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Michelle Cristine Medeiros Jacob [1]

[1] Universidade do Rio Grande do Norte, Departamento de Nutrição. Natal, RN, Brasil.

Correspondence
Michelle Cristine Medeiros Jacob
michellejacob@ufrn.edu.br

Biodiversity of underutilized food plants in a community-based learning garden

Biodiversidade de plantas alimentícias não convencionais em uma horta comunitária com fins educativos

Abstract

Underutilized food plants (UFP) offer the opportunity to overcome issues that are currently facing sustainable food systems. The scarcity of data on them and the gaps found in the nutrition workforce are challenges that limit their approach. To addresses some of them, a community-based garden project was developed in an undergraduate program in nutrition at a federal university in northeastern Brazil. This paper aims to present the results obtained with this project in its first twelve months concerning the use of Garden-Based Learning (GBL). During 2018 eight plants were studied with the support of this method. The data gathered on UFP by students included: botanical family, vernacular names, origin, the biome of occurrence, food uses, and nutritional indicators. The use of GBL involved some strategies such as definition of theme, elaboration of a culmination product, and fostering the research of different kinds of knowledge. The GBL method mediated the educational process implied with concepts, practices, and attitudes. The plants studied have the potential to contribute with Food and Nutrition Security due some criteria such as adequacy to the biome of the study setting and variety of nutrients. Recognize native and adapted food plants resilient to the dry landscape is central to enhance environmental and human health. The resulting data served as a basis to promote sustainable diets with the surrounding community, from lectures to hands-on activities in the garden and kitchen.

Keywords: Biodiversity. Food Plants. Food and Nutrition Security. Higher Education. Problem-Based Learning.

Resumo

As plantas alimentícias não convencionais (PANC) oferecem a oportunidade de superação de desafios que se impõem aos sistemas alimentares. Todavia, a escassez de dados sobre essas plantas e as lacunas encontradas na formação em Nutrição são gargalos que dificultam sua abordagem. Para abordar alguns desses limites, um projeto de horta comunitária foi desenvolvido em um curso de graduação em nutrição em uma universidade federal do nordeste do Brasil. Este artigo tem como objetivo apresentar os resultados obtidos com esta iniciativa em seus primeiros doze meses com o uso do método Aprendizagem Baseada em Hortas (ABH). Durante 2018, oito plantas foram estudadas. Os dados coletados sobre PANC pelos alunos incluíram: família botânica, nomes populares, origem, bioma de ocorrência, usos alimentícios e indicadores nutricionais. O uso da ABH envolveu algumas estratégias, tais como definição de tema, elaboração de um produto de culminância e promoção da pesquisa em múltiplas bases de evidência. O método ABH mediou o processo educacional implicado com conceitos, práticas e atitudes. As plantas estudadas têm potencial para contribuir com a Segurança Alimentar e Nutricional, devido a alguns critérios, como adequação ao bioma do ambiente de estudo e variedade de nutrientes. Reconhecer plantas alimentícias nativas e adaptadas, resilientes à paisagem da Caatinga, é essencial para melhorar a saúde ambiental e humana neste bioma. Os dados resultantes da experiência de ensino serviram de base para ações de promoção de dietas sustentáveis junto à comunidade inserida no projeto, por meio de conversas e atividades práticas na horta e oficinas culinárias.

Palavras-chave: Biodiversidade. Plantas Alimentícias. Segurança Alimentar e Nutricional. Ensino superior. Aprendizagem Baseada em Problemas.

INTRODUCTION

It is estimated that, although there are about 30,000 species of edible plants, more than half of the global energy requirement is currently served by only four crops: rice, potatoes, wheat and corn.[1] There is, therefore, a gap concerning food biodiversity in human consumption.

Food biodiversity refers to the diversity of plants, animals, and other organisms used as food.[2] Scientific evidence indicates that the richness of dietary species, or counting the number of different species consumed per day, serves as an evaluator of their nutritional adequacy.[3] Thus, assessing the food biodiversity of systems provides a unique opportunity to cross two critical dimensions of sustainable development - human and environmental health.[4]

The scarcity of data on biodiversity in studies of availability, consumption, and composition of food acts as a significant bottleneck in determining its importance to Food and Nutrition Security (FNS).[5] This lack of data is significant in the case of wild and underutilized species.

Underutilized Food Plants (UFP) are defined as those with underexploited potential to contribute to FNS, health and nutrition, income generation and environmental integrity. Its definition depends on geographic, social, economic and temporal aspects and includes a wide range of wild, traditional, indigenous and local foods.[6] UFPs are edible plants, exotic or native, that are not easily recognizable or available to purchase by local population.

