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# Biodiverse food plants: Which gaps do we need to address to promote sustainable diets?

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## INTRODUCTION

Several fields of knowledge show that the low diversity of diets has negative impacts on human and environmental health (Willet et al. 2019; Dwivedi et al. 2017; Lachat et al. 2018). Expanding the diversity of food produced, distributed, and consumed is undoubtedly one of the most significant challenges of planetary nutrition, and that must be faced to foster the sustainability of food systems (Powell et al. 2015). Although the global food biodiversity available is estimated at 30,000 plants, an average of only 15 to 200 species are used by humans. If the analysis is made in terms of energy contribution, about 60% of the global calories ingested come from only three plants: rice, wheat, and corn (Fao 2010; Fao 1999). Diets, in the global agri-food system, tend to remain unchanged regardless of the geographic, climatic, cultural or seasonal situation. This homogenization trend is more significant in urban contexts and, especially, in low-income households (Ipes-Food 2015; Wertheim-Heck, Raneri and Oosterveer, 2019).

It is from this scenario that the argument for sustainable diets rises, recognized by their potential to address in an integrated way the challenges of food and nutrition security and biodiversity conservation, expressed in objectives 2 and 15 of the United Nations Agenda 2030[1]. Sustainable diets are those based mainly on diverse plants and which may occasionally have modest amounts of animal protein (Willett et al. 2019; Forouhi and Unwin 2019). Therefore, plant food biodiversity is central to the discussion of sustainable diets (Burlingame 2012; Mason and Lang 2017).

In this editorial, we use the term biodiverse food plants (BFP) to refer to edible plant biodiversity. We define BFP as those species of extensive use (eg., beans, rice, and corn), as well as unconventional, generally native, often neglected and of limited cultural use. We also consider native and heirloom varieties of conventional plants grown locally to be unconventional. What do we still need to learn about these plants to promote sustainable diets? In this article, we present four main gaps that can help us to design an interdisciplinary research agenda among nutritionists, ethnobiologists, anthropologists, and other scientists

1 With the Sustainable Development Objective (SDG) 2, the proposal sought by the member states of the United Nations is to end hunger, to achieve food security, to improve nutrition, and to promote sustainable agriculture. With the SDG 15, they aim to protect, to recover, and to promote the sustainable use of terrestrial ecosystems, to manage forests in a sustainable way, to combat desertification, to stop, and reverse land degradation, and to stop the loss of biodiversity.

interested in the topic.

## Food biodiversity data is inaccessible

Knowing the state of biodiversity available in local food systems is a crucial step for building knowledge about BFP and, consequently, for the elaboration and execution of food and nutrition security policies. Therefore, the lack of accessible data is the first gap that we present (FAO 2017). In Brazil, the expressiveness of this problem is evident when we observe, for example, the national ordinance n°. 284 of 2018[2] - which establishes the list of food species in Brazilian biodiversity - mentions only 83 plants. The country, on the other hand, has an estimated flora of 46,861 species, including algae, angiosperms, bryophytes, fungi, gymnosperms, ferns, and lycophytes (Flora do Brasil 2020).

One way to address this problem is to gather existing data. In fact, there are a variety of publications that present information about BFP, but they are separated into different areas of knowledge. The development of systematic review studies can be useful in the task of connecting these data. Although ethnobiology science needs to overcome the era of list compilation, as stated by Albuquerque and Medeiros (2012), the collection and publication of secondary data is a job that needs to be done to achieve strategic areas for the promotion of sustainable diets. The solution would be to compile these lists together with broader research questions and a more significant scientific impact[3].

## Need for interdisciplinary methods and interprofessional research teams

The task of mapping data on BFP in the field requires an approach that considers the complexity of this problem, that is, it demands research methods that situate us within the analysis landscape that includes, simultaneously, people, their plants, and their diets (Tumilowicz, Neufeld and Pelto 2016). Dietary assessment studies, for example, could be valuable channels for mapping food biodiversity. However, the tools available today in nutrition to assess food consumption, due to their low cultural adaptation, are not designed to capture information related to biodiversity (FAO 2017). The work of biologist and anthropologist Nina Etkin, especially her research on foods with medicinal potential among the Hausa in Nigeria, offers an excellent example of how the cross-disciplinary approach favors the construction of methods that resonate the dialectic between nature and culture of food plants (see Etkin 2006). The author, therefore, highlights the contemporary challenge of scientific disciplines giving space for the formation of interprofessional capacities to advance food plant science. The dialogue between nutrition, ethnobiology, and anthropology, for example, is strategic for the improvement of dietary assessment tools and for the development of new ones.

