Use and Management of Nipa Palm (*Nypa fruticans*, Arecaceae): a Review[1]

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*Nipa palm (*Nypa fruticans*) is a useful, versatile, and fairly common component of mangrove forests of Asia and Oceania. Because of its usefulness, it has been introduced into West Africa. In addition to a host of local subsistence uses ranging from medicines to hats and raincoats, some important commercial uses have led to management efforts and are initiating a new interest in its potential. Sap production from nipa produces an intoxicating beverage, sugar, vinegar, and alcohol that may be used as fuel. The tapping of nipa for sap involves a rather unusual kicking or beating process called "gonchanging." Further research in nipa sap production, together with development of more efficient collection and handling methods, might greatly enhance the usefulness of this palm.*

One of the most common, widely distributed, and useful palms in the mangrove forests of South and Southeast Asia is nipa (*Nypa fruticans* Wurmb.; Arecaceae). Short synopses of botanical characteristics were provided in Corner (1966), Moore (1973), and in Whitmore (1973). A good description of the inflorescence—its growth, phenology, and pollen vectors—was given by Uhl and Moore (1977). Aksornkoae (1976) discussed the ecology of nipa in a mangrove forest in Thailand. For a concise account of a commercial plantation in Malaysia, Hinchy (1938b) is recommended.

The recently published *Global status of mangrove ecosystems* (Saenger et al. 1983) stated that nipa occurred in two (Asia and Oceania) of the six regions of the world as subdivided by them, and had been introduced into West Africa in 1906. Local information exists for Australia (Bunt et al. 1982; Covacevich 1981); Indonesia (Johannes 1979; Samingan 1980); Papua New Guinea (Paijmans and Rollet 1977; Percival and Womersley 1975); Philippines (Agaloos and Nepomuceno 1977; Gonzales 1979); Thailand (Aksornkoae 1976; Changprai 1984); Malaysia (Burkill 1935; Fong 1984; Whitmore 1973); India (Anonymous 1966; Thothathri 1980); and Bangladesh (Khan and Karim 1982). In addition, nipa is known to occur in Vietnam, Sri Lanka, Burma, and the Carolines, Ryukyus, and Solomons (Fong 1984; Moore 1973); it has been introduced into Nigeria (Zeven 1973). From fossil records it is known to have once occurred in Brazil, Europe, and Africa (Tralau 1964).

USES

This versatile palm has historically provided useful products to indigenous peoples living near or in the coastal and estuarine mangrove forests. Products were obtained by use of leaves, the juice or sap from the inflorescence stalk, and the fruit. These uses continue and some have become the bases for cottage in-

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dustries and commercial operations. More recently, some large-scale commercial interest has developed.

Nipa palm leaves have traditionally been harvested for roof thatching and for walls of dwellings. Mature leaves are dried; the midrib is removed; and the pinnae are folded at two-thirds of their length over a rod of hardwood or bamboo, and, with vines, are stitched in place with overlap and sewn together in lengths of 1 or 2 m to make a shingle for roofing or walls (Robillos 1978). These are serviceable from 3 to 5 yr or more; a commercial market has developed. Leaf petioles are used as floats for fish nets; the main axis is used for fish poles; and the leaflet midribs are soaked and twisted as ropes (Fong 1984). In the Philippines, dried petioles and stalks are used for fuel in firewood-scarce areas (Brown 1951). Petioles have also been chopped and boiled to obtain salt (Browne 1955). Young leaflets are used as cigarette wrappers; older ones, to weave hats, umbrellas, raincoats, baskets, mats, and bags (Burkill 1935; Robinson 1911). Leaves have also been tried in insulation board. Though it was found that the pith and leaf-stalks were unacceptable, the outer layer of the leaf-stalk yielded pulps suitable for making good-quality boards of intermediate density (Razzaque 1969). Leaves have been found to be unsuitable for paper pulp (Hossain and Siddique 1969).

Young seeds (the gelatinous endosperm) are eaten raw or preserved in syrup; in Malaysia they flavor a commercial ice cream ("attap chi") and enter local ice confections. River boats full of the seeds are brought into Bangkok, and the soft endosperm is extracted and bagged in cellophane for sale in the street stalls (Hamilton, pers. obs.). The hardened endosperm of mature fruits is used as a vegetable ivory and for buttons (Fong 1984).

