	26.40	17.81
Alkaloid (as arecoline %)	Nil	0.06	0.14	0.20	0.22
Fat (%)	1.22	5.02	8.08	13.74	14.29
FFA (as oleic acid -%on fat)	1.40	2.13	0.88	0.65	0.45
Crude fibre (%)	1.97	6.32	8.23	10.75	13.42
Total polysaccharides (hydrolysable, %)	4.68	13.50	17.58	21.26	23.57
Nitrogen (%)	2.67	1.60	1.51	1.36	1.20
Ash (%)	3.77	3.31	2.52	1.71	1.50
Water soluble ash (%)	1.98	1.72	1.46	1.02	0.91
Water insoluble ash (%)	1.79	1.59	1.16	0.69	0.59
Alkalinity of soluble ash (ml. of N HCl/100g)	4.00	3.50	2.52	2.75	2.50
Acid insoluble ash (%)	0.15	0.08	0.05	Nil	Nil

polysaccharides, fat and fibre contents increase. The free fatty acid content decreases with maturity, indicating its use for biosynthesis of fat. Similar results have been reported by other workers (Raghavan, 1957; Kartha *et al.* 1959). In a few cases, the fat increases up to mature green stage, followed by decrease have also been reported (Banerjee *et al.* 1961; Mathew *et al.* 1964).

Uses of Tannins and Fats

1. *Tannins*: Long before the nature and properties of tannins were determined, tannins in arecanut were used for dyeing clothes, rope, etc. and for tanning leather for some use in South-east Asian and Pacific Ocean countries. Tannins are obtained as a by-product from the process of preparing immature nuts for masticatory purposes. This liquor obtained in the boiling process of the nuts is known as 'chogaru' or 'kali' and this could be utilized successfully for a wide range of leathers (Selvarangan, 1955; Govindarajan, 1968). Whole nut tannins have better tanning properties. The composition of water extracts of arecanut is given in Table 3. Earlier studies have shown that the condensed tannins of arecanut, tan leather satisfactorily, except for the colour. Pilot plant studies showed that this material could be used as such or in blend with myrob (1:1 or 1:2) for retanning chrome leather. Tannins extracted from defatted arecanut were of better quality and the percentage recovery of total solubles was also higher (Table 3).

Other uses for tannins are as an adhesive in plyboard manufacture (Narayanamurthi and Gupta, 1963; Rao, 1977) and as a textile dye (Anonymous, 1964). 'Chogaru' was used for preparing tannin-formaldehyde adhesive used for preparing plyboards.

Another possible use of areca tannins has been as a food colour. They become red at an alkaline pH and with the increasing prohibition of the use of synthetic food colours, this possibility assumes greater importance. This line of work has been taken up in the Department of Chemical Technology, University of Bombay (Garde, 1982).

2. *Fats*: The nut contains 8-12 per cent fat. The analytical characteristics of areca fat are given in Table 4. (Anonymous 1978) Broadly, areca fat has comparable characteristics with hydrogenated coconut oil. It contains both saturated and unsaturated fatty acids. Areca fat could be made edible by refining it but using an alkali. The refined areca fat is harder than cacao butter, and even better, due to its high myristic acid content. Sweets, savouries and biscuits prepared from refined areca fat were as good as those prepared from Vanaspathi fat (Reddy *et al.* 1976). Arecanut fat could be used for certain confectionary purposes after modification using different blend ratios of areca fat and cacao butter or areca fat and butter fat. This could be used as a substitute for cacao butter or for the manufacture of imitation dairy products. The biochemical constituents of deoiled arecanut powder are given in Table 5. The polymerised

Table 3. *Constituents of water extracts of arecanut*

Constituents	Tannin from whole nut	Tannin from defatted nut
Total solubles	75.0	88.0
Tannins	42.0	46.0
Non-tans (Salts)	33.0	41.0

(Source: CLRI, Madras)

polyphenolics in arecanut are highly promising as a natural colouring matter for certain food and non-food products. Arecanut extract could be used successfully in the preparation of chewing gums.

Table 4. *Particulars of arecanut fat*

Particulars	Value
Fat content	12.9%
Acid number	Trace
Saponification number	222.5
Iodine number	26.6
Melting point	42°C-43°C
Unsaponifiable matter	1.6%
Tannin in defatted arecanut	10%

(Source: RRL, Hyderabad).

Medicinal uses of Arecanut Kernel

In Ayurveda, arecanut was long considered as having medicinal properties. Vagbhata's (4th Century AD) reference to arecanut is probably the earliest reference in any text. He describes

its use in the treatment of leucoderma, leprosy, cough, fits, worms, anaemia and obesity. It was also used as purgative, appetizer, stimulant and as an anthelmintic. Work on pharmacological

Table 5. *Constituents of deoiled arecanut powder.*

Constituent	Sample I	Sample II
Moisture %	11.09	9.65
Tannins %	6.70	10.32
Non-tannin %	7.71	6.75
Insolubles %	74.50	73.28
Detanned arecanut powder		
Total solubles %	14.41	17.07
Oils	0.50	0.70
Total N%	1.05	1.08
Soluble N%	0.46	0.51
Protein %	3.75	3.60

(Source: CLRI, Madras).

aspects of arecanut was carried out at the Indian Drugs Research Laboratory, Pune and Central Drugs Research Institute, Lucknow. The pharmacological work carried out earlier were reviewed by Mujumdar, *et. al.*, (1982). Here work carried out by the above two institutes are summarized. (i) Arecoline has hypoglycemic and hyperglycemic effect at low and higher doses.