There is no doubt that ethnobiology has been making a relevant contribution to the methods of studying food plants. In addition to providing inventories on BFP, diverse ethnobiological research nowadays can analyze the input of these plants to food and nutrition security, local economy, and biodiversity conservation (see Reyes-Garcia

2 The entire list can be seen here: http://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/29306868

3 Due to the fast process of biodiversity loss the world faces, we highlight the contribution of ethnobiology historical studies in the rescue of information registered in a time when landscapes were largely preserved (Nunes et al. 2012). For this reason, we suggest that this kind of research should be present in systematic reviews.

et al. 2019, Kasper-Pakosz, Pietras and Łuczaj 2016, O 'Neill et al. 2017). On the other hand, its dialogue with other disciplines, such as nutrition, would help to define critical information for food analysis that should be included in research protocols with food plants. Besides, the focus of this discipline on medicinal plants and in non-urban communities limits its ability to produce more extensive data on BFP (Liporacci et al. 2017, Nunes et al. 2012). This broadening of scope is essential for dialogue with the international sustainable diet agenda, which faces its most significant challenges in urban contexts and in human groups integrated with the market economy (Mason and Lang 2017, Reyes-Garcia et al. 2019).

## Lack of culinary data in ethnobotanical studies

As important as making an inventory of plants is knowing their culinary uses. However, several ethnobotanical studies still do not collect this data when working with food plants, which delays our ability to better understand the nutritional potential of BFP for human populations. In this sense, to associate the elaboration of lists of food plants with well-conducted and detailed ethnographic studies could advance our knowledge base.

Take the example of *Dioclea grandiflora* Mart. ex Benth (mucunã), plant analyzed by Carvalho et al. (2011) in a study of chemical composition. The authors raise the hypothesis that the seeds of mucunã could be considered safe for human consumption after heat treatment, as this species, in its analysis, presented anti-nutritional factors and toxicity like common legumes, such as beans and soybeans. Data from ethnobotanical studies, on the other hand, state that even after cooking, the consumption of these seeds could cause intestinal problems or even death due to its toxicity. Only after washing the seed flour "in several waters" (exhaustive dialysis), would it be fit for human consumption (Nascimento et al. 2012).

This example shows the importance of ethnoculinary data for the advancement of research on BFP. We can define ethnoculinary or ethnocuisine as a multidisciplinary field of study of food processing techniques in the context of different food systems[4]. Actions such as to wash, to soak, to dehull, to mill, to heat, to roast, to boil, to infuse, to germinate, to ferment, to cure, to preserve, and to dehydrate, or the combinations of some of these strategies, can act on the bioavailability of nutrients and on the inactivation or reduction of anti-nutritional factors (Akeem et al. 2019, Jones 1998). Therefore, it is relevant that ethnobiological studies collect information on the culinary uses of food species. The registration of the edible part and its processing method, using the techniques listed above and others identified locally, is fundamental for the progress of our analyzes.

## Scarcity of nutritional composition data

Even though they play a crucial role in planning recommendations, processing programs, and other food and nutrition security policies, the data on the nutrient composition of BFPs are still scarce (Fao 2017). Take, for example, the study by Bortolotto et al. (2015), who assessed the

4 We use the term ethnoculinary or ethnocuisine instead of ethnogastronomy because we understand that gastronomy is an event that has a historical reference dated to the end of the 18th century and the beginning of the 19th century. Gastronomy is about restaurants, spaces proper from bourgeois culture, that have its origin in the French Revolution. The term culinary or cuisine, on the contrary, deals with the concept of transformation techniques in a much broader historical perspective, which is linked with the birth of language itself. In this sense, our theoretical approach dialogue with Claude Lévi-Strauss, Mary Douglas, and Nina Etkin's perspective.

consumption of native food plants in rural communities, including indigenous groups, along the Paraguay River in the Brazilian Pantanal. Among the 54 species cited by residents, only four have chemical composition data in the main food table in the country, the Tabela Brasileira de Composição de Alimentos (TACO): *Acrocomia aculeata* (Jacq.) Lodd. Ex Mart. (boicaúba, macauba or maguedji, in Guató indigenous language), *Caryocar brasiliense* Cambess. (pequi), *Plinia cauliflora* (Mart.) Kausel (jabuticaba, native jabuticaba), and *Eugenia uniflora* L. (pitanga)[5].

How to analyze diets without data? One of the possible approaches is the Food Matching method, which seeks to match plant data available in international tables, articles, labels or other sources (Stadlmayr et al. 2012). This strategy, however, has limitations, as food composition data have significant differences related to the agroecological zone (management techniques, climate, soil), seasonality and, most importantly, genetic diversity (Hunter et al. 2019). The development of composition studies is essential for the correct interpretation of the nutritional contribution of the food consumed. Besides, we believe that the production of data of this nature can stimulate the pursuit of dietary assessments that consider the BFP since, currently, it is unproductive to collect data that will not be appropriately analyzed.

### Final Considerations

The four gaps introduced by us present ways to build a research agenda that brings together several fields of knowledge considering a biocultural approach. We believe that these are the main gaps to advance the debate on BFP. There are bigger ones. One of them, particularly challenging for the sciences of ethnobiology and nutrition is the following: how to assess the consumption of BFP in population-based studies in the urban context, where: (1) the informants do not have the skills to provide taxonomic details of the species, (2) foods do have high levels of processing, (3) and composition of diets do have an ample supply of imported foods? The answer to these questions, built-in collaboration with different scientific disciplines, can help us move forward, fostering sustainable diets.

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