Young shoots, decayed wood, and burned roots or leaves have been used medicinally in various parts of Southeast Asia for herpes, toothache, and headache (Burkill 1935). Herpes is treated both by drinking the juice from the young shoot mixed with coconut milk and by applying the pulp from which the juice is extracted to the affected area.

The sap is a source of sugar, around 14–17% sucrose according to Halos (1981). The sap is used to produce vinegar, alcohol, and, in particular, a widely used distilled or fermented beverage called "tuba" or "soom" in the Philippines, "arak" or "tuak" in Indonesia, and "toddy" in Malaysia, India, and Bangladesh. Information on sap utilization compiled by Murphy (unpublished data) goes back to early work beginning in 1911 in the Philippines (Cole 1922; Gibbs 1911) and in the early 1920s in Malaysia (Dennett 1925, 1926, 1927a, 1927b, 1929; Eaton and Dennett 1923; Wood 1925). Most of this early study was due to an interest in fuel alcohol. The sap was also considered very promising for sugar production (Hinchy 1938b; Roxas 1929), again mainly in the Philippines and Malaysia. The high cost of fossil fuel and fertilizer has initiated a new look at its fuel alcohol and sugar potential.

There are currently two factories in Sarawak for the utilization and manufacture of sugars from nipa to make alcohol (Chai and Lai 1984). Vinegar production from the sap is practiced in Papua New Guinea (Adams and Flynn 1982) and in the Philippines. A program to produce alcogas from nipa stands was under study in the Philippines (Halos 1981), and interest in nipa as an energy source has been shown in several other quarters (Duke 1977). For instance, in Papua New Guinea the Department of Primary Industry was reported to be planning an alcohol-from-nipa project, and a laboratory and study center were established in the Gulf province (Newcombe et al. 1980). Nipa alcohol may be blended with petrol up to a 1:4 ratio without the need to redesign or adapt the carburetors of gasoline engines (Anonymous 1978).

CULTIVATION AND MANAGEMENT

Much harvesting of nipa leaves, sap, and fruit is from the wild, almost pure stands in which nipa usually occurs. The palm is also sometimes scattered among other mangrove or freshwater trees. Salinity regimes vary during a single year as the dry season comes and goes. Tree density is often up to 2,500 palms per hectare or more (Gibbs 1911), but only 700–750 are sap-producing palms. Production apparently can be improved by wider spacing. Dennett (1927a) quoted 500 per hectare though Johnston (unpublished data) suggested 380. In thinning to the desired density, Gonzales (1979) recommended that the rhizomes of the plants to be removed be cut up in order to prevent them from regenerating. Stands are planted in the Philippines at a spacing of 1.5–1.7 m, approximately 390 per hectare (Gonzales 1979). For planting, seedlings are grown in nurseries until a hand-span high and then transplanted into pockets in the sides of planting drains. In Bangladesh, the best germination and survival in the nursery have been obtained in locations submerged at least 4 h per day.

Pollination of nipa is by drosophilid flies (Essig 1973); therefore if mangrove areas are to be used for nipa production, it is unwise for managers to use contact insecticides for such problems as mosquitoes.

The main pests of young seedlings are grapsid crabs. No reports of serious insect or disease problems in mature trees have come to light, but Wood (1925) reported that monkeys and pigs caused serious damage in North Borneo.

When thatching is the product, mature leaves may be cut off near the ground, as long as two to three are left (Melana 1980). A treatise on cultivation and management of nipa for shingles was published by Vincent (1957) for Malaysia. Palms tapped for sap should not be cut for thatch since loss of mature leaves reduces yield. Old leaves must be cut out before falling naturally, since nipa's shape and unarmed petioles may result in directing the fallen leaves of adjacent palms into its center where they may destroy the tapping stalks. Vegetation around the trees is cleared to allow free growth and access for tapping. In developing an old stand, careful thinning and clearing brings many trees into bearing soon afterwards (unpublished data). In a new plantation, although trees may fruit as early as 3 yr, fruit are full sized only after 5 yr. Tapping would not ordinarily commence before the fifth year (Burkill 1935).

TAPPING NIPA FOR SAP

Sap is collected from its mature fruit stalk after cutting away the almost full-grown fruit-head. The stalks grow from ground level, so that skilled climbers are not needed, as in tapping for coconut sap. Mature trees average two tappable stalks at any one time. When tapping begins, the freshly cut stalk-end is inserted into a hole in an earthenware pot or a bamboo container. Each day after collecting the juice, a thin end slice of about 2 mm is removed. It is important to disinfect the cutting tool since flow is reduced by bacterial growth. Skillful tapping, so that a slice as thin as possible is cut each time, can greatly prolong tapping life. Cutting tool design deserves research. Stalk length varies from 0.6 to 1 m in the Philippines to 1.4 m in Sumatra and 1.9 m in Papua New Guinea; tapping life depends on the length of stalk available.

