

flavor enjoyed by most who tried it. These few tentative trials suggest that the longan should be seriously considered for processing in Florida and other warm parts of the world.

Longan selections, made this fall from the evaluated seedlings, will be propagated for additional testing in our program to obtain improved varieties.

## LYCHEES

Survival data (Table 1) indicate that lychee seedlings have been less successful in our well-drained calcareous soils than have the longans. Percentages mean little between the lychee populations, but a comparison with the longan seedlings is illustrative: 75.46 percent of 163 longan seedlings (P. I. 89409) field-set in 1962 were already fruiting by summer 1968, while one lychee fruited of the population of 23 surviving seedlings of M. 17599, Wirt No. 1, and 9 plants (2.23 percent) fruited in another population of 403 living seedlings (m-8516A). The few seedlings which fruited exhibited enough variation in fruit characters (color, surface texture, and horticultural quality) to suggest interesting possibilities for selection when appreciable numbers begin production.

## CONCLUSION

The past summer's observations on longans indicated that the extent of seedling variation

is great enough in the young trees—derived from open-pollination of P. I. 89409—to enable us to select individuals horticulturally superior to the parent plant. If the selections made this year continue to exhibit the desired qualities, then introduction of the most outstanding ones as named varieties will be justified. The marked variability in the population observed indicates that apomixis is either non-existent or of very rare occurrence in this line of longans.

The small number of lychee seedlings that have fruited to date, and their comparatively small crops, have precluded extensive observations, but it is already evident that sister seedlings resultant from open-pollination do vary markedly among themselves. As more young lychees begin to fruit, more intensified evaluation, similar to that already undertaken on the longans, will be initiated.

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# TROPICAL FRUIT TREE AND OTHER EXOTIC FOLIAGE AS HUMAN FOOD

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To most of us, the terms "green vegetable" and "vegetable greens" convey an image of the leafy products of herbaceous plants commonly cultivated as annual garden or field crops. It has recently been made quite obvious to me that, in terms of world food sources, this is a rather limited view. Though I have long known that

the leaves of certain trees and other woody plants are edible, have been resorted to in emergency, or, like those of the European bay (*Laurus nobilis* L.) and the Asiatic curry (*Murraya koenigii* Spreng.), commercially dried and utilized as spice, I did not fully realize that, for large populations in tropical countries, eating fresh tree leaves as vegetables is not a matter of casual nibbling but is truly a way of life.

This past spring, while engaged in a field survey in the Philippines and Southeast Asia, in

the interests of military survival, I became aware that the indigenous people were "leaf-eaters"; that leaves gathered in the forests or from trees, shrubs and woody vines grown near dwellings, are important accompaniments in a predominantly rice diet. Furthermore, leaves are always present (except on deciduous trees) whereas fruits and nuts are seasonal and generally found first by birds and four-footed animals.

The practice of leaf-eating was noticed by Grace Thompson Seton who wrote in 1938 of her journey to the Angkor Wat and remarked that the Moi tribesmen ate "roots of many kinds of plants and trailing vines and the tender leaves of almost any kind of tree that is not poisonous" (27). Her words are nearly echoed by Nicholls in the book, *Tropical Nutrition and Dietetics* (1961): "An assortment of numerous leaves is used in the diets of tropical populations. Many of these are wild and could very often be more used than they are, but are sometimes looked down on as 'poor man's food'. However, almost any young leaves from trees, shrubs or herbs may be used in small or large amounts, frequently or occasionally, only those repulsive to taste or poisonous being avoided" (21).

G. J. A. Terra, in the more recent publication, *Tropical Vegetables*, states: "Most vegetables are annual plants. But in the tropics young leaves, shoots, pods and other fruits are often harvested from shrubs and trees. Their great advantage is the fact that they often continue to grow and yield in the dry period, when the growing of annual vegetables meets with difficulties" (30). Rosedale and Milsum, in the booklet, *Malay Leaf and Other Vegetables and Their Analyses*, place their subjects in three groups, one of which "consists mainly of trees which, once established in the kampong, thrive with little or no cultivation and provide a more or less continuous supply of green foodstuff to the landowner" (26).

From my own observations, it is apparent that leaves with pronounced acid flavor are preferred; bitter leaves are not scorned but relished. Most are eaten raw or only slightly cooked. The use of mature leaves is exceptional. Usually the tender new shoots and young leaves are gathered while in the juvenile color stage—bright-green, yellowish, pink, brownish, various shades of red or purple—and these are generally within easy reach. Because of the widespread practice of shifting, or so-called "slash-and-burn", agricul-

ture, extensive areas once densely forested are now relatively open woodlands replete with new growth springing from stumps or saplings. Favored species, often planted in fencerows around yards, are regularly "topped", that is, cut back, to provide a constant supply of foliage.

Forest dwellers recognize and have common names for a great many edible, medicinal and otherwise useful plants and the same genera appear in the roster of edible leaves of widely separated populations.

