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How is knowledge of the term Unconventional Food Plant (UFP) disseminated among chefs and cooks working in the gastronomy of Minas Gerais?

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ABSTRACT

This study aimed to evaluate chefs' or cooks' knowledge of the term Unconventional Food Plant (UFP) in restaurants in the gastronomic circuit of Minas Gerais (MG). A semi-structured questionnaire was administered to 202 chefs and cooks working in these establishments. Most respondents (63.9%) were familiar with the term UFP, associating it with potential nutritional benefits. Chefs and cooks who understand the concept of UFP indicated that they acquired this knowledge mainly through academia and the media, and were influenced by their ancestors. Knowledge of the term UFP does not affect the general knowledge of these plants. However, the UFP concept is not fully disseminated among participants. Even those who are unaware of the term have demonstrated knowledge about the use of these plants in everyday food and Minas Gerais gastronomy. Thus, there is a need for greater dissemination of information and training on the subject, particularly in gastronomic contexts, to expand the use and appreciation of UFPs in Minas Gerais cuisine.

Keywords: Wild food plants; Unconventional vegetables; Sustainability.

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SIGNIFICANCE STATEMENT

We emphasize the novelty of this study as it represents pioneering research in this field. It has the potential to spark interest among chefs and cooks to learn more about UFPs and their use in gastronomy, thus promoting the dissemination of this important food culture. In addition, the data obtained can encourage new research and the development of public policies that promote the cultivation and commercialization of UFPs. The difficulty of finding these plants is one reason for their low consumption. Thus, this study can contribute to the recovery and expansion of this important food culture, which can provide pleasure and nutritional benefits while also supporting more sustainable agricultural practices.

INTRODUCTION

Unconventional Food Plants (UFPs or "PANC" in Portuguese) are plant species that have one or more parts with the potential to be used as food, but which are not commonly used by most people in a region, country, or the world (Kinupp and Lorenzi, 2014). Kinupp coined the term UFPs, which became popular in academic and gastronomic circles after the release of the book *PANC: Guia de identificação, aspectos nutricionais e receitas ilustradas*, to promote this important cultural practice (Kinupp and Lorenzi, 2014). Other terms have also been used in the literature, such as hunger foods, alternative food plants, wild edible plants, unconventional vegetables, traditional vegetables, plants for the future, wild food plants, and regional food plants (Leal et al., 2018).

Similar terms to the UFP concept have been used internationally, such neglected and underutilized species and orphan crops (Padulosi et al., 2021), and biodiversity and edible wild species (BEWS) in English. After spreading worldwide, the UFP concept has been translated into different terms in scientific literature, including unconventional food plants (UFPs), unconventional edible plants (UEPs), non-conventional edible plants (NCEPs), non-conventional food plants, non-conventional edible vegetables, wild edible plants (WEPs), and wild food plants (WFPs) (Durigon et al., 2023).

In 2019, the Food and Agriculture Organization (FAO) declared in 2019 that the revival of traditional crops such as UFP enriches food, protects agriculture, combats climate change, preserves traditional knowledge, and supports small farmers and local producers (FAO, 2019). Despite these advantages, consumption of UFPs is decreasing due to a lack of knowledge about these plants (Leal et al., 2018; Mazon et al., 2020; Narcisa-Oliveira et al., 2021; Penzo and Bastos, 2021), especially among younger people (Barreira et al., 2015; Polesi et al., 2017; Terra and Ferreira, 2020). Reviving this food culture is believed to be a strategy that could promote the dissemination of information about UFPs, encourage healthier and more sustainable eating, and address an increasingly urgent global need. Studies on UFPs have contributed to disseminating knowledge, as misinformation about these plants is a crucial factor in their underuse or disappearance (Padilha et al., 2020). However, few studies have been published, and more research is needed to inform public policies and food and nutrition programs (Durigon et al., 2023; Andrade et al., 2023).

Despite media coverage of the use of UFP in haute cuisine restaurants and food festivals, little is known about it in scientific circles. It is believed that the gastronomic world can help disseminate knowledge of and promote the use of these plants in the daily diet of Brazilians. The revaluation of traditional plants in the gastronomic world redefines UFP from "poor people's food" to "gourmet dishes," contributing to their appreciation among chefs, entrepreneurs in the gastronomic world, and consumers (Embrapa, 2017; Globoplay, 2021; Junqueira and Perline, 2019; Penzo and Bastos, 2021).

Minas Gerais is widely recognized for its rich gastronomic tradition, which combines regional ingredients and authentic culinary techniques with a strong connection to Brazilian food culture. In this context, chefs and cooks play a strategic role in promoting regional foods, including UFPs. These professionals create culinary trends and have the potential to revive traditional food practices, promoting sustainability and food biodiversity. Choosing Minas Gerais as the setting for this study is particularly relevant given the state's prominence in the national gastronomic scene, with a gastronomic circuit that attracts both tourists and culinary enthusiasts. For this study, cities that are considered tourist attractions were selected (Brasil, 2012). The cuisine in these cities reflects the cultural richness and influence of colonizers, native peoples, and enslaved peoples (Braga, 2016). According to the Tourism Map (Brasil, 2022), the municipalities included in this study belong to the following tourist regions: Belo Horizonte (the state capital); Congonhas, Mariana, Ouro Preto, and Sabará (in the Ouro region); and São João Del Rei and Tiradentes (in the Trilha dos Inconfidentes region).

To understand how this concept is disseminated and applied in one of Brazil's main gastronomic hubs, it is essential to assess the knowledge of this term among chefs and cooks in the region. This assessment will also help identify strategies to expand the use and appreciation of these plants in everyday food and gastronomy. Thus, the present study aimed to evaluate chefs' and cooks' knowledge of UFPs in restaurants in the gastronomic circuit of Minas Gerais.

MATERIAL AND METHODS

This quantitative and qualitative cross-sectional study is part of a project entitled "Unconventional Food Plants (UFPs) in restaurants in cities of Minas Gerais". The Institutional Ethics and Research Committee approved the conduct of the study (CAAE 64298922.0.0000.5150).

Study design

The study was conducted from November 2022 to December 2023, through online interviews via Google

Meet with chefs and cooks from restaurants in Minas Gerais. The study region encompasses the capital city of Minas Gerais (Brazil), Belo Horizonte (19°55'15" S, 43°56'16" W), and the historic cities located in the surrounding area up to 200 km from the capital, namely: Congonhas (20°30'00" S, 43°51'28" W), Brumadinho (20°08' S, 44°11' W), Sabará (19°53'09" S, 43°48'25" W), Mariana (20°22' S, 43°24' W), São João Del Rei (21°08' S, 44°15' W), Tiradentes (19°55'15' 'S, 43°56'16" W), and Ouro Preto (20°23'07" S, 43°30'13" W) (Distância entre Cidades, 2021).