Sap flow depends entirely on prior preparation of the stalk. Yield is low and only a few days in duration if this is not done. The traditional practice of kicking the tree sounds apocryphal but is invariably carried out. The base of the stalk is kicked "about five times at weekly intervals, several kicks each time" (Cole 1922). It can also be beaten with a mallet (Burkill 1935), as is done in India to the inflorescence bracts of coconut to increase sap exudation (Milburn and Zimmerman 1979). Dennet (1927a) stated that "the process is started when the fruit-head is fairly well grown but before any darkening of the seed takes place. It consists of gently oscillating the fruit once a day. As the fruit grows, the violence of the operation is increased until it becomes a good hard kick or violent shaking by hand."

Paivoke (1985), in a Papua New Guinea study, reported the standard practice to be: bending the stalk 12 times in one direction; patting the length of the stalk backwards and forwards with the bare hands 64 times; kicking the base of the stalk 4 times; and repeating these 4 times per week. Yield was influenced by frequency of treatment in his experimental studies, with a yield of only 155 ml of sap per 24 h per palm over a month when the treatment was once a week, whereas treatment three to five times a week yielded an average of 1,300 ml of sap per 24 h per palm over a month. Highest yield was 1,800 ml of sap in intensively treated younger-aged stands.

According to Melana (1980) in the Philippines, the schedule of kicking continues as follows over the 3-mo, 10-d period for one palm: first month after flowering, kicked once each week; second month, twice each week; third month, once every 2 d; and fourth month, daily for 10 d.

Evidently this process called "gonchanging" is important and deserves research. For *Cocos* and *Ricinus,* Milburn and Zimmerman (1979) suggested that the beating or massage first reduces flow, but that eventually a greater exudation results. The stalk is also progressively bent for tapping convenience, but this may also increase sap flow. The most complete account of gonchanging is given in Paivoke (1985).

Sap flow is low for the first 3 wk (about 0.5 l per palm per day) rising then to about 1 l per palm per day throughout the life of the stalk (unpublished data). Paivoke (1985) in Papua New Guinea obtained average yields of 1.3 l per palm per day, though yield of 1.8 l was achieved following the most intensive pretreatment gonchanging. Yield is highest in cloudy weather, and it is claimed that transpiration competes with sap yield but is partly compensated by variation in sugar content (Hinchy 1938a).

During the slow process of collecting, the sap begins to invert its sugar, to ferment, and to acidify. Although not a problem for alcohol use, this must be controlled if potential sugar yields are to be realized. Containers designed to exclude insects and allow continuous liming have been described elsewhere. Enzyme inhibitors and disinfectants such as chlorine are added; even so, collecting twice a day is needed for the highest yields. Recoverable sugar means crystallizable sucrose, the most valuable market product; for this, inversion must be minimized. The success of a commercial sugar plantation depends on attention to sterile technique.

ECONOMIC ASPECTS

For the only real commercial plantation in the world before World War II (that in Kuala Selangor, Malaysia), Dennett (1927a) gave figures of alcohol production close to 15,600 l per hectare per year based on tapping twice daily for 340 d per year. Annual yield in the Philippines is currently somewhat lower, with traditional practice yielding 6,480 to 10,224 l per hectare, though it is thought that under improved management this could be pushed up to 18,165 l (Halos 1981). For comparison, sugarcane is estimated to produce from 3,350 to 6,700 l per hectare per year; cassava, from 3,240 to 8,640; sweet potato, from 6,750 to 18,000; and coconut sap, 5,000 (del Rosario n.d.).

For sugar production, Dennett's (1927a) figures are potentially equivalent to 20.3 t per hectare per year recoverable sugar. For a Sumatra estate, Johnston (unpublished data) used 22.4 t as a "conservative estimate." Assuming tapping twice daily, he proposed an estate force of 38 per 10-ha plot (30 on tapping/collecting, 5 on "gonchanging" and maintenance, 2 on syrup transport, and an overseer). With eight persons for a boiling station, and four extra for reserve, this corresponds to an average workforce of 5 per hectare, which is much more labor intensive than sugarcane.

