10

ALTERNATIVE USES OF ARECANUT

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Arecanut has been widely used since long throughout south and south–east Asia and the Pacific Ocean Islands. While its primary use has been as a masticatory, it was also finding use among the local populations in native systems of human and veterinary medicine, in certain religious and social functions and in farms and households (packaging, construction), etc. With the development of modern systems of medicine, the use of arecanut fruit, leaves, stems and roots for medicinal purposes steadily began to wane.

The use of arecanut as a masticatory has been declining since the last 2–3 decades with the incursion of modern ways of living into the lives of the rural people, particularly in south–east Asia. It has been in this context that studies on developing alternate and better uses for arecanut were taken up by the erstwhile Indian Central Arecanut Committee in the fifties and since the early seventies by the Indian Council of Agricultural Research under the auspices of the CPCRI Regional Station, Vittal.

In this chapter a brief review of the varied uses for which betel nut has been put to in south and south–east Asia has been given along with summaries of the work carried out on alternative uses of arecanut under the various schemes.

I. Uses of various constituents of nuts

The quest for developing alternate uses for arecanut has been based on finding best uses for the various constituents of the nut. Studies carried out on the utilization of constituents of arecanut like tannins and fats are given below:

1. Tannins

Long before the nature and properties of tannins were determined, the tannins in arecanut were being made use of, for dyeing clothes, rope etc. and for tanning leather for home use in south-east Asian and Pacific Ocean countries. (Watt, 1889; Burkill, 1935; Baens, 1941; Brown, 1952).

Tannins are obtained as a by-product from the process of preparing immature betel nuts for masticatory purposes. In this, the immature nuts are husked, and boiled in water or a mother liquor left over from the earlier boiling, either as whole or after cutting them into two or more pieces. This liquor containing considerable quantities of tannins is known as *chogaru* or *kali*. The sediments found in the liquor when dried is called arecanut dust. The dust and *chogaru* are traditionally used as a masticatory or for tanning leather.

Raghavan (1957) found that tannic acid or gallic acid from the nut, when mixed, with ferrous sulphate in warm distilled water gave black writing ink of acceptable quality. He used immature fallen nuts for this purpose.

Banerjee and coworkers (Banerjee, Ghani and Nayudamma, 1963) have studied the physico-chemical characteristics of areca tannins as compared to wattle tannins. They compared the water extractives of tender arecanut with concentrated *chogaru* liquor, arecanut dust available as by-products of arecanut processing and commercial *Mimosa* extract, for non-tan (salt) ratio, gelatine number, rate of diffusion etc. The results are given in Tables 10.1 and 10.2.

Table 10.1. *Analytical data of different tanning materials*

Analytical data	Tanning materials				
	Tender arecanut (air dried)	Arecanut dust	*Chogaru* liquor	*Mimosa* extract	Aqueous extract of arecanut
Moisture (%)	15.2	13.47	48.28	10.35	11.71
Total solubles (%)	16.49	23.77	27.22	87.25	81.38
Tannin (%)	9.86	13.94	15.55	66.73	43.16
Non-tannin (%)	6.64	9.83	11.67	20.52	38.22
Tannin/non-tannin ratio	1.48	1.42	1.34	3.25	1.13
Insolubles (%)	68.31	62.76	24.50	2.40	6.90

Table 10.2. *Acid and salt constituents of different tanning materials*

Tanning material	pH of the liquor of 20° Bk strength	Weak acids mg. eq/litre of 100° Bk	Salts of weak acids mg. eq/ litre of 100° Bk	Ratio of weak acids to their salts	Buffer index
Arecanut	4.6	55.0	285.0	0.19	2.22
Chogaru liquor	5.0	50.0	300.0	0.17	2.33
Arecanut dust	4.8	53.0	295.0	0.18	2.32
Mimosa extract	4.7	25.0	95.0	0.26	0.80

The areca tannins have a lower acid/salt ratio. As a consequence, they produce a mellower type of leather. Being richly endowed with non–tans (salt), they show quicker rate of diffusion through leather. The hydrothermal stability of leather tanned by areca tannins is good. *Chogaru* liquor is not sufficiently good for tanning leather as the whole nut tannins, but it can still be utilized successfully for a wide range of leathers (Selvarangan, 1955; Govindarajan, 1968).