It is essential to highlight that the unconventionality criterion is always relative in terms of geography and culture. In other words, the plant by itself is not conventional or unconventional; it is just a plant. Depending on the region or community in relationship with the plant, we can call it conventional or unconventional. For instance, *Spondias tuberosa* Arruda (*umbu*) is defined as unconventional for most people in the south part of Brazil, and conventional in the northeast part. In this same region, the Northeast, the *umbu* can be unconventional for some people living in the urban context.

The gaps found in training in the nutrition workforce are a second bottleneck. Like many health sciences, nutrition is fragmented into traditions of thought, which bring challenges to food systems thinking. The hegemonic approach of this science prioritizes the nutrient, giving little emphasis to the questions of how, where, and by whom food is produced, processed, and distributed. Also lacking emphasis is consideration of whether and by what means public access to them happens, as well as of the quality of diets and their impacts on the environment.[4,7] Thus, it is necessary to discuss training of a workforce who can think about food from a broader perspective that includes the complexities of nutrition. These complexities may then be addressed in policies, research, and the provision of relevant services to the community that will be consistent with the approach of food systems, in which there is discussion of food biodiversity.[8]

This paper reports one educational experience in which undergraduate students of a nutrition program could interact with the local population and biodiversity during their training in the university. Professors, students and the local community in a public higher education institution in northeastern Brazil designed a community garden, the Nutrir Community Garden (NCG), with representative plants of the local biodiversity.[a] The project emerged in 2017 as a formative proposal in the nutrition program, built with support from various areas of knowledge and in dialogue with the community. Nowadays, the garden is a laboratory and has five professors, three staff people, 15 students, and between 20 and 30 community volunteers.

[a] For further information see: http://www.nutrir.ufrn.br

The method that guides activities in the project from its inception is the Garden-Based Learning (GBL). The use of active learning methodologies in health training has been recommended as a way to break with the disciplinary structure aiming at systemic situations analysis.[9] Active teaching and learning methodologies are based on teaching strategies, critical-reflexive, that value the problematization and intervention on reality and that favor the collective construction of knowledge.[10] GBL is an active methodological approach that invites students to experiment and collaborate to act on issues of a transdisciplinary nature, stimulating new forms of communication, learning, and reflection in action.[11-13]

The aim of this paper is to present the results obtained with this project in its first twelve months, with respect to the following questions: What were our main strategies and benefits using GBL approach in nutrition training? Which are the potentials of UFP to contribute with Food and Nutrition Security that emerged from this experience?

