Chapter 6
Ethnobotany, Science and Society

Within the dynamic in which the relationship between people and plants is developed along with the multitude of issues and interactive levels that surround it forms a complex of ethical, social, philosophical, ideological, biological, and practical implications that ensure to qualify ethnobotany as a science that aims for human progress. Thus, the results of an ethnobotanical research can and should return, elaborately and systematically, to the social environment from which the information was collected. This type of engagement is very common when we associate it with phytotherapy and folk medicine programs in which, at the end of the project, a fusion of folk and scientific knowledge occurs. This fusion can return to the community in the form of booklets or brochures with updated and systematized knowledge about the plants that are commonly used, and their cultivation, collection, and preparation.

However, the proposals and implications of ethnobotany are even more comprehensive. It is just to note, as pointed out by the Belém Letter elaborated during the International Congress of Ethnobiology held in Belém, Pará state, in 1998, that tropical forests and other fragile ecosystems are disappearing, that many species of animals and plants are going extinct, that indigenous cultures around the world are disappearing or being destroyed, that the economy, agriculture, and health of people depend on these resources, that native peoples have been responsible for about 99% of the world's genetic resources, and that there is a close link between biological and cultural diversity. It is thus easy to make sure that with the disappearance of tropical forests and other important ecosystems, humanity will no longer know the drugs for many of today's ills, as well as the food and nutritional value of many plants that will disappear along with their respective environments.

Native populations around the world are responsible for a large list of the plants currently cultivated to supply food, industrial, or medical needs, as well as cultivars used by these populations that are still unknown. The ethnobotanical research conducted over the past 100 years has shown this clearly. From these investigations, concrete measures may be taken to remedy the problems we focused on above and

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ensure, as Posey (1999) pointed out, that "*fair compensation of indigenous peoples for their full knowledge and guarantee the rights of intellectual property for traditional knowledge.*"

Ethnobotanical research breaks away from the contemporary discourse of science. The distinction is especially apparent when we consider that ethnobotany regards traditional techniques and folk botanical knowledge not as primitive and inferior, but that traditional botanical knowledge is a distinct way of learning and is a valid form of knowledge. These are the propositions that ethnoecology also assumes, challenging the paradigms of contemporary science, as noted by Toledo (1992).

Ethnobotany has ethical, social, and ideological commitments to science and society, breaking away from existing vertical relationships (when decisions and policies are performed by some and merely "obeyed" by others) and consolidating a type of scientific thought shared by other natural ethnosciences. Ethnobotany acts as a mediator between different cultures, bringing them closer socially, and is guided by the "understanding and mutual respect among peoples," as mentioned by Posey (1999) when addressing ethnobiology.

This means that in practical and biological terms, the accumulation of knowledge from ethnobotanical research, with its innovative, constructive, creative, and motivational spirit, enables:

- The discovery of substances of plant origin with medical and industrial applications, due to the growing interest in natural chemical compounds.
- The knowledge of new applications for substances already known.
- The study of plant drugs and their effects on the individual and collective behavior of users against certain cultural or environmental stimuli.
- Recognition and preservation of potentially important plants in their ecosystems.
- Documentation of traditional knowledge and the complex systems of management and conservation of the natural resources of traditional peoples, as well as the promotion of programs for the development and preservation of natural resources of tropical ecosystems.
- The discovery of important cultivars traditionally manipulated and unknown to our science.
- Mediation between local and scientific knowledge.

Ethnobotanical studies can provide valuable contributions to bioprospecting, that is, the search for plants and animals that may contain compounds for the treatment of diseases (Box 6.1). The discovery of the therapeutic potential of these compounds can bring benefits to the pharmaceutical industry interested in new alternatives, as well as for society in general. For example, Quinimax® used for the treatment of malaria is formed by a combination of the compounds of quinine, quinidine, and cinchonine present in the bark of species belonging to the genus *Cinchona* (Ferreira Júnior et al. 2012). In Brazil, the phytotherapy medicine Acheflan® is produced from a plant known as medicinal by many human groups, the whaling herb (*Cordia verbenacea* DC), another example of ethnobotany's contributions to medicine.

Box 6.1: Pharmacological Potential of the Selection of Medicinal Plants in Bioprospecting

In search of new potential possibilities of therapeutic importance, researchers have used some approaches to bioprospecting such as random and ethnodirected approaches. The first approach is associated with a random selection of plants or other resources for pharmacological research. From the ethnodirected approach, the researchers select the plant resources that may have pharmacological potential based on popular knowledge on the use of medicinal resources. In this case, which approach is more effective in selecting plants with therapeutic potential? To answer this question, Silva et al. (2013) conducted a study to compare the antimicrobial potential of plants randomly selected (random approach) and plants obtained from two types of selection based on popular knowledge (ethnodirected approach). The authors selected three groups of herbaceous plants in northeastern Brazil, based on three types of selection: (1) a set of plants presenting popular indication for treatment of parasitic and infectious diseases (direct ethnopharmacological selection); (2) a second set of plants presenting popular indication for the treatment of conditions not related to parasitic and infectious diseases (indirect ethnopharmacological selection); and (3) a third set of herbaceous plants that did not have popular indication in the treatment of diseases (random selection).

