CHAPTER 8

Ethnobotany

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American botanist J. W. Harshberger first defined the term "ethnobotany" in 1896 as "the studies of plants used by primitive and aboriginal people" (Balick and Cox 1996). Since then, many attempts have been made to provide a descriptive definition (Bennett 1997). In broad terms, ethnobotany is the study of the relationship and interactions between plants and people (Balick and Cox 1996). This field of study analyzes the results of indigenous manipulations of plant material together with the cultural context in which plants are used (Balick and Cox 1996). It includes collaboration with disciplines such as ecology, chemistry, anthropology, economics, and linguistics (Prance 1991). However, the amount of interdisciplinary work done in ethnobotany needs to be increased in the future (Martin 1995, Prance 1991).

HISTORY OF THE USES OF PLANTS IN TROPICAL AMERICA

The use of plants by indigenous Americans dates back more than 10,000 years (Hoyt 1992, Porter 1981). Man was largely a predator of the fauna and a gatherer of the surrounding flora: grains for food, bark for clothing, and probably herbs for medicine. The first deliberate planting of seeds was probably the logical consequence of a simple series of events (Raven and others 1992). People who gathered grains (fast-growing weeds) probably spilled some of them accidentally near their campsites or maybe planted them deliberately and created a more dependable source of food (Raven and others 1992). Domestication, selection of parent material, and irrigation played a major role in the development of agriculture (Smith 1967), which in any form implies favoring useful plants over nonuseful within a particular culture. From the time he first conceived agriculture, man began important changes in his relationship with plants and engaged in ethnobotany.

FOODS

The region we now know as Mesoamerica (which includes central and southern Mexico, Guatemala, Belize, El Salvador, Honduras, and northern Nicaragua) has been the source of genetic resources in modern agriculture for many fruits and vegetables (Hoyt 1992). Seeds of many species of gourds and squashes from 6000 B.C. have been found in ancient Mesoamerican settlements. These well-preserved seeds record in some measure the history of agriculture and development of cultures in the New World (Cutler and Whitaker 1967). For example, it has been shown that seeds of *Cucurbita pepo* (Cucurbitaceae) were eaten with sugar obtained by the action of an enzyme. This food, called "pepitoria," is still eaten by natives of Mexico and Guatemala with the only difference being that now the sugar is obtained from sugar cane (*Saccharum officinarum*), a well-known plant introduced from New Guinea (Davidse and others 1994) by the Spanish colonists.

Another important plant of American origin is maize (*Zea mays*, Poaceae), one of the world's most productive plants, which accounts for a large percentage of the global food production. This cereal was planted in Mexico as early as 3000 B.C., although ancestral forms dating back to 5000 B.C. have been found in Puebla (Mangelsdorf and others 1967). Maize formed the agricultural basis of all the major New World civilizations: the Maya, Aztec, Inca, and Anasazi. This crop was also used as a main source of food by all the European explorers and conquerors who came to America. Mangelsdorf and Reeves (1943) suggest that without maize the colonization would not have been a success. It was and still is cultivated in association with beans and squash. Preparation methods for food made from maize vary, but one still finds handmade tortillas (maize patties made with limestone-treated grains) and stone-grinding slabs (metates) like those used by ancient Mayas (Sahagún 1582). A hot beverage called atole is made from mashed corn grains and is also probably of pre-Columbian origin. Maize was not only an important food crop but had religious significance as well; as the Mayan bible (Popol Vuh) tells, humans were formed from corn flour, and maize was represented too by many gods like Centlotl (Saenz 1988).

As many authors have stated, cacao (*Theobroma cacao*, Sterculiaceae) is America's contribution to the world as an important stimulating beverage (Coe and Coe 1996, Thompson 1956, Young 1994). The origin of the cacao tree is still debated. While some consider it as being from the Amazon (Smith and others 1992, Young 1994), others have stated that it is probably of Mesoamerican origin (Coe and Coe 1996). In any case, this "food of gods" (from *Theo broma*, the name Linnaeus gave to this species) was domesticated in Central America and was a valuable plant used as food and currency, as well as being a religious symbol for Olmecs and Mayas. A fossil record from an Olmec site in San Lorenzo, Mexico, dates its use to 1000 B.C., while the Dresden Codex has pictures depicting offerings of cacao fruit celebrating a new calendar year (Coe and Coe 1996). The Aztecs of Mexico and Mayans of northern Central America prepared a chocolate drink by pounding cacao beans with maize kernels, then adding boiling water with hot pepper chile. In the 1920's Wilson Popenoe reported that this traditional beverage was still served in San Cristobal Verapaz, Guatemala (Smith and others 1992). Cacao was not well received at first in Europe after the conquest, but as traditional spices were replaced by sugar, its popularity increased dramatically. Various techniques have developed to create chocolate liquor, cocoa, and chocolate as we now know it. One of the most famous is *dutching*, which uses pressure to extract the fat of the cotyledons, or *nibs*, yielding darker, milder flavored, and more soluble cocoa. About 90 percent of all cocoa used today is dutched (Simpson and Conner-Ogorzaly 1986).

MEDICINES

Long before Europeans came to America, native Americans, including Mayas, Aztecs, and Incas, had a well-developed understanding of plants, especially those used for medicine. The Badianus Manuscript (Emmart 1940), written by Martin de la Cruz in 1552, includes more than 200 species of plants used by Aztecs as medicine. Many of these plants are still in use today throughout America and some have even been naturalized in most tropical areas. Such is the case of *Psidium guajava*, a member of the Myrtle family (Myrtaceae) and mostly known as guava. This tree is most esteemed for its sweet-sour fruits used to make thick jelly or paste for desserts, but Aztecs and Mayas long ago prepared a decoction of leaves and bark of guayaba to treat gastrointestinal problems such as diarrhea (Emmart 1940). Today guayaba is known in every Mesoamerican and Caribbean country as a medicinal plant (Gupta 1995).

"Many American indigenous cultures lived, and still do, in tropical areas which are rich not only in plant diversity but fauna as well (Groombridge, 1992), and are threatened by encounters with a variety of dangerous animals such as poisonous snakes. Old manuscripts as well as current ethnobotanical information reveal that the use of *Dorstenia contrajerva*, of the mulberry family, (Moraceae) was and continues to be popular among tropical settlements (MacVean, 1995; Emmart, 1940) as an antidote to snake bites. Malaria, a disease caused by a mosquito-borne of the protozoan *Plasmodium* spp., is another example. Early in the 1600's during the conquest of the Inca empire many Spanish soldiers suffered from horrible fevers and Jesuits learned from the Incas that the bitter bark of a native tree was given as a beverage to treat fevers. Since then, the world has been indebted to the Incas that used the alkaloid, quinine, obtained from *Cinchona* spp. Today synthetic antimalarial drugs such as Fansidar (sulphadoxine perymethadine) and Aralen (cloroquinine) replace the need for quinine. Cinchona is still important in treating heart arrhythmias (Balick & Cox, 1996)."

OTHER USES

Narcotics

Coca leaves from the South American bush *Erythroxylum coca* (Erythroxylaceae) are valued by the people of the Andes region as a source of stimulatory alkaloids. From the Spanish conquest to the present, leaves have been collected, then dried for fermentation and chewed with lime, an agent that aids the absorption of alkaloids (Simpson and Conner-Ogorzaly 1986). These are taken to maintain blood sugar levels and alertness, to help travelers adjust to high altitude, and to reduce hunger pangs. Coca too was domesticated in pre-Columbian times. Archaeological findings show utensils and coca bags more than 3,000 years old (Furst 1972). Spanish conquerors tried to prohibit coca use until they realized that the Indian slaves would work harder if allowed to chew it. This plant was taken back to Europe and acquired fame with Angelo Mariani's wine, which contained extracts of the leaves. The Coca Cola Company originally used both *Erythroxylum coca* and *Cola nitida* (Sterculiaceae) to make its caffeine-rich, stimulating beverage, whereas today coca leaves, with the cocaine removed, are used to flavor the syrup from which this soda is made (Balick and Cox 1996, Plowman 1984, Simpson and Conner-Ogorzaly 1986). Due to cocaine-induced violence, the Harrison Narcotics Act was passed in 1900 in which the drug was declared illegal. Nevertheless, the abuse of cocaine has escalated to the point at which its legal use in medicine has become difficult (Balick and Cox 1996).

Materials

Since plant material does not preserve well in humid and tropical conditions it can only be speculated that ancient peoples used plants for shelter. The descendants of the Maya, for example, use palms as a source of construction material (Balick and Cox 1996). When visiting the Yucatán Peninsula, México, or Petén, Guatemala, the traveler can see that most of the small houses are still built with poles made from different native tree species. These poles are lashed with tough vines (most of them from the Bignoniaceae). The roof is usually thatched with palms such as *Sabal* spp. which currently suffers from great harvesting pressure as a resource for thatching (Caballero 1994), not only for small village housing but also for resort hotels and chalets.

CONSERVATION AND THE INVOLVEMENT OF INDIGENOUS PEOPLE

The examples above illustrate the richness of traditional knowledge about plants. This knowledge, inherited through many generations, can still be gathered in many regions, especially throughout Mesoamerica and South America, but the need to record it before it disappears is urgent. As biological diversity diminishes so does the cultural heritage of indigenous groups, where the elders are the ones with the most knowledge of the uses of plants (MacVean 1995). Finding new, nontimber alternatives and encouraging agroforestry practices to diminish the pressure on traditional agriculture is critical in developing neotropical conservation efforts (Martin 1995), which are essential if people are to continue to depend on the forest for sustenance.

For example, traditional practitioners provide up to 75 percent of the primary health care needs of rural people in Belize (Balick and Mendelsohn 1991). Setting an example for conservation through nontimber alternatives, the Association of Traditional Healers in Belize established a reserve for medicinal plants, located in the Yalbak region of Belize. Local healers gather medicinal plants from the reserve while scientists carry out ecological inventories as well as studies of regeneration of plants after harvest. To prevent habitat destruction and overharvesting of the supply of medicinal plants, the Ix Chel Tropical Research foundation has started a program to develop horticultural nurseries (Arvigo and Balick 1995, Balick and Cox 1996).

QUANTITATIVE ETHNOBOTANY

Historically, rain forests have been very profitable as sources of timber, whose harvest was a quick and simple way to obtain cash. The remains of the rain forest were burned. Today another form of forest destruction is slash and burn, a consequence of demographic pressure and the conversion of forested land to annual crops. However, ethnobotanists have pointed out that there are other viable and profitable alternatives to clearcutting. An interdisciplinary team from the New York Botanical Gardens led by Charles Peters did a 1-ha plot inventory of useful plants and estimated the net present value of harvesting fruits and latex at $6,330 (Peters and others 1989). Tree farming in countries such as Brazil gave yields of $3,184 per ha, while cattle pasture gave a net present value of $2,960. The yield from nontimber products is higher and provides a method of integrating the use and conservation of South American forests. Botanist Brian Boom has done similar quantitative ethnobotany with the Chacobo Indians in Bolivia and has found that 82 percent of the species on a hectare (75 of 91) were useful (Boom 1989, Prance 1991). In order to suggest a sustainable use of tropical forests, quantitative ethnobotany and density studies that include regeneration rates are necessary. To date, few studies of this sort exist for the Neotropics (Balée 1987, Balick and Mendelsohn 1991, Boom 1989, Di Stefano and Morales 1993, MacVean 1995, Peters and others 1989, Phillips and others 1994, Phillips and Gentry 1993).

Plants for Food

Of the several thousand species of plants known to be edible, only about 150 have ever become important enough to enter into modern agriculture and commercial trade (Plotkin 1988). Foods used by natives since pre-Columbian times are mostly unknown, undervalued, and underutilized, which illustrates how developing countries are both biologically and culturally rich but are cash poor. Problems such as overpopulation and malnutrition are rampant. However, combining ethnobotanical, nutritional, and biochemical research efforts, scientists have found that the nutritional status of the rural poor can be improved by native plants. Such is the case for amaranth and a variety of pot herbs.

Amaranth

Amaranth (*Amaranthus* spp., Amaranthaceae) was a very important cereal during pre-Columbian times. Its decline can be attributed in part to the fact that early Spaniards forbade its use because the Mayans and Aztecs used it in religious services as well as for food (Balick and Cox 1996, Simpson and Conner-Ogorzaly 1986). Even though prohibited, amaranth flourished because of its hardiness and easy cultivation. Natives were nutritionally dependent on this plant mainly because it was a grain with high lysine content (Plotkin 1988). Central American grain amaranth species are not true grains but the fruit of the species, though their flavor and cooking procedures are similar to that of grains. This beautiful plant is still used by Indians throughout the Mexican and Guatemalan highlands. Amaranth has several features that make it appealing as a crop for developing countries: it is a plant that can flourish in arid environments, it can be easily harvested, and it has high protein content. The works of Ricardo Bressani, editor of the Amaranth Newsletter (Universidad del Valle de Guatemala) show that amaranth pasta, for example, has 30 percent higher protein value than regular pasta. The protein quality of amaranth is higher than that of any other cereal grain currently used in the human diet (Bressani 1997) (see table 1). Amaranth is currently being marketed in the United States as breakfast cereal and is now being sold in health food stores (Plotkin 1988).

Table 1

Protein Quality of Amaranth and Other Common Cereal Grains

Grain	Protein quality (% of Casein)	Reference
Amaranthus caudatus		
Raw	74.8*	Pedersen [and others] 1987
Popped	74.4*	
Drum dried	89.1	Bressani [and others] 1987
A. cruentus		
Drum dried	86.1	Bressani [and others] 1987
A. hypochondriacus		
Drum dried	85.0	Bressani [and others] 1987
Maize, lime cooked	45.0	Bressani and Marenco 1963
High protein grain		
Raw	72.6	Bressani [and others] 1990
Lime cooked	82.6	Bressani [and others] 1990
Sorghum, raw	30.6**	
Rice	60.0	Howe [and others] 1965
Wheat flour	26.0	Howe [and others] 1965
Oats	73.6	Howe [and others] 1965
Rye	52.0	Howe [and others] 1965

*Net protein utilization

**Relation nutritive value

Source: Bressani 1997, unpublished data.

Table 2

Composition Per 100 g of Fresh Edible Leaves in Mesoamerica

	Protein	CHO*	Fiber	Calcium	P	Iron	Vit A**	Vit B1	Vit B2	Niacin	Vit C	Energy
	(g)	(g)	(g)	(mg)	(mg)	(mg)	(mg)	(mg)	mg)	(mg)	(mg)	kcal
Chaya	5.2	10.7	2.4	244	71	2.2	2.5	0.2	0.4	1.6	350	64
Bledo	3.7	7.4	1.5	313	74	5.6	1.6	0.05	0.24	1.2	65	42
Chipilín	7.0	9	2	287	72	4.7	3	0.33	0.49	2	100	56
Macuy	5.0	7	1.4	199	60	9.9	0.2	0.18	0.35	1	61	45
Calabash	4.2	3.4	1.5	127	96	5.8	0.8	0.14	0.17	1.8	58	26
Spinach	2.8	5	0.7	60	30	3.2	1.2	0.06	0.17	0.6	46	30
Lettuce	1.0	3	0.5	16	23	0.4		0.05	0.03	0.3	7	13

Chaya = *Cnidosculus aconitifolius*
Bledo = *Amaranthus* sp.
Chipilín = *Crotalaria longirostrata*
Macuy = *Solanum americanum*
Calabash = *Cucurbita* sp.
Spinach = *Spinacea oleracea*
Lettuce = *Lactuca sativa*

*Carbohydrates
**Vitamin A activity
Source: Molina-Cruz [and others] 1997

Pot Herbs

Pot herbs such as chipilín (*Crotalaria longirostrata*), macuy (*Solanum americanum*), and Chaya (*Cnidosculus aconitifolius*) are underutilized in all of Mesoamerica. These native plants need special attention since they are highly nutritional alternatives to conventional vegetables in the human diet (table 2). They all have a high content of protein, vitamin B2, and vitamin C. They are also fast growing and well adapted to a wide range of altitudes. Both chipilín and macuy can be planted from seeds and chaya sprouts very easily from cuttings. It seems contradictory and ironic that plants such as lettuce and spinach, with much lower nutritional content, have been commercialized throughout the world while hardly anyone has ever heard of the much more nutritious and tasty chaya (Molina-Cruz and others 1997) (table 2).

Plants for Fiber

Fiber plants are second to food plants in terms of usefulness to humans (Plotkin 1988). People of the Tropics still use plant fiber for housing, hammocks, netting, baskets, and furniture (Balick and Cox 1996, MacVean 1995, Plotkin 1988). Promising American species include palms such as *Desmoncus* spp. (Arecaceae), the rattan of the New World. Many natives, including the Maya Itzá and Peruvian peasants, have started using this climbing palm, called bayal in Guatemala, to make artisanal products that include furniture and baskets. The stem from this palm is cleaned (de-barked), left to dry, and then shaped into beautiful handwork (MacVean 1995).

Ethnobotanists face many challenges in the future, especially because of biological and cultural loss. There is urgent need to document thoroughly, analyze, and sustainably use our biodiversity—involving local people, giving them credit and intellectual property rights to discoveries that result from information provided. Indigenous cultures, granted equal partnership with modern societies, are capable of leading their own future, helping us continue to discover the gifts of the relationships between plants and man.

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