METHODS

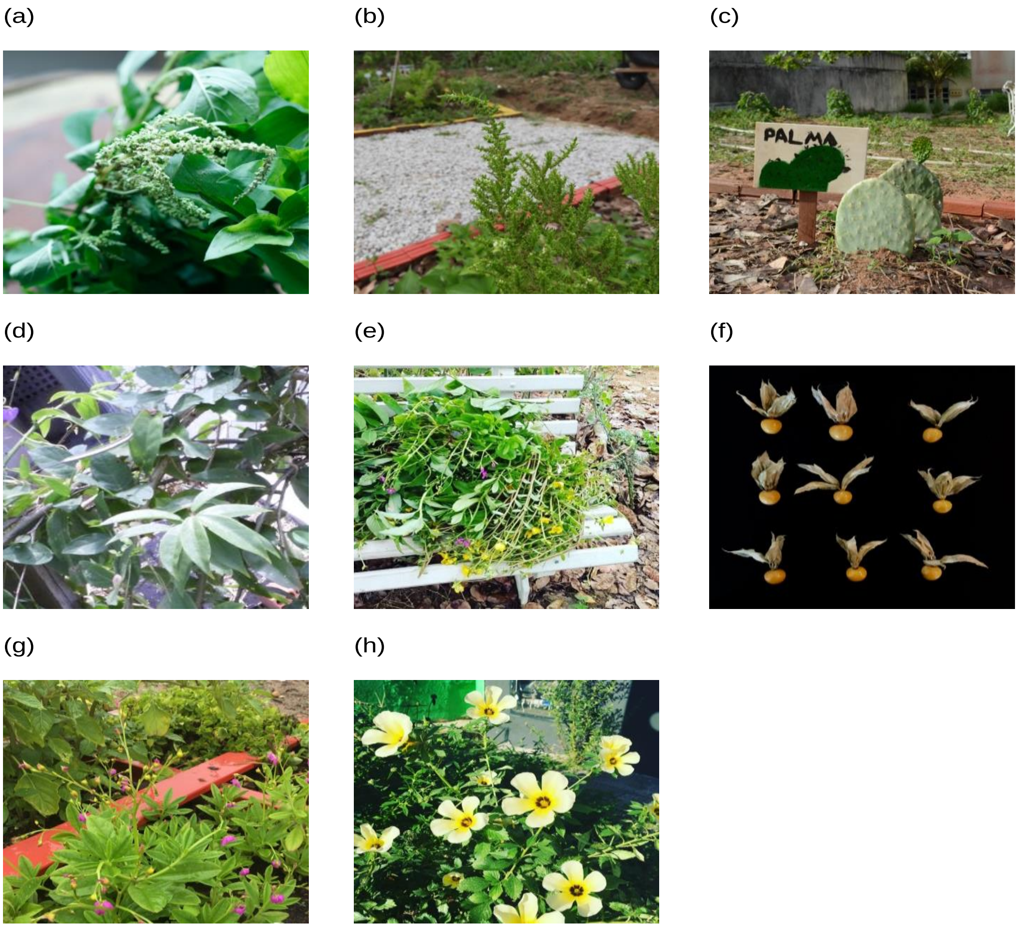
The NCG is located in the urban area of the city of Natal, in Rio Grande do Norte state, Brazilian northeastern region, at the main campus of Rio Grande do Norte Federal University (Figure 1). Activities in the garden began in 2017. The NCG covers an area of 1,200 m^2 and contains more than 131 edible plants, distributed in 55 different botanical families, half of them UFP. This project, in 2018, was nominated by the FAO's Global Food and Nutrition Security Forum as a successful experiment in the application of the Voluntary Guidelines for the Right to Adequate Food in the Context of National Food Security.[b]

Figure 1. Aerial View of Nutrit Community Garden in 2017 and 2019. Source: NCG Archive

[b] The report of our experience, entitled "Community gardens to food democracy: Right to Adequate Food, higher education and awareness-raising through the approach to sustainable food systems in the Brazilian northeast", can be viewed at https://bit.ly/2pjcKYX.

The results reported in this paper are related to the learning experience of NGC members in 2018. The eight plants studied in that year were: Amaranthus viridis L., Dysphania ambrosioides (L.) Mosyakin & Clemants, Opuntia ficus-indica (L.) Mill., Pereskia aculeate Mill., Portulaca oleracea L., Physalis pubescens L., Talinum fruticosum (L.) Juss., and Turnera subulata Sm. These plants are showed on Figure 2.

Figure 2. Plants studied at the Nutrir Community Garden in 2018. (a) Amaranthus viridis L., (b) Dysphania ambrosioides (L.) Mosyakin & Clemants, (c) Opuntia ficus-indica (L.) Mill., (d) Pereskia aculeate Mill., (e) Portulaca oleracea L., (f) Physalis pubescens L., (g) Talinum fruticosum (L.) Juss., And (h) Turnera subulata Sm. Fonte. NCG Archive



RESULTS AND DISCUSSION

Garden-Based Learning at Nutrir Community Garden

GBL is, in short, a pedagogical strategy that uses gardens as teaching tools, like a living laboratory.[14] Its theoretical basis lies on the framework of experiential education, a chain of thought that brings together diverse methodologies in which educators and learners deliberately engage in direct experience and focused reflection in order to build knowledge, develop skills and attitudes that contribute to community life.[15]

There is a wide range of scientific evidence attesting the effectiveness of this method. These include: 1) Increased acceptance of the community to fruits and vegetables; 2) Voluntary changes in diet; 3) Improving understanding about the environment; 4) Promoting community and social participation; 5) Improving behavior; 6) Greater rate of learning, when compared with conventional methods of education.[16,17]

Despite being a method that is still little employed in higher education institutions, some studies legitimize the effectiveness of GBL. Veronica Gaylie[13] brings experience in the university environment as a starting point for reflection on ecocentrism. When faced with problems during the implementation of the garden, the students had to critically discuss solutions on issues of social and environmental justice, which led to the reflection on their attitudes towards the environment. In a study that analyzed the perspectives of the actors involved in the implementation of a garden on a university campus in Hong Kong, Cheang et al.[12] underlined the gains related to the communication of the actors involved in the project.