The above studies have shown that the condensed tannins of arecanut, tan leather satisfactorily except for the colour. Pilot plant studies (Anonymous, 1978c) showed further that areca tannin extracted by seeping in water for four days (1 part nut: 4 parts water) has a pH of about 5.3 and that total solubles come to about 7.5 per cent containing tans to non–tans in about equal proportions. This material can be used as such or in blend with myrob (1:1 or 1:2 ratio) for retaining chrome leather. Tannins extracted from defatted arecanut were of better quality. The percentage recovery of total solubles was also higher in this case.

Other uses for which areca tannins have been tested, has been as an adhesive in plyboard manufacture, (Narayanamurthi and Gupta, 1963; Rao, 1977) and as a textile dye (Anonymous, 1961, 1962b, 1963, 1964). Studies carried out in Delhi University, Department of Chemistry showed that *chogaru* gave a satisfactory brown shade to cotton, that was fast to acid, alkali and washing tests. *Chogaru* was also found to be a good dye for wool and paper. It could produce a variety of shades with metallic salts as mordants (Anonymous, 1964). During the processing of raw nuts, the leucoanthocyanidins get polymerised into leucocyanidin which is found in *chogaru*. These polymerized compounds act as good inhibitors in the oxidation of sodium sulphate. However, the *chogaru* liquor was not an effective corrosion inhibitor. The Delhi University work has suggested the possibility of using leucocyanidin in the purification of sugar juice because of its action as an antioxidant (Anonymous, 1964).

Narayanamurthi and Gupta (1963) and Rao (1977) used *chogaru* for preparing tannin–formaldehyde adhesives used for preparing plyboards. They tested a number of formulations on several species of timber for the glue–adhesion properties and found that *chogaru* possesses glue–adhesion strength in the dry and wet conditions according to IS:303–1975 specification for plywood for general purposes.

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. Two approaches are possible in this, (1) preparing and using natural pigments as a safe food colouring agent and (2) rendering the food colour unabsorbable in the intestine by combining it with a macromolecular matrix. This line of study has been taken up in the Department of Chemical Technology, University of Bombay by Rege and Garde, (Garde, 1982). According to this work, the areca polyphenolics can be fractionated as monomers and dimers into one fraction and the polymers (highly polymerised substances–HPS) into another fraction. The HPS fraction is red in colour. The results obtained so far have been promising. These workers have taken up studies for optimizing the conditions for maximizing the yield of HPS, its purification for varying the extent of polymerization and for determining the effect of various environmental conditions on the yield and stability of the HPS fraction.

2. Fats

The nut contains 8–12 per cent fat. Fat from arecanut can be extracted by solvent extraction using hexane. Improper storage of raw nuts over prolonged periods lead to lipolysis. The analytical characteristics of areca fat are given in Table 10.3.

The biglyceride distribution in the fat appears to be unusual and does not follow the predicted distribution pattern (Anonymous, 1978d; Shah, 1980).

Broadly, areca fat has comparable characteristics with hydrogenated coconut oil. It contains both saturated and unsaturated fatty acids. Areca fat can be made edible by refining it using an alkali (Anonymous, 1978d). The refined areca fat is harder than cocoa butter, and even better, due to its high myristic acid content. The fat could be softened by fractional crystallization using hexane 25°C and randomisation using sodium methoxide which gave products desirable for use as confectionery fat. Simple blending of areca fat with butter fat at 3:1 ratio followed by inter esterification of areca fat and cocoa fat at 1:1 ratio gave good products acceptable in confectioneries. Limited studies show that areca fat can be used as an extender of cocoa butter for various purposes. Further, sweets, savouries and biscuits prepared from refined areca fat were as good as those prepared from *vanaspati* fat (Reddy et al., 1976).