With Negrito guides in the Philippines, I sampled the lemon-flavored leaves of the wild vine, *bali nac nac* (*Embelia philippensis* A.DC.) of the family Myrsinaceae. These leaves are enjoyed with fish—quite understandably. In Indonesia, the acid young leaves and shoots of *Embelia ribes* Burm. f. are eaten raw or added when cooking other foods (23). In East Africa, the sorrel-flavored leaves of *Embelia schimperi* Vatke are popular. Closely related is our popular ornamental, *Ardisia humilis* Vahl., the pinkish new leaves of which are enjoyed in tropical Asia without cooking.

In the jungle, we frequently encountered the red-leaved *Cissus repens* Lam. (Vitidaceae), which is tart and savory and much appreciated by the Negritos as it is by East Indian people generally. *Cissus discolor* Blume, well-known as a decorative plant in hanging baskets, also grows wild in the East Indies and the acid young leaves and growing tips are commonly added to various dishes (23).

There were a number of giant vines of the same family which we cut for drinking water. One, called *lungnikit* (*Tetrastigma harmandii* Pl.) also provides edible leaves. Because they are agreeably sour, they, too, help to quench thirst and they are locally used in cookery, as are those of *T. loheri* Gagnep. (4). In searching for waternives in a forest ravine in Thailand, we came upon *Tetrastigma lanceolarium* Planch., a good source of water and of leaves that are eaten raw or cooked.

In the Philippines and elsewhere in the East Indies, the rather tough and slightly bitter young terminal leaves of *Pleomele angustifolia* N.E.Br. (Liliaceae) and of *P. elliptica* N.E.Br. are cooked and eaten or crushed and the green juice used as a food color (30). We ate raw only the tender white bases of the new leaves.

In dry woodlands of northeast Thailand, I was fed more leaves by helpful men from native villages. The pink-tinged young foliage of the



Figure 1.—Young leaves of the mango tree, *Mangifera indica* L., are eaten raw or cooked in the East Indies.  
—Photo by Julia Morton

sorrel tree, *Cratoxylum prunifolium* Dyer (Hypericaceae) is pleasantly acid and delicious raw. My guides liked the purplish new leaves of the blue laurel, *Litsea firma* Hook. f. (Lauraceae) but they were too bitter for my taste. It is appropriate to note that the leaves of *Litsea guatemalensis* Mez. were analyzed by Munsell and co-workers in a study of the food plants of Central America and results reported with the following comment: "Leaves of this tree appear to be an outstanding source of calcium (803.0 mg. per 100 g.) and iron (15.04 mg.). The sample also gave high values for carotene (9.479 mg.), riboflavin (0.649 mg.), and niacin (2.465 mg.), and a significantly high value for nitrogen (2.190 g.). It can be an important source of all these nutrients." Both fresh and dried leaves of this species and of *L. glaucescens* HBK. are marketed for use with meat and in soups and stews (17).

The Thais also eat raw the young leaves of *Caryea arborea* Roxb. (Barringtoniaceae). The

new leaves of *Barringtonia racemosa* Blume, *B. acutangula* Gaertn., *B. insignis* Miq. and *B. asiatica* Kurz are slightly astringent but often marketed and eaten raw or stewed in Malaya and Indonesia, even though the fruit, seeds and bark of these trees are used to stupefy fish (5, 23).

The people of Thailand make much use of the young shoots of members of the Myrtaceae, particularly *Eugenia grata* Wight, which I found in heaps on the Nakon Phanom market. Leaves of *E. duthieana* King are regularly marketed in Perak and their chemical composition is reported by Rosedale and Milsum (26). In the East Indies, the young shoots of *E. longiflora* Fisch. and *E. polycephala* Miq. are consumed raw with rice and the dried young leaves of *E. polyantha* Wight are used, like bay leaves, for flavoring (23).

Other tree leaves eaten by the Thais include the leaves of *Crateva nurvala* Buch. Ham. (Capridaceae) which are utilized raw, cooked or

pickled; also the bitter foliage of *Azelia xylocarpa* Craib (Leguminosae) and the acid new growth of *A. bijuga* A. Gray. Young leaves of the woody vines, *Derris uliginosa* Benth., *D. elliptica* Benth. and *D. heptaphylla* Merr. are enjoyed raw despite the widespread use of *Derris* species as fish poisons (5).

The thorny new branch tips of another legume, *Acacia insuavis* Laco., are very popular and sold throughout the country. They are eaten raw with chili pepper sauce, or boiled or baked; or they are chopped, added to raw eggs and the mixture fried like an omelette. Bunches of the young branchlets of *Leucaena leucocephala* De Wit (formerly *L. glauca* Benth.), with immature flower clusters and tender pods attached are sold for cooking as greens in Thailand, as they are in the East Indies, Central Africa and many other tropical areas (10, 23). This small tree is a well-known fodder plant for cattle, sheep and goats but causes hair loss and other symptoms of toxicity in horses, donkeys, mules and pigs.

