Infrastructure of research on medicinal plants and herbal medicines in the Brazilian Amazon

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Introduction

Medicinal plants and herbal medicines compromise a spending of US$ 14 billion dollars in the world annually and employ an average of 100 thousand people. According to the national association of pharmaceutical laboratories (ALANAC) the Brazilian market has generated an average annual volume of US$ 400 million in 2010. Moreover, the Brazilian Health Ministry sanctioned the *Programa Nacional de Plantas Medicinais e Fitoterápicos* (PNPMF, National Program of Medicinal Plants and Herbal Medicines) in 2008. The aim of this program is to guarantee access to safe and rational use of medicinal plants and herbal medicines for the Brazilian population; promote the sustainable use of biodiversity; promote the development of the productive chain and the national industry, and to incorporate the use of such medicines in the Brazilian Unified Health System (SUS). One of the guidelines set by the PNPMF is to identify the basic research carried out in the area, and this is the main focus of this study.

Therefore, this study presents the infrastructure of the research done on medicinal plants and herbal medicines in the Brazilian Amazon, a region with approximately 40 thousand species of plants.

Methodology

The infrastructure of research discussed in this work is characterized by four categories: 1) researchers, 2) institutions, 3) research groups, and 4) interactions with the productive sector, both currently and potentially for the development of the sector. For the mapping of the information, the CNPq Directory of Research Groups (DGP) in Brazil, a database of the National Council for Scientific and Technological Development (CNPq in the Portuguese acronym) was utilized. This database utilizes declaratory data to organize information of the official infrastructure of research in Brazil, such as the ongoing lines of research and human resources involved, the areas and subareas of knowledge, the application sectors involved, and the patterns of interaction with the productive sector.

Several authors have used the directory as a source of information to map research in different areas of knowledge [Erdmann, A.L. & Lanzoni, G.M.M. (2008); Freitas, C.M., Tambellini, A.M., Schultz, G.E., Bertolini, V.A. & Franco Netto, F.A. (2009); Barbosa, S.F.F., dal Sasso, G.T.M. & Berns, I. (2009)].

The first methodological step included a search of the Research Groups listed in the DGP with the following terms: *phytotherapy*, *herbal medicine* and *medicinal plants* (chosen from the

terminology adopted by PNPMF). This search was restricted to the nine states of the Amazon region: Acre, Amazonas, Amapá, Roraima, Rondônia, Pará, Maranhão, Mato Grosso and Tocantins.
The search strategy utilized in the Directory of Research Groups allows the search to be carried out only in the following fields: group name, field of research, and keyword. In order for the results to contain only the information effectively related to herbal medicines, further analysis was necessary to confirm the data.

Results

After an initial analysis, the results included 492 researchers working in 254 research areas, aggregated into 75 research groups. There is in average between one or two researchers per research area, heterogeneously distributed among the nine states. The research areas cover a period of 24 years, in which there is no clear pattern of growth. There is some evidence which indicates a relation between the increase in the number of research areas with the public support for research.
The groups and the research lines are mainly concentrated in the states of Amazonas, Pará and Maranhão, but can also be found in all the states of the biome. Out of the nine states which make up the Amazon biome, three do not have research support foundations: Tocantins, Roraima, and Rondônia. It is noteworthy that these states, despite being young and recent in the development of their infrastructure, already contain research areas that regard such issues. Thus, the research funding in these states and the infrastructure of research reflects not only 100% of the federal investment, but also seem to explicit a clear induction of research in the region.

Institutions

Throughout the Amazon biome, the research groups are housed in 24 institutions; of which 14 are public universities (10 federal and 4 state), 2 are private universities, 2 are federal institutes of education, science, and technology; 3 are state institutions, 3 are federal institutions.
Of the three federal institutions, *Goeldi Museum*, the *Instituto Nacional de Pesquisas da Amazônia* (INPA), and the *Empresa Brasileira de Pesquisa Agropecuária* (EMBRAPA), only the latter has research areas/groups in more than one state: Pará, Acre e Amazonas.
INPA is acknowledged as an important repository of research expertise on the Amazon biome and this is also true when the focus is on medicinal plants.

Areas of Knowledge

In relation to the greater areas of knowledge, analyses were done based on CNPq's classification system. Since a line of research may have been classified into more than one area of knowledge, the data collected allowed us to analyze the degree of interdisciplinarity among the areas of research. Biological Science is prevalent and has a low correlation with other areas. The Agricultural Sciences and the Applied Social and Human Sciences are related more closely. The latter also relates, though remotely, with the Exact and Earth Sciences, and Health Sciences. Health Sciences, in turn, seems to relate closer to Exact and Earth Sciences, due to the natural affinity to Chemistry and Pharmacy.
We also analyzed the subareas of knowledge as classified by CNPq. It has been noted that the area of Human Sciences are not commonly present in the research of medicinal plants and herbal medicines. This may cause some concern once it is essential to also include the context of local knowledge and traditional community practices into the lines of research mentioned.

Application Sectors

The lines of research are labeled by their participants into one or more sectors of application. According to the database created by CNPq, these sectors are then categorized into their areas of economic, social, technological, and cultural activity of which the research is applied. Such categorization into sectors allows us to consider the lines of research from a perspective which regards the structures of the productive chain. In the sector labeled as *Caring for people's health*, research in the area of hypertension and heart issues is highlighted.

In the sector of *Biotechnological products and processes for human or animal health*, there is research on different therapies, such as: anti-inflammatory, antibacterial, antimicrobial, antitumor, among others.

Relationships with the productive sector

Eight research groups with an institutional relationship with the productive sector were identified, in a total sum of eleven companies. Most of these companies (9) are private, and the remaining two belong to the national government. It is noteworthy that a research relationship prevails, in seven groups.

Regarding the type of remuneration flowing between the groups and the companies, this occurs mainly through the transference of material inputs, more specifically, from the companies to the groups. Four groups work in partnership without the transference of funds whatsoever, charactering it as a risky relationship.

Conclusion

The research conducted so far indicates that there is an infrastructure of research on medicinal plants and herbal medicines present in the Amazon Biome, in all states of this region.

Research in the area of Health Sciences is still weak in the studied context, especially if considered that only nine lines of investigation are focused in the area of Public Health. Considering that the rational use of medicinal plants, in the context of PNPMF, requires a broader view of the context of traditional knowledge, it is also important to note the low number of research done in the areas of Humanities and Applied Social Sciences.

Last but not least, this study highlights the importance of strengthening relationships between research and the productive chain, since the results indicate that only about 10% of the research groups have some relation to the productive sector.

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