Table 10.3. *Analytical characteristics of areca fat*

Characteristics	Value (range)
Free fatty acids	Highly variable
Acid value (A. V.)	Highly variable
Saponification value (S. V.)	222–235
Iodine value (I. V.)	17–26
Melting point (°C)	38–42
Slip point (°C)	36–39
Saturated fatty acids (%)	
Myristic acid	50
Lauric acid	18
Palmitic acid	14
Capric acid	1
Unsaturated fatty acids (%)	
G S_3 (trisaturated)	60.2
G S_2U (monounsaturated disaturated)	22.0
G SU_2 (disaturated monounsaturated)	17.7
G U_3 (triunsaturated)	0.1

In several native systems of medicine, arecanut is assumed to provide several beneficial effects on digestion, strengthening of gums and stopping of bleeding etc. Because of these, some work on these lines has been taken up by Rege and Garde in Bombay University (Garde, 1982) for preparing chewing gum and tooth paste based on arecanut. Encouraging results have been obtained in preparing chewing gum and tooth paste using arecanut extract.

Scented *supari* has been prepared using both defatted and detannined arecanut. Normally, for extracting tannins and fats, the nuts have to be crushed before extracting them with water or hexane, and the crushing and extraction make the arecanut somewhat softened, and this has been sometimes found to adversely affect the consumer acceptability of such scented *supari*. However, this seemed to become an adverse factor only in the case of detannined arecanut and not in defattened arecanut. It is necessary to conduct some more studies on consumer acceptability and product improvement.

It would thus appear that with the present level of supply and marke price, and our present state of knowledge on product development with the nu constituents, it would not be economical to use arecanut solely for extracting jus one constituent of the nut. It may be feasible to develop a system by which th various constituents can be progressively extracted in a modular pattern with eac of them put to different uses.

II. Arecanut husk

It is the outer cover of the areca fruit. It constitutes 60–80 per cent of th total volume and weight of the fruits (fresh weight basis). About 1,00,000 tonne of dry husk are estimated to be available annually in India alone. It is now bein largely wasted except for being used as an inferior fuel and mulch. It was use in Indochina and the Philippines for tooth brushes (Brown, 1952; Anonymou 1958).

The biochemistry and physical properties of the husk have been studied b Baruah, Raghavan and Murthy, (1957) and at the Jute Technological Researc Laboratory (JTRL), Calcutta (Anonymous, 1973). The husk can be anatomicall divided into three zones, *viz.*, (1) the outer epidermal layer covered with th cuticle; (2) the middle layer which encloses the fibres; and (3) the hard and ston inner layer adpressed to the nut.

1. Fibre

The husk fibres are predominantly composed of cellulose with varyin proportions of hemicellulose, lignin, pectin and protopectin. The fibr adjoining the inner layer are irregularly lignified group of cells called 'hard fibre and in the portion of the middle layer below the outermost layer are soft fibre The total hemicellulose content varies with development and maturity, the matu husk containing less hemicellulose than immature ones. The lignin conte proportionately increases with development till maturity is reached. The bi chemical constituents of husk are given in Table 10.4 (Baruah et al., 195 Govindarajan, 1968).

Table 10.4. *Biochemical constituents of husk*

Constituents	Percentage (range)
Pectin	1.5– 3.6
Protopectin	1.5– 2.1
Hemicellulose	35.0–64.8
Lignin	13.0–26.0
Furfuraldehyde	18.8
Ash	4.4

At the Jute Technological Research Laboratory, Calcutta, the physical properties of areca fibre were studied and compared with those of jute (Anonymous, 1973). The average filament length of areca husk fibre was too short (2.4 cm; C. V. 30%) compared to the filament in jute yarn (68 cm; C.V. 75%). Their tenacity, fineness, and textural and torsional rigidity were also studied. The areca husk fibre consists mostly of two types of filaments, very coarse and very fine. The coarse ones are about 10 times as coarse as the jute ones,and the fine ones are similar to jute fibre. Spinning trials with standard jute and coir machinery were not quite successful. However they prepared non-woven fabric using synthetic rubber latex as bonding agent at 8 per cent concentration. Based on the various tests, the JTRL proposed that areca husk fibre could be used for making such items as thick boards, fluffy cushions and non-woven fabrics (Ghosh, Sinha and Bandopadhyay, 1975).

Retting trials for extracting the fibre have shown that perceptible softening could be obtained after three weeks soaking (Prabhu, G. N. 1978, personal communication). The fibres can be extracted later by beating with a mallet. 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.

2. Hard boards and plastics

Several studies have been 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).

