

Wild Plants as Food and Medicine in Polynesia

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The importance of the interaction between plants and people cannot be overstated in the case of Polynesia, where plants play a disproportionately large role in the cultural landscape, compared, for example, to pastoral peoples of continental areas. Lacking all domestic animals save pigs, chickens, and dogs, Polynesians depended on plants for their food, shelter, religious rituals, and healing practices. From the construction of the large oceangoing rafts that carried them, to the crops and agricultural strategies they introduced to the islands they colonized, Polynesians celebrated plants in practice and legend, intertwining the origin of plants with the genesis of cultural heroes. To understand the development, expansion, and intensification of Polynesian cultures, an appreciation of Polynesian plants is not only desirable but necessary (Cox and Banack 1991).

Polynesian Prehistory and Plant Environments

In Polynesian legends, cultivated and wild plants are not of equal salience, with Polynesian mythology focusing on the origin of cultivated plants. Clearly the cultigen "kit" developed and carried by the Lapita ancestors of the Polynesians was the technological innovation that allowed the colonization of perhaps the largest, most ecologically diverse, and environmentally unpredictable area on the surface of the earth: the islands of the South Pacific. The major Polynesian cultivars—particularly yams, taro, and breadfruit—exerted a strong influence on the nature of Polynesian human and material culture. This influence was potent in the intensification phase of the Polynesian cultures, where the agri-

cultural surpluses generated from Polynesian crops were governed by chiefly classes (Kirch 1984). In the hierarchical cultures of pre-European contact Hawaii, Tahiti, and Tonga, carefully designed plantings of cultigens determined the trajectory of society, with wild plants playing only a peripheral role. Yet earlier in the colonization and establishment phases of Polynesian cultures, wild plants played a much more important role, providing not only food and shelter, but also the complete material basis of the large oceangoing rafts (Banack 1991; Banack and Cox 1987). Although the material artifacts associated with cultivated plants—such as the massive breadfruit fermentation pits of the Marquesas or the taro pounders of Hawaii—have long played a prominent role in Polynesian archaeology (Davidson 1979; Kirch 1984; Kirch and Yen 1982), the importance of wild plants has only recently garnered attention.

The wild plants (meaning here all noncultivated plants) utilized by Polynesians prior to European contact have three different possible origins, listed in reverse chronological order: (1) some were introduced subsequent to human colonization as a product of voyaging and trade; (2) others were introduced, deliberately or inadvertently, during the colonization process, and (3) many species predated human presence on the islands. Trying to distinguish between aboriginal plant introductions and truly indigenous plants is occasionally a difficult process, but recently Art Whistler (1991) made a contribution to this inquiry.

The first category, wild plants used as items of exchange during Polynesian trade, has received little consideration. The biological consequences of such plants remain poorly understood. For example, extensive commerce in Lauan oceangoing canoes by Fijians and Tongans depended upon the existence of wild stands of large *Intsia bijuga* (Leguminosae) trees on Kabara island, Lau, Fiji (Banack and Cox 1987), which were used to create large single-piece canoe hulls renowned for their remarkable strength and durability. Yet there is no evidence that this trade resulted in the introduction of *Intsia bijuga* to other islands. Similarly, ethnohistorical accounts from Samoa suggest trade within and between archipelagos in *ie toga* (gloss: "fine mats," lit.: "Tongan mats") woven from wild *Freycinetia* (Pandanaceae) leaves, but again there is no evidence that this trade furthered the spread of *Freycinetia* throughout the islands. Commerce in *kato halu*, ceremonial baskets woven from the aerial roots of *Rhaphidophora* (Araceae), was also important throughout Tonga, but again transplantation of plants from one point to another as a result of this trade seems unlikely.

The reason that the products of wild plants, but not the plants themselves, were disseminated during trade is likely morphological: leaves and shoots but not fruits and seeds were the usual items of exchange. Thus, there was little possibility that a reproductive propagule would be transported and possibly

inadvertently released into the natural environment. But there were perhaps a few exceptions to this general pattern. The sweet, colorful syncarps of certain wild *Pandanus tectorius* (Pandanaceae) may have been carried from island to island as confections or decorative necklaces. Certain varieties of *Aleurites moluccana* (Euphorbiaceae), the oily seeds of which were ignited to provide light, may also have been disseminated in this manner.

