



Ethnopharmacology

Edited by

Michael Heinrich and Anna K. Jäger

GOLPES

• Para este tipo de dolencias, se recomienda utilizar las siguientes plantas medicinales:

- Suda consolda, romero, salvia virgen, azul de mata y ruda.
- Para este cocimiento de hierbas, se macera en alcohol.

TRASTORNOS
MENSTRUALES

• Para este tipo de molestias se recomienda tomar las siguientes plantas:

- ✓ Ruda, hojas del milagro, guarumo.

ÚLCERAS
ESTOMACALES

• Para combatir estos síntomas se recomienda utilizar las siguientes:



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The Anthropology of Ethnopharmacology

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3.1 Introduction

Ten years ago, Nina Etkin and Elaine Elisabetsky, in the 100th issue of *Journal of Ethnopharmacology*, argued for a multidisciplinary ethnopharmacology of equal parts, they said: ‘ethno- (Gr., culture or people) [and] pharmacology (Gr., drug) ... a transdisciplinary exploration that spans the biological and social sciences’ (Etkin and Elisabetsky, 2005). They also noted that a number of analyses done over time looking closely at the flagship journal of the field showed that *Journal of Ethnopharmacology* was nearly fully populated by articles that were purely pharmacology or pharmacognosy; only 4–6% of articles, they noted, were multidisciplinary in nature. Surely this is still true today.

Moreover, much research in ethnopharmacology to this day trumpets the ideal of finding the cures for cancer and Aids (or other high-profile diseases) in the tropical forest; see, for example, Albuquerque *et al.* (2012) or Saslis-Lagoudakis *et al.* (2012) or Leitão *et al.* (2013) to mention only a few.

This remains a popular cry even though the record of the past 50 years is very thin indeed: the Vinca alkaloids (Wani and Horwitz, 2014), Taxol from *Taxus brevifolia* Nutt. (Suffness, 1993)¹ and perhaps artemisinin from *Artemisia annua* L. (Miller and Su, 2011). These cases show that it is possible, but the rise and fall of Shaman Pharmaceuticals (Clapp and Crook, 2002), for example, and the sad history of Paul Cox’s prostratin (probably the best ethnobotanical lead of all times (Gustafson *et al.*, 1992; Cox, 2001), which could probably cure both AIDS and

¹ Taxol was originally identified in a random screen; the plant had been in use by many north-western native Americans and First Nations people, often for skin irritations (Moerman, 1998).

ebola, and 15 years later it still isn't approved for use) all point to the difficulties inherent in this enterprise.

By contrast, there is much satisfaction to be obtained from pursuing a richly multidisciplinary approach to the relationships between plants and the people who know, or think about, or care for them. We give one longer and several shorter examples of this, operating on dramatically different scales.

3.2 Primary example: Traditional medicine in New York City

Botánicas in New York City are Hispanic/Latino-Afro-Caribbean stores that sell statues, beads and potions for spiritual well-being and often also herbal remedies (Viladrich, 2006) (Figures 3.1, 3.2 and 3.3). During a visit to one of these *botánicas*, I (IV) met a middle-aged woman from the Dominican Republic who was purchasing a *botella* (a herbal mixture; Vandebroek *et al.*, 2010) prepared by the store owner. I asked her about her health complaint and she told me she had been diagnosed with ovarian cysts. She explained that she had gone to the hospital to find out what she was suffering from. As soon as she got her diagnosis, she knew exactly what treatment to choose. I asked her why she had chosen a *botella*. The answer she gave was without hesitation: she had faith in the *botánica* owner and in his remedies. The Dominican community in New York City is tight knit and easily exchanges information about health, and the *botánica* owner is well-known for successfully treating ovarian cysts



Figure 3.1 Storefront of a *botánica* in New York City. Banner reads: 'Cleansing treatment for all kinds of problems'.



Figure 3.2 Inside a *botánica* in New York City. Statues and candles for spiritual well-being.

with his own recipes. Thus, it did not come as a surprise that the *botánica* was exactly where the woman went for help.

This is not an isolated story and it reveals three issues of relevance to ethnopharmacology as a scientific discipline.