Participants

The study population included chefs and cooks from restaurants in the study area. The terms chef and cook were used to encompass the diversity of self-reported roles in the Brazilian gastronomic sector. Although these positions often overlap in practice, they may denote distinct levels of responsibility, autonomy, and formal academic training (Fine, 1996).

An initial survey of restaurants in the study area was conducted using the TripAdvisor website. Restaurants were identified using the following filters: lunch and/or dinner service, and type of cuisine (Brazilian, healthy, fast food, contemporary, or vegetarian). This resulted in an initial list of 1,070 establishments. Information such as the restaurant's name and contact details (phone number, WhatsApp, and email address) was obtained directly from the platform.

During the recruitment process, an additional 28 restaurants were identified through recommendations from participating chefs and cooks and were added to the sample. After verification, 258 establishments were excluded because they were no longer in operation or did not offer dining services, in accordance with the study's eligibility criteria. Thus, the final sample universe comprised 847 restaurants.

The sample size was estimated using OpenEpi (Dean and Sullivan, 2020), with the restaurant serving as the sampling unit. A simple random sampling design was assumed with a 95% confidence level, a 5% margin of error, and an expected prevalence of 50%, as there were no previous studies reporting the outcome of interest. Based on these parameters, the minimum required sample size was 265 restaurants. Since one chef or cook was invited to participate from each restaurant, the target was 265 chefs or cooks.

The recruitment process was based on the total number of restaurants identified in the study area (n = 847). From March to December 2023, restaurant managers were contacted via email, telephone, and WhatsApp and invited to participate in the study. Those who agreed to participate were asked to nominate a head chef or cook to be interviewed. Of the 847 head chefs and cooks contacted, 105 (12.4%) declined to participate, 539 (63.6%) did not respond after repeated contact attempts, and one nominated participant did not complete the interview. After all recruitment efforts were exhausted, 202 chefs and cooks were successfully interviewed (Figure 1). This recruitment window was strictly defined to mitigate temporal variation bias, preventing external factors or the invitation itself from prompting participants to seek prior knowledge about the research topic, which could have otherwise compromised the spontaneity of the responses.

Interview questionnaire

A semi-structured questionnaire was developed and divided into two sections (Aditional File 1). The first section included questions about the characteristics of both the participants and the restaurants, while the second section included questions designed to assess knowledge of the term UFP. Subjective questions (name and contact details of the participant and the restaurant, location of the restaurant) and objective questions (biological sex, age, color or race, education, position, experience, and monthly income of the participant; and restaurant type, service type, and time in operation) were included to characterize the participant and the restaurant.

The questionnaire included the following questions to assess participants' knowledge of UFP: 1) whether they were familiar with the term (yes or no). Affirmative respondents were requested to define the concept in their own words. If unfamiliar, the interviewer provided a standardized definition, and the interview proceeded to question 3; 2) how they had heard of the term (in the family, in academic circles or courses, in the media, at agroecological fairs and/or other sources); 3) whether they knew of any UFP in the restaurant's region (yes or no); 4) whether they cultivated any species (yes or no); 5) what the nutritional benefits of UFP are (proteins, vitamins, minerals, fiber, unsaturated fatty acids and/or antioxidant effect); and 6) 33 types of UFP (common name and image) were presented to the participants and they were asked whether or not they knew the plant (Figure 2). These species were selected based on literature identifying them as the most prevalent and recognized in the state of Minas Gerais (Kinupp and Lorenzi, 2014; Almeida and Correa, 2012; Barreira et al., 2015; Leal et al., 2018; Mazon et al., 2020; Penzo and Bastos, 2021; Silva and Andrades, 2022; Terra and Ferreira, 2020).

The questionnaire was preliminarily tested with 12 chefs and cooks who had graduated from the Gastronomy program at the Federal Institute of Minas Gerais (IFMG), Ouro Preto Campus. Between March

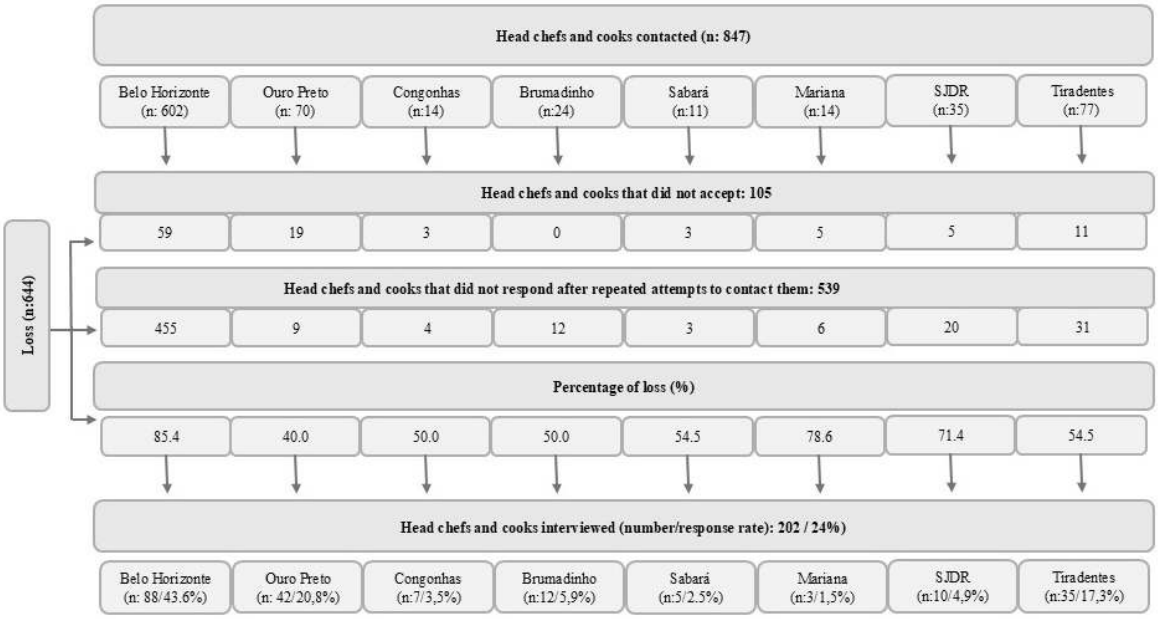


Figure 1. Flowchart showing the initial number of chefs and cooks contacted and the final number of interviews.

and April 2023, four trained researchers conducted the interviews via video calls using the Google Meet platform. The questionnaire was administered to the same participants twice (test-retest), with an interval of two to four weeks to assess reproducibility, as recommended in the literature (Beaton, 2000). At the end of the process, participants evaluated the clarity of the questions and reported any difficulties in understanding them. The assessment of interview reproducibility also served as a training exercise for the interviewers.