The proposal of Aftandilian and Dart[18] is closer to the idea presented in this report. The authors used GBL in undergraduate courses to work for food justice in the context of FNS, improving teaching practices, and strengthening links between academia and the community. The results present a positive evaluation of the proposal and emphasize the importance of developing excellent communication among the actors, which encourages the construction of relations based on dialogue.

The NCG was born as a result of discussions between teachers involved in nutrition training. Some of their questions were: How to approach the local biodiversity in curricula? How to make this discussion meaningful in the social context? The central assumption of these professors was that it was necessary to have an approach with several knowledge areas. Consequently, the first step involved finding a specific strategy for integrating curricular components from distinct departments, including Nutrition, Botany, Ecology, and Agronomy. The thematic approach helped to guide the transdisciplinary aspect of GBL. In this case, the theme was UFPs. Some authors define other forms of organization in a pedagogical proposal, a problem, strategies to solve a problem, or a theme itself.[19]

Each semester, four UFP are defined for study. The definition of the plants is made in agreement with the garden community, composed not only of students and professors, but also by members of the external community involved in the project. For each curricular component, students examine different aspects of these plants. There are four components studying UFP nowadays in nutrition program: Socio-Anthropological Aspects of Food; Food and Nutrition Education, Elements of Agroecology, and Sustainable Food Systems to Food Security.

Establishing goals for the culmination of the collective work is an important part of these pedagogical proposal.[19] Each semester the final products generated are the fact sheets about the four plants studied in the garden elaborated in the learning process. All information produced is compiled in fact sheets that include the following information: scientific name of the plant, photograph, vernacular names, origin, the biome of occurrence, food uses, nutritional indicators (macronutrient, micronutrient, and bioactive compounds), and references. The fact sheets reflect the intention of generating a palpable model of this transdisciplinary experience. Besides, they are instruments of scientific dissemination, providing support for the development of food and nutrition educational activities in the community, in forms such as lectures, cooking, and gardening workshops.

The research is another crucial aspect of this strategy. To build these sheets in the learning process, the students need to achieve different kinds of knowledge, such as scientific and popular. Concerning UFP, for instance, there is a gap in traditional uses of plants, that just could be filled with contact with the community.[20] In this sense, the extension activities in NCG are essential to promote communication, in a Freirean sense, between local members and students.[21]

In order to collect scientific data about the plants, students are oriented to access the Flora do Brasil 2020 (Rio de Janeiro Botanical Garden) database, gray literature, reference bibliography, as well as to collect data through the following databases: Web of Science (WoS), Medline; Scopus and Brazilian Agricultural Research Database by EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária, in Portuguese). In addition to the scientific name of the plant, other terms were used: "food plant", "nutrient", "bioactive", all in English, except for the national database. All references collected were ordered with the support of the reference management tool Mendeley. Information was extracted from the publications and documented in a spreadsheet containing all the fields necessary to fill the plant's fact sheets, such as: botanical family, vernacular names, origin, biome of occurrence, food uses (including preparation technique), and nutritional indicators. In the end, teachers reviewed the material and provided guidelines to share it among the members of the project community to obtain new information, for example about local traditional names, culinary techniques, etc.

In sum, the use of GBL in NCG involves some strategies that here are summarized in three points. First, the definition of theme, that guides the transdisciplinary experience. Second, the elaboration of a culmination product, that helps to establish collective goals. Third, fostering the research of all kinds of knowledge as a part of the learning process.

A detailed study evaluating the impacts of the methodology on the student community is underway. However, we developed an evaluation with the students supporting the NCG. The results found that relate to GBL's potential in nutrition training are: (1) acquisition of technical knowledge related to agroecology, sustainable food systems, biodiversity; (2) acquisition of research, management and teamwork skills; (3) acquisition of attitudes related to the strengthening of community ties, citizenship, and responsibility.[22]

General presentation of the studied plants in 2018 and its potential for Food and Nutrition Security

Table 1 presents the data of botanical family, scientific name, popular name, origin, the biome of occurrence, and food uses of these plants.

The eight plants belong to six botanical families, and most are from drought-deciduous families: Amaranthaceae, Cactaceae, Portulacaceae and Talinacea.[23] This characteristic could make them relevant plants to FNS in Rio Grande do Norte state, which is in 95% Caatinga biome area, the largest tropical dry forest in South America.[24]

Table 1. Botanical and culinary data from plants studied in Nutrir Community garden in 2018. Natal-RN, Brazil.