3.2.1 Missing out on cultural context

The first issue is that the full picture may not be seen if culture is not included in research into the pharmacological effects of plants. Culture is at the heart of plant meaning. Understanding the use of medicinal plants without detailed knowledge of their cultural context is like watching a movie in a language you do not understand. Much as you might misinterpret the images of a foreign movie without subtitles, you may come to incorrect conclusions about plant use if you



Figure 3.3 Inside a *botánica* in New York City. Boxes of dried medicinal plants for health care.

only take into account your own scientific understanding of the pharmacology of plants. Thus, important pieces of information may be missed. That information is cultural. For example, in the Dominican community there is a shared cultural belief that plants with bitter properties ‘burn sugar in the blood’, which renders them useful medicines for treating diabetes (Vandebroek *et al.*, 2007). In Jamaican culture, bitter plants are believed to cleanse the blood and thereby rid the body of skin rashes and other skin problems (Payne-Jackson and Alleyne, 2004). According to Italian traditional knowledge, bitter edible greens are perceived as being particularly beneficial for the liver and for cleansing the blood (Nebel *et al.*, 2006). Cultural meaning can also include the belief that for a plant medicine to work properly, it should be able to expel something from the body, through either vomiting or stools. In the Dominican community, the shared belief exists that pharmaceuticals hide the pain of the disease but do not cure it because nothing is expelled; in contrast people use plants that are able to promote this desired physiological effect. These cultural observations may be of importance to the ethnopharmacological evaluation of the efficacies of different groups of plant chemicals, as well as their toxicities. This kind of information can enrich laboratory data in complementary ways, and may even lead to testing new mechanisms of action. For example, do all ‘bitter’ plant species used for a similar ethnobotanical purpose, even those belonging to different plant families, show a similar mechanism of action when tested in the laboratory?

3.2.2 People change plants due to availability

The second issue is that culture influences the dynamics of plant knowledge and use. In an urban context, immigrants from the Dominican Republic who move to New York City substitute plants with others that are more easily available in their new environment (Ososki *et al.*, 2007). Examples of this include the use of cat’s claw (*Uncaria tomentosa* DC.,

Rubiaceae) and cranberry (*Vaccinium macrocarpon* Aiton, Ericaceae) for treating uterine fibroids. Dominicans also adapt their plant pharmacopoeias to better match and respond to the epidemiological context of New York City. For example, in the Dominican Republic *botellas* are used more often to treat genitourinary disorders, whereas in New York City they become more popular for treating respiratory disorders (Vandebroek *et al.*, 2007).

3.2.3 The spiritual component

The third issue is that a plant medicine usually has more than one meaning. Its physiological effect cannot be separated from its anticipated other meanings – emotional or spiritual – by the people who use or sell the plant. Another *botánica*-related story illustrates this. A Puerto Rican man in his 50s has been a needle user for about 20 years. He has been in and out of different drug programmes and travels back and forth to Puerto Rico to detox. When he comes back to New York City, he often relapses. He regularly visits a *botánica*, usually once or twice a day, to drink a herbal tea remedy prepared by the *botánica* owner. The owner claims it helps him deal with the anxiety associated with his substance abuse problem. The tea consists of half an ounce of *sándalo* (mint, *Mentha* sp., Lamiaceae) mixed with *perejil* (parsley, *Petroselinum crispum* (Mill.) Fuss, Apiaceae) and one branch of *ruda* (rue, *Ruta* spp., Rutaceae). The owner prepares the remedy in advance in bulk and stores it in the refrigerator, so that when the patient drops in he can get immediate assistance. While explaining the use of medicinal plants, the *botánica* owner stressed the importance of the spiritual component of healing. He reiterated that whereas medicinal plants assist in alleviating a biomedical problem, healing also has a spiritual component. It prepares the patient mentally in the healing process. Spiritual healing can be achieved through cleansing (*'limpieza'*), bathing, faith and spiritual consultations. This supposedly 'cuts off' the negative energy that a patient has been accumulating. It is important to note here that it is not the issue whether or not a spiritual component is effective, but that this component is relevant to both traditional healthcare provider and patient. It contributes to the realm of healing, and as such merits its place as a subject of scientific inquiry.

The needle user's story unravels the many often complex layers of traditional medicine, entwining physical, cultural, emotional and spiritual dimensions. The richness of the cultural context clearly goes beyond utilitarian knowledge about plants. This multidimensionality is not restricted to isolated rural areas, nor is it something from the past. It exists within urban and even transnational environments, for example in New York City, and it is used today for conditions as 'modern' as substance abuse and ovarian cysts.