A small tree peculiar to Thailand is *Melientha suavis* Pierre (Opiliaceae). I went out in the woods above Korat with two youths who were sent by the camp cook to gather the new leaves for soup, and we collected a sackful. Later, I saw heaps of the shoots (called *pak wan*) for sale in the bazaar-like "city market" in Bangkok. Yet I was told that sometimes people pick "the wrong kind" of *pak wan* and are fatally poisoned, and I found a 1931 report which states that hardly a year passes without deaths attributed to this cause. The author of the report, having made a personal investigation, verified the identity of suspect shoots as *Melientha suavis* but relates that at times there are abnormal shoots on the tree which show evidence of attack by a boring insect which he assumes might render them toxic (11). Nevertheless, the Thais are very fond of the shoots and continue to eat them, just as Jamaicans continue to enjoy the occasionally treacherous akee (*Blighia sapida* Koen.).

In both Thailand and Vietnam, I encountered *Premna integrifolia* L. (Verbenaceae), the leaves of which are cooked with fish. *Erioglossum rubiginosum* Blume (Sapindaceae), is a small tree with edible but not very appealing fruits. Its young, velvety shoots, however, are popular in Southeast Asia and in the East Indies and are eaten raw as a relish or mixed with other foods. They have the reputation of being mildly

soporific. Asians and Indonesians also eat the young leaves of *Schleichera oleosa* Merr. (syn. *S. trijuga* Willd.), of the same family, either raw or cooked with rice or fish (23).

I photographed *Melastoma malabathricum* L. (Melastomaceae) in Saigon but it occurs wild throughout Southeast Asia and the East Indies, quickly invading forest clearings. Though its young leaves are coated with hairs, their sourness is appreciated and they are combined with other foods that are lacking in flavor (23). The red-fleshed fruit is sweet and edible. Because it stains the mouth it has given rise to the plant's Australian nickname, "blue tongue". This attractive shrub was carried from Florida to Hawaii in 1916 and has spread over much of the island of Kauai where it is not classed as a food but rather as a noxious weed.

It occurs to me that horticulturists have remained largely unaware of the edibility of common fruit-tree leaves because of the exclusion of this information from books dealing with tropical and subtropical fruits. Ochse and Bakhuizen van den Brink, in their esteemed work on *Fruits and Fruitculture in the Dutch East Indies*, speak of edible foliage only in connection with the papaya (*Carica papaya* L.) (22), yet in their larger work, *Vegetables of the Dutch East Indies*, they present in detail the edible aspects of the foliage of many of the fruit trees discussed in the former volume. In fact, 93, nearly one-fourth of the species included as vegetable sources by these authors, are trees, shrubs or woody vines from which leaves are gathered (23).

Wilson Popenoe, whose *Manual of Tropical and Subtropical Fruits* (25) has been a standard reference for several decades, makes no mention of leaf-eating, nor do other popular guides for the fruit-minded, including the recent book of *Malayan Fruits* by Betty M. Allen in Singapore (2).

Accordingly, it will surprise many to learn that the young, sour leaves of bignay, *Antidesma bunius* Spreng. (Euphorbiaceae) are prized in the East Indies raw or steamed and often partaken of in combination with less tasty foods (29), as are also the conspicuous red shoots of *A. ghaesembilla* Gaertn. (23), and of *A. dianthum* Roth. in India. The protein content of the latter is reported as 7.2% (30).

Other fruit-producing members of this family with acid and appetizing young foliage eaten raw or cooked as greens are the Otaheite goose-

