Food Composition Data: Edible Plants in the Pampa

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1 Introduction

Biomes with non-forest vegetation systems have been particularly neglected by public policies for conservation and sustainable development. This is precisely the case of the Pampa biome. Also known as southern Brazilian grasslands, the Pampa is a mosaic of different types of vegetation with a landscape that comprises savannah, steppe, steppic savannah, coast, transition areas, and semi-deciduous and deciduous forests (Chomenko and Bencke 2016) with a particular flora and fauna and great biodiversity (Quadros et al. 2008). In Brazil, it is only found in Rio Grande do Sul (RS) state, where it occupies nearly 63% of the territory (Suertegaray and Silva 2009). It has a unique cultural, genetic, and natural heritage with regional, national, and global importance. Despite this, from an official conservation perspective, only 0.4% of the Pampa is legally protected in conservation units, which is far from the global average of 17% per biome (Sosinski et al. 2019). Figure 1 presents an idea of the landscape of this biome, in which fields and forest islands coexist.

The conservation and sustained management of agrobiodiversity, through actions to support consumption of edible native species, are essential strategies for food and

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Fig. 1 Mosaic of ecosystems in the Pampa, Santana do Livramento, RS. (Photo: Trevisan ACD/ Echoes of the Pampa)

nutritional sovereignty and security. Knowledge about the species' nutritional composition has an essential role in advancing these strategies. Some of the species have higher nutrient concentrations of carotenoids, fibers, anthocyanins, vitamins, and minerals than foods commonly consumed (Martins et al. 2019; Rockett et al. 2020; Schmidt 2018b). From a nutritional and phytochemical perspective, the edible native species of the Pampa biome have strong potential to be included in the diet of the population.

In this chapter, we present nine native food plants from the Pampa with different common uses among local people: six are eaten, one used as a spice, and two taken as tea for medicinal purposes. In addition, the three species used as spices and medicine have an important role in the ecological landscape because they provide ecosystem services to food systems. *Schinus molle* L. offers an abundance of food to avifauna that are predators of many undesirable insects. The intense fluorescence of *Aloysia gratissima* (Gillies & Hook) Tronc helps to maintain pollinators, while *Elionurus muticus* (Spreng.) Kuntze is a companion plant to *Butia yatay* (Mart.) Becc. and marks the territory of family farms because this medicinal plant is found in the butiazal understory where there is animal grazing (Curicaca et al. 2018; Lemos et al. 2014). This chapter is composed of three sections, in addition to the introduction. The first explains how the species were chosen, considering their ecology and nutritional composition. The final considerations reflect on gaps in existing knowledge.

2 The Pampa and the Selection of its Edible Species

The long history of environmental degradation and contamination caused by industrial husbandry, associated with landownership concentrated in large properties, has devalued the use of species from the Pampa. Cultural practices forged by pressure from the dominant economic model have led to neglect of the Pampa's natural heritage, which has been forgotten by inhabitants of the territory. Local species with great food and economic potential are not only neglected but are often also suppressed, given that they are thought to "pollute the fields." Nevertheless, studies are underway in the territory that demonstrate opportunities for sustainable use of the Pampa's natural heritage, serving to generate income and stimulate social development and reproduction of local communities.

From the perspective of sustainable use of edible species from biodiversity, it is necessary to understand the ecology of each species, to be able to guide practices linked to handling of natural populations and/or domestication of the species. To manage the natural population, it is understood that the strategies used should be specific to each species, correlating with their ecological plasticity. When planning domestication, it is important to emphasize that given the large genetic variation within populations, it is always necessary to define the objectives of selection, that is, to determine if the intention is production of fruits, juices, spices, teas, essential oils, fibers, crafts, or phytotherapeutic products. Studies demonstrate that various native vegetable species of Brazilian flora have significant quantities and varieties of nutrients such as food fibers, minerals, and vitamins (Rockett et al. 2020; Schmidt 2018b; Seraglio et al. 2018; SiBBR 2020), and they have revealed antioxidant (Dalla Nora et al. 2014a; Rockett et al. 2020), antihyperglycemic (Vinholes et al. 2017), and anti-inflammatory properties. It is also important to highlight that scientific studies have related the consumption of anthocyanins and carotenoids to protection of the human organism and to reducing risk of developing non-transmissible chronic diseases (Sampaio and Almeida 2009; Strack and Souza 2012) including Alzheimer's (Silveira et al. 2011). Each one of the fruits has structural peculiarities, such as strong or fragile seeds, smooth or fibrous bark, fluid, or dense pulp, so that their processing becomes an important challenge that must be studied and understood.