Narayanamurthi, Ranganathan and George (1947) studied the preparation of hard boards from areca husk by Asplund process. Insulation and hard boards of satisfactory quality were prepared by a process of defibration or hydrolysis with weak acid or alkali at the Forest Research Institute, Dehra Dun (Anonymous, 1952). The boards compared favourably with standard foreign boards like Masonite in respect of thermal conductivity, thickness, density and strength properties, but water absorption and swelling properties were not satisfactory.

Narayanamurthi and Singh (1961a, 1961b, 1964) developed several processes for preparing fibre boards and plastic boards from husk. Simple treatments of the husk followed by oil tempering with cashew nut shell liquid (CNSL), and adding furfural and aniline, to the mass, gave boards of increased strength and less water absorption. The preparation of plastics by thermal condensation with

20 per cent sodium thiosulphate and furfural was found to be the best method due to condensation of colloidal sulphur. The boards compared favourably with oil tempered hard boards and filled phenolic plastics, though modulus of elasticity was slightly lower than that of typical PF plastics. The boards had good microbial resistance and better properties than those made from bamboo. Hard boards with satisfactory strength properties could be also made by chemical pulping of the husk and by using cold and hot setting adhesives.

Plastic and hard boards of satisfactory strength and water repellant properties can be made from areca husk; but so far, these processes have not been commercially exploited. However, their cost-economics also require to be worked out. The insulation wool produced by beating air-dry husk with wooden mallet compares favourably in respect to thermal conductivity, moisture content, density of packing etc, with standard products like Palcowool, defibrated teak bark and granulated cork (Anonymous, 1952; Raghavan and Baruah, 1957). Its usefulness in thermal insulations, accoustical correction, packing etc. appears to be promising.

Husk can be processed into insulating wool and felt in admixture with jute and caddles (Raghavan and Baruah, 1957). Soft cushion pads made from spongy fibrous mass obtained by boiling the green husk with 5 per cent NaOH solution for 30 min and defibration, compared well with cushion pads made with imported material and that these could be used as packaging for books, for making cushioned envelopes, soft boards etc. (Anonymous, 1962a, 1962b).

3. Pulping and paper boards

The first work on preparing paper from arecanut husk was carried out during early twenties (Anonymous, 1922). Since then during the fifties and sixties, more work was done on this aspect (Singh and Guha, 1960; Subramanian and Govindarajan, 1962; Guha et al., 1963). Broadly, these have shown that brown wrapping papers in satisfactory yields and quality could be prepared from blends of arecanut pulp and bamboo or banana pseudostem pulp.

In subsequent studies carried out at the FRI, Dehra Dun, sulphate pulps prepared from digesting husk, using 13.5–18.6 per cent, chemicals at 170°C for 4 hr, had fibre length of 0.96 mm, fibre diameter of 0.0196 mm, hot water solubility of 19.7 per cent, and lignin 30 per cent and the pulp yield was 40.4–57.5 per cent (Anonymous, 1976b). The strength properties were not satisfactory for producing kraft wrapping paper, but brown wrapping paper with improved properties could be prepared when mixed with jute or bamboo pulp (Table 10.5; Singh and Guha, 1960).

Table 10.5. *Properties of arecanut husk pulp sheets mixed with jute and bamboo pulps*

Properties	Arecanut husk pulp sheets	
	Mixed with jute sticks pulp (40–80%)	Mixed with bamboo pulp (40–80%)
Breaking length in m	6220–8448	4650–5000
Tear factor	92–103	124–143
Burst factor	32.3–43.1	27.5–32.1
Folding endurance	131–346	68–255

The studies carried out at the CFTRI, Mysore (Anonymous, 1962a; Subramanian and Govindarajan, 1962) in collaboration with Mandya National Paper Mills showed that areca husk when chemically pulped by soda cooking process with 17.5 per cent of NaOH in the ratio 5:1 at 170° C for 2 hr and beaten for $1\frac{1}{2}$ hr in edge runner, gave pulp material having properties of ordinary kraft paper. However, bleaching of pulp could not be done with sulphite process, but lighter and brighter pulp was achieved. 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 (Table 10.6).