The three sets of plants were evaluated for their antimicrobial potential by investigating the effect of methanolic extracts from the leaves of the species in inhibiting the growth of a group of microorganisms. Silva et al. (2013) observed that the group of ethnopharmacological plants from direct selection presented the greatest number of active plants with higher levels of activity against the tested microorganisms compared with groups of plants from indirect and random selections. Furthermore, the group of plants from direct selection presented activity for a large number of microorganisms compared with the other groups of plants. These results show that ethnodirected selection, particularly direct selection (directed to the possible activity of the plant), has greater potential for the search of plants with antimicrobial activity. The findings also suggest that improving the ethnodirected approach could ensure the successful selection of plants with pharmacological potential for certain diseases of interest.

Bioprospecting uses a set of strategies that guide the search for new plant candidates with therapeutic potential. The use of plants for the treatment of diseases has occurred since our evolutionary past, and different human groups present a long history of using such medicinal resources, leading to local knowledge and practices that can be very important for bioprospecting strategies. In these cases, the long period of testing plants can lead to the perception that some of them show greater efficacy in the treatment of diseases. This type of information, when verified in an ethnobotanical study, may require a series of phytochemical and pharmacological studies that investigate the potential of these plants that people perceive as being very effective (Table 6.1).

Table 6.1 Some plants popularly used for medicinal purposes that present pharmacological activity observed in laboratory[a]

Family	Species	Common names	Pharmacological activity
Anacardiaceae	*Schinus molle* L.	Peruvian pepper, American pepper, Peruvian peppertree, escobilla, false pepper, molle del Peru, pepper tree, peppercorn tree, Californian pepper tree, pirul, and Peruvian mastic	Antifungal activity
Apiaceae	*Foeniculum vulgare* Mill.	Fennel	Antioxidant, hepatoprotective, antibacterial, antifungal, analgesic, and antipyretic activities
Arecaceae	*Copernicia cerifera* (Arruda) Mart.	Carnaúba, carnaúba palm or carnaubeira palm	Antioxidant activity
Asphodelaceae	*Aloe arborescens* Mill.	Aloe	Laxative, anti-inflammatory, antibacterial, antifungal, and hypoglycemic activities
Asteraceae	*Bidens pilosa* L.	Black-jack, beggar-ticks, cobbler's pegs, and Spanish needle	Antimicrobial activity
Asteraceae	*Achyrocline satureioides* (Lam.) DC.	Macela, marcela	Anti-inflammatory, antispasmodic, analgesic, choleretic, immunostimulant, antiviral, antimicrobial, hypoglycemic, and antioxidant activities
Combretaceae	*Terminalia brasiliensis* (Cambess.) Eichler	Amêndoa brava, cerne amarelo, capitão do campo, catinga de porco, mussambê	Antioxidant activity
Euphorbiaceae	*Croton cajucara* Benth.	Sacaca	Hypoglycemic, hypolipidemic, anti-inflammatory, antinociceptive, and anti-ulcer activities
Fabaceae	*Copaifera multijuga* Hayne	Copaíba	Anti-inflammatory activity
Fabaceae	*Copaifera cearensis* Huber ex Ducke	Copaíba	Anti-inflammatory, analgesic, and antiparasitic activities