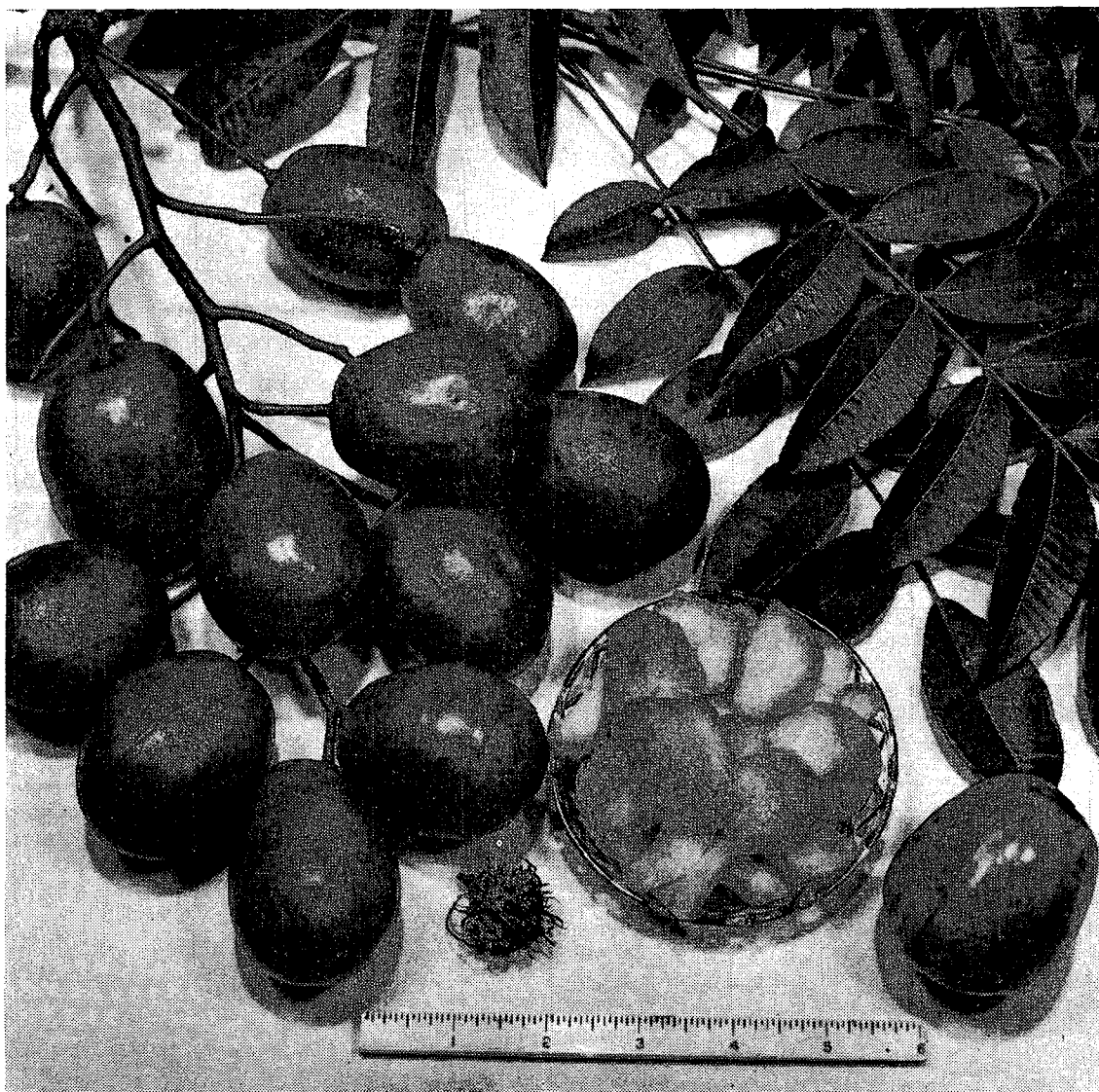


Figure 2.—New leaves of the ambarella, *Spondias dulcis* Forst., have a pleasing acid flavor. Need not be cooked.  
—Photo by Julia Morton

berry, *Phyllanthus acidus* Skeels and the emblic, *P. emblica* L., of tropical Asia and Oceania (26); also *P. muellerianus* Exell of West Africa (10).

In the Anacardiaceae, several fruit trees furnish comestible foliage. The young leaves of the common mango, *Mangifera indica* L., particularly while red and tender, are eaten raw with rice or, together with the new inflorescences, cooked, chopped and served as greens (23). Old

mango leaves have been given to cattle in Africa and India in times of feed scarcity. Continued feeding produces a yellow dye in the urine which was recovered commercially in India until the practice was banned. It was deemed cruel and ultimately caused the death of the cattle (5). It is rather remarkable that, though mature mango leaves can cause dermatitis, they are used in Mexico and elsewhere for cleaning the teeth

and toning the gums; and in Curacao and some other islands of the West Indies an infusion of the mature, partly sun-dried, leaves is taken as a remedy for high blood pressure and other ailments. However, I do not intend to digress further from the subject of leaves as food.

The new leaves of *Mangifera caesia* Jack are never cooked but are popular raw with rice (23).

The related *Bouea oppositifolia* Meisn., with fruits like miniature mangoes, is common wild and cultivated in Thailand and South Vietnam, as is the very similar *B. macrophylla* Griff. in Malaya and the East Indies. Their young purplish leaves are often sold for eating raw.

The new compound leaves of the ambarella, *Spondias dulcis* Forst., are enticingly acid and consumed raw, or steamed and eaten with salted fish and rice. If cooked with tough meat, they are said to tenderize it. In the Philippines, Java and Thailand, the sour new shoots of *S. pinnata* Kurz are steamed as greens and are much used in stews (4). In Guatemala, the red or purplish new leaves of the red mombin, *S. purpurea* L., are eaten raw. They are pleasingly tart and contain 4.3% protein (30).

The cashew tree, *Anacardium occidentale* L., though native to Brazil, has been exploited with more enthusiasm in the tropics of the Old World. There, even the leaves are an accepted food. They are commonly eaten raw in the East Indies and are sold in little bundles in Malayan bazaars. Their protein content ranges from 3.8 to 5.2% (26, 30).

The very red new growth of the Malay apple, *Syzygium malaccense* Merr. & Perry (Myrtaceae) is consumed raw with rice (23). Red shoots of the paniala, *Flacourtia jangomas* Raeusch. (Flacourtiaceae), and the rukam, *F. rukam* Zoll. & Morr., are marketed in the East Indies for the same purpose (23, 30). They have the acidity and astringency of rhubarb.

Asiatics eat, too, the young leaves and the flower petals of the famous durian, *Durio zibethinus* Murr. (Bombacaceae); and they are very fond of the young shoots of the jackfruit, *Artocarpus heterophyllus* Lam. (Moraceae), often cooking them together with the young male flower spikes (23, 30). In the East Indies, the young shoots of the white mulberry, *Morus alba* L., though rough in texture, are frequently cooked as greens or in vegetable stews. While in this family, I may add that the new shoots of the India rubber tree, *Ficus elastica* Roxb., while still enclosed in rosy sheaths, and the

young leaves of *F. glomerata* Roxb. and many other species of *Ficus* are routinely eaten raw in Asia and Africa (23, 29).