The aspiring ethnopharmacologist might wonder if this complexity in traditional medicine is something he or she should take on as a research task. How relevant is culture in the face of the evaluation of the pharmacological properties of plants in the laboratory? Perhaps the question can be rephrased as follows: should ethnopharmacologists focus only on that part of culture that is associated with the utilitarian aspect of plants? Do we take culture into account when we want to obtain data on local plant uses, but not when it relates to other types of knowledge linked to plants, the kind that is psycho-social or spiritual in nature? An easy answer would be 'I cannot do it all.' Or 'the funding agency I am applying for does not support these kinds of musings'. Nevertheless, generating a rich, inclusive dataset to develop a comprehensive plant monograph can be indispensable to understand (cultural patterns of) plant knowledge, as opposed to a reductionist (and inevitably incomplete) approach. It also serves the added benefit that it can help preserve the integrity of cultural heritage. The psycho-social, religious or spiritual components of plant knowledge contain a lot of meaning for conservation of useful plant species at the community level since unfragmented stories associated with plants have

direct cultural relevance to keep knowledge about plants (and their uses) alive. It has been argued before that to ‘deprive a people of their language, culture and spiritual values [makes them] lose all sense of direction and purpose’ (Posey, 1999).

As an ethnobotanist educated in and trained from a botanical perspective, I became increasingly aware of the overarching importance of culture during fieldwork. The more I studied medicinal plants, the more I began to understand that culture shapes everything, including plant knowledge. After all, biomedicine is a cultural construct too, which is elegantly demonstrated by Miner (1956) in his influential article about the Nacirema. Furthermore, anthropology has highlighted the importance of cultural relativism, the view that beliefs, customs and ethics vary from culture to culture and that all are equally valid; no one system is ‘better’ than another (Spiro, 1986). Spiro writes: ‘In short all science is ethnosience. Hence, since modern science is western science, its truth claims (and canons of proof) are no less culturally relative than those of any other ethnosience.’ Other scholars have gone as far as to bring up the notion that traditional medicine needs to be evaluated within its own cultural framework rather than approved and subdued by the rules of biological (western) medicine (Gorn and Sugiyama, 2004). Finally, Lynn Payer’s compelling work *Culture & Medicine: Varieties of Treatment in the United States, England, West Germany and France* (Payer, 1996) shows in a compelling way how even contemporary western cultures differ, sometimes dramatically, in the ways in which they construct scientific medicine.

The key to improving healthcare in an increasingly globalized world may lie in integrating different cultural dimensions of healthcare, or at least in keeping an open mind about different ways in which other cultures think about, experience and respond to health and healthcare. In that regard, it would be useful to adopt the term ‘culturally competent healthcare’ systems (Anderson *et al.*, 2003), which take into account the cultural knowledge, beliefs and practices of patients as well as physicians. Ethnopharmacology can be at the forefront of building bridges between these different systems of healthcare by embracing culture as the indispensable link between a plant and a medicine.

3.3 An example from ancient Roman architecture

A paper on Roman architecture shows how the most minor architectural details refer to a number of big ideas in the culture of ancient Rome (Caneva *et al.*, 2014). The Ara Pacis Augustae in Rome is an elaborate monument – an altar to the worship of Pax, the goddess of peace – built between 13 and 9 BCE to celebrate the victories of the Roman Emperor Augustus in his campaigns in Gaul and Spain. After very close observations of the altar, the authors of the paper were able to identify about 100 species of plants in the various carvings and other representations. For example, one of the most common plants was *Acanthus mollis* L. (bear’s britches). ‘In the Mediterranean region, this perennial has a seasonally specific form and phenology: it appears dead in the summer, but starts to grow again at the beginning of autumn. *Acanthus* is frequently represented in classical sculptures as a symbol of rebirth ... [in this case it] represents Rome’s rebirth and prosperity’ (ibid., p112) after the external rebellions and internal struggles that started with the murder of Julius Caesar in 44 BCE. The authors note that *Acanthus* is only shown in association with the founding of Rome (with Romulus and Remus, the twin boys raised by a wolf who founded Rome) and with images representing the time of the triumphant Augustus.

These representations can be complex. One of them displays not only an emerging *Pteridium aquilinum* [L.] Kohn (bracken fern) but also a flying eagle; note that bracken fern is also known as eagle fern, and that the specific epithet is based on the Latin *aquila*, meaning ‘eagle’.