Fabaceae	*Copaifera langsdorffii* Desf.	Copaíba	Antitumor, anti-inflammatory, and antiparasitic activities
Fabaceae	*Copaifera reticulata* Ducke	Copaíba	Antioxidant and antiparasitic activities
Fabaceae	*Cenostigma macrophyllum* Tul.	Caneleiro, canela de velho	Antioxidant activity
Lamiaceae	*Rosmarinus officinalis* L.	Rosemary, anthos	Antifungal and antimicrobial activities
Lamiaceae	*Origanum majorana* L.	Marjoram, sweet marjoram, knotted marjoram, and pot marjoram	Antimicrobial activity
Lamiaceae	*Salvia officinalis* L.	Sage, common sage, garden sage	Antimicrobial activity
Lamiaceae	*Plectranthus barbatus* Andrews	Indian coleus, forskohlii	Antibacterial, anti-inflammatory, and hypotensive activities and a relaxant of tracheal smooth muscle
Myrtaceae	*Eugenia uniflora* L.	Pitanga, Suriname cherry, Brazilian cherry, Cayenne cherry, or Cerisier Carré	Diuretic, hypotensive, antimalarial, and antimicrobial activities
Myrtaceae	*Psidium guajava* L.	Common guava, yellow guava, lemon guava	Antidiarrheal, antipyretic, anti-inflammatory, antibacterial, antifungal, and antinociceptive activities
Nyctaginaceae	*Mirabilis jalapa* L.	Marvel of Peru, four o'clock flower	Antifungal activity
Phytolaccaceae	*Phytolacca americana* L.	American pokeweed, pokeweed	Antifungal activity
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Lemon grass, oil grass	Antinociceptive, hypotensive, diuretic, anti-inflammatory, anxiolytic, antipyretic, anticonvulsant, neuroleptic, antioxidant, antibacterial, and antifungal activities
Rutaceae	*Citrus* × *aurantium* L.	Bitter orange, Seville orange, sour orange, bigarade orange, or marmalade orange	Antispasmodic and antimicrobial activities and acts on the treatment of diarrhea
Rutaceae	*Citrus* × *limon* (L.) Osbeck	Rangpur, Citrus × limonia, lemandarin, mandarin lime	Antifungal activity

[a]Compiled information from Maciel et al. (2002), Vendruscolo et al. (2005), Fenner et al. (2006), Haida et al. (2007), and Sousa et al. (2007)

Box 6.2 Reflecting on the Selection of Plants for Pharmacological Investigations

It is quite common that in ethnodirected approaches, medicinal plants selected for phytochemical and pharmacological studies are the most popular in a community, that is, they are known to a larger number of people. However, some researchers wonder about the almost unrestricted adoption of this criterion.

Thus, we begin with the following question: are unpopular plants necessarily less relevant in terms of bioprospecting? Studies have suggested that natural selection favored the emergence of psychological biases that lead people to learn from those individuals most likely to have adaptive information (Henrich and Broesch 2011). Factors such as the prestige of the individual owner of the new information (e.g., medicinal plants to treat high blood pressure) may influence on whether the information in question will be or not effectively disseminated in a community (see, for example, Henrich and Broesch 2011). Therefore, sometimes it is possible that information about a medicinal plant cannot be spread simply by the fact that the individual possessing such information does not have enough prestige to have their behavior copied by others.

In addition, the unpopularity of certain plants may be due to their recent incorporation in local medical systems, so that there was not enough time for the information to be disseminated. Thus, such a group of plants may be important from the point of view of bioprospecting and disregarding them may lead to the loss of useful information for drug discovery of commercial interest.

Over time, ethnobotanists have developed a set of criteria that are important for selecting potential plants for pharmacological studies based on popular knowledge. One criterion is the consensus about the knowledge of a plant, suggesting that the more consensus people have on the uses of a plant, the higher its pharmacological potential. Thus, the plants presenting more consensus can be used in phytochemical and pharmacological studies. For example, if a plant is mentioned for treating a disease by a large proportion of people in the community, it means that it can present interesting compounds for the treatment of the mentioned disease.

Another criterion has been the therapeutic versatility of plants. The versatility of a plant in medicinal use relates to the number of diseases it can treat according to some human group. Accordingly, a highly versatile plant may be interesting for further pharmacological and phytochemical studies because it may have important compounds for treating a broad spectrum of diseases, for example (Box 6.2).

Despite these contributions, some researchers have encountered the following difficulties: even with a large number of ethnobotanical studies, little progress has been made from this approach to discovering new pharmaceutical drugs. This means that we still face many challenges ahead in order to develop new strategies and improve the existing ones to search for new possibilities for discovering new drugs. Currently, the major problem in starting from the most popular plants in a community to conduct laboratory studies is that the most popular plants are often repeated in different areas, being exotic plants and native plants that are generally available. Thus, new bioprospecting strategies should be designed in order to use other criteria, in addition to popularity and versatility, to identify plants with medicinal potential from local knowledge.

In addition to bioprospecting, ethnobotany can contribute to public policies that promote the health of local communities. Thus, ethnobotanical studies may signal issues concerning healthcare, such as the shortage of medicinal plants that may be locally important for the treatment of various diseases.

Another direct contribution of ethnobotanical studies consists of biodiversity conservation strategies. When we speak of the relationship between human beings and natural resources, we generally have a tendency to associate this relationship with negative effects such as the loss of biodiversity, habitat modification, and changes to ecosystem functioning. This is natural, because we have increasingly started to realize that the lifestyles of human populations threaten biodiversity conservation. However, in ethnobotany, we cannot accept this as a rule, but neither can we begin our studies from the perspective that people live in harmony with the environment.