Prominent among exotic vegetable greens are the young leaves and juvenile male plants of the papaya, *Carica papaya* L. (Caricaceae). Boiled in two waters to eliminate most of the bitterness, they are of considerable importance in Indonesia, Malaya, Madagascar and tropical Africa (10, 26).

The notably drought-tolerant tree, *Gnetum gnemon* L. (Gnetaceae), is cultivated as much for its leaves and inflorescences as for its fruits in the Philippines, Indonesia and Malaya. The leaves contain 4.6% protein and the flowers 5%. Chemical composition is reported by Rosedale and Milsum (26) and also by Munsell *et al.* who analyzed the leaves of the sole tree at the Lancetilla Experiment Station in Honduras (20). Foliage of *G. africanum* Welw. and *G. buchholzianum* Engl. forms part of the diet in West Africa where the leaves of the Indian jujube, *Zizyphus mauritiana* Lam. (Rhamnaceae) are also eaten (10).

The tropical American soursop, *Annona muricata* L. (Annonaceae), cultivated throughout the Old World tropics for its fruit, yields edible foliage as well. The very young leaves and shoots are steamed and eaten with rice (23, 30).

The young, tender shoots of the sapodilla, *Achras zapota* L. (Sapotaceae), are washed to rid the severed parts of exuding latex, and are then eaten raw or steamed (3). Leaves and tender seedlings of the tamarind, *Tamarindus indica* L. (Leguminosae), are eaten in soups and curries (5).

In some cases, the foliage of a tree proves to be more nutritious than the fruit. The fresh leaves of the kaki or Japanese persimmon, *Diospyros kaki* L. (Ebenaceae), contain as much as 2,726 mg. of ascorbic acid per 100 g. (21), while only 13 to 30 mg. have been found in the delectable fruit.

To some tastes, the foliage of certain species may be far more appealing than the fruit, whether nutritious or not. The odoriferous Indian mulberry, *Morinda citrifolia* L. (Rubiaceae), is repellent to many, but the leaves have no such handicap. The young ones are much eaten raw or cooked. Older leaves serve to wrap fish for cooking and are eaten with the fish (5, 30). *M. elliptica* Ridl., wild in Malaya, has smaller, narrower leaves used similarly (30).