Table 10.6. *Properties of paper produced from areca husk pulp mixing with banana stem pulp (25%)*

Properties	Paper from areca husk pulp mixed with 25% banana stem pulp	Ordinary kraft paper
Breaking length in m	3133	3779
Tear factor	76.5	77.0
Burst factor	19.1	17.5
Basic weight (g/m²)	73	70

In 1975, plant level studies carried out at the Punalur Paper Mills Limited, Kerala (Anonymous, 1974, 1976a) confirmed the earlier finding that areca husk could be pulped chemically at 170°C for 4 hr giving 45–50 per cent yield. The pulp was short fibred and could produce paper of only low bursting strength and break factor. 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 bamboo pulp. Guha et al., (1963) (*also* Anonymous, 1977b) have described a pilot plant for producing low grade wrapping paper using a mixture of areca pulp (60%) and bamboo pulp (40%). All the studies have shown that it is difficult to bleach the paper made out of areca husk pulp.

The data presented here would indicate that while kraft paper of acceptable quality can be prepared from areca husk (Table 10.6) the high cost of transporting husk to the factory and the high amounts of chemicals required for digesting the husk are factors to be reckoned against it in exploiting commercially.

4. Other possible uses

Areca husk can be a good source of furfural. When distilled with acid at high pressure and temperature, the husk yielded 5.5 per cent furfural (Anonymous, 1952; Singh, 1956). The husk contains about 18 per cent furfuraldehyde (Raghavan and Baruah, 1957).

Preliminary investigations carried out at the Indian Drugs Research Laboratory, Pune, (Anonymous, 1981) revealed that areca husk upon acid hydrolysis followed by neutralisation and precipitation in ethanol could yield 2–3 per cent xylose. Xylose is a monosaccharide and xyletol derived from xylose by hydrogenation is sweet.

Possibilities of producing activated carbon from arecanut husk have been investigated by Latif and Khundkar (1952) and Chowdhury, Chakravarthy and Bhattacharya (1971). The residue of areca husk after extracting xylose can be used for producing activated carbon of good quality. The yield is about 25–28 per cent.

Possibilities exist also for using areca husk as a manure. It contains 1.0–1.1 per cent N_2, 0.4–0.5 per cent P_2O_5 and 1.0–1.5 per cent K_2O. Hence, it can form good organic manure if properly composted. The total quantity of 1,00,000 tonnes of dry husk would give, if collected and composted, about 1000 tonnes N_2, 500 tonnes, P_2O_5 and 1000 tonnes K_2O (Biddappa, 1960). However, the husk is very resistant to microbial degradation because of the presence of ligno-cellulose.

III. Leaf sheath

Leaf sheath is yet another raw material obtained from the arecanut palm. In a year, a palm sheds 5–6 leaves. About 1,000 million leaf sheaths weighing about 2,33,000 tonnes are available annually in India alone (Bavappa and Murthy, 1960; Menon, Annamalai and Nayar, 1982).

The sheaths measure 75–85 cm long and 35–40 cm wide at the centre and 15–20 cm wide at the stalk end. Freshly fallen sheaths contain 55–60 per cent moisture. This reduces to 11–16 per cent after drying in the open, under shade for 5–6 days. The sheath of an adult palm shows a concavity in the centre. The leaf sheath is heterogenous in structure, composition and appearance and these create problems as well as widen the scope for product development. The outer surface of the sheath is greenish or brown, waxy and tough, while the inner surface is creamy in colour and has a natural glossy finish. The constituents of the leaf sheaths are cellulose–43 per cent; crude fibre–33 per cent and ash–5 per cent. From the manurial point of view, they contain N_2–0.7 per cent; P_2O_5–0.3 per cent and K_2O–1.0 per cent (Biddappa, 1960). In certain regions of Kerala, leaf sheath is also used as a cattle feed.

In recent years, trials have shown that quality pulp suitable for making packing paper boards can be also obtained from areca leaf sheath. Laboratory level testing on pulping of areca sheath by digestion by sulphite process at 162°C for 3½ hr gave a pulp yield of 36–40 per cent with burst factor of 50 and tear factor 113 and breaking length of 6200 m. The pulp in admixture with other pulp can be use for making packing paper boards (Narayanamurthi, 1957; Subramanian and Govindarajan, 1962).