Interviews with chefs and cooks nominated by participating restaurants were conducted between April and December 2023. Participants received a link to access the online interview via email or WhatsApp one day in advance, along with reminder messages sent via WhatsApp. The interviews were carried out via video call using the Google Meet platform by trained interviewers. Before the start of each interview, the Informed Consent Form (ICF) was presented on screen, and participants were asked to provide verbal consent for both participation and audio recording. Subsequently, the questionnaire was administered, with questions read aloud by the interviewer and simultaneously displayed on the screen for the participants to follow. Responses were recorded directly in the form by the interviewer.

Data analysis

Cohen's Kappa test was performed on the preliminary questionnaire. The following intervals were considered when interpreting the Kappa coefficient: 0.01–0.20 – slight; 0.21–0.40 – fair; 0.41–0.60 – moderate; 0.61–0.80 – substantial; and 0.81–1.00 – almost perfect or perfect agreement (Hallgren, 2012). In addition, the percentage of agreement among participants' answers to the four questions on understanding/clarity was evaluated.

The data obtained from the interviews were tabulated using Microsoft Excel. Statistical analyses were performed at a 5% significance level using Stata software, version 15.0. Descriptive statistics were used to summarize the data, and categorical variables were expressed as absolute and relative frequencies. The normality of the continuous variable (number of known UFPs) was assessed using the Shapiro-Wilk test. Since the data followed a normal distribution, the results were presented as the mean and standard deviation (SD). Pearson's chi-squared or Fisher's exact tests were used to examine the association between knowledge of the term UFP and the categorical explanatory variables. For continuous outcomes, independent Student's t-tests and one-way ANOVA were performed. Finally, univariate logistic regression models were used to estimate odds ratios (ORs).

Responses to the qualitative question "What do you understand about UFP?" were analyzed to explore participants' knowledge of these plants. The responses were transcribed into a textual corpus following the analytical parameters of the IRaMuTeQ (Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires), version 0.7 alpha 2. Subsequently,

Ora-pro-nóbis, lobrobrô, lobrobró, carne-de-pobre, mata-velha, guaiapá



Serralha, chicória-brava, serralha-branca, serralha-lisa, serralheira, ciúmo



Figure 2: Example containing two of the 33 UFPs presented in the questionnaire used for the interview with chefs and cooks.

similarity analysis and descending hierarchical classification were performed.

The qualitative corpus was originally composed of participants' responses in Portuguese. For the qualitative analysis and international dissemination of the results, the corpus was translated into English prior to analysis. The qualitative analysis was then conducted using the translated corpus.

RESULTS

The study included participants of both biological sexes, with a predominant profile of individuals over 40 years of age (67.8%), self-identified as white (54.5%), and with completed basic education (54%). Regarding professional background, 48.5% were head chefs, and 73.3% had over 10 years of market experience. The most frequent monthly income bracket was BRL 2,001.00 to 5,000.00 (36.5%). Statistical analysis revealed no significant association between these sociodemographic or professional variables and familiarity with the term UFP (Table 1).

Most restaurants were classified as traditional establishments (44.5%), offered à la carte service (76.7%), and had been in operation for more than 10 years (58%). A significant association was observed between knowledge of the term UFP and the type of food service offered. Participants working in restaurants with à la carte service were 2.01 times more likely to be familiar with the term UFP than those working in restaurants with other service types (Table 1).

Although most participants (63.9%) reported being familiar with the term UFP (Table 1), no significant difference was observed in the number of species recognized by those who knew the term and those who did not (19.5 vs. 18.4 species; p=0.154).

Table 1. List of profiles of interviewed chefs and cooks, who have knowledge of the term UFPs, working in restaurants in Belo Horizonte and historic cities in Minas Gerais, Brazil.

			Knowledge of the term UFPs[1]			
Factors		**Total**	**NO**	**YES**	***OR (95%CI)**	**p-value**
		202	73 (36.1%)	129 (63.9%)	-	-
Sex						
	Female	97 (48.0%)	45.2%	49.6%	1.00	0.547
	Male	105 (52.0%)	54.8%	50.4%	0.84 (0.47-1.49)	
Age						
	20 to 29 years old	17 (8.4%)	6.8%	9.3%	1.00	
	30 to 39 years old	48 (23.8%)	20.6%	25.6%	0.92 (0.27-3.1)	0.888
	40 to 49 years old	59 (29.2%)	31.5%	27.9%	0.65 (0.2-2.1)	0.473
	Over 50 years old	78 (38.6%)	41.1%	37.2%	0.67 (0.21-2.1)	0.485
Ethnicity						
	White	110 (54.5%)	63.0%	49.6%	1.0	
	Black	25 (12.4%)	8.2%	14.7%	2.28 (0.84-6.14)	0.105
	Yellow	5 (2.5%)	5.5%	0.8%	0.18 (0.02-1.66)	0.130
	Brown	56 (27.7%)	20.6%	31.8%	1.96 (0.97-3.96)	0.060
	Indigenous	0 (0.0%)	—	—	—	—
	No declaration	6 (3.0%)	2.7%	3.1%	1.43 (0.25-8.18)	0.683
Education						
	Basic education	109 (54.0%)	52.1%	55.1%	1.0	
	Higher education	62 (30.7%)	26.0%	33.3%	1.21 (0.62-2.36)	0.574
	Graduate studies	31 (15.3%)	21.9%	11.6%	0.50 (0.22-1.12)	0.094
Position						
	Cook	31 (15.3%)	16.4%	14.7%	1.0	
	Head Chef	98 (48.5%)	48.0%	48.9%	1.14 (0.49-2.61)	0.763
	Owner and Chef/Cook	73 (36.1%)	35.6%	36.4%	1.14 (0.48-2.72)	0.765
Experience						
	Less than 5 years	23 (11.4%)	15.1%	9.3%	1.0	
	From 5 to 10 years	31 (15.3%)	13.7%	16.3%	1.93 (0.63-5.85)	0.248
	Over 10 years	148 (73.3%)	71.2%	73.3%	1.69 (0.70-4.10)	0.244
Monthly income (BRL)						
	< 2,000.00	11 (6.9%)	9.1%	5.8%	1.0	
	2,001.00 to 5,000.00	58 (36.5%)	49.1%	29.8%	0.96 (0.26-3.50)	0.947
	5,001.00 to 10000.00	46 (28.9%)	21.8%	32.7%	2.36 (0.61-9.17)	0.215
	> 10,000.00	44 (27.7%)	20.0%	31.7%	2.5 (0.64-9.83)	0.190
Type						
Traditional	No	112 (55.5%)	54.8%	55.8%	1.0	0.888
	Yes	90 (44.5%)	45.2%	44.2%	0.96 (0.54-1.71)	
International	No	182 (90.1%)	90.4%	89.9%	1.0	0.910
	Yes	20 (9.9%)	9.6%	10.1%	1.06 (0.40-2.78)	

Table 1. List of profiles of interviewed chefs and cooks, who have knowledge of the term UFPs, working in restaurants in Belo Horizonte and historic cities in Minas Gerais, Brazil.