The bael fruit, *Aegle marmelos* L. (Ruta-

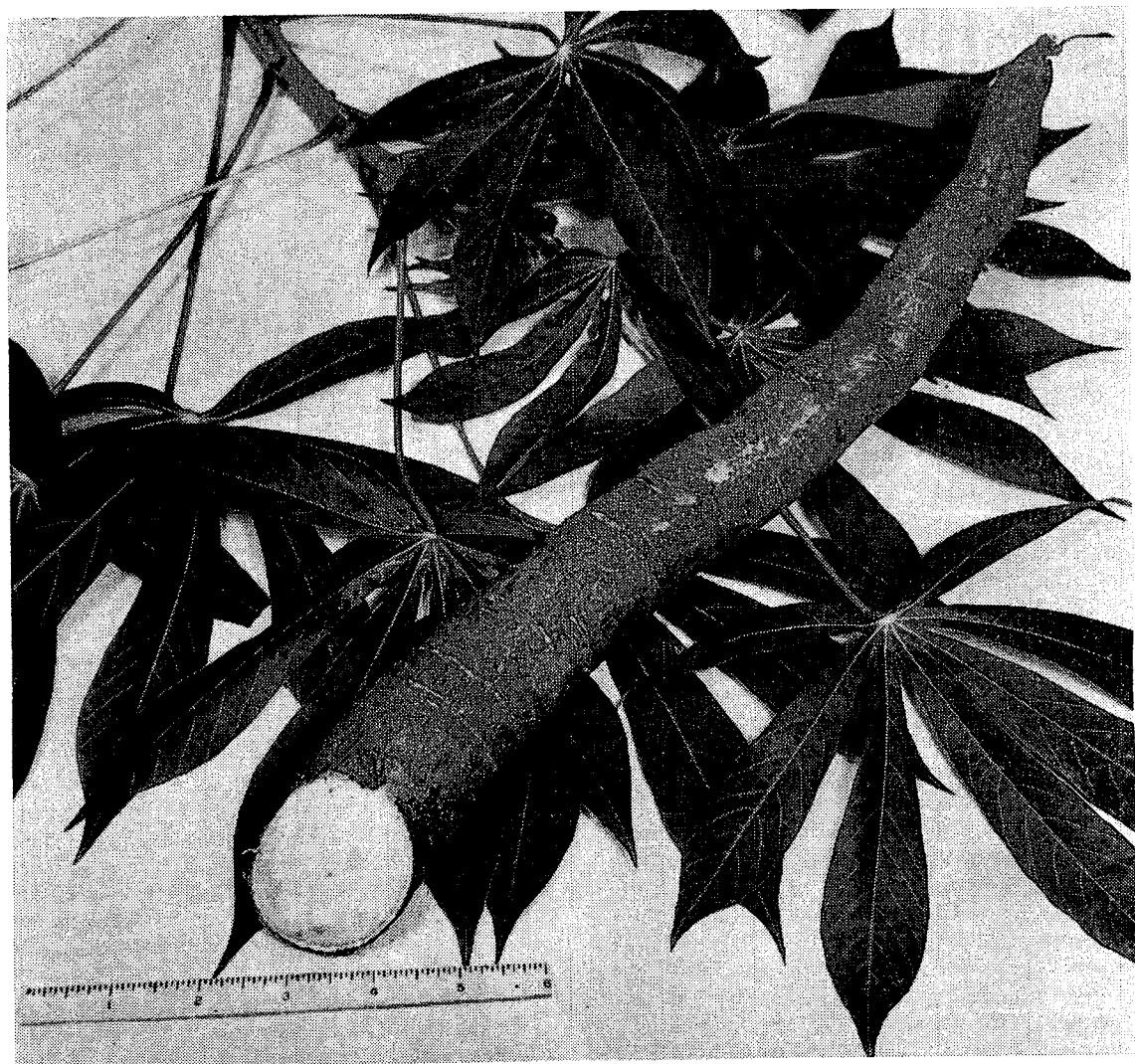


Figure 3.—Young leaves of cassava, *Manihot esculenta* Crantz, have greater food value than the starchy root. —Photo by Julia Morton

ceae), is little esteemed outside of India. The young leaves and shoots of the tree, consumed as vegetables in Southeast Asia and Indonesia, might well find acceptance wherever the tree succeeds (30).

The ugly porcupine orange, *Citrus hystrix* DC., of the same family, is valued in the Far East more for shampooing than in the culinary, but the leaves are often marketed. Fresh or dried, they are chopped or crushed and added to meat and fish dishes (23). *Citrus* leaves are

customarily used as wrappers for the grubs of the Indian honey bee which are cooked in coconut milk with seasonings.

The knowledge that neglected leafy materials may exceed in food value the better-known products of certain plants can be of especial importance to those rendering aid in developing areas having low nutritional levels. As an example, the tuberous roots of sweet varieties of cassava, *Manihot esculenta* Crantz (Euphorbiaceae), though a staple starchy food in tropi-





Figure 4.—The young leaves of the ornamental *Bauhinia tomentosa* L. are tart and enjoyed with rice.

—Photo by Julia Morton

cal countries, are very poor sources of protein and vitamins. The young leaves, on the other hand, contain 6 to 10% protein; are fairly rich in methionine (30). They hold, according to Munsell *et al.*, large amounts of calcium (269.3 mg./100 g.), iron (12.78 mg.), thiamine (0.259 mg.), riboflavin (0.400 mg.), niacin (3.080 mg.) and ascorbic acid (420.0 mg.). Nitrogen content (1.430 gm.) is high for a green vegetable (18). The new leaves and shoots are steamed or boiled only a few minutes and eaten like spinach or shredded or chopped and added to soups, stews or various meat and vegetable preparations (29).

The young leaves of the chayote, *Sechium edule* Swartz (Cucurbitaceae), likewise surpass the squash-like fruit in nourishing properties. The leaves are eaten as greens in north and tropical Africa and Madagascar (10) as well as in Central America and, as analyzed in Costa Rica, contain "moderate amounts of iron (2.74

mg./100 g.), carotene (2.270 mg.), thiamine (0.119 mg.), riboflavin (0.208 mg.) and niacin (1.432 mg.)" (19).

Leafy dietary supplements from fiber crops should not be ignored, especially those in the family Malvaceae. New leaves of kenaf, *Hibiscus cannabinus* L., are cooked and eaten in West Tropical Africa (as are the leaves of almost any species of *Hibiscus*). Africans eat the leaves and flowers of the so-called Madagascar jute or caddillo, *Urena lobata* L. (10), which is a naturalized honey plant in South Florida. Young foliage of cotton, *Gossypium arboreum* L., *G. brasiliense* Macf. and *G. herbaceum* L., is popularly cooked as greens in Thailand.

Ramie, *Boehmeria nivea* Gaud. (Urticaceae), provides edible young leaves in Vietnam and Indonesia (30); *B. platyphylla* D. Don in the Congo (10).