However, there are considerable advantages over cane, at least for equatorial regions. Continuous productivity means no displaced labor, which is a major problem in cane economies. Production is not interrupted by replanting and rotation. There is no bagasse disposal problem (waste from the crushing mills), and the sugar factory itself is greatly simplified since there is no expensive crushing mill to maintain. Though bamboo is cheap and reusable, manpower reductions by using PVC pipelines and disposable polyethylene bags are worth investigating to replace the traditional vessels. Unlike cane, nipa does not compete with other crops for agricultural land except where total reclamation is undertaken on mangrove land. The sugar yields cited compare very favorably with values for the Indonesian cane industry, where about 8 t per hectare per year are taken as standard, making no allowance for replanting or rotation.

The shingle thatch "industry" is locally a very important source of revenue. The shingle (construction previously described) is usually 2 m in length, though shorter lengths are also produced. Vincent (1957) gave per hectare yields under a continuous "mature-leaf-only" cutting system for Pahang, Malaysia, as 1,782 leaves with a total of 10,662 running meters of utilizable leaf.

In 1983, in some areas of the Philippines, prices for 2-m nipa shingles were U.S. $7 to $10 per hundred. Production figures, difficult to obtain, are not always consistent. Philippine Bureau of Forest Development Statistics showed increasing shingle production from 1976 to 1980, with a 1980 figure of 2,978,000 pieces. This is "commercial" production and does not include home use. One study of shingle production in Thailand reported a yield of 15,300 pieces per hectare, with a value of U.S. $230 per hectare (Christensen 1982). The commercial value of nipa production for thatching in the Sundarbans of Bangladesh in 1976 was reported as U.S. $12,188 (Bangladesh Water Development Board 1976). Annual production of thatching from the Sundarbans has varied from 62,900 to 118,000 t over the 20-yr period 1957 to 1977, with an average of 81,600 t (Khan and Karim 1982).

The soft endosperm of the immature seeds is sold in commercial trade in Bangkok and elsewhere, but no cost or price data have been reported for this cottage industry.

LITERATURE CITED

Adams, M. R., and G. Flynn. 1982. Fermentation ethanol: an industrial profile. Rep. Tropical Products Inst. No. G169, London.

Agaloos, L. C., and P. M. Nepomuceno. 1977. Ecology of Calauit Island. Sylvatrop 2:163–178.

Aksornkoae, S. 1976. Structure of mangrove forest at Amphoe Khlung Changwat Chantaburi, Thailand. Forest Res. Bull. 38, Faculty of Forestry, Kasetsart University, Bangkok.

Anonymous. 1966. *Nypa* Wurmb. Pages 73–74 *in* The wealth of India. Raw materials, vol. 7. Publications & Information Directorate, New Delhi.

———. 1978. Liquid fuels from renewable resources: feasibility study. Prepared for Government of Canada. Interdepartmental Steering Committee on Canadian Renewable Liquid Fuels, Ottawa.

Bangladesh Water Development Board. 1976. Special report on forests. Special Studies Directorate, Dacca.

Brown, W. H. 1951. Useful plants of the Philippines, vol. I. Techn. Bull. Dept. Agric. & Nat. Resources 10. Manila.

Browne, F. G. 1955. Forest trees of Sarawak and Brunei. Gov. Printing Office, Kuching.

Bunt, J. S., W. T. Williams, and H. J. Clay. 1982. River water salinity and distribution of mangrove species along several rivers in North Queensland, Australia. Austral. J. Bot. 30:401–412.

Burkill, I. H. 1935. *Nipa.* Pages 1557–1561 *in* A dictionary of the economic products of the Malay Peninsula, vol. II. Crown Agents for the Colonies, London.

Chai, P. K., and K. K. Lai. 1984. Management and utilization of the mangrove forests of Sarawak. Pages 785–795 *in* E. Soepadmo, ed., Proc. Asian symposium on mangrove environment: research and management, August 1980. Univ. Malaya, Kuala Lumpur.

Changprai, C. 1984. Mangrove soils and their utilization in Thailand. Pages 521–533 *in* E. Soepadmo, ed., Proc. Asian symposium on mangrove environment: research and management, August 1980. Univ. Malaya, Kuala Lumpur.

Christensen, B. 1982. Management and utilization of mangroves in Asia and the Pacific. FAO Environ. Paper 3. Food and Agriculture Organization, Rome.