However, arecoline has no significant effect on alloxan induced diabetes eventhough, it reduces the blood sugar level (CPCRI, 1983).

(ii) Miotic activity was seen in arecoline and non-arecoline fractions.

(iii) Antihelminthic action was seen in arecoline fraction.

(iv) Marked central nervous system (CNS) depression was caused by the alcohol soluble, water soluble and water insoluble fractions of arecanut. Hence, they are valuable pharmacological tools for investigations of various aspects of CNS activity.

(v) All the fractions caused respiratory disturbances.

(vi) All the fractions showed cholinomimetic property.

(vii) Alcohol extract of arecanut husk also showed a mild cholinomimetic activity.

Carcinogenic Activity

Cancer Research Centre, Tata Memorial Research Institute, Bombay has carried out work on carcinogenic activity of arecanut. Boyland (1968) reviewed the carcinogenic effect of alkaloids of tobacco and arecanut. Syed *et. al.*, (1980) noted the inhibition of humoral and cell mediated immune response in mice after arecoline treatment. This immuno-suppressive effect may facilitate betel-quinid induced oral and oesopharyngeal carcinoma. The aflatoxins B and G, which are known carcinogens have been isolated from spoiled arecanut (Thuan and Amarasingham, 1978).

Water extract of arecanut is mutagenic and also tumorigenic in mice when administered subcutaneously. However, intraperitoneal injections failed to produce any tumors in treated mice. Gavage feeding of water extract of arecanut induced systemic tumors while polyphenolic fraction had no effect. Gavage feeding of arecoline, an important alkaloid of arecanut also induced lung and stomach tumors. Lack of tumorigenicity in water extract of betel-quinid and water extract of betel quinid + tobacco suggests that there is some anticarcinogenic agent present in the quinid. It was reported earlier that probably betel leaf has some protective action. Cancer Research Centre work has shown that betel leaf is neither mutagenic nor tumorigenic. When

water extract are arecanut and betel leaf were administered no tumors were observed in treated mice.

Another interesting observation was that tannin fraction of arecanut is carcinogenic when injected subcutaneously. However, when the same fraction is fed by gavage no tumors were observed. This indicates that either tannins are not absorbed in the gastrointestinal tract or they are rapidly detoxified. since arecanut is consumed orally, this observation is very important and it appears that only the alkaloid from arecanut are mutagenic and carcinogenic. The results of the work carried out at Cancer Research Institute clearly indicate that betelnut and its polyphenol fraction are carcinogenic to mice, rats and hamsters, in the latter two cases, the oral and buccal mucosa being affected. Rodent buccal mucosa is comparable to human oesophagus and since oesophageal cancer is common in betel-quinid chewers, it is suspected that betel nut is an etiological factor.

The inclusion of betel leaf in the extract did not produce any tumors. Hence it could also be concluded that betel leaf interferes with carcinogenicity of betelnut (Anonymous, 1982).

Work carried out at Indian Institute of Science, Bangalore in the early seventies showed that arecanut extracts (dimethyl sulphoxide extract of cured powdered nut) have a retarded and/or an inhibitory effect on the growth and development of tumors induced by known chemical carcinogen, benzpyrene. This inhibition of tumor development may be due to the polypehnnols and tannins present in the arecanut.

It is possible that arecanut alkaloids are oxidised (dehydrogenated) in the animal body to yield nicotinic acid which prevents pellagra, which is virtually unknown in the Far East where areca is used for chewing.

By-product Utilization

Arecanut husk: After extracting kernel the husk remains as an almost waste product. It is used as a cheap inferior fuel and mulch. About 1,00,000 tonnes of dry husk are estimated to be available annually in India alone. And it was used in Indonesia and the Philippines for tooth brushes (Brown, 1952). The husk fibre are predominantly composed of cellulose with varying proportions of hemicellulose (35-65%), lignin (13-26%), pectin (1.5 to 3.6%) and protopectin (1.5-2.1%).

The biochemistry and physical properties of the husk have been studied by Baruah *et. al.*, (1957) and at the Jute Technological Research Laboratory, Calcutta (Anonymous, 1973). The average filament length of areca husk fibre is too short (2.4 cm C.V. 30%) compared to the filament in jute yarn (6.8 cm, C.V. 75%). Areca husk fibres consists mostly of two types of filaments, very coarse and very fine. Spinning trials with standard jute and coir machinery were not quite successful. However, non-woven fabric using synthetic rubber latex as binding agent at 8 per cent concentration could be prepared. JTRL proposed that areca husk fibre could be used for the manufacture of thick boards, fluffy cushions and non-woven fabrics (Ghosh *et. al.*, 1975).