Taking a cue from the numerous traditional uses to which areca leaf sheaths have been and are being used [*eg.*, caps (Fig. 10.1) and hats for farm workers, containers and packing cases for collecting and transporting materials at home like toddy, fish etc. and scoop for watering garden] throughout south and south east Asia, and based on its mechanical properties, a series of studies were initiated and sponsored by the CPCRI Regional Station, Vittal to develop active economic uses for the material. The process consists essentially of flattening the sheath under heat and pressure and then utilizing it for making various products (Menon et al., 1982).

1. Throw-away cups and plates

The flexibility and pliability of the sheath when it is wet makes it a good material for heat moulding. The CFTRI, Mysore has developed a machine for making cups (Fig. 10.2) and throw-away plates which can substitute the paper plates now being used (Anonymous, 1977a, 1978b, 1980). The machine is manually operated by leg and is capable of producing 100 cups per hour with one skilled operator and helper. For this, the leaf sheath is subjected to 158°C temperature for 10 seconds in the machine for moulding. Such cups (Fig. 10.3A) and plates (Fig. 10.3B) are already being produced in a small scale unit in Karnataka.

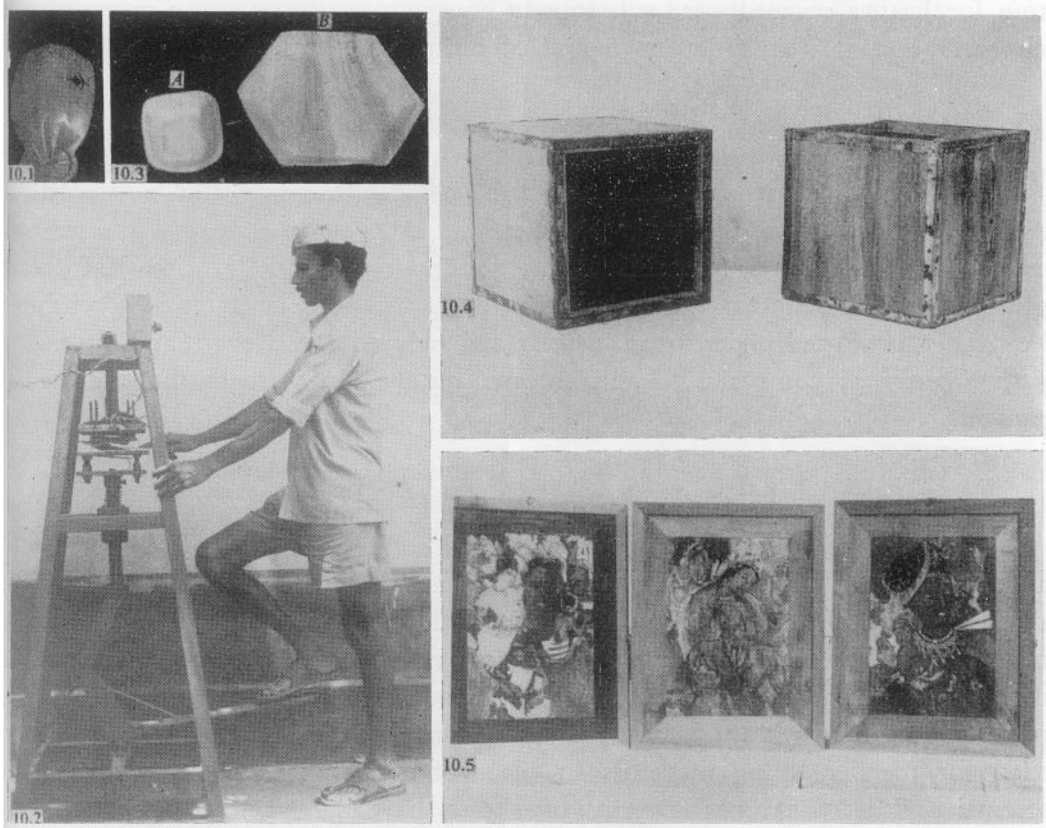
2. Leaf sheath plyboards

The tensile strength though moderate and the flat surface of the processed sheath make it a suitable material for preparing plyboards (Annamalai and Nayar, 1982). As the sheaths are weak across the grain direction, they are strengthened by interposing one plywood veneer between two plies of sheaths and gluing them to make 3-ply boards.