Family	Scientific name	Vernacular name	Origin	Biome of occurrence	Food uses
Amaranthaceae	*Amaranthus viridis* L.	Bredo, caruru, caruru-verdadeiro, caruru-de-porco, caruru-de-mancha.[1,2]	Caribbean[1]	Amazon, Caatinga, Cerrado, Atlantic Forest, Pampa.[3]	Leaves, stalks and grains. Cooked[4]
Amaranthaceae	*Dysphania ambrosioides* (L.) Mosyakin & Clemants	Mastruz, menstruz, mastruço, erva-de-santa-maria, chá-do-México, epazote.[1,5]	Central America, probably Mexico[6]	Amazon, Caatinga, Cerrado, Atlantic Forest.[3]	Leaves and inflorescences. Cooked[7]
Cactaceae	*Opuntia ficus-indica* (L.) Mill	Figo-da-índia, palma, palmatória, palma-gigante, jamaracá, jurumbeba, figueira da Índia, cacto[5]	Mexico[3]	Caatinga, Atlantic Forest [3]	Young filocladium (average of 30 days)[8], flowers, seeds and fruits. Raw (fruits; flowers) or cooked[9]
Cactaceae	*Pereskia aculeata* Mill.	Ora-pro-nóbis, lobrobô, lobrobró, carne-de-pobre, mata-velha, guaiapá, mori[5]	Brazil[3]	Caatinga, Cerrado, Atlantic Forest [3]	Leaves, fruits and flowers. Cooked[10,11]
Portulacaceae	*Portulaca Oleracea* L.	Beldroega, caaponga, verdolaga, porcelana, beldroega-da-horta, bredo-de-porco, onze horas, portulaca[5]	Brazil[3]	Caatinga, Atlantic Forest, Amazon, Cerrado[3]	Leaves, stems and flowers. Raw or cooked. [13]
Solanaceae	*Physalis pubescens* L.	Fisális, camapú, camapum, canapum, cerejas de judeu, balãozinho, capucho.[5, 12]	Peru[3]	Amazon, Caatinga, Cerrado, Atlantic Forest [3]	Fruits. Raw or cooked[14]
Talinaceae	*Talinum fruticosum* (L.) Juss.	Cariru, beldroega-graúda, major gomes, lustrosa-grande, maria-gorda, beldroegão, beldroega grande, erva-gorda[5]	Brazil[3]	Caatinga, Atlantic Forest, Amazon, Pantanal[3]	Leaves, steams, flowers. Raw or cooked.[15]
Turneraceae	*Turnera subulata* Sm.	Chanana, damiana, flor-do-guarujá, albina, boa-noite, bom-dia[5]	Brazil[3]	Amazon, Caatinga, Cerrado, Atlantic Forest [3]	Leaves and flowers Raw (flower) or cooked (leaves) [16]

Source: 1.(31) 2.(64) 3.(34) 4.(65) 5.(36) 6.(66) 7.(47) 8.(67) 9.(48) 10.(68) 11.(28) 12.(69) 13.(50) 14.(70) 15.(71) 16.(41)

The popular names reveal the association between humans and the use of plants.[25] This means that the number of names referred to a single plant can proportional to its importance to the local community. Our data show that, despite the fact these plants are not broadly recognized as edible nowadays, there are several popular names related to them. There is probably a gap in cultural knowledge related to these plants. Someday they were recognized as useful to the locals. In the study scenario, NCG members recognized some of them as famine foods, those used by people in times of food scarcity.[26] Rio Grande do Norte state is in the Brazilian northeast, an area covered by the Caatinga biome, marked by a long dry season with hard effects on food production, and consequently on the state of food security of local people.

The eight plants are originated from the South American continent and have a confirmed occurrence in the Caatinga biome. The presence of local plants in the diet is a central concept of sustainable diets, which are protectives and respectful about biodiversity and ecosystems.[4] In terms of Caatinga biome, the presence of native plants is an essential strategy to coexist with semiarid conditions instead of combatting them.[c] Recognizing native and adapted food plants resilient to the dry landscape is central to enhance environmental and human health.

Food uses are diverse and include leaves, stems, flowers, and fruits of the plants. The rescue of traditional culinary techniques of UFP is a growing field of practice and empirical research, mainly by cookers and cuisine chefs in Brazil. The work of the nutritionist Neide Rigo is remarkable in this area. Since 2006 she has a blog[d] to promote recipes of UFP, as a result of a process of in-depth experiential research in traditional communities and the scientific literature. Her work inspires professionals of several fields working with FNS.