			Knowledge of the term UFPs[1]			
Factors		**Total**	**NO**	**YES**	***OR (95%CI)**	**p-value**
Gastronomic	No	157 (77.7%)	78.1%	77.5%	1.0	0.926
	Yes	45 (22.3%)	21.9%	22.5%	1.03 (0.52-2.06)	
Snack / Fast food chain	No	191 (94.6%)	93.1%	95.3%	1.0	0.514
	Yes	11 (5.4%)	6.9%	4.7%	0.66 (0.19-2.25)	
Restaurant/hotel	No	195 (96.5%)	97.3%	96.1%	1.0	0.666
	Yes	7 (3.5%)	2.7%	3.9%	1.43 (0.76-2.91)	
Specialty	No	148 (73.3%)	78.1%	70.5%	1.0	0.240
	Yes	54 (26.7%)	21.9%	29.5%	1.49 (0.76-2.91)	
Specialty of Minas Gerais	No	173 (85.6%)	89.0%	83.7%	1.0	0.292
	Yes	29 (14.4%)	11.0%	16.3%	1.58 (0.66-3.77)	
Type of service						
Table d'hôte	No	186 (92.1%)	91.8%	92.3%	1.0	
	Yes	16 (7.9%)	8.2%	7.7%	0.94 (0.33-2.70)	0.906
Room service	No	199 (98.5%)	98.6%	98.4%	1.0	
	Yes	3 (1.5%)	1.4%	1.6%	1.13 (0.10-12.7)	0.918
Delivery	No	159 (78.7%)	76.7%	79.8%	1.0	
	Yes	43 (21.3%)	23.3%	20.2%	0.83 (0.42-1.66)	0.603
À La Carte	No	47 (23.3%)	31.5%	18.6%	1.0	
	Yes	155 (76.7%)	68.5%	81.4%	2.01 (1.04-3.91)	0.039
Set menu	No	183 (90.6%)	89.0%	91.5%	1.0	
	Yes	19 (9.4%)	11.0%	8.5%	0.76 (0.29-1.98)	0.573
Self-service	No	152 (75.2%)	72.6%	76.7%	1.0	
	Yes	50 (24.8%)	27.4%	23.3%	0.80 (0.42-1.55)	0.514
Operation time						
	Up to 2 years	33 (16.3%)	15.1%	17.1%	1.0	
	From 3 to 5 years	18 (8.9%)	8.2%	9.3%	1.0 (0.30-3.38)	1.000
	From 5 to 10 years	34 (16.8%)	15.1%	17.8%	1.05 (0.38-2.90)	0.932
	Over 10 years	117 (57.9%)	61.6%	55.8%	0.8 (0.38-1.80)	0.591

Legend: *OR: Odds ratio; CI: Confidence interval. [1] Pearson's chi-squared or Fisher's exact test (for N<5).

A similarity analysis of qualitative data from participants familiar with the term *UFPs* (Figure 3a) identified *UFPs* as the central node, closely linked to the term *plant*. Other prominent lexical clusters include *unconventional*, *edible*, *consume*, *food*, and *traditional*. These results align with participants' conceptual understanding and are consistent with established literature, effectively reflecting the core attributes of the UFP definition.

The graph map (Figure 3a) shows words associated with the central theme, UFP, such as "don't know," "don't find", "market", "not used," "not familiar" and "not found". Additionally, the terms "people" and "used" are also observed. Words related to place and context, including "region" or "regions", "Minas Gerais", "restaurant," "gastronomy" and "cuisine" appear in proximity. Specific UFPs that were frequently mentioned include *"ora-pro-nobis", "taioba", "peixinho," "serralha", "mostarda"* and *"capuchinha"*. Furthermore, words such as "grandmother", "grandparent", "knowledge", "daily", "countryside", "farm", "old", "backyard" and "house" emerge in the graph, suggesting associations with traditional knowledge and domestic environments.

The descending hierarchical classification dendrogram (Figure 3b) shows that the corpus was constructed with 137 texts and 168 text segments (TS), generating five classes. The lexicographic analysis of the textual corpus yielded 4,334 occurrences, including 765 active forms. The thematic corpus was divided into two subcorpora.

The five classes are divided into two main branches: the first group, consisting of class 1 (28.4% of TS), and the second group, consisting of classes 5, 4, 3, and 2, being more representative with 71.6% of TS. The classes were given the following names: "Traditional UFPs in Minas Gerais" (Class 1), "Difficulties in consuming UFPs" (Class 5), "Concept of UFP" (Classes 4 and Class 2), and "Traditional knowledge of UFP" (Class 3) (Figure 3b).

Class 1 (Figure 3b) highlights words referring to the presence of UFP in the region of Minas Gerais. Participants in this class associate certain species with local traditions and habitual consumption, specifically citing *ora-pro-nóbis, taioba, peixinho-da-horta,* and *capuchinha*, as well as their culinary use in restaurants. Nevertheless, these species are characterized by their irregular availability. This is further evidenced by the representative text segments extracted from the participants' discourse.

"It is relevant to say that, in Minas Gerais, ora-pro-nóbis is UFP. I use it a lot here; we also use peixinho and cará-do-ar at the restaurant. As for the rest of the country, ora-pro-nóbis would be considered a UFP." (P134)

"UFP is a prodigious discovery. I keep trying to create dishes with it. I use it in several dishes, such as ora-pro-nóbis. I made a risotto with turmeric, ora-pro-nóbis, and chicken". (P126) "For example, taioba is considered UFP, but I don't consider it UFP. They are plants that are not commonly found in some places or regions". (P44)

Similarly, the words "market," "daily", "life" and "don't find" appear frequently in class 5, referring to the difficulty of finding these plants for everyday consumption. The following statements illustrate these classes:

"UFPs are not found every day at fairs or in markets. They are available, but people don't know about them. They are available in gardens and on sidewalks; they are not commercialized. UFPs have greater value when used in kitchens by chefs who promote conservation and awareness". (P7)

Classes 4, 3, and 2 contain words that describe UFPs, such as *unconventional food plants*, which are generally unknown and are more common in rural areas. These results illustrate the thematic interrelationship between Classes 4, 3, and 2, which is further substantiated by representative text segments extracted from the participants' discourse.