Baruah *et al.* (1957) found that pectinolytic bacteria were more effective than hydrolytic agents for rapid softening of husk and also that the quality and nature of the fibres depended mainly on cellulose content and non-cellulose encrustations. Retting trials for extracting the fibre have shown that perceptible softening could be obtained after three weeks soaking (Prabhu, G.N -Personal communication).

Hardboards and Plastics: Several studies were carried out, particularly in the Forest Research Institute (FRI), Dehra Dun to see if arecanut husk could be utilized for preparing hard boards and plastics (Narayanamurthi, 1957;

Narayanamurthi and Singh, 1964). Insulation and hard boards of satisfactory quality were prepared from areca husk. These boards compared favourably with standard boards like Masonite in respect of thermal conductivity, thickness, density and strength but water absorption and swelling properties were not satisfactory. Arecanut husk could be used for production of activated charcoal and xylose. The activated charcoal is comparable with standard charcoal from E.Merck. Xylose could be converted to xyletol.

Fibre boards and plastic boards were also prepared from arecanut husk (Narayanamurthi and Singh, 1964). Plastic and hard boards of satisfactory strength and water repellent properties could be made from arecanut husk, but these process have not been commercially exploited nor their cost economics worked out. Insulation wool can also be produced and its usefulness in thermal insulations, acoustical correction, packing, etc. appears to be promising (Raghavan and Baruah, 1957). Soft cushion pad prepared from (spongy fibrous mass obtained by boiling) the green husk (with 5% NaOH solution for 30 min) could be used as packaging for books, for making cushioned envelopes, soft boards etc. (Anonymous, 1962a, 1962b).

Branch Small Industries Service Institute, Shillong (Meghalaya) has developed some industrial uses for the arecanut husk. It was found that the husk fibre could be used as cushioning material, as a substitute to cotton wool and as a complimentary material to coir. It was used for making rubberised mattresses and fibre boards.

Pulping and Paper boards: Earlier work carried out has shown that brown wrapping papers in satisfactory yields and quality could be prepared from blends of arecanut pulp and bamboo or banana pseudostem pulp. Singh and Guha (1960) have shown that brown wrapping paper with improved properties could be prepared when mixed with jute or bamboo pulp.

Paper produced from mixing of beaten banana stem pulp 25 per cent to areca husk pulp, was found to provide equal strength of ordinary kraft paper.

Plant level studies carried out at the Punalur Paper Mills Limited, Kerala have confirmed that when the areca pulp was blended with bamboo pulp (3:1 ratio) the kraft paper made with it possessed comparable physical properties of paper made with pure pulp of bamboo. But all the studies have shown that it is difficult to bleach the paper made out of areca husk pulp.

Other uses: Possibilities exist also for using areca husk as a manure. It contains 1.0-1.1 per cent N, 0.4-0.5 per cent P_2O_5 and 1.0-1.5 per cent K_2O . Hence it could form good organic manure if properly composted.

Leaf Sheath: Every year 5-6 leaves are shed from each manure palm and it is expected that about 1000 million leaf sheaths weighing about 2,33,000 tonnes are available annually in India alone. The constituents of the leaf sheaths are cellulose 43 per cent, crude fibre 33 per cent and ash 5 per cent, N 0.7 per cent, P_2O_5 0.3 per cent and K_2O 1.0 per cent respectively.

The flexibility and pliability of the sheath when it is wet makes it a good material for heat moulding. CFTRI, Mysore has developed a machine for making cups and throw away plates which could substitute the paper plates. Such cups and plates are being produced in small scale units in Karnataka.

The tensile strength though moderate, the flat surface of the processed sheath make it suitable for preparing plyboards. These plyboards do not meet fully the ISI requirements of tea chest plywood, but they are superior in wet glue shear strength than most of the non-ISI grade plyboards available in the market. Hence, tea chest and packing cases made of areca leaf sheath

plyboards could be put to most of the uses for which plyboards are presently used. A few trials carried out in Cochin with tea chest made from areca leaf sheath plyboards for transporting tea from Kerala to north India after storing tea for three months were successful.

Other possible uses of arecanut leaf sheath are for making veneer boards and picture mounts, decorative panels of wooden almirahs and teapots, house sandals, file boards, bags, trays, spectacle cases etc. However, the commercial viability and durability of these products need to be studied. Preliminary studies showed that areca leaf sheath and husk could be used as a substitute for growing *Pleurotus* sp., an edible mushroom (CPCRI, 1985).

Arecanut stem and leaf: Arecanut stem because of its hardness is widely used as building material in rural areas. Stationery articles like rulers, shelves, waste paper baskets etc. could be made out of stem. Nails made of areca stem are widely used in furniture industry. Hollow stems lend themselves into drainage and irrigation pipes in the villages.

Leaves are good source of organic manure. Leaves contain about 0.94 per cent N, 0.096 per cent P_2O_5 and 1.00 per cent K_2O . Leaves are also used for thatching the roofs in villages.

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