The symbol, the authors assert, represents simultaneously the idea of ‘the world soul ... and ideas of imperial power and conquest’. While these representations provide rich insights into the power and richness of decoration with plants, and of the world of meaning of ancient Romans, there is no mention of pharmacological leads.

3.4 An example from native North America

Among the 49 American species of crane’s-bill, or wild or hardy geranium, the one most favoured as a medicine by native peoples was *Geranium maculatum* L., the spotted crane’s-bill (Figure 3.4). A favourite of a number of Midwestern tribes – Menominee, Meskwaki and Ojibwa used it for diarrhoea, sore gums and toothache – its use by the Iroquois shows us some important elements in the medical thinking of non-western peoples (Herrick and Snow, 1995). As it goes to seed, *Geranium maculatum* develops a series of very distinctive hooks from its pistil which hold newly formed seeds (Figure 3.5). These hooks, for the Iroquois, were distinctive and important, putting it in a special category of plants with ‘hook-like or ensnaring features’ (Herrick and Snow, 1995), along with a number of other plants like *Anemone canadensis* L. (Canadian anemone), which has spiky hooks on its seeds, as does *Geum rivale* L. (purple avens) and a number of other species.

Most of these are utilized by the Iroquois for conditions of eversion, looseness or escape, like cold sores or diarrhoea. Their idea is that the hook-like, ensnaring quality of the plant will engage, grab or capture the looseness and pull it back, and so a tea of the roots is used to wash a chancre sore and a poultice of dried root is applied to the unhealed navel of an infant. The ethnopharmacologists are happy when they find that the geranium root contains substantial quantities of tannin, which is a strong astringent, hence validating this usage.



Figure 3.4 *Geranium maculatum* L. Wild geranium or crane’s bill in flower.



Figure 3.5 Wild geranium seeds, with 'hooks'.

The wild geranium, however, has more uses than that. Suppose a wife was suspected of having a flirtation with another man. Putting a bit of geranium root or flower in her food or drink might capture her and bring her back. Similarly, when fishing it would be a good idea to sprinkle some of this tea on the bait to entice a fish closer to the hook or it could be used to bring a rabbit closer to a snare. Likewise, when trying to sell some baskets, they could be sprinkled with geranium root tea to ensnare a buyer (and I (DM) can attest that books with drawings of wild geraniums included in them sell better than ones that don't). There is more to medicine than chemistry (Moerman, 2002). In addition, no garden is complete without an assortment of wild geraniums.

3.5 Comparative ethnobotany

It is also possible to learn a great deal about people and the plants they use on a much larger scale than is evident in the preceding examples from Dominicans in New York, ancient Roman architecture or geraniums for the Iroquois. Having worked with very large scale analyses of the medicinal uses of plants by native American and First Nations peoples of Canada (Moerman, 1998), I (DM) have also, with colleagues, done comparisons of such uses elsewhere in the world (Moerman *et al.*, 1999). In those studies, and others, it commonly happens that some plant families are far more likely to be utilized for medicines than others. Most authors use a technique similar to one I developed in the 1970s (Moerman, 1979) using regression analysis; recently other authors have developed more complex approaches, for example using Bayesian statistics, which ordinarily come to essentially similar results (cf. Weckerle *et al.*, 2011).

In the North American case, a regression analysis of the number of medicinal species per family on the total number of species per family gives very interesting results. Figure 3.6 displays a graph of the relationship.

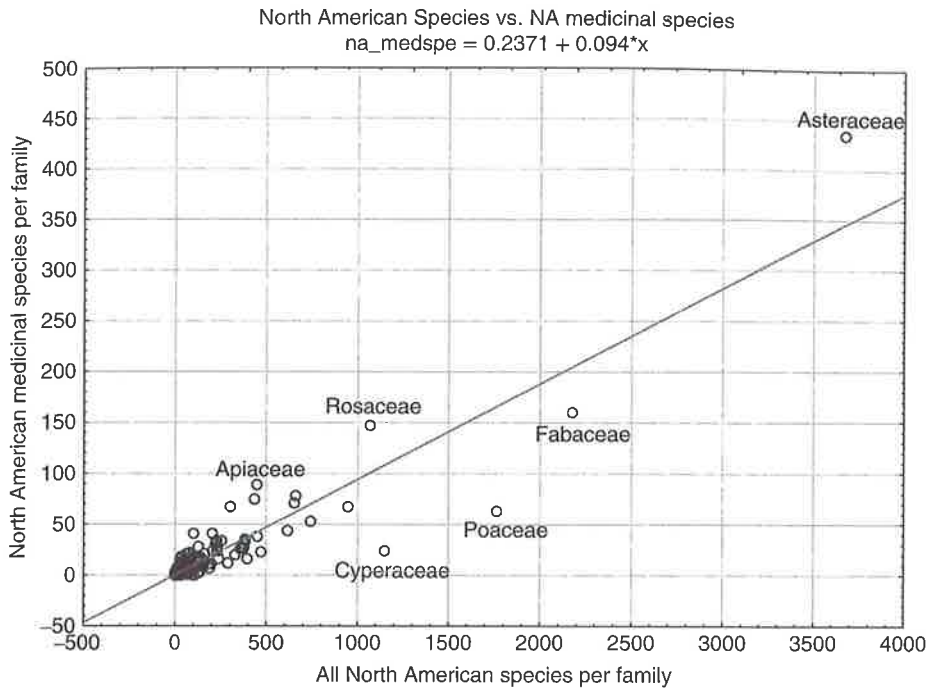


Figure 3.6 Regression analysis of native North American medicinal plants (by family) on all North American plants.

Compare two families, the Asteraceae and the Poaceae, which are both very large. The Asteraceae (sunflowers) have about 3600 species in North America (north of Mexico), of which 427 are used as medicines. The Poaceae (grasses) have nearly 1800 species, of which only 63 are used medicinally. In a regression analysis, the line shown is the one line that is 'closest' to all the points in the graph. The vertical distance between the line and each point is called the residual, which is positive if it is above the line and negative below the line. In such an analysis, if you add all the residuals together the result is zero. In this situation, the families listed above the line are ones used more often than chance; they are positively selected for use. Families below the line are less utilized as medicines. The residual in Figure 3.6 for Asteraceae is about 80; the residual for Poaceae is about -100. Asteraceae is far more useful as a source of drugs than is Poaceae. This result has been shown many times; in the northern hemisphere, it seems always to be true. Note that Poaceae is neglected as a source of medicines, but not as a source of foods. Our major food grains – wheat, barley, rice, millet, oats, rye, and corn or maize – are all members of the Poaceae family. One reason that plants are medicinal at all is that they often contain chemicals toxic to insects. Such biologically active substances – like the opium in poppies or nicotine in tobacco – are often toxic in large doses, but in smaller ones can be useful in varying ways, in these cases as narcotic analgesics or as satisfying mood altering drugs. The Poaceae family rarely produces such toxic substances to protect against browsers so it is a useful source of food plants.

Some families are rather in the middle of this. Most famous is the Solanaceae family, which produces some very toxic plants (like nightshade, *Solanum* spp.) but also some very important food plants, like potatoes, tomatoes, eggplants, peppers and tobacco. It seems clear that these

generalizations are true for large areas of the planet, including almost all of the northern part of the globe, and some places in Africa as far south as Namibia. By contrast, in the Amazon region, with probably the richest flora in the world, it seems that tropical peoples each follow their own paths and select medicinal floras dramatically different from those in the north, and also significantly different from each other. For a compelling example, see Glenn Shepard's comparison of two peoples living on opposite sides of the same river in eastern Ecuador, who select very different plants from the very same flora (Shepard, 2004). This kind of an analysis, only touched on here, can provide rich detail about the lives of human beings all over the world as they interact with the plants that are the basis of their foods, drugs, dyes, fibres and the flowers in their hair.

3.6 Conclusions

The study of people and the plants that they use, grow, forage, think about and imagine is a rich way to more fully understand the ways that people enact their humanness. This is not to say that the study of plants and people is more important or valuable than the study of people and birds (Hage and Miller, 1976), or any other aspect of ethnobiology (Anderson *et al.*, 2012), but it is unlikely that many other areas in the human sciences will pass the majesty of, say, Nancy Turner's *Ancient pathways, ancestral knowledge: Ethnobotany and ecological wisdom of indigenous peoples of northwestern North America* (Turner, 2014). Anthropology has shown us that human beings 'operate in an environment as they *perceive* it, not as it *is*' (Brookfield 1969, cited in Cotton, 1996). Research has come a long way from Harshberger's definition of ethnobotany more than 100 years ago, which emphasized the utilitarian aspects of plants, towards a discipline that has embraced peoples' perception and management of the natural world, in addition to their use of those natural resources. In order to understand why and how people use and manage plants, we need to understand first how they perceive their environment. There are many ways to learn about how plants are culturally perceived. The most obvious way is first-hand experience in the field, but even the use of information sources less conventionally accessed by ethnopharmacologists, for example Shakespeare, has something to teach us. In *King Henry IV, Part I, Act II, Scene IV*, Shakespeare writes about his observation of the ecological resilience of chamomile: '... for though the chamomile, the more it is trodden the faster it grows, yet youth, the more it is wasted the sooner it wears'. In *Othello, Act III, Scene III*, Shakespeare refers to the narcotic effect of the poppy: '... Not poppy, nor mandragora / Nor all the drowsy syrups of the world / Shall ever medicine thee to that sweet sleep / Which thou ow'dst' yesterday'. In *Romeo and Juliet, Act II, Scene III*, the poisonous and medicinal plant belladonna features: 'Within the infant rind of this weak flower / Poison hath residence, and medicine power / For this, being smelt, with that part cheers each part / Being tasted, slays all senses with the heart'.

Sources such as these show that detailed cultural and contextual information about plants as observed by the keen human eye can be found everywhere we are willing to look. Hopefully, ethnobotanists and ethnopharmacologists alike may continue to find joy and scientific wisdom in exploring the diverse array of ethno-related knowledge, beliefs and practices, both from conventional and non-conventional sources, with an open mind. After all, has it not been said repeatedly that local people's science is good science? Shakespeare's observation of plants stems from his life as a countryman, not as a botanist, yet his descriptions faithfully report what he observed about the English plant species that surrounded him.

References

- Albuquerque, U.P., Ramos, M.A. and Melo, J.G. (2012) New strategies for drug discovery in tropical forests based on ethnobotanical and chemical ecological studies. *Journal of Ethnopharmacology*, **140**, 197–201.
- Anderson, L.M., Scrimshaw, S.C., Fullilove, M.T., *et al.* (2003) Culturally competent healthcare systems: a systematic review. *American Journal of Preventive Medicine*, **24**, 68–79.
- Anderson, E.N., Pearsall, D., Hunn, E. and Turner, N. (2012) *Ethnobiology*, John Wiley & Sons, Ltd, Chichester.
- Brookfield, H.C. (1969) On the environment as perceived. *Progress in Geology*, **1**, 51–80.
- Caneva, G., Savo, V. and Kumbaric, A. (2014) Big Messages in Small Details: Nature in Roman Archaeology. *Economic Botany*, **68**, 109–115.
- Clapp, R.A. and Crook, C. (2002) Drowning in the magic well: Shaman Pharmaceuticals and the elusive value of traditional knowledge. *Journal of Environment & Development*, **11**, 79–102.
- Cotton, C.M. (1996) *Ethnobotany: Principles and Applications*, John Wiley & Sons.
- Cox, P.A. (2001) Ensuring equitable benefits: The Falealupo covenant and the isolation of anti-viral drug prostratin from a Samoan medicinal plant. *Pharmaceutical Biology*, **39**, 33–40.
- Etkin, N.L. and Elisabetsky, E. (2005) Seeking a transdisciplinary and culturally germane science: the future of ethnopharmacology. *Journal of Ethnopharmacology*, **100**, 23–26.
- Gorn, S.B. and Sugiyama, E.I. (2004) Between traditional and scientific medicine: a research strategy for the study of the pathways to treatment followed by a group of Mexican patients with emotional disorders, *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, **5**, Issue 2.
- Gustafson, K.R., Cardellina, J.H., McMahon, J.B., *et al.* (1992) A nonpromoting phorbol from the samoan medicinal plant *Homalanthus nutans* inhibits cell killing by HIV-1. *Journal of Medicinal Chemistry*, **35**, 1978–1986.
- Hage, P. and Miller, W.R. (1976) ‘eagle’ = ‘bird’: a note on the structure and evolution of Shoshoni ethnoornithological nomenclature 1. *American Ethnologist*, **3**, 481–488.
- Herrick, J.W. and Snow, D.R. (1995) *Iroquois Medical Botany*, 1st edn, Syracuse University Press, Syracuse, NY.
- Leitão, F., Leitão, S.G., de Almeida, M.Z., *et al.* (2013) Medicinal plants from open-air markets in the State of Rio de Janeiro, Brazil as a potential source of new antimycobacterial agents. *Journal of Ethnopharmacology*, **149**, 513–521.
- Miller, L.H. and Su, X. (2011) Artemisinin: discovery from the Chinese herbal garden. *Cell*, **146**, 855–858.
- Miner, H. (1956) Body Ritual of the Nacirema. *American Anthropologist*, **58**, 503–507.
- Moerman, D.E. (1979) Symbols and selectivity: a statistical analysis of native American medical ethnobotany. *Journal of Ethnopharmacology*, **1**, 111–119.
- Moerman, D.E. (1998) *Native American Ethnobotany*. Timber Press, Portland, OR.
- Moerman, D.E. (2002) *Meaning, Medicine, and the ‘Placebo Effect’*. Cambridge University Press, Cambridge.
- Moerman, D.E., Pemberton, R.W., Kiefer, D. and Berlin, B. (1999) A comparative analysis of five medicinal floras. *Journal of Ethnobiology*, **19**, 46–67.
- Nebel, S., Pieroni, A. and Heinrich, M. (2006) Ta chòrta: Wild edible greens used in the Graecanic area in Calabria, Southern Italy. *Appetite*, **47**, 333–342.
- Ososki, A.L., Balick, M.J. and Daly, D.C. (2007) Medicinal plants and cultural variation across Dominican rural, urban, and transnational landscapes, in *Traveling Cultures and Plants: The Ethnobiology and Ethnopharmacy of Migrations* (eds A. Pieroni and I. Vandebroek), Berghahn Books, New York, pp. 14–38.
- Payer, L. (1996) *Medicine and Culture*, *An Owl Book*, Henry Holt and Company, New York.
- Payne-Jackson, A. and Alleyne, M.C. (2004) *Jamaican Folk Medicine: A Source of Healing*, University of West Indies Press, Kingston.

- Posey, D.A. (1999) *Cultural and Spiritual Values of Biodiversity: A Complementary Contribution to the Global Biodiversity Assessment*. Intermediate Technology Publications.
- Saslis-Lagoudakis, C.H., Savolainen, V., Williamson, E.M., *et al.* (2012) Phylogenies reveal predictive power of traditional medicine in bioprospecting. *Proceedings of the National Academy of Sciences*, **109**, 15835–15840.
- Shepard, G.H. (2004) A sensory ecology of medicinal plant therapy in two Amazonian societies. *American Anthropologist*, **106**, 252–266.
- Spiro, M.E. (1986) Cultural relativism and the future of anthropology. *Cultural Anthropology*, **1**, 259–286.
- Suffness, M. (1993) Taxol: From discovery to therapeutic use. *Annual Reports in Medicinal Chemistry*, **28**, 305–314.
- Turner, N. (2014) *Ancient Pathways, Ancestral Knowledge: Ethnobotany and Ecological Wisdom of Indigenous Peoples of Northwestern North America*, McGill-Queen's Press.
- Vandebroek, I., Balick, M.J., Yukes, J., *et al.* (2007) Use of medicinal plants by Dominican immigrants in New York City for the treatment of common health conditions. A comparative analysis with literature data from the Dominican Republic, in *Traveling Cultures and Plants: The Ethnobiology and Ethnopharmacy of Human Migrations* (eds A. Pierone and I. Vandebroek), Berghahn Books, New York, pp. 39–64.
- Vandebroek, I., Balick, M.J., Ososki, A., *et al.* (2010) The importance of botellas and other plant mixtures in Dominican traditional medicine. *Journal of Ethnopharmacology*, **128**, 20–41.
- Viladrich, A. (2006) Botánicas in America's backyard: Uncovering the world of Latino healers' herb-healing practices in New York City. *Human Organization*, **65**, 407–419.
- Wani, M.C. and Horwitz, S.B. (2014) Nature as a remarkable chemist: a personal story of the discovery and development of Taxol. *Anti-cancer Drugs*, **25**, 482–487.
- Weckerle, C.S., Cabras, S., Castellanos, M.E. and Leonti, M. (2011) Quantitative methods in ethnobotany and ethnopharmacology: Considering the overall flora—hypothesis testing for over- and underused plant families with the Bayesian approach. *Journal of Ethnopharmacology*, **137**, 837–843.