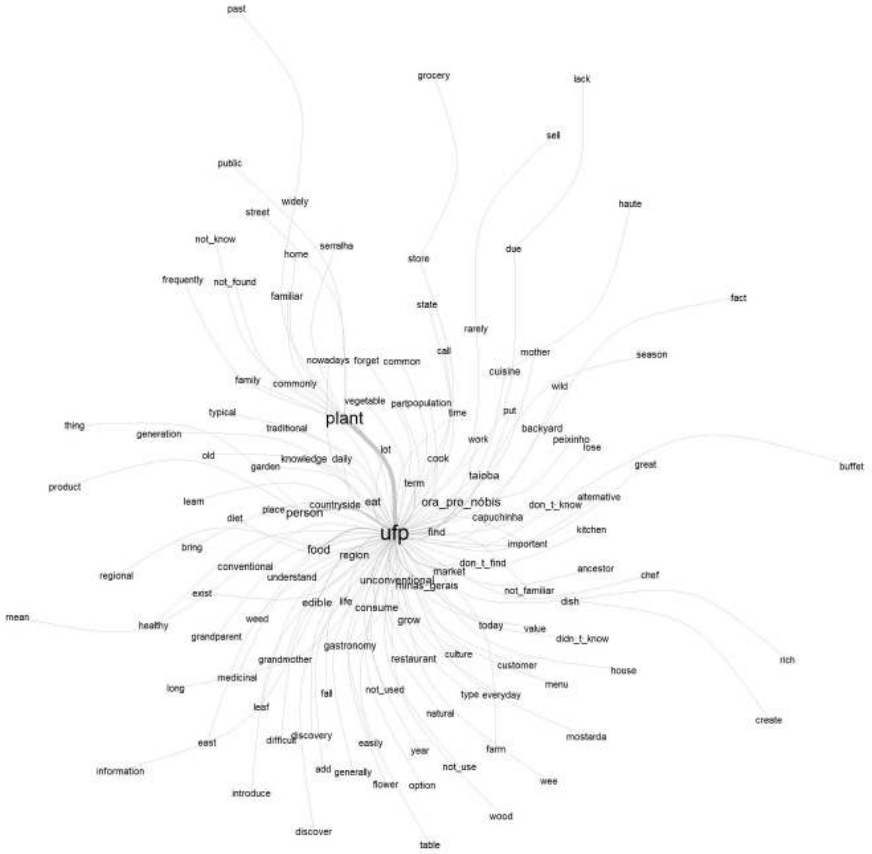
UFPs are plants that are not commonly used, but are edible. You won't find them in large chains or markets, but rather in family farms. (P43)

The main elements related to class 3 (accounting for 23.3% of ST) (Figure 3) were: "person", "home", "countryside", "mother", grandmother," and others. The content of this class reflects traditional knowledge about UFPs, which was usually acquired by ancestors who were unaware of the term but knew about the plants used as food. Such evidence can be seen in the significant text segments below.

"At the restaurant, I like to work with taioba and ora-pro-nóbis, which are plants from this region. The people from the farm share many recipes containing UFPs, which were taught to them by their mothers and grandmothers. These recipes feature lighter seasoning, natural and regional products, and more emotional food." (P29)

"UFP is that little plant from grandma's garden that, until then, was only grown indoors: capuchinha, taioba, and ora-pro-nóbis. We were even afraid to serve them to the public, but today, we use them." (P58)

While most chefs and cooks (72.3%) were unaware of the UFPs present in their region, there was a high perception of their value: 92.1% recognized their significant nutritional potential, and 97.5% affirmed their health benefits for consumers. Furthermore, 58.9% reported cultivating at least one UFP species. Regard-



(a)

Text Corpus
168 ST (Use of **78.26%**)

Class 5 20ST (17%) Difficulties in consuming	
Word	**X²**
Market	57,82
Daily	35,76
Life	35,52
Don't find	25,06
Time	19,37
Find	10,07
Lose	5,27
Old	5,27
Farm	5,27

Class 3 2TST (23%) Traditional Knowledge	
Word	**X²**
Person	9,12
Home	6,21
Cook	4,78
Countryside	4,38
Mother	3,25
Diet	3,25
Food	2,89
UFP	2,61

Class 2 17ST (15%) Concept of UFP	
Word	**X²**
Unconventional	23,34
Edible	20,61
Consume	15,46
Part	13,69
Natural	6,66
Plant	5,47
Grow	4,14
Commonly	3,73
Borrow	2,68
Region	

Class 4 19ST (16%) Concept of UFP	
Word	**X²**
Conventional	43,31
Mean	15,72
Understand	15,44
Familiar	15,44
Not used	15,44
Eat	12,25
Term	10,93
Call	5,69
Grow	3,42
Person	3,13

Class 1 33ST (28%) Traditional UFP in MG	
Word	**X²**
Ora-pro-nóbis	75,22
Taioba	42,20
Peixinho	15,91
Minas Gerais	12,0
Peixinho	12,0
Capuchinha	10,42
Season	10,42
State	7,75
Dish	6,82
Restaurant	6,76
Region	5,87
Lot	4,89
Place	4,41
Traditional	2,56
Customer	2,21
Regional	2,21
Mostarda	2,21

(b)

Figure 3: Similarity analysis (a) and Descending Hierarchical Classification (DHC) and their chi-squared values (b), representing the qualitative analysis of discourses referring to the knowledge of the term UFP among chefs and cooks in the capital Belo Horizonte and historic cities of Minas Gerais (MG), 2023.

ing the acquisition of knowledge about the UFP term, academic settings or professional courses were the primary source for 43% of the participants, followed by the media (26%), gastronomic circles or events (17%), and family traditions (10%). In contrast, agroecological fairs represented a minor source of information, cited by only 3% of the sample (Table 2). Participants also identified nutrients present in UFPs that provide nutritional benefits, such as proteins, vitamins, minerals, fiber, unsaturated fatty acids, and antioxidants. Participants who stated that UFPs can provide nutritional benefits to consumers were 7.42 times more likely to be familiar with the term. The other variables related to knowledge of UFPs did not show a significant relationship with knowing the term (Table 2).

Table 2. List of factors that affect the knowledge of chefs and cooks in the capital Belo Horizonte, and historic cities of Minas Gerais regarding the term UFP.