Leaves are a useful by-product, too, of the



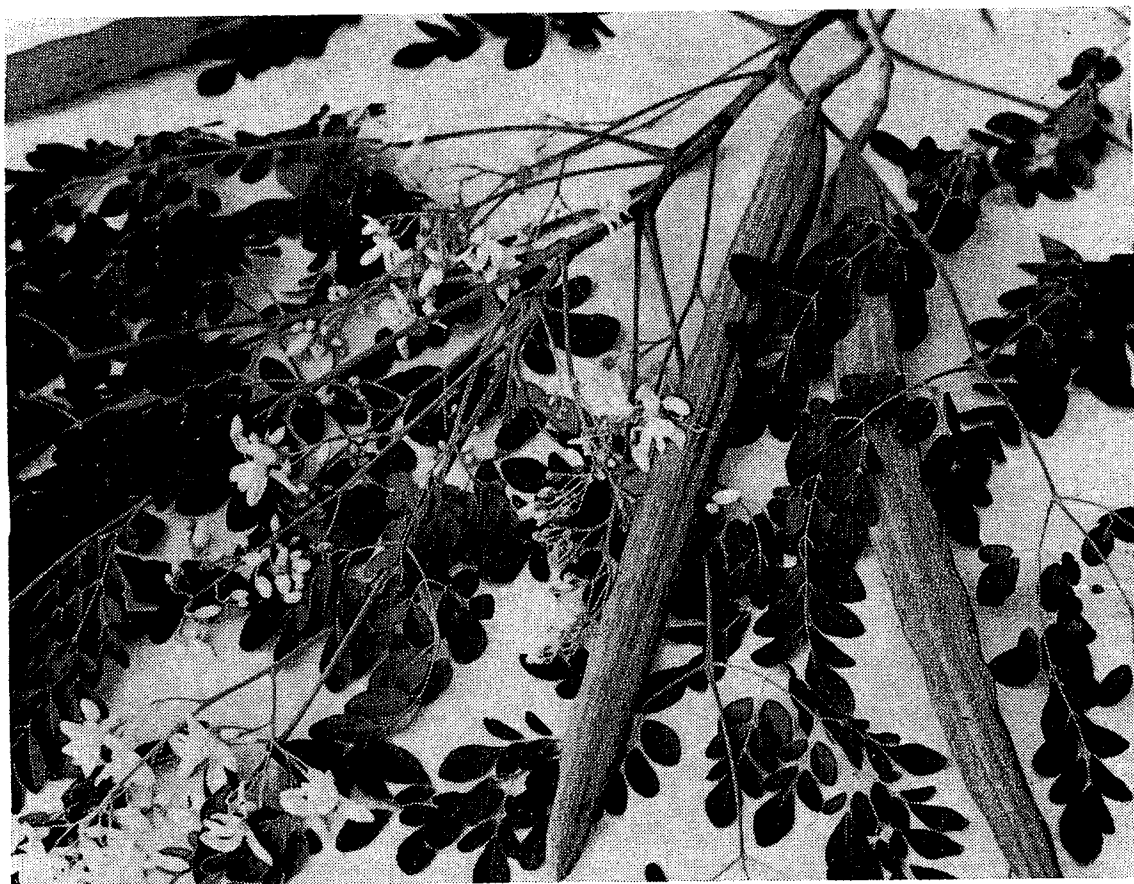


Figure 5.—In the East Indies and Oceania, the new foliage and flowers of the horseradish tree, *Moringa oleifera* Lam., are commonly cooked as greens. —Photo by Kendal and Julia Morton

pigeon pea, *Cajanus cajan* Millsp. (Leguminosae), a semi-woody shrub so widely grown for its seeds. The young shoots are consumed raw or cooked in Indonesia and West Africa and Madagascar and could be more commonly employed. Protein content is reported as 9% (10, 30).

A short-lived tree grown in home yards throughout the Tropics for its new leaves as well as its edible flowers and slender immature pods, is the legume, *Sesbania grandiflora* Benth., especially the white-flowered variety. The same useful parts are derived from *S. sesban* Merr. and *S. tetraptera* Hochst. in the Sudan and East Africa (10).

Many of the leguminous trees and shrubs familiar to us as ornamentals are sources of food to other people. The young leaves of the St.

Thomas bush, *Bauhinia tomentosa* L., are tart and served as a side-dish with rice or added to other foods (23). Young leaves and shoots of *B. variegata* L. and *B. purpurea* L. are eaten raw or cooked in tropical Asia and the flowers and flowerbuds are pickled (30). In the Philippines, Indonesia and Burma the acid leaves of *B. malabarica* Roxb. are commonly consumed raw or cooked with meat and fish (4, 23). In Africa, the new growth of *B. reticulata* DC. and *B. thonningii* Milne is much used for food (10, 30). These last two species are usually transferred to the genus *Piliostigma*.

The new leaves of the Indian coral tree, *Erythrina variegata* var. *orientalis* Merr., are cooked as greens (23) and so are those of many other species of *Erythrina*, including our native *E. herbacea* L. The young shoots of *E. berteriana*



Figure 6.—Mature leaves of the baobab, *Adansonia digitata* L., are important in the diet of Africans, usually dried and powdered for thickening soup. —Photo by Julia Morton

Urban were analyzed by Munsell *et al.* in Guatemala and El Salvador and reported as high in thiamine, iron and carotene (16, 18).

The leaves of various species of *Cassia* are gathered as greens, among them *Cassia mimoides* L., *C. occidentalis* L., *C. surattensis* Burm. f., *C. laevigata* Willd., *C. siamea* Lam., *C. siebe-*

*riana* DC., *C. singueana* Del., and *C. garrettiana* Craib. Those of *C. fistula* L. are utilized only in emergency (10, 23).