Studies on glue adhesion properties of the boards (Annamalai, Menon and Nayar, 1982) have shown that plyboards prepared using cold setting/hot setting urea formaldehyde (UF) resin as glue, extended with tamarind seed powder (TSP) or deoiled sal meal upto 15 per cent and with any ordinary 1.5 mm thick wood veneer as core ply and pressed (at 4 kg/cm^2 pressure for 16 hr for cold setting glue and 14kg/cm^2 pressure at 95–100°C temperature for 7–10 min for hot setting glue) gave satisfactory results. The glue shear strength of the boards (4.2 mm thick) was 45–55 kg (average) in dry state and 12–16 kg (in wet state after 24 hr soaking in water at 28°C) and the boards could withstand delamination upto 6 days when soaked in water for seven days. These plyboards do not meet fully the ISI requirements of tea chest plywood, but they are superior in wet glue shear strength than most non–ISI grade plyboards available in the market.

Hence, tea chest and packing cases made of areca leaf sheath plyboards can be put to most of the uses for which plyboards are presently used. These boards further possess better impact strength and double the flexibility over the 3-plywood boards. These are properties, that are most desired for use in preparing suitcases.

A few trials carried out through the courtesy of a leading tea agent in Cochin, Kerala with tea chest made from areca leaf sheath plyboards (Fig. 10.4) for transporting tea from Kerala to north India and even to London after storing tea for three months were successful. Such tea chests not only withstood the rigours of long distance transport, but the quality of tea also remained unaffected. More than threefourths of the tea chests made in India are produced from non-ISI grade plyboards produced by cottage and small scale industries. Even if areca sheath plyboards are used to meet half of the requirements, the saving of softwood timber that will be brought about will be a significant gain in view of the increasing scarcity of timber in India.



Figs. 10.1—10.5 Items made out of areca leaf sheath and a machine for making cups and plates from areca leaf sheath. *Fig. 10.1 Cap; Fig. 10.2 A machine for making cups and plates from areca leaf sheath; Fig. 10.3A Throw-away cup; Fig. 10.3B Throw-away plate; Fig. 10.4 Tea chests; Fig. 10.5 Picture mounts.*

3. Decorative veneer panels and picture mounts

Aesthetically attractive and imaginative novelties can be made from areca leaf sheaths taking advantage of the natural colour and grain variations on the surface. For this, the sheath surface is given a finish in varnish or french polish. They make beautiful picture mounts (Fig. 10.5) or decorative panels. The dark and white faces of the outer and inner surfaces of the sheath can be exploited to prepare decorative panels of wooden almirahs (Fig. 10.6) and teapoys (Fig. 10.7) (Menon et al., 1982)

4. House sandals

The firmness combined with the easy yielding of the sheath and its ability to absorb moisture in the form of sweat suggest its usefulness as a cheap substitute for leather or cardboard sole tops in house chappals and cheap summer wear chappals (Fig. 10.8) in the drier regions of India and elsewhere.