Some plants, like *O. ficus-indica* and *P. aculeta*, need to be boiled to inactivate anti-nutritional factors such as lignin, tannin, nitrates, saponin, phytate, and oxalate.[27,28] The study of anti-nutritional factors and toxicity is a relevant field of research to the proper consumption promotion of UFP. It is essential to highlight that these studies need to be contextualized in terms of human diets. For instance, *Manihot esculenta* Crantz, a widespread edible plant all over Brazil, is recognized as cyanogenic. However, if it is adequately cooked, under the rules of the indigenous culinary techniques, it is safe for consumption.[29]

The culinary factor plays a significant role in the analysis of toxicity. This explanation could help understand why some plants referred to as edible in ethnobotany studies are considered toxic in some food science studies. Information such as culinary techniques, absolute and relative contribution of these plants in the context of diets are relevant to design proper studies of toxicity.

There is a dual interface of UFP to be considered: sometimes they are recognized as medicine, in others as food, and occasionally such interfaces overlap. It is worth underlining that in food history, the medicinal or edible qualities of plants, are much more a continuum than two well-delimited categories.[30] Hippocratic medicine, cultural systems as Ayurveda or Candomblé, or several disciplines such as Ethnopharmacology, Ethnobotany and Anthropology, can confirm this duality of food plants. This is what happens in the case of UFP in our study.

Many of these plants stand out for their therapeutic potential. *A. viridis*, for instance, is a plant widely used in folk medicine in Brazil. It is considered to be diuretic, laxative, and stimulant of lactation and consumed primarily in the form of herbal infusion.[31,32] There are also records of food uses, being popularly used in salads and as ingredient in stews.[33] In some states of the Northeast region, for example, during Lent,

[c] This is the main message of Brazilian Semi-Arid Articulation, a network formed by several civil society organizations in Brazil. For further information, see: https://knowledge.unccd.int/kss/brazilian-semi-arid-articulation
[d] See: https://come-se.blogspot.com

it composes the traditional *caruru* with coconut milk. *D. ambrosioides* is one of the plants most used as medicine worldwide. It is listed in the *National List of Medicinal Plants of Interest to the Unified Health System* (Renisus, in Portuguese). It is considered to be a powerful antihelminthic, and also used in the treatment of gastric diseases and bronchitis. The topical use of the smashed plant is carried out in the case of wounds, bruises, and fractures. The leaves can be beaten with a little milk or be prepared in the form of herbal infusion and several kinds of syrups.[31,34,35] In Brazil, its use as food is scarce, but in other Latin American countries, such as Mexico, it is widely employed as condiment or as base for salty preparations, such as the cheese *quesadilla* with epazote.[36,37]

T. subulata is popularly applied in infections, kidneys and uterus inflammation, as well as itching and boils.[38] In Rio Grande do Norte, an infusion of the root of *T. subulata* is used as an abortifacient, and the flowers fight influenza and tumors, and are used to treat cuts.[39] Several *Turnera* species are used as an abortifacient in the Brazilian northeast.[40] The most common uses of the plant are in the form of herbal infusion, infusion mixed with several others plants (which is called *garrafada* in the Brazilian northeast), syrups, bath, and compresses.[38-42] Further studies, focusing on the use of these plants as food, are essential to refine this debate.

With this concern in mind, in the NCG experience nutritional indicators of these plant were collected. Table 2 summarizes the nutritional content data collected from the eight plants studied. The food composition indicator refers, in a given system, to at least one value for nutrient (macro or micro) or bioactive compound.[5] Data on specific parts of plants (leaves, grains) are presented separately when available. The blanks refer to data not available or not found. Due to the limit of space to discuss all the data gathered, some nutritional aspects of each plant are highlighted here. The others remain in the paper for register. They could be useful because the nutrition data of these UFP are not available yet in nutrition composition tables in the country.

Table 2. Nutritional content data from plants studied in Nutrir Community garden in 2018. Natal-RN, Brazil.

Scientific name	Macronutrients	Micronutrients	Bioactives
Amaranthus viridis L ., dry grains	100g 12,0 to 19,0 g protein 6,1 to 8,1 g fat 71,8 total carbohydrate 3,5 to 5,0 total fiber[1]	-	-
Amaranthus viridis L., fresh leaves	100g 2,11 g protein 0,47 g fat 7,67 g total carbohydrate 1,93 g total fiber[2]	Significant amount of K, Mg, Fe, Mn e Cu[3]	-
Amaranthus viridis L., dry whole plant	-	-	1g 11, 1 mg alpha-linolenic acid[4] Rich in phenolic compounds[5,6]
Dysphania ambrosioides (L.) Mosyakin & Clemants, dry whole plant	-	-	100g 768,27 mg ± 10,70 flavonoids 822,33 mg ± 12.25 phenolic compounds 202,34 mg ± 5.02 tocopherols[7]
Opuntia ficus-indica (L.) Mill, fresh filocladium	100g 1,1g protein 0,1g fat 4,6g total carbohydrate 3,1g total fiber[8]	-	-
Opuntia ficus-indica (L.) Mill, fruit	-	-	Significant number of flavonoids (gallic acid and quercetin)[9].