While commenting on legumes, I might add that two quite recent publications on the food plants of Africa include the leaves of *Abrus precatorius* L. Jardin lists them under "Sugars and

Sweeteners" (10), and Busson says that they are used to sweeten certain drinks and dishes because of their glycyrrhizine content (6). One often reads that the leaves are nibbled here and there but I was astonished on one occasion to see an armload of the fresh vine on the native market in Curacao and was obliged to chew a bit of it to please the vendor. I probed into the matter and learned that the people often chew a cud of the vine in lieu of chewing tobacco. On several occasions since, I have voluntarily chewed a leaf or two when in the field, just for the pleasant flavor.

Often mistaken for a legume, the horseradish tree, *Moringa oleifera* Lam. (Moringaceae), is prized as a food source in some regions, valued only as an ornamental in others. In Malaya, Indonesia and the Philippines and among Filipinos in Hawaii, the new shoots, tender leaves and flowers are greatly relished. They are cooked and eaten in salads and soups and with meat and fish. The trees are cut back so frequently that they seldom are allowed to reach more than head high. Miller *et al.* reports the crude protein content of the leaves as 9%, "unusually high for a green leafy vegetable" (14). In the raw state, horseradish tree leaves are pungent as mustard and purgative but brief boiling renders them mild and wholesome and, to me, the firm texture is pleasing. The tree flourishes in the extremely dry island of Curacao and is very common on roadsides and in gardens, but I have found these people entirely unaware of the food potential of the foliage.

The revered and drought-resistant neem tree, *Azadirachta indica* A. Juss. (Meliaceae), is an important source of edible foliage in India and East Africa. The leaves are lopped for fodder and are also cooked as greens or simply dried and eaten raw. The bitter young leaves contain 11.6% protein; older leaves contain 7.2%. Yogis eat these leaves to achieve immunity from the lure of beauty and as a protection from poison. The leaves are also placed in books and among stored garments to drive away insects. It would be interesting to learn if animals and humans become insect-repellent by eating this foliage!

The status of the baobab tree, *Adansonia digitata* L. (Bombacaceae) varies from one part of Africa to another. In Ghana, Kenya, Nyasaland and other areas, the foliage of a smooth-leaved variety is marketed and forms an important part of the diet (10). After sun-drying, the leaves are pulverized and the powder em-

ployed as a mucilaginous thickening for soups and sauces (6). Dr. Marjorie Whiting, who lived among the Bushmen of the Kalahari desert for two months in 1967, says that these undernourished people do not use the leaves of the tree though it is common there. Story suggests that the Kalahari trees may not be of the preferred variety (28). I feel that leaf-eating is a matter of tradition or culture and may not be a general practice among desert dwellers. The foods of the Bushmen are mostly roots, seeds, fruits and edible gums. Meggitt, writing on the foods of desert inhabitants in Central Australia says: "Edible leaves form but a minute part of the diet and are usually eaten raw . . ." (13).

I have not heard of West Indian or tropical American people eating the leaves of the kapok tree, *Ceiba pentandra* Gaertn. (of the same family as the baobab). Yet in Indonesia the young seedlings are consumed as vegetable greens raw or scalded (23), and in tropical Africa the new leaves are dried and used in cooking, as are the leaves of *C. guineensis* A. Chev. and *C. thonningii* A. Chev. (10). Both the leaves and flowers of *Bombax malabaricum* DC. and *B. buonopozense* P. Beauv. are eaten (10, 30).

New leaves of *Polyscias scutellaria* Fosberg and *P. fruticosa* Harms (Araliaceae) are often cooked as vegetables (23).

Strongly recommended as "tree spinach" are the leaves of chaya, *Cnidoscolus chayamansa* Mc-Vaugh (Euphorbiaceae) of Yucatan and *C. aconitifolius* Johnston of southern Mexico and Central America. They are said to be rich in ascorbic acid. In some areas one species or the other may be grown exclusively as an ornamental and not recognized as a source of food (20).

A member of the same family regarded strictly as an ornamental plant in Florida is the showy croton, more properly leafcroton, *Codiaeum variegatum* Blume. In Indonesia the young leaves are steamed, boiled or roasted as vegetables, or stewed with the addition of sugar. Protein content is about 5% (23, 29). Red-leaved varieties are apt to be acrid raw. Pure yellow forms are mild and seem to me quite agreeably nutlike in flavor.

Indonesians eat raw the young shoots of the related shrub which we call copperleaf, *Acalypha wilkesiana* Muell Arg. They reportedly contain 6 to 7% protein (30).

Even the young shoots and very young leaves of the poinsettia, *Euphorbia pulcherrima* Willd., are sold as fresh greens in the East Indies but

they are always cooked, never eaten raw. The young leaves also of the ill-famed physic nut tree, *Jatropha curcas* L., are popular potherbs in parts of Indonesia. Ochse and co-author tell us that they are cooked with goat meat to deodorize it (23).

In the Orient, the red new leaves of rose bushes (*Rosa* spp.) are common fare, uncooked or merely steamed (23).

The foregoing sources of edible leaves are but selections from among 385 species which I listed for consideration. They serve to illustrate the present use of perennial foliage as daily food; the prospect of immediate improvement of diets where leaf-eating can be successfully introduced; and they may help to intensify interest in the current proposals for enhancing the world food supply by the extraction of leaf protein from sources not universally recognized as suitable for human consumption (1, 7, 8, 12, 24).

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