Cole, H. I. 1922. Manufacture of industrial alcohol and alcohol motor fuel in the Philippine Islands. Philipp. J. Sci. 21:17–46.

Corner, E. J. H. 1966. The natural history of palms. Weidenfeld and Nicholson, London.

Covacevich, J. 1981. Distribution of the *Nypa* palm in Australia (*Nypa fruticans*). Principes 25:184–188.

del Rosario, E. J. n.d. Fuel alcohol from agricultural crops and residues. Paper presented at: Regional Workshop on the Technology of Fuel Alcohol Production, October 1982. Univ. Philippines at Los Baños, College, Laguna.

Dennett, J. H. 1925. A report on the nipah palm and the production of alcohol in British North Borneo. Malayan Agric. J. 13:64–71.

———. 1926. The nipah palm, further investigations on tapping and preservation of the juice. Malayan Agric. J. 14:375–383.

———. 1927a. Final observations on the nipah palm as a source of alcohol. Malayan Agric. J. 15: 420–432.

———. 1927b. Alcohol fuel and the nipah palm, a popular outline. Malayan Agric. J. 15:433–445.

———. 1929. A note on the ash of nipah juice and some experiments on preservation using alcohol and heat as sterilizing agents and copper sulphate and lime as preservatives. Malayan Agric. J. 17:437–448.

Duke, J. A. 1977. Palms as energy sources. Principes 21:60–62.

Eaton, D. J., and J. H. Dennett. 1923. Preliminary and interim report on investigations on the production of alcohol from nipah palms. Malayan Agric. J. 11:47–63.

Essig, F. B. 1973. Pollination in some New Guinea palms. Principes 17:75–83.

Fong, F. W. 1984. Nipa swamps—a neglected mangrove resource. Pages 663–671 *in* E. Soepadmo, ed., Proc. Asian symposium on mangrove environment: research and management, August 1980. Univ. Malaya, Kuala Lumpur.

Gibbs, H. D. 1911. The alcohol industry in the Philippine Islands. Philipp. J. Sci., Ser. A, 6(2/3): 99–206. [Nipa 110–145, 8 plates.]

Gonzales, L. L. 1979. Nipa and its innumerable uses. Canopy 5(5):9.

Halos, S. C. 1981. Nipa for alcogas production. Canopy 7(8):15.

Hinchy, V. M. 1938a. The relation between frond transpiration and yield of sap in the nipah palm. Malayan Agric. J. 26:420–425.

———. 1938b. The commercial production of sugar from the nipah palm. Int. Sugar J. 40:301–303. (Reprinted from Malayan Agric. J. 26:426–430.)

Hossain, S. M., and A. B. Siddique. 1969. Pulping studies of gulpata (*Nypa fruticans*). Forest-Dale News 1(2):36–39.

Johannes, H. 1979. Pangan dan bensin dari nipah dan sagu serta bensin dari enceng gondok. Bull. Fak. Kehutanan, Univ. Gadjah Mada, No. 10. Yogyakarta.

Khan, M. S., and A. Karim. 1982. Bangladesh: utilization of the deltaic zone. Pages 85–102 *in* C. Soysa, L. S. Chia, and W. H. Collier, eds., Man, land, and sea. Agricultural Development Council, Bangkok.

Melana, D. M. 1980. Leaf harvesting and juice extraction techniques of nipa in Alabat Island, Quezon Province. Canopy 6(9):6–7.

Milburn, J. A., and M. H. Zimmerman. 1979. Preliminary studies on sapflow in *Cocos nucifera* L. #II. Phloem transport. New Phytol. 79:543–558.

Moore, H. E. 1973. Major groups of palms and their distribution. Gentes Herb. 11:27–41.

Newcombe, K., E. B. Holmes, and A. Paivoke. 1980. Palm energy. Alcohol fuel from the sago and nipa palms of Papua New Guinea. Papua New Guinea, Dept. of Minerals & Energy, Energy Planning Unit Rep. 6.

Paijmans, K., and B. Rollet. 1977. The mangroves of Galley Reach, Papua New Guinea. Forest Ecol. & Managem. 1:119–140.

Paivoke, A. E. A. 1985. Tapping practices and sap yields of the nipa palm (*Nipa fruticans*) in Papua New Guinea. Agric., Ecosyst. & Environ. 131(11):59–72.