Thus, ethnobotanical studies arise bringing scientific evidence regarding the use of plant resources, the criteria used by human populations for species selection, the collection practices employed, and whether these factors may or nor relate to the decline of plants in a particular ecosystem. Local populations can provide valuable information on the extraction of forest resources and the vegetation dynamics, which are fundamental components of management strategies for achieving sustainable use and conservation of native vegetation (Albuquerque 2010).

For example, during 4 years of ethnobotanical research in a Caatinga (seasonal dry forest) area in Pernambuco State, northeastern Brazil, researchers from our research group established a ranking of priority plant species for conservation in the studied region. The ranking used an index that considered the number of indicated uses for each species, its status in the local vegetation, and the degree of attention given by the population in the management and cultivation of these species in agroforestry homegardens (Albuquerque et al. 2009). This type of research has provided a series of recommendations to be adopted by local resource managers, such as (a) creating reforestation programs in areas where resources have been heavily exploited in order to ensure their future availability; (b) encouraging people to use agroforestry homegardens with native species, thus reducing the need for people to move to the forest areas to collect resources; and (c) replacing the use of dead cuttings, used as hedges by the population, with the use of hedges made from native species.

Another practical example of the contribution of ethnobotanical research to the conservation of biodiversity consists of a study conducted on the northern coast of Rio Grande do Sul on the extraction activity of the black fern (*Rumohra adiantiformis* (G. Forst.) Ching), a species whose fronds are collected to make floral arrangements.

Although this activity comprises the main source of income of farmers in the studied region, its extraction was illegal. It was through a series of studies carried out with this species that the ecological and social viability of this activity was discovered, enabling the formulation of public policies for legalizing its extractive activity (Souza 2003; Baldauf 2006).

When we speak of conservation we cannot limit ourselves to purely technical issues related to ecological research: we need to identify the ways in which different social actors think and feel about nature, that is, how they deal with the duality of both using and enjoying *x* preserving. Traditional knowledge should be taken into account in decision-making aimed at the conservation of biodiversity, and when ethnobotanists detect that populations develop unsustainable practices, they should seek ways to help in this process through return actions that do not cause even greater conflict with the populations.

Another key issue is that we must not only consider the conservation of biodiversity to be important, but also the set of knowledge and symbols related to it. Thus, the concepts of diversity and biocultural conservation are gaining importance in modern ethnobotany, so that conservation strategies should ensure that, along with plants, animals, etc., the "cultural creativity" involving it is also maintained. Therefore, whenever possible, it is preferable to think of conservation strategies involving sustainable use rather than strategies that involve drastic substitutions of cultural practices related to certain natural resources.

Finally, the intersection of ethnobotany and conservation, in terms of strategies and policies, must be done with great caution. It is common for the young researcher, enthusiastic about the findings of his or her research, to want to show the community the most appropriate ways to manage certain resources or the maximum amount of resources that can be exploited. However, we must not forget two things:

1. Environmental problems are usually associated with socioeconomic problems. Sometimes, knowing that a practice is unsustainable is not enough to stop doing it. Some studies have shown an inverse relationship between income and use of plant resources (Dahdouh-Guebas et al. 2000; Medeiros et al. 2012). Thus, people with lower incomes who depend on the use of these resources for their livelihoods will often not stop using them even knowing the negative implications for biodiversity. This shows that the resource utilization issues are complex and conservation actions cannot be summarized to *educate community residents about the ecological importance of species X, Y, and Z.*
2. Conservation strategies cannot be designed from the top down. Even though we have innovative and efficient solutions to conservation problems, such solutions need to be discussed and agreed to in the communities. Moreover, it is necessary to present the conservation problems identified in the research and to have open discussions so that the communities can participate in suggesting strategies. You, reader, have probably heard that it is much easier to engage in something that you helped to build. This is perfectly valid in the context of local communities. Conservation strategies created from the top down tend not to rely on the commitment of the communities, which in most cases is essential for their effective progress.

All that was discussed, dear reader, consists of direct information, naturally enriched by parallel or subsequent investigations, inside or outside the field of ethnobotany. After having examined these aspects—theoretical, methodological, epistemological, and practical—we remain with a poetic reflection:

> *Cultures have come and gone during the historical-evolutionary path of humanity; they manipulated and met their botanical world precisely as it was possible to them. Unquestionable truth: people have much to say of plants, and the plants—from the most modest cryptogam to the phanerogams trailblazer of heights, from the living photosynthetic cells to the reproductive remnants amalgamated in archaeological sites—what do they have to say of people? Who we are or were then, what we eat or cultivated them; finally, everything that relates to our relationship with plants, our lives or their lives* (Albuquerque 2005).

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