The second category, wild plants introduced during the colonization process, has also received little comment. Certainly the origin, modification, and intensification of agricultural materials introduced by the Polynesians has been the focus of much distinguished research (Kirch 1991; Yen 1991). Yet to my knowledge, only Whistler (1991) has attempted a broad botanical analysis of the introduction of wild plants, including weeds, during Polynesian colonization episodes. Many of us researchers hope that he and others will continue to search for the story contained within the weeds, which, unlike cultivars, were not subject to intentional genetic manipulation by the Polynesians. Analysis with new genetic techniques may therefore shed new light on the pattern and timing of early Polynesian migrations by allowing biogeographic analysis of cultivar origins and distributions (Yen 1991).

In this chapter I focus on the third class of wild Polynesian plants, those that occurred on the islands prior to human advent. This topic is of particular interest since, unlike continental areas, Polynesia was subject to human intervention only within the last two to three thousand years (Jennings 1979). Also, unlike many cultures that developed in continental areas, Polynesian subsistence sprang from an already sophisticated agricultural system. With the exception of subsistence reef foraging and fishing (which continues to this day), there was never a hunter-gatherer phase in Polynesian prehistory (Jennings 1979). Instead the islands, with their wild plant communities, were colonized by people carrying exotic cultivars and well-developed agricultural systems, particularly arboriculture and cultivation of rhizomatous aroids (Yen 1991). In some ways the Polynesian settlement of Oceania resembles the rapid European colonization of America more than the slow Amerindian development of the same continent.

The early Polynesian colonists were faced with wild plant environments that were largely superfluous to their attempts to establish dependable plantings of the crops they brought with them. On any given island, the first colonists were likely already familiar with some of the wild plants they encountered, particularly pan-Pacific and pantropical species in the strand and littoral communities. But plant species of the interior forests, many of which are endemic, were likely unfamiliar to the new settlers, requiring careful investigation to discover possible utility. Uses for new species of an already familiar genus

might have presented themselves, but possible uses of species of endemic genera or endemic families likely took some time to determine.

Polynesian Wild Plants: Endemic, Indigenous, or Introduced?

We can divide Polynesian plants into two groups based on the probable familiarity of colonists with them: (1) indigenous plant materials with which the Polynesians were familiar on arrival, and in fact may have had a reasonable expectation of finding in the new locality, and (2) endemic plants that were not known to Polynesians prior to colonization. These two groups can be distinguished ecologically as well as ethnobotanically: the first category is characterized largely by strand and littoral species that form a more or less continuous flora throughout island Polynesia, while the second category is largely composed of inland rainforest and cloud species where rates of endemism are the highest.

Upon this template of two differing wild plant types can be superimposed Polynesian plant uses. For convenience I divide these uses into three types: (1) wild plants used to make durable goods, (2) wild plants used as food, and (3) wild plants used as medicine. To facilitate discussion, I concentrate on Samoa, although many of these examples are applicable to other island groups as well.

Wild Plants as Durable Goods

The use of wild plants to produce durable goods ranging from kava bowls to canoes has been well documented in Polynesia. For example, Sandra Banack and I (1987) detailed the use of many species of wild plants in the construction of large oceangoing canoes in Lau, Fiji. Each of these species was carefully selected for texture, tensile strength, buoyancy, and other structural qualities in much the same manner as contemporary engineers select materials for aircraft manufacture. But specialized uses of wild plants are of limited saliency within the general population: in the case of Lauan canoes, only a few hereditary clans of Polynesian shipwrights had the knowledge necessary to identify, select, and use the plants necessary for ship construction.

The types of Samoan durable goods constructed from wild plants include canoes and kava bowls from *Intsia bijuga* wood; fine mats made anciently from wild *Freycinetia* leaves; ceremonial skirts from *Sterculia fananiho* (Sterculiaceae) leaves; digging and fruit harvesting implements from various timbers; salt water-resistant fish traps from *Freycinetia* roots; fish nets, drills, and various toys such as darts formed from *Miscanthus floridulus* (Gramineae); and, of course, house timbers from *Intsia bijuga* and *Securinega flexuosa* (Euphorbiaceae) (Hiroa 1930). Although the production of these goods from wild

plants was important, it may not have been deterministic in a cultural sense except in a few cases. For example, Samoans claim that *ifi lele* (*Intsia bijuga*) is essential for material culture, since it is the preferred wood for kava bowls; and the production of 'enu, specialized fish traps, has recently waned in Ofu island, due to the lack of the necessary *Freycinetia reineckeii* roots.

Wild Plants as Famine Foods

The use of wild plants as food in Samoa is rare. They are resorted to only in times of famine, with the exception of *Cordyline terminalis* (Agavaceae), which is infrequently used as a confection (Cox 1982). Wild plants used as famine foods include species shunned by all except children in times of plenty (such as *Aleurites moluccana* [Setchell 1924]), as well as plants reported to have been used in ancient times as either staple foods such as *Tacca leontopetaloides* (Taccaceae) or as confections such as *Cordyline terminalis*.