		Total	Knowledge of the term UFP[1]			
			No	**Yes**	***OR (95%IC)**	**p-valor**
			73 (36.1%)	129 (63.9%)		
Do you know of any UFPs in the restaurant area?						
Yes		56 (27.7%)	26 (35.6%)	30 (23.3%)	1.0	0.062
No		146 (72.3%)	47 (64.4%)	99 (76.7%)	1.83 (0.97-3.43)	
UFPs have high nutritional potential.						
I disagree or have no opinion		16 (7.9%)	7 (9.6%)	9 (7.0%)	1.0	0.514
I agree		186 (92.1%)	66 (90.4%)	120 (93.0%)	1.41 (0.50-3.97)	
Do you grow any UFP?						
No		119 (58.9%)	40 (54.8%)	79 (61.2%)	1.30 (0.73-2.33)	0.372
Yes		83 (41.1%)	33 (45.2%)	50 (38.8%)	1.0	
Do UFPs provide nutritional benefits to those who consume them?						
No		5 (2.5%)	4 (5.5%)	1 (0.8%)	1.0	0.042
Yes		197 (97.5%)	94.5% (69)	128 (99.2%)	7.42 (0.81-67.7)	
Nutritional benefits believed to be associated with UFPs						
Proteins	No	49 (24.3%)	16 (21.9%)	33 (25.6%)	1.0	0.558
	Yes	153 (75.7%)	57 (78.1%)	96 (74.4%)	0.82 (0.41-1.61)	
Vitamins	No	18 (8.9%)	8 (11.0%)	10 (7.7%)	1.0	0.448
	Yes	184 (91.1%)	65 (89.0%)	119 (92.3%)	1.46 (0.55-3.89)	
Minerals	No	72 (35.6%)	28 (38.4%)	44 (34.1%)	1.0	0.546
	Yes	130 (64.4%)	80 (61.6%)	50 (65.9%)	1.20 (0.66-2.18)	
Fibers	No	34 (16.8%)	11 (15.1%)	23 (17.8%)	1.0	0.612
	Yes	168 (83.2%)	62 (84.9%)	106 (82.2%)	0.82 (0.37-1.79)	
Unsaturated fatty acids	No	148 (73.3%)	50 (68.5%)	98 (76.0%)	1.0	0.252
	Yes	54 (26.7%)	23 (31.5%)	31 (24.0%)	0.69 (0.36-1.30)	
Antioxidant effect	No	63 (31.2%)	19 (26.0%)	44 (34.1%)	1.0	0.230
	Yes	139 (68.8%)	54 (74.0%)	85 (65.9%)	0.68 (0.36-1.28)	

*OR: Odds ratio; CI: Confidence interval. [1] Pearson's chi-squared or Fisher's exact test (N<5).

DISCUSSION

Most chefs and cooks reported familiarity with the term UFP. However, a qualitative analysis of the participants' definitions revealed a consistent conceptual alignment regarding these species, despite linguistic variations. The similarity analysis identified core attributes that align with the existing literature, which defines UFPs as species that are little known, have limited commercial presence, and, consequently, have low frequency of consumption in contemporary diets (Kinupp and Lorenzi, 2014).

It is important to distinguish between conceptual knowledge of the term and the recognition of specific plant species. Although no similar studies with the same target audience were found in the scientific literature, studies with diverse populations present divergent results. Some studies have observed that most interviewees in the southwestern region of the state of Paraná were familiar with the term UFP (Mazon et al., 2020), and in communities oriented toward sustainability, such as those in Maceió-AL (Penzo and Bastos, 2021). However, other studies indicate that recognition of the term is limited, even among individuals familiar with the plants themselves (Fangueiro et al., 2023; Madriaga and Antunes, 2023; Narcisa-Oliveira et al., 2018; Terra and Ferreira, 2020).

The term UFP is still little known among the general population and often evokes unfamiliarity or surprise. Kinupp and Lorenzi (2014) describe this lack of knowledge as botanical illiteracy, emphasizing that plants that are not recognized or named tend not to be valued, cultivated, marketed, or consumed. This lack of conceptual recognition can occur despite practical familiarity with certain species, which limits awareness of their gastronomic, nutritional, and cultural potential. Furthermore, the absence of public policies that promote the use and dissemination of UFPs may contribute to the gap between knowledge and practice (Narcisa-Oliveira et al., 2018; Padilha et al., 2020).

The results of the present study indicate that there was no association between sociodemographic characteristics and knowledge of the term UFP. The study did not identify clear explanatory factors for why some participants were unfamiliar with the term. This finding reinforces the results of previous studies (Fangueiro et al., 2024; Mazon et al., 2020; Narcisa-Oliveira et al., 2018; Penzo and Bastos, 2023), which also reported this gap without fully explaining its determinants.

The lack of a significant difference in knowledge of the term between chefs and cooks suggests that the professional role does not strongly influence familiarity with this concept. This finding may be explained by the absence of a clear distinction in formal educational pathways between these roles, as both chefs and cooks often access similar training environments. In this context, knowledge about UFP appears to be primarily acquired through academic settings and professional courses, as indicated by the results (43%), rather than being restricted to a specific professional category. Furthermore, the chef role does not necessarily imply higher formal education because it is often obtained through professional experience, further contributing to the overlap in knowledge levels observed between the groups (Fine, 1996). Consequently, both chefs and cooks tend to have similar levels of awareness, suggesting that the dissemination of this knowledge remains diffuse within the field of gastronomy. In addition, interest in UFPs may be associated with broader gastronomic trends that prioritize fresh, local, and regional ingredients. Studies also suggest that future professionals are becoming more concerned with ethical and sustainable food choices and recognize their role in influencing consumer behavior (Cole et al., 2023; Dogan and Teker, 2023; Jones; Young; Ensaff, 2025).

Although the literature suggests that knowledge of and familiarity with UFP species are more prevalent among older individuals, our findings did not reveal a significant association between age and familiarity with the term. This divergence may be due to the difference between experiential knowledge and formal nomenclature. Older individuals often have extensive practical expertise regarding these plants, but they may not recognize the technical term UFP. Conversely, younger participants, potentially influenced by academic curricula, digital media, and contemporary gastronomic trends, are more familiar with the terminology despite potentially lacking field experience (Polesi et al., 2017; Barreira et al., 2015; Marques et al, 2021).

The only restaurant-related factor associated with knowledge of the term UFP was the type of service (e.g., à la carte). This may be related to the greater presence of professional chefs in à la carte establishments, as opposed to self-service restaurants, which are typically staffed by cooks. Chefs tend to value local ingredients and reinterpret traditional dishes, often incorporating them into more elaborate or gourmet preparations (Junqueira and Perline, 2019). Additionally, chefs are more likely to have formal culinary training, in which the term UFP is more widely discussed. Qualitative analysis supports this interpretation; terms such as "*ora-pro-nóbis*," "restaurant," "gastronomy," and "cuisine" indicate that UFPs, particularly *ora-pro-nóbis*, are more strongly associated with the professional gastronomic context.

If participants reported being unfamiliar with the term UFP, it was explained to them before continuing with the questionnaire. A study conducted in Bahia

found that participants had difficulty understanding the term until it was fully explained as "unconventional food plants," which often required examples and clarification (Assis et al., 2016).

The only factor associated with knowledge of UFPs was agreeing that they provide nutritional benefits. Participants who recognized the health benefits of UFP were more likely to be familiar with the terminology. This pattern suggests that knowledge is predominantly disseminated through formal educational channels, where the dietary advantages of these plants are integrated into gastronomic and scientific discourse. Indeed, the scientific literature primarily focuses on the nutritional composition and health benefits of these plants, while fewer studies address their culinary applications and food potential (Mariutti et al., 2021; Padilha et al., 2023).