Thus, in addition to the need to revive local knowledge, the creation of environments of innovation that offer support by linking the knowledge between local peoples and research institutions is of strategic importance today. One of the environments of innovation being developed in the Pampa is found at the Universidade Estadual do Rio Grande do Sul (UERGS), in the research and extension group "Ecology of Knowledge in agroecosystems of the Pampa biome – Echoes of the Pampa" that has been collecting results with the species presented in this chapter. In addition to "Echoes of the Pampa," the choice and description of the species was assisted by research groups at the Universidade Federal do Rio Grande do Sul (UFRGS) that work with food and nutritional sovereignty while emphasizing the ecology of knowledge and sustainable use of biodiversity anchored in species important to local communities. The species presented here (Table 1) were selected

Table 1 Selected food and medicinal species of the Pampa biome

	Scientific name	Popular names	Family	Habit
1	<i>Butia odorata</i> (Barb. Rodr.) Noblick)	Butiá, coquinho-azedo, butiazeiro	Arecaceae	Arboreal
2	<i>Butia yatay</i> (Mart.) Becc.	Butiá-jataí, jataí, yataí, yatay	Arecaceae	Arboreal
3	<i>Eugenia involucrata</i> D.C.	Cerejeira-do-rio-grande, cerejeira-do-mato, cereja do-rio-grande, cereja-do-mato	Myrtaceae	Arboreal
4	<i>Myrcianthes pungens</i> (O.Berg.) D. Legrand	Guabijú, guabijuzeiro	Myrtaceae	Arboreal
5	<i>Guetardura uruguensis</i> Cham. & Schltd	Veludinha, veludinho	Rubiaceae	Arboreal
6	<i>Acanthosyris spinescens</i> (Mart. & Eichler) Griseb	Sombra de touro, quebracho-rojo	Santalaceae	Arboreal
7	<i>Schinus molle</i> L.	Anacauita, piriquiteira, aroeira-sala	Anacardiaceae	Arboreal
8	<i>Aloysia gratissima</i> (Gillies & Hook) Tronc.	Garupá, alfazema-do-Brasil, mimo do Brasil, cedrón-del-monte	Verbenaceae	Shrub
9	<i>Elionurus muticus</i> (Spreng.) Kuntze	Capim-corona, Capim-limão	Poaceae	Herbaceous

with a focus on three principal criteria: (1) having popular use, (2) proven multifunctionality, and (3) being linked to agroecological productive systems for management of pasture and or agroforestry systems.

The species presented in this chapter represent only a sample of the potential that the botanic biodiversity of the Pampa offers to local communities in terms of food and nutritional security as well as the potential to generate income. The information is based on the results of studies being conducted by UERGS/Echoes of the Pampa and at the Universidad de la Republica del Uruguay in the Pampa territory. Specifically, to select the priority species we present here, we prepared an analysis matrix with data from floristic surveys in home gardens, interviews with farmers, and discourse analysis of participants in a radio program that each week discusses a plant species from the Pampa. The data matrix allowed identifying the most common species in home gardens and those best known to Pampa residents. This led to the selection of thirty-five species from which the authors of this chapter selected nine species based on the criteria presented in the previous paragraph.

Due to the scarcity of scientific publications, only three species (*B. odorata*, *M. pungens*, and *E. involucrata*) will have their nutritional and phytochemical composition presented. For the other species, articles were found that examine their biological properties, such as fungicidal, bactericidal, and insecticidal or as food preservatives, but not their use as food. It is essential to establish links between local production systems and the diffusion of knowledge about biodiversity to expand reflections about cultural habits and preferences and to intensify the sustainable use and conservation of the biome. The dominant productive model in the territory, which gives little value to local knowledge, combined with regional asymmetries of development and gaps in scientific studies about the Pampa, is an impediment to

increasing value and stimulating innovation with sociobiodiversity. Figure 2 presents images of some of the species presented, to introduce readers not only to the colors, textures, and shapes described but to the diversity found in the Pampa.