Although the list of wild plants used as famine foods presented in Table 6.1 is not exhaustive, it illustrates several principles that characterize how Samoans select wild famine foods. First, and somewhat surprisingly, indigenous wild plants are not used as famine foods in Samoa. All but two of the species listed in Table 6.1 are clearly aboriginal introductions that now persist in a semiferal state (Whistler 1991). And of these two, the diploid seeded banana—*Musa acuminata* ssp. *banksii* (Musaceae), called in Samoan *tae manu* (lit.: “animal excrement”)—may have also been transported to Samoa through human agency in prehistoric times (Purseglove 1972; Simmonds 1962). Only *Terminalia catappa* (Combretaceae), a strand tree that is pantropical in its distribution, likely occurred in Samoa prior to Polynesian colonization.

Although this pattern of reliance for famine foods on an introduced flora rather than an indigenous one contrasts greatly with the situation of continental peoples, it is consistent with the belief that agriculture did not independently evolve in situ within Samoa. Instead, probably Samoa was first colonized by Lapita potters traveling from the west who carried with them a highly developed cultivar kit based on extensive development of starchy aroid cultivation and arboriculture prior to their arrival in Samoa (Davidson 1979; Yen 1991). Given the obvious superiority of the crops they carried with them, these colonists saw little need to explore for new cultivars from the indigenous flora of Polynesia.

The second selective principle is that the use of wild plants as famine foods in Samoa demonstrates the preference for plant taxa that collectively form a culinary analogue to the plants used as staples in the regular Samoan diet. Under this view, the rhizomes of *Cyrtosperma chamissonis* (Araceae) are analogous to the *Colocasia* (Araceae) and *Alocasia* (Araceae) rhizomes that are staples in times of plenty, and would be cooked and prepared the same way. In fact,

Table 6.1 Wild Plants as Samoan Famine Foods

<i>Taxonomic Reference</i>	<i>Family</i>	<i>Samoan Name</i>	<i>Edible Part</i>	<i>Preparation</i>
Monocotyledons				
<i>Cordyline terminalis</i> (L.) Kunth	Agavaceae	ti vao	rhizomes	cooked
<i>Cyrtosperma chamissonis</i> (Schott) Merrill	Araceae	pula'a	rhizomes	cooked
<i>Dioscorea alata</i> L.	Dioscoreaceae	ufi vao	roots	cooked
<i>Dioscorea esculenta</i> (Lour.) Burkill	Dioscoraceae	ufi lei	roots	cooked
<i>Musa acuminata</i> Simmonds	Musaceae	tae manu	fruits	cooked
<i>Metroxylon upoluense</i> ? Beccari	Palmae	niu lotuma	stem	starch extraction?
<i>Cocos nucifera</i> L.	Palmae	niu/toala	meristem	cooked/raw
<i>Tacca leontopetaloides</i> (L.) Kuntze	Taccaceae	masoa	roots	starch extraction
Dicotyledons				
<i>Terminalia catappa</i> L.	Combretaceae	talie	seeds	cooked
<i>Inocarpus fagifer</i> (Park.) Fosberg	Leguminosae	ifi	seeds	cooked
<i>Adenanthera pavonina</i> L.	Leguminosae	lopa	seeds*	raw
<i>Syzygium samarangense</i> (BL.) Merr. & Perry	Myrtaceae	nonu fi'afi'a	fruits	raw

*Early European introduction

their required inclusion in the very large ovens used to cook *Cordyline terminalis* rhizomes may trace to an early time when both species were used more extensively as food (Cox 1982; Kramer 1903). Similarly, tubers of *Dioscorea alata* and *D. esculenta* (Dioscoreaceae) are analogous to the yam cultivars of the same genus that are prestige foods in traditional Samoan culture and that require little, if any, alteration in processing and preparation techniques. Thus, ordinary culinary practices as well as preparation techniques require only minimal adjustment during the shift to such famine foods. The relative lack of use of the feral sago palm *Metroxylon upoluense* (Palmae) as a starch source in Samoa, even during times of famine, strengthens the hypothesis that the famine foods, in some sense, are a mirror image of the regular Samoan diet during times of

plenty. The only cultural analogue for *Metroxylon* starch is *Tacca lentopetaloides*, also a famine food.

The third selective principle for wild famine foods in Samoa is that the wild plants used in the famine diets of Polynesia may consist largely of previous prototype cultivars that may have been discarded in favor of the new improved models. The inclusion of a few nut crops such as *Inocarpus fagifer* (Leguminosae) and *Terminalia catappa* may, for example, harken back to the long-forgotten days of *Canarium* (Burseraceae) cultivation by the Lapita ancestors of the Polynesians, while the denigration of the seeded banana by the appellation *tae manu* may perhaps disguise its former importance in the evolution of more recent seedless banana cultivars. Certainly the trend toward seedlessness in Polynesian crops such as bananas and breadfruit would result in a greater likelihood of the earlier, seeded varieties persisting in a feral state; the more "advanced" seedless cultivars would obviously require active human intervention for their perpetuation.

Of course the use of wild plants in obtaining food is not limited to food plants themselves. Wild ichthyotoxic plants such as *Barringtonia asiatica* (Barringtoniaceae) and *Tephrosia piscatoria* (Leguminosae) were used to poison reef fish (Cox 1979). Fish nets woven from wild *Hibiscus tiliaceus* (Malvaceae) were able to withstand the ravages of seawater. Wild plants were even used to preserve harvests of cultivated plants: the leaves of *Heliconia paka* (Heliconiaceae) were used to provide airtight linings for breadfruit fermentation pits (Cox 1980a), while the leaves of *Barringtonia asiatica* were used to form durable baskets in which the fermented product *masi* could be stored underground (Cox 1980b).

Wild Plants in Polynesian Ethnomedicine

Perhaps the most complex and sophisticated use of wild plants in Samoa can be found in traditional herbal medicine. Most Samoan medicinal plants are gathered from the wild, although some cultivated plants such as breadfruit and certain banana and *Hibiscus* (Malvaceae) cultivars play a role as well. This pattern extends throughout Polynesia; Bernhard Zepernick (1972) found that 427 plant species from more than 300 genera had been reported to be used in Polynesian medicine. Of these 427 species, 55 are officinal in Western medicine, 1 was used in European folk medicine, 16 were used in Chinese and Tibetan folk medicine, and 72 were used in Melanesian folk medicine (excluding Fiji). Thus, in Polynesia 67% of the Polynesian ethnopharmacopoeia is used for medicine only. (Such data argue against the view that Polynesian traditional medicine in general and Samoan ethnopharmacology in particular were derived from the early European missionaries and explorers [Cox 1991].) But even more convincing is an analysis of the status of the plant species used in Samoan

ethnopharmacology, which reveals that a majority of Samoan medicinal plants are indigenous. Over the last several years, my interviews with Samoan traditional healers about medicinal plants have revealed that 81 ethnotaxa comprising 75 different species are used in traditional therapies. Of these 75 species, 41 (55%) are plants indigenous to Samoa, and 4 (5%) are endemic. Of interest in the context of this essay is the number of wild species within the Samoan ethnopharmacopoeia; 50 (67%) are wild or feral species. These high percentages of wild and indigenous species are indicative of a healing tradition that continued to grow after initial colonization but remained somewhat diffuse and unformalized. Otherwise wild medicinal species might have been brought into cultivation in a manner similar to that of the physic gardens of Europe during the early Renaissance.

Unlike some Oriental traditions, Samoan ethnopharmacology relies almost exclusively on fresh plant material in the formulation of plant remedies. This, in turn, requires that a healer be able to locate, identify, and gather pharmacologically active plants as needed. Such expertise requires, as in the case of Lauan shipwrights (Banack and Cox 1987), maintenance of a specialist tradition of wild plant use. In Samoa, this guild is composed largely of *taulasea*, women herbalists who pass on their knowledge matrilineally.

I use the term *guild* in a rather loose sense since there is no economic advantage in becoming a *taulasea*. Samoan *taulasea* do not accept payment for their healing services, contending that the plants they use are gifts from God and that their skill in using them is a calling from God (Cox 1990a). Using a precise botanical lexicon in discussion of their work, the *taulasea* are far more knowledgeable about plants than other members of Samoan society. Having served informal but lengthy apprenticeships with their mothers or other female mentors, they command numerous details of disease diagnosis and etiology, plant taxonomy, and formulation.

During these apprenticeships, they learn how and where to collect wild medicinal plants. Preparation of Samoan medicines usually involves macerating the plants and infusing them in either water or, less frequently, coconut oil. Multispecies formulations are the rule. Most infusions are then rubbed directly on the forehead, back, and chest; and some are drunk. Treatments continue daily, sometimes with exhortations to observe certain types of dietary prohibitions called *sa*. Typical *sa* include avoidance of sweet or fatty foods.

The knowledge and skill of a healer increases with her age and experience. Unfortunately, the infirmities of age also reduce a healer's ability to journey into the forests for wild plants. Older healers must rely either on trained assistants who retrieve plants from the forest or upon small gardens of wild medicinal plants that they transplant to areas near their residences.

Although space precludes a detailed analysis, it is perhaps useful to analyze

the Samoan ethnopharmacopoeia using the principles presented at the beginning of this chapter. Thus we can illustrate the Samoan ethnopharmacopoeia by presenting examples of medicinal plants that the ancestors of the Samoans may have brought with them to the islands, medicinal plants that they might reasonably have expected to find growing on the island when they arrived, and medicinal plants that they may have discovered only after arrival on the island.

An example of a medicinal plant deliberately introduced to Samoa during early aboriginal migrations is *Aleurites moluccana*. Known in Samoa as *lama*, the leaves are used to treat thrush, an infection of the oral cavity caused by the fungus *Candida albicans*. The seeds of *lama* or candlenut tree were used in ancient times to provide illumination for homes and night fishing; to this day, nighttime fishing in Samoa is still called *lama*. Although the large trees were perhaps at one time cultivated, today in Samoa they are feral, found on the outskirts of villages and along roadsides.

The beach morning glory, *Ipomoea pes-caprae* (Convolvulaceae), is an example of the second type of medicinal plant—i.e., one that was not carried by the Polynesians on voyaging but could be reasonably expected to occur wherever they journeyed throughout island Polynesia. Famed for its anti-inflammatory properties throughout the Pacific and Southeast Asia, this plant is used topically in Samoa to treat rashes, swellings, and various inflammatory processes. In Samoa it is called *fue moa* (lit.: “chicken vine”), and children use the immature floral buds as toplike toys.

Homalanthus nutans (Euphorbiaceae), an example of the third type of medicinal plant, was probably not exploited by the ancestors of the Samoans prior to colonization. A small tree that grows along the edge of the interior forests, *Homalanthus* is used by healers to treat *fiva samasama*, which may be translated as either “yellow fever” or “jaundice with fever”—hence, hepatitis. In either case, the stem wood is said to be useful against diseases whose counterparts in Western medicine are known to be of viral origin. My collaborators and I at the Natural Products Branch of the National Cancer Institute have found that extracts of *H. nutans* are active against the human immunovirus HIV-1 in human cell culture. Fractionation yielded the phorbol prostratin (12-deoxyphorbol 13-acetate), which is currently being investigated by the National Cancer Institute as a drug candidate for acquired immune deficiency syndrome (AIDS) therapies (Gustafson et al. 1992)

Regardless of the eventual success or failure of prostratin as a clinical antiviral therapy in Western medicine, its discovery vindicates the ethnopharmacological approach to drug discovery (Cox 1990b). The study of indigenous uses of wild plants is now transcending purely ethnographic or ethnobotanical value and is taking a place in Western biomedical research. For example, more than 86% of the medicinal plants used by Samoan healers show some type of

pharmacologic activity in broad-based screens (Cox et al. 1989). Indeed, even earlier studies indicated the possible antibiotic activity of the Samoan ethnopharmacopoeia (Norton et al. 1973). And yet it is puzzling that ethnopharmacology, a topic of such antiquity, would have been paid so little attention by the academic community.

It is important, now that possible commercial utility has been discovered in the Samoan ethnopharmacopoeia, that ethnobotanists not repeat the previous depredations of European sandalwood traders upon Polynesians. Specifically, it is crucial that the intellectual property rights of indigenous Polynesian peoples be explicitly recognized in light of potential Western development of Polynesian pharmaceuticals. In the case of prostratin, strenuous efforts have been made to ensure that the Samoan people are treated fairly. First, prior to the discovery of prostratin, written agreements concerning the disposition of any possible royalty income from Samoan medicinal plants were negotiated and signed with village chiefs. Second, prior to obtaining a use patent for prostratin, both the National Cancer Institute and Brigham Young University guaranteed that a significant portion of any royalties would be returned to the people of Samoa. Of course, at this early stage of research on prostratin, it would be just as cruel to prematurely raise villagers' expectations of financial return as it would be to raise AIDS patients' hopes of a cure. But even in the early stages of ethnobotanical research, it is important that the rights of indigenous people always be explicitly considered and protected.

Throughout Polynesia, as in the rest of the world, knowledge of wild plant uses is vanishing at a rapid rate. Perhaps this book will encourage others to join in studying the uses of wild plants before all opportunities to do so have vanished.

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