Percival, M., and J. S. Womersley. 1975. Floristics and ecology of the mangrove vegetation of Papua New Guinea. Bot. Bull., Division of Botany, Dept. of Forests, Papua New Guinea.

Razzaque, M. A. 1969. Manufacture of insulation-type boards from golpata and rice-stalk. Forest-Dale News 2(1):50–57.

Robillos, Y. U. 1978. The nipa shingle industry of Batangas. Forpride Digest 7(1):58–66.

Robinson, C. B. 1911. Philippine hats. Philipp. J. Sci. Series C, 6(2):93–129.

Roxas, M. I. 1929. The manufacture of sugar from nipah sap. Philipp. J. Sci. 40:185–229.

Saenger, P., E. J. Hegerl, and J. D. S. Davie, eds. 1983. Global status of mangrove ecosystems. Commission on Ecology Papers No. 3. Int. Union for Cons. Nature and Nat. Resources, Gland, Switzerland.

Samingan, M. T. 1980. Notes on the vegetation of the tidal areas of South Sumatra, Indonesia, with special reference to Karang Agung. Pages 1107–1112 *in* J. Furtado, ed., Tropical ecology and development. Proc. Vth Int. Symposium of Tropical Ecology, International Society of Tropical Ecology. Kuala Lumpur.

Thothathri, K. 1980. Plant resources and their utilization in the Andaman and Nicabar islands, India. J. Econ. Taxon. Bot. 1:111–114.

Tralau, H. 1964. The genus *Nypa* van Wurmb. Kongl. Svenska Vetenskapsakad. Handl. IV. 10(1): 1–29.

Uhl, N. W., and H. E. Moore, Jr. 1977. Correlations of inflorescence, flower structure, and floral anatomy with pollination in some palms. Biotropica 9(3):170–190.

Vincent, A. J. 1957. A study of the growth, stocking and yield of nipah (*Nypa fruticans* Thunb). Res. Pamphlet 21, Forest Res. Inst., Federation of Malaya, Kuala Lumpur.

Whitmore, T. C. 1973. Palms of Malaya. Oxford University Press, London.

Wood, D. D. 1925. The production of alcohol for motor fuel from the nipa palm in North Borneo. Bull. Imp. Inst. Gr. Brit. 23:175–181.
Zeven, A. C. 1973. The introduction of the nipa palm to West Africa. J. Nigerian Inst. for Oil Palm Res. 5(18):35–36.

Book Review

Living Liqueurs. James A. Duke. Quarterman Publications, P.O. Box 156, Lincoln, MA 01773. 1987. 110 pp. $15.00 (paper).

Living Liqueurs is a "fun book," more about the herbs used in liqueurs than about the liqueurs themselves, and as such covers an appropriate subject for economic botanists. Following the expected warnings about the potential toxicity of both herbal extracts and alcohol in a lengthy introduction, the author devotes an average of two pages for each of the 50 herbs chosen for this short treatise. Each herb is dealt with in three paragraphs: culture, uses, and folklore. Unfortunately, as a book, it is too reminiscent of the databases it originated from, and can be recommended only as a short reference for the amateur botanist.

By the nature of the format, the style quickly becomes repetitive; by mid-book, one wonders if there are any herbs that are not antispasmodic or anodyne. At the end of the book, a series of indices and tables are well made and useful to the adventurous experimenter. Although the author indicates a few of his preferred concoctions, the treatise is not a recipe book *per se,* and the reader is encouraged to explore a few extracts on his own. In the index to folk medicinal uses, under the heading "aphrodisiac," a list of plants includes anise, basil, coriander, cumin, fennel, fenugreek, ginseng, marjoram, parsley, rue, saffron, sarsaparilla, sassafras, sweet cicely, and wormwood. With a few selections of the weeds in our backyard and kitchen's spice rack, I am tempted to try some potent philter. I will report to *Economic Botany* on the results of my experiments at a later date.

I have not found the right brew yet to calm an upset stomach resulting from an overdose of the author's poetry. Try to imagine reading through fifty stanzas of the following caliber:

Some herbalists seem to be int'rested
In an herb to change women, flat-chested.
One mideastern sheikh
Fed his girls fenugreek
They quickly became double-breasted.

However, I must admit that many of the author's limericks are like his liqueurs: they can be pleasant and elicit a chuckle when taken in small doses. As a final note, the excellent illustrations by Peggy K. Duke justify the purchase of this tome as a conversation piece for the coffee table.

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