Sociobiodiversity is understood to be the relation between biological diversity, traditional agricultural systems, and the use and management of these resources combined with the knowledge and culture of traditional communities and family farmers (BRASIL 2000, 2009). This concept comes from the Brazilian discussion around the sustainability of extractivism while recognizing the diversity and importance of traditional peoples and family farmers. Experiences in the construction of sociobiodiversity product chains have demonstrated the capacity for inclusion of family farmers, extractivists, traditional peoples, and communities that manage and conserve native biodiversity. This reality has contributed to the supply of healthy,

Fig. 2 Fruits and flowers of sociobiodiversity of the Pampa biome. (a) Anacaúta (*S. molle*), (b) garupá (*A. gratissima*), (c) guabijú (*M. pungens*), (d) cerejeira-do-rio-grande (*E. involucrata*), (e) butiá (*B. odorata*), (f) veludinha (*G. uruguensis*) (Photos from Echoes of the Pampa: Lika Furtado (a–e) and Franciely Pando (f))

fresh food or with little processing, with high nutritional values, which is increasingly necessary considering the poor diets, malnutrition, and overweight condition of most of the Brazilian population (Ramos et al. 2017; Tutwiler et al. 2017). In the case of the Pampa biome, it is necessary to overcome the negligence and underutilization of many native species that have multiple potentials for food, medicinal, aromatic, and cosmetic uses. As we present in this chapter, we believe that overcoming the existing gaps in knowledge and giving value to the use of these species should take place by supporting the ecology of knowledge, guaranteeing the qualified participation of local communities. The governance processes used in this production of knowledge are essential to protect traditional knowledge, guarantee the sharing of benefits, and avoid that knowledge is appropriated by distant actors with greater economic and political power. Moreover, to overcome the current situation, it is necessary to redesign the productive units in the Pampa to promote resilience based on biodiverse productive systems from an agroecological perspective.

3 Edible and Medical Species of the Pampa: Ecology and Nutrition

The species selected are potential resources for the development of sustainable productive systems in the Pampa. The ecological aspects presented are the result of a review of the literature and primary data from extension and research projects being executed by the Echoes of the Pampa at UERGS. The databases researched were Portal de Periódicos Capes, SciELO, ScienceDirect, and Redalyc (from 1959 to present). The search descriptors were the scientific names of the nine species presented here, and the inclusion criteria were articles and theses that address species use, sociobiodiversity, or species ecology. With the same search descriptors, the data about nutritional composition are also presented from a review conducted by researchers at UFRGS in the following databases: Web of Science, Bireme, SciELO, Scopus, ScienceDirect, and CAPES (without limiting the time period), in addition to research in The Brazilian Biodiversity Information System (SiBBr) of the Ministry of Science, Technology, Innovation and Communications (MCTIC), with technical support from the United Nations Environment Program (UNEP) and financial support from the Global Environmental Fund (GEF). The inclusion criteria were articles and theses with results that address phytochemical and nutritional qualities.

The Butiás

The butiá or Brazilian palms are composed of the *Butia* genus in the Arecaceae family and are found from Bahia and Goiás to Rio Grande do Sul and neighboring countries (Rodrigues et al. 2008). All the butiás originate from mother plants whose stem grows below ground level and form a natural gregarious population with large production of edible fruits (Meerow et al. 2009). The *butiazais*, as butiá palm groves are known, have a strategic role in the conservation and restoration of the Pampa

biodiversity, because by forming islands in the landscape of open fields, they increase ecological resilience by promoting connectivity. The Brazilian palm groves are extremely threatened by the absence of regeneration due to their elimination by intensive cattle grazing and agriculture and expansion of urban areas (Fonseca 2014). Given this situation, