



Why is change feared? Exotic species in traditional pharmacopoeias

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Introduction

Ethnobotanical literature is usually concerned about the effects of rapid cultural and environmental changes on the maintenance of traditional ecological knowledge (TEK). This concern is explained by the increasingly high loss of information about natural resource use and the substitution of internal community knowledge for information that comes from the outside, especially from industrialized societies. Regarding medicinal plant use, this expressive external influence can significantly lead to changes in both the structure and processes of local medical systems, for example, by substituting medicinal plants for allopathic medicine. Despite the importance of analyzing the above-cited example, this article focuses on another kind of change, which often comes earlier: the entrance of exotic species in local pharmacopoeias. The clarification of the real meanings of this type of change can help understanding cultural evolution and can help to decide how to deal with change in cultural systems.

The first ethnobotanical interpretations to this phenomenon have one thing in common: the (implicitly or explicitly) negative valuation of the process, by stating that exotic plants-dominated pharmacopoeias are common in communities that are suffering acculturation or knowledge erosion (see Alencar et al. 2010). Recent studies have questioned this idea and claimed that exotic species entrance on a pharmacopoeia is mostly to fill blanches not filled by native plants (Albuquerque 2006; Alencar et al. 2010). Here I argue that, no matter if they replace or not native species, the exotic plants entrance in a pharmacopoeia is a natural evolutionary phenomenon and scientists need to be cautious when attributing negative or positive values to it, since this valuation depends on the instance being analyzed. Previous

studies have pointed out the evolutionary and adaptive attributes of these phenomena. However, I believe there is still a blank, given that none of these studies develops a deep explanation based on the adaptive advantages of employing exotic species.

Thus, the main questions which I deal with in this article are: (1) why can the entrance and popularity of exotic species in local pharmacopoeias be considered an evolutionary phenomenon? (2) Can it be considered negative? (3) If so, under what contexts? (4) What are the competitive advantages of exotic species?

Hypothesis to explain exotic species entrance and popularity in a local pharmacopoeia

Before developing my point of view, it is important to mention the existent literature on the subject. A large amount of studies have found exotic species to dominate or at least to play an important role on local medical systems (Albuquerque 2006; Cadena-González et al. 2013; Eyssartier et al. 2008). The main explanation to these findings is somehow plausible: the presence of exotic products signalize that people are incorporating things other than what is generated in their own culture, what could be characterized as acculturation. However this kind of interpretation carries the long-term inheritance of some anthropological schools that used to focus on what is 'static' about traditional societies. Nowadays it is very clear that traditional knowledge is dynamic and its changes can come from internal (e.g. experimentation) or external sources. This statement gives place to new interpretations on the role of exotic species on local pharmacopoeias.

The pioneer study performed by Palmer (2004) mentions that the entrance of alien plants on a traditional pharmacopoeia may be part of its evolutionary process so that it can adapt as a response to ecological and cultural changes. More recently, Albuquerque (2006) questioned the current simplistic ideas to explain the presence of exotic plants on local medical systems. The author suggested that exotic species act as diversifiers, since, as mentioned before, their entrance in local medical systems is claimed to fill some blanks which are not filled by native plants. For example, if there is no adequate native species to treat Malaria, an exotic species will be likely to take this vague space. In fact, the first study to test this hypothesis (Alencar et al. 2010) found that, for a community placed in the Brazilian *Caatinga*, some therapeutic indications were treated only by exotic species and from a phytochemical point of view some compounds found on exotic plants were not present in autochthonous species.

Medeiros (2012) tested the diversification hypothesis on local, regional and national scales, but considering only the utilitarian (not chemical) perspective. The study also points out that in all these scales there were diseases treated only by exotic species. However a multivariate analysis showed that, despite those individual cases, there was a tendency of overlap between native and exotic plants in terms of diseases treated by them. Therefore, the presence of diseases only treated by alien species, added to this overlap tendency could possibly lead to two different interpretations: (1) Exotic species first entered the pharmacopoeias to fill blanks (diversification hypothesis) and then their application was extended to the other diseases already treated by the native plants, and (2) Exotic species invaded the systems, occupying functions already developed by native plants, so that the existent native blanks could have been formed a *posteriori* (native species uses forgotten after exotic species entrance for some cases).

Actually it is not easy to understand how exotic plants have come to occupy their current position. And maybe those paths depend on the context, i.e. different communities may have their exotic species entering by distinct reasons and ways. Whether their entrance was 'well-intentioned' to fill blanks or was a true 'invasion', the point is that it has an evolutionary value.

Cultural evolution and change: where can we place exotic species?

To add evolution to this discussion, I find it necessary to make some explanations about my theoretical positioning on the subject. The terms 'evolution' and 'adaptation' employed to refer to cultural systems are not ruled by the same norms as the biological systems. When we use 'adaptation' and 'evolution' to refer to a biological species or population we are certainly considering genetic and epigenetic changes. On the other hand, cultural evolution is related to the decisions and behaviors developed as a response to environmental challenges, which does not need to be genetically fixed. However, despite their differences, I believe that the processes behind biological and cultural evolution are analogues and this analogy is important to exemplify why, in my opinion, we cannot attribute negative values to native plants replacement by aliens under an evolutionary point of view.

The main argument for attributing a negative valuation to native plants replacement is that this knowledge may be needed and requested in the future. This may be true under many points of view (as we will see in the last section), but not the evolutionary. Let's imagine that we have a population of a species x in a forest environment. After a large time scale, this environment turned to a savanna and generated evolutionary forces that favored individuals with attributes different than those required in the previously forested environment. If, someday, the forest environment returns in this hypothetical region, some of the previously acquired attributes (now extinct) would be extremely useful, but simply are not there anymore. However if there is a new change, new evolutionary pressures will take place. That is how evolution works.

We can use an analogy to describe why native species knowledge loss is not a problem under the evolutionary point of view. If people from future generations once again need this knowledge, evolutionary forces will certainly lead to a restructuring process, so that people will learn by diffusion or even restart a process of trial and error. It would certainly be easier to maintain this knowledge, but its loss is perfectly suitable to the principles of (cultural) evolution.

Competitive advantage of exotic species

What forces would make exotic plants interesting from an adaptive point of view? Before explaining some of the competitive advantages of exotic species, something must be clarified. While native species significantly change from an environment to another, exotic species used in different communities tend to be more similar, at least in a single country or region. This pattern can be found, for example, in a large-scale study carried out with Brazilian local populations (Medeiros et al. 2012). But why is it important? Because most high popular exotic species share some common attributes which make them interesting in many types of contexts. These are:

- (1) Their occurrence in anthropogenic zones – exotic species used for medicinal purposes are mostly cultivated in household areas (such as homegardens) or spontaneously grow next to roads, abandoned fields etc (Voeks 1996). It

means that they are often closer to people than native species are. If we consider that people's behavior follows an optimal pattern whose cost/benefit relation tends to be as high as possible (Winterhalder 1981), the use of exotic species would in many cases decrease the harvesting costs, thus increasing the optimal balance.

- (2) Their palatability – Some cultivated medicinal species have been passing through a domestication process, in which their characteristics are adaptively modulated to adequate to humans needs. Therefore, they may have more pleasant tastes and odors when compared to most wild medicinal plants. This can be a good reason for substituting native for exotic species. In a study developed in the Argentine Patagonia, Estomba et al. (2006) observed that, in spite of the preference for native species, exotic plants were more frequently mentioned to treat gastrointestinal problems than native plants. The authors argue that several substances can treat digestive problems, given their low specificity. Therefore, if some affection has a plenty of treatment possibilities, the most palatable would be chosen. Albuquerque (2006) also considers palatability to explain the substitution of some native species from the *Caatinga* (seasonally dry tropical formation) for exotic equivalents.
- (3) Their reliability – Most high popular exotic plants have a long-term use tradition. They mostly come from the Old World and had their use disseminated to the New World during colonization. Their popularity and global distribution make them obvious targets for the development of studies that seek to scientifically validate their indications. Moreover, they are the most common plants shown in the media and in traditional medicine divulgation books. All this support makes them apparently more reliable and safe. Consequently it is expected that societies with high access to the media will rely on these resources.

Is fear justified?

Finally, after discussing the role of exotic species on traditional pharmacopoeias, I will answer the question proposed in the title of this article. In my opinion fear is not sustained by the evolutionary point of view. However, it is elsewhere justified. The increasing substitution of native for exotic species can lead to a homogenization of medicinal plant knowledge and a decrease in medicinal plant diversity on local communities. Some aspects of cultural homogenization are often considered as negative under the ethic point of view. Furthermore high similar exotic-based pharmacopoeias also bring negative consequences to bioprospecting, since most high popular exotic species have already been studied, while many native medicinal species remain untouched in terms of scientific research.

So it becomes clear that the valuation of negative and positive consequences of this change depends on the instance (e.g. evolutionary, cultural, scientific etc.) and in terms of evolution, explaining the forces that lead to certain behaviors is definitely more important than attributing values to them.

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