The results suggest that familiarity with the concept does not necessarily lead to greater recognition of species. Rather, they indicate that participants may possess practical knowledge of plants that is independent of formal or scientific terminology. When presented with a photo of a UFP species, participants unfamiliar with the formal nomenclature demonstrated comparable recognition levels to those who knew the term. These findings highlight a significant disconnect between conceptual knowledge and practical experience. While familiarity with the term UFP did not necessarily translate into the ability to identify species, many professionals exhibit deep-rooted experiential knowledge and use these plants without adhering to formal terminology. Notably, recognition of local species was a stronger predictor of culinary integration than theoretical awareness. Consequently, strategies to promote UFP consumption should transcend mere terminological dissemination and focus on hands-on pedagogical approaches and enhancing skills related to identification and practical application.

Studies on the term UFP, conducted with different populations (Fangueiro et al., 2023; Penzo and Bastos, 2021), have shown that people who are familiar with many UFP species may have difficulty classifying them according to the formal definition of the term. When asked about the plants they know, grow, or consume, people can name a considerable number of UFPs, but often cannot identify which species fit into this category. According to Fangueiro et al. (2023), this may be related to market availability, as the most frequently cited species are those that are more easily purchased, such as *taioba* (*Xanthosoma sagittifolium*), *peixinho-da-horta* (*Stachys byzantina*), and *ora-pro-nóbis* (*Pereskia aculeata*). Penzo and Bastos (2021) observed that populations in sustainable communities knew a wide range of species and recognized the term UFP, which may be associated with dietary patterns such as vegetarianism, which is common in these populations.

The food culture surrounding the consumption of UFPs is long-standing. Therefore, many individuals who regularly consume these plants are unaware that they are classified as UFPs, as this is a relatively recent term (Fangueiro et al., 2023). When introduced to UFP species, individuals often associate them with childhood memories and rural experiences (Souza et al., 2021). As observed in the qualitative results of this study, participants' knowledge of and consumption of UFPs appear to be strongly linked to cultural heritage and family traditions. References include terms such as "grandmother," "countryside," "farm," "backyard," and "home".

Contemporary gastronomy increasingly emphasizes the use of local products and fresh ingredients while supporting local economies and food-producing communities (Jones; Young; Ensaff, 2025; Zaneti, 2017). Accordingly, Zaneti (2017), renowned restaurants in Brazil and internationally have incorporated local ingredients into their menus, including UFP species. This contributes not only to the appreciation of food biodiversity but also to the evocation of cultural memories and lived experiences. When presented with UFP species, individuals often associate them with childhood memories and rural contexts, thereby reinforcing their symbolic and affective dimensions. However, despite their growing visibility in contemporary gastronomy, UFPs remain largely peripheral to dominant food systems, revealing tensions between their cultural, ecological, and nutritional potential and their limited integration into formal markets and broader consumption patterns (Jones; Young; Ensaff, 2025; Zaneti, 2017).

This tension reflects the complex relationship between knowledge, access, and the cultural meanings associated with UFP. According to the Food and Agriculture Organization of the United Nations (FAO, 2018), neglected and underutilized food species, such as UFP, remain on the margins of dominant food systems, not because they lack nutritional value or adaptability, but because they have low visibility, limited market integration, and sociocultural devaluation. The findings of the present study align with this perspective, indicating that knowledge about UFPs is more closely associated with lived experience and sociocultural context than with a formal understanding of the concept. The FAO report further highlights that these species are often known and used in local contexts, particularly in rural areas and within family farming systems. However, this knowledge is rarely systematized or incorporated into formal production and consumption chains (FAO, 2018).

The frequent association of UFP with terms such

as "don't know," "don't find," and "not used" suggests that, despite their presence in the environment, these plants are marginal in everyday food practices, largely due to limited visibility in commercial markets and weak integration into mainstream food systems. This reinforces the idea that availability alone does not ensure consumption; rather, accessibility is mediated by cultural recognition and market structures.

The prominence of specific plants such as *ora-pro-nóbis, taioba*, and *peixinho*, especially in Minas Gerais, suggests that the classification of UFPs is context-dependent and not fixed. Foods considered "non-conventional" in one region may be perceived as traditional and familiar in another, reflecting the dynamic and culturally situated nature of food systems. This finding supports the idea that the concept of UFPs is socially constructed and influenced by regional dietary patterns and local identities (Madriaga and Antunes, 2023; Silva et al., 2022).

The dendrogram further reinforces this interpretation by separating a class associated with regional tradition from classes related to conceptual understanding and access barriers. While Class 1 highlights the integration of certain UFPs into local gastronomy, particularly in restaurants, Class 5 underscores ongoing challenges of accessing these foods in daily life. This tension reveals a paradox: although UFPs are increasingly valued in gastronomic contexts, and are often associated with innovation, sustainability, and cultural heritage, they are rarely incorporated into routine consumption. UFPs are recognized for their provenance, menu innovation, and sensory quality. However, Vargas et al. (2026) have highlighted some limitations to their inclusion in menus, including infrastructural and policy constraints, production instability in seasonal systems, and temporal and climatic unpredictability.

Moreover, the significant presence of terms associated with family, home, and rural environments in Class 3 emphasizes the importance of intergenerational knowledge transmission. Participants frequently associated UFPs with memories of their mothers and grandmothers, suggesting that knowledge about these plants is preserved in informal, domestic settings rather than through formal education or professional training. This may explain why many participants are practically familiar with certain plants yet lack a clear understanding of the term UFP.

Finally, the clustering of conceptual definitions (Classes 4 and 2) around ideas of unfamiliarity and rurality indicates that UFPs are still perceived as peripheral to urban and industrialized food systems. Together, these findings suggest that promoting the consumption of UFPs requires increasing their market availability and strengthening cultural recognition and formal knowledge dissemination.

Recent research evaluating the acceptance of culinary preparations using wild edible plants has demonstrated their significant potential to influence gastronomy, increase consumer interest and acceptance, and contribute to the innovation and diversification of culinary practices. These preparations were more widely accepted by older individuals, those with higher education and income levels, males, and individuals with low food neophobia (Santos et al., 2024).

Chefs influence contemporary eating practices and promote healthier and more sustainable dietary behaviors through their technical knowledge, personal experiences, and creative processes (Gajdzik et al., 2023; Previatti, 2024; Giousmpasoglou et al., 2025). Their influence extends beyond the physical space of restaurants and expands through the media.

Abras (2018) highlights the role of chefs in the resurgence of UFPs in contemporary food systems. Their presence on restaurant menus, in media programs, and on digital platforms has helped reframe these plants as valued gastronomic ingredients rather than marginalized foods. However, the resurgence of UFPs, driven by researchers, chefs, and cooks, appears to be independent of the terminology used, which reinforces the distinction between conceptual knowledge and practical engagement.