Table 2. Nutritional content data from plants studied in Nutrir Community garden in 2018. Natal-RN, Brazil. (continues)

Scientific name	Macronutrients	Micronutrients	Bioactives
*Opuntia ficus-indica (*L.) Mill, fruit fresh pulp	100g 0,73g protein 0,51g fat 9,57g total carbohydrate 3,6g total fiber[10]	-	-
Pereskia aculeata Mill., fresh leaves	3,02g protein 0,29g fat 2,66g total carbohydrate 5,58g total fiber[11]	-	-
Pereskia aculeata Mill, fresh fruits	-	-	100g 401 RAE (carotenoids)[12]
Physalis pubescens L., fresh fruit	100g 1,75 g protein 0,16 g fat 8,03 g total carbohydrate 5,8 g total fiber[13]	100g 2.200 to 3.200 UI Vitamin A[14]	-
Portulaca oleracea L, fresh whole plant	100g 1,67g protein 0,37g fat 4,05g total carbohydrate 1,45 total fiber[15]	100g 1320 UI Vitamin A[16]	Significant amount of omega-3 fatty acids[17]
Talinum fruticosum (L.) Juss., fresh whole plant	100g 1,7g protein 0,4g fat 1,8g total carbohydrate 1,1g total fiber[18]	-	Significant amounts of carotenoids (carotene and lycopene) and flavonoids (quercetin)[19] 36.7% of medium chain fatty acids per 100g of lipid portion[20]
Turnera subulata Sm., dry leaves	-	-	1g 23.43 ± 0.56 mg phenolic compounds and 53.11 ± 1.82 mg flavonoids[21, 22]

Source: 1.(72) 2.(73) 3.(65) 4.(43) 5.(44) 6.(45) 7.(46) 8.(74) 9.(67) 10.(75) 11.(76) 12.(49) 13.(77) 14.(36) 15.(78) 16.(50) 17.(48) 18.(71) 19.(52) 20.(53) 21.(54) 22.(79)

A. viridis stands out for its protein quality, having a favorable essential amino acid composition when compared to the standards established by the World Health Organization. Also stands out for its content of alpha-linolenic acid, an essential acid of the Omega-3 group present in 11.1 mg/g dry matter.[43] Its antioxidant content, among them phenolic compounds, gives this plant its potential cardioprotective and hepatoprotective.[44,45]

D. ambrosioides is rich in antioxidant compounds, especially flavonoids, phenolic compounds, and tocopherols (vitamin E), with the presence of α-tocopherol being the most relevant.[46] The consumption of its essential oil as food may have moderate toxic potential with value IC50 (inhibition concentration of 50%) of 700 μL/mL.[47] Also rich in antioxidants is *O. ficus-indica*. All parts of the plant, including flowers, are rich in flavonoids, such as gallic acid and quercetin.[48] The *P. aculeata* fruits present bioactive substances, such as pro-vitamin A carotenoids with antioxidant potential, associated with a reduction in the risk of development of some chronic degenerative diseases.[49]

Another nutritional indicator that deserves attention in these plants is the content of omega-3 fatty acids of *P. oleracea*. This plant, also popularly known as purslane, is one of the most abundant plants in omega-3 fatty acids in the world.[50] It also has a broad spectrum of neuroprotective, antimicrobial, antidiabetic, antioxidant, anti-inflammatory, antiulcerogenic and anticancer properties associated with its various chemical constituents, including flavonoids and alkaloids.[51]

T. fruticosum also contains significant amounts of bioactive compounds such as carotenoids (carotene and lycopene), flavonoids (quercetin), and others. Its leaves hold a considerable amount of medium chain fatty acids.[52,53] The highlight of *T. subulata* is also related to its bioactive potential, especially phenolic compounds and flavonoids, attesting some of its antioxidant and anti-inflammatory activities referred to in ethnobotanical studies.[54]