5. Gin washers

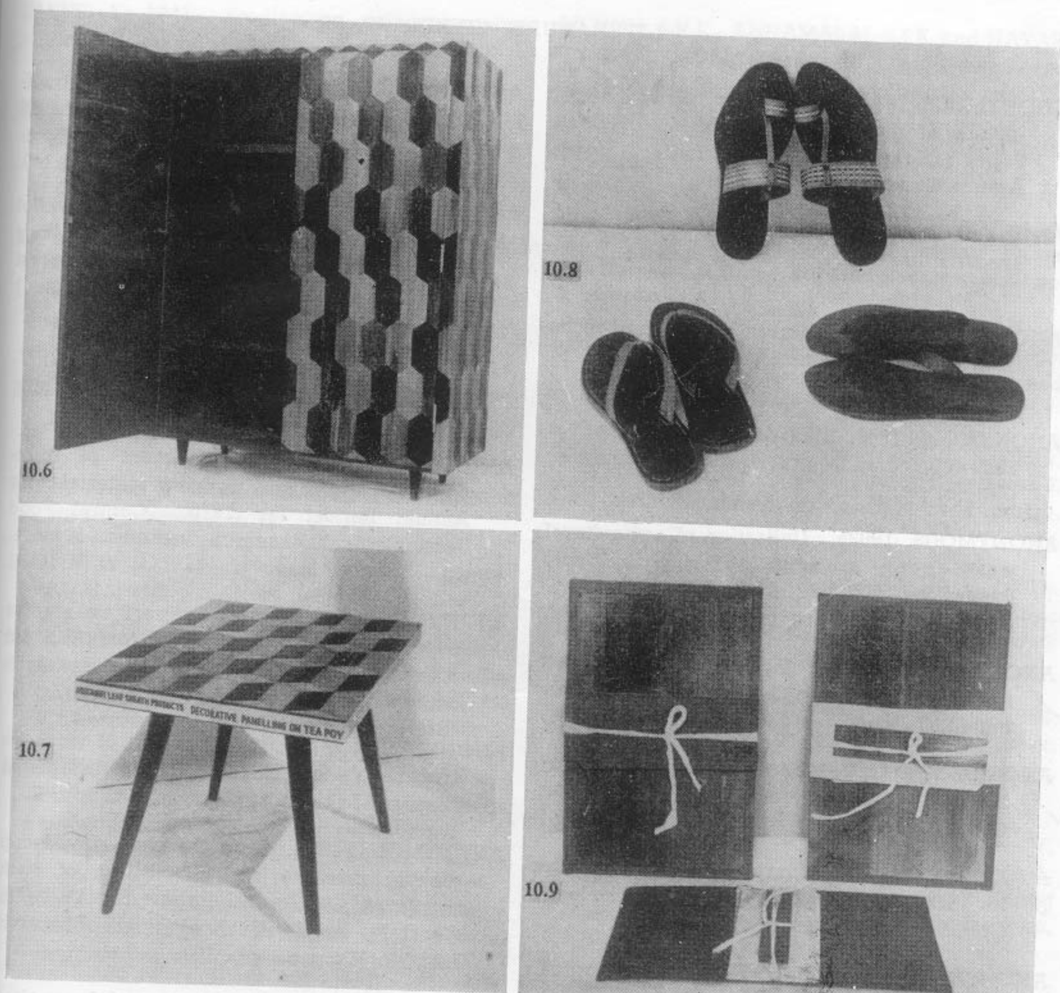
The trials carried out at Ahmedabad Textile Industries Research Association, Ahmedabad and Cotton Technological Research Laboratory, Bombay (Anonymous, 1978 a; Menon et al., 1982) with cotton ginning rolls made of areca leaf sheath gin washers showed that their performance was not satisfactory as they generated heat faster, produced higher trash in lints and reduced the strength and out put of yarn slightly as compared to the chrome leather gin washers that are used at present.

6. Other possible applications

Brief cases, bags, spectacle cases, tea and coffee trays, file boards (Fig. 10.9) and many other fancy and utility products have been prepared out of areca leaf sheaths. Possibilities for using the sheaths in the manufacture of match boxes, match sticks and paper boards for packing also appear to be promising. The corky feel and lightness of the sheath make it possible to convert the sheaths into packing wool for packing glassware and such fragile articles. Sheaths can be also tried for making lining materials in place of cork sheets. Tests conducted for thermal and electrical conductivity of sheath have shown that it could enter manufacturing fields where thermal and electrical insulations are needed.

IV. Arecanut stem and leaf

Arecanut stem forms a useful building material in the villages and it is widely used throughout south and south–east Asia for a variety of construction purposes. Because of its hardness and its golden yellow colour, the timber can be used for making a variety of elegant utility articles (Bavappa and Murthy, 1960). Stationery articles like rulers, shelves, waste paper baskets, etc. made of the stem are both durable and attractive. In south Asia, the stem after sharpening is used for husking coconuts. Nails made of areca stem are widely used in furniture industry. Hollow stems lend themselves into drainage and irrigation pipes in the villages.



Figs. 10.6—10.9 Useful items made out of areca leaf sheath.
Fig. 10.6—10.7 Decorative panels of wooden almirah and teapoy;
Fig. 10.8 Chappals and sandals with areca leaf sheath sole tops;
Fig. 10.9 File boards and flaps made out of areca leaf sheath.

The leaves are good source of organic manure. About 3,40,000 tonnes are estimated to be available annually in India alone. Their approximate composition is N_2–0.94 per cent; P_2O_5–0.096 per cent and K_2O–1.00 per cent (Biddappa, 1960).

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