This study has several limitations. First, the non-response rate among restaurants identified on TripAdvisor was high. Since chefs and cooks were invited to participate based on referrals from restaurants, the high non-response rate may have excluded professionals whose characteristics, opinions, or behaviors differ from those of the participants. If the results only include professionals who are more interested in gastronomy, are familiar with UFPs, or are involved in research activities, they may overestimate the actual knowledge about UFPs and cannot be generalized to all chefs and cooks in the region studied. Despite the rigorous recruitment protocol, the high non-response rate may be attributed to the demanding work schedules characteristic of the gastronomic sector.

Second, the geographic restriction of the study to Minas Gerais may prevent the generalization of the findings to other Brazilian regions with different biomes and culinary traditions. However, focusing on Minas Gerais is justified by the state's prominent role in Brazilian gastronomy and its rich tradition of utilizing UFPs. This regional delimitation allowed for a more precise selection of the 33 UFP species based on local biomes and cultural heritage. Another limitation is the possibility of response bias during interviews. Given that UFPs are currently linked to sustainability and culinary innovation, participants may have overreported their familiarity with or positive perceptions to align with professional expectations. However, the use

of a standardized interview protocol was emphasized to mitigate this bias. Furthermore, the discrepancy observed between *conceptual knowledge* and *practical recognition* (as seen in Figure 2) suggests that participants were honest regarding their limitations, which lends a degree of validation to the results.

Finally, the distinction between knowing the term UFP and recognizing or using specific species may also limit the present study. An initial focus on formal nomenclature might not fully account for participants' practical expertise. Professionals with extensive practical knowledge may have felt like *laymen*, which could have affected their confidence during the rest of the interview.

Nevertheless, distinguishing between knowledge of the term and recognition of the species is one of the most valuable findings of the present study, as it shows that traditional knowledge is often fragmented from scientific nomenclature. Initiatives aimed at integrating UFP into professional kitchens must therefore use visual and sensory literacy.

Furthermore, the heterogeneity of the sample is a strength of this study, as it encompasses professionals with diverse educational backgrounds and levels of seniority operating across various types of establishments. This diversity of perspectives enabled a multifaceted understanding of the phenomenon. Another important strength is that both metropolitan and traditional contexts were included, which facilitated a comparative analysis of how the UFP concept is disseminated across different gastronomic ecosystems. This analysis revealed the direct influence of regional identity and cultural heritage on local food practices. Methodologically, using a mixed-methods approach enhanced the rigor of the investigation by enabling data triangulation. While the quantitative component measured terminological familiarity, the qualitative analysis provided a deeper understanding of botanical recognition and the practical application of specific species.

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DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: LTP, CCM, and NCC.
Carried out the experiment: LTP, CCM, NCC, MAP, RPA, and LAC.
Carried out the data analysis: LTP, CCM, NCC, LAAMJ, and FRR.
Wrote the first draft of the manuscript: LTP.
Review and final writing of the manuscript: LTP, CCM, and NCC.
Supervision: CCM, and NCC.

FUNDING DECLARATION

DISCLOSURE OF AI USE

The authors used ChatGPT to improve the clarity of the language and summarize the background literature. The authors reviewed and edited the content to ensure its accuracy and appropriateness.

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Additional Files

Add File 1. Unconventional Food Plant (UFP) species included in the study, with their respective common names, scientific names, botanical families, and reference images.

Common name	***Scientific name***	**Botanical family**	**Images**
Almeirão-do-campo / radite peludo	*Hypochaeris radicata L.*	Asteraceae	
Almeirão-do-mato	*Hypochoeris brasiliensis Griseb.*	Asteraceae	
Almeirão roxo	*Lactuca canadensis*	Asteraceae	
Amora preta	*Rubus sellowii*	Rosaceae	

Common name	***Scientific name***	**Botanical family**	**Images**
Araçá do campo	*Psidium cattleianum*	Myrtaceae	
Araruta	*Maranta arundinacea L.*	Marantaceae	
Assa-peixe	*Vernonanthura phosphorica*	Asteraceae	
Azedinha	*Rumex acetosa L.*	Polygonaceae	
Beijo-turco, maria-sem-vergonha, beijinho	*Impatiens walleriana*	Balsaminaceae	
Bertalha	*Basella alba L.*	Basellaceae	
Broto de Bambu	*Phyllostachys edulis*	Poaceae	
Broto de samambaia	*Pteridium aquilinum*	Dennstaedtiaceae	

Common name	***Scientific name***	**Botanical family**	**Images**
Cansanção	*Urera aurantiaca*	Urticaceae	
Capeba	*Piper umbellatum L.*	Piperaceae	
Capiçova, caruru-amargo, caruru arnica, cariçoba, erva-gorda	*Erechtites hieraciifolius (L.)*	Asteraceae	
Capuchinha, chaginha	*Tropaeolum majus L.*	Tropaeolaceae	
Cará-do-ar	*Dioscorea bulbifera L.*	Dioscoreaceae	
Caruru, caruru-rasteiro, bredo	*Amaranthus deflexus L.*	Amaranthaceae	
batata doce, batata-da-terra, batata-da-ilha, jatica, jetica (folhas)	*Ipomoea batatas (L.)*	Convolvulaceae	

Common name	***Scientific name***	**Botanical family**	**Images**
Jambu, agrião-do-pará, agrião-do-norte, agirão-do-brasil	*Acmella oleracea (L.)*	Asteraceae	
Peixinho-da-horta, orelha-de-lebre, orelha-de-cordeiro, lambari-da-horta	*Stachys byzantina*	Lamiaceae	
Lingua-de-vaca, labaça	*Rumex obtusifolius L.*	Polygonaceae	
Ora-pro-nóbis, lobrobô, lobrobró, carne-de-pobre, mata-velha, guaiapá	*Pereskia aculeata*	Cactaceae	
Mangarito	*Xanthosoma riedelianum*	Araceae	
Maracujá do mato, suspiro, maracujá-de-cheiro	*Passiflora nitida*	Passifloraceae	

Common name	***Scientific name***	**Botanical family**	**Images**
Mentruz	*Coronopus didymus*	Brassicaceae	
Mostarda, mostarda-verde, mostarda-repolho, mostarda-chinesa	*Brassica juncea*	Brassicaceae	
Serralha, chicória-brava, Serralha-branca, serralha-lisa, serralheira, ciúmo	*Sonchus oleraceus L.*	Asteraceae	
Taboa, paina-de-flexa, espadana, landim, capim-de-esteira	*Typha domingensis*	Typhaceae	
Taioba, taioba verde, taiá, inhame de folha, macabo, mangará	*Xanthosoma taioba*	Araceae	
Tanchagem, tansagem, línguas-de-vaca, cinco-nervos	*Plantago australis*	Plantaginaceae	
Banana (corações, umbigo, bogós)	*Musa X paradisíaca L.*	Musaceae	

Common name	***Scientific name***	**Botanical family**	**Images**
Urtiga	*Urtica dioica L.*	Urticaceae	

Source: Authors' elaboration based on Kinupp and Lorenzi (2014).