It is important to mention that the action of bioactive compounds in the food depends on their ingestion in the right quantities. A rich diet, diverse in its colors, is an indicator of the presence of bioactive compounds.[55] So, variety is one of the principles that should guide the choice of food for healthy eating.[56] One of the reasons for this orientation lies in the fact that the richness of dietary species, or counting the number of different species consumed per day, serves as an evaluator of its nutritional adequacy. In other words, the higher the number of species or varieties of foods in the diet, the higher the chance of obtaining adequacy in the consumption of macro- and micronutrients and bioactive compounds.[3] Therefore, the consumption of these plants can, in the context of a varied diet, help obtain essential nutrients to health. The orientation of the consumption of these plants is related not only to the health of the individual, based on the notion of nutritional adequacy, but also with environmental health and, finally, with FNS.

All plants analyzed are native to the South American continent and occur in the Caatinga, one of the most threatened and altered biomes by anthropic action, mainly by deforestation, presenting extensive degraded areas, which have already reached 46% of its extent, and soils under intense desertification process.[57] This accelerated process of degradation highlights the urgency of strategies to protect its diversity of species, many of which are restricted to this ecosystem.[58] The study and conservation of Caatinga biological diversity, for this reason, are part of the most significant challenges of Brazilian science today.[59]

Knowing the biome plants is one of the requirements in the process of conscious use and appreciation of this diversity. It is impossible to value what is not known. Also, stimulating the cultivation of plants already adapted to the biome can facilitate the management, increasing the viability of the species without the use of associated chemical compounds, such as pesticides, with reduced water use, and developing the local economy.[60] A diet rich in these products has the potential to promote human and environmental health simultaneously.

The FNS concept, presented by the Rome Declaration on World Food Security, is defined by three key dimensions: availability, access, and efficient use of food resources, which we call quality.[61] In 2009, at the World Summit on Food Security, the stability dimension was added as an indicator of the resilience of food systems in the short term, such as the ability to withstand natural disasters such as floods or temporary droughts.[62] More recently, the perspectives and diagnostics around the year 2050 draw a debate around a possible fifth dimension: sustainability. According to Berry et al.,[63] thinking about food policies and programs today, without integration with the idea of sustainability, may be the cause of growing food insecurity in the future. The authors defend sustainability as a long-term dimension, the fifth-one, in the evaluation of food systems.

The UFP promote FNS because, besides being available in the territory, they are accessible, often being obtained spontaneously, being associated with the efficiency both in the use of natural resources and in the bioavailability of nutrients. It is also worth noting that in a scenario where more than half of the global energy need is met by only four crops, stimulating the consumption of other species confers resilience to the food system, both short (stability) and long-term (sustainability).

FINAL REMARKS

The UFP offer the opportunity to overcome the various challenges that are currently facing sustainable food systems. However, this approach presents challenges for nutrition, since it depends on the development of food composition studies with local plants and redirection of training in order to bring this local knowledge closer to the nutrition workforce. The project presented in this article proposes a possible pedagogical approach to address these challenges. Some of its main results were presented to illustrate the potential of a garden to work nutrition subjects. In this proposal we tried to bring the science of nutrition closer to the construction of a food system based on a sustainable and agroecological approach, potentializing actions of food sovereignty.

In the context of teaching, we consider the GBL method as an effective educational strategy by articulating knowledge of a diverse nature in a transversal way, and by mediating an process implied with concepts, practices, and attitudes. This method can be useful to support, in the university environment, educational projects that can fill the professional gaps for the achievement of the Sustainable Development Goals, especially in developing countries.

Working with GBL pedagogical proposal brings several challenges that could be the topic of another paper. The convincement process of colleagues that work closer to a traditional nutrition epistemology, the institutional design, the collective dynamic, the technical knowledge required by a garden, the management of a community garden are some of them. However, the gains are numerous. Some unexpected discussions emerge from this experience, such as the dual interface between food and medicine, how to improve the quality of toxicity studies, the role of culinary in ethnobiological assessments, and mainly, the impossibility to build a meaningful knowledge in Nutrition science apart from the community and other areas. Some of these gains were presented in our discussion.

This article presented how the relationship between biological and cultural diversity (plants and community) can be approached in the context of projects involving food systems. The NCG has been working on training future professionals prepared to develop community education actions for sustainable development, thus contributing to their training as ethical, politicized, and active citizens in the social context. This approach contributes to the training of professionals who also can act in the elaboration of a future agenda that includes the complexities of nutrition in policies, research, and service delivery to the community with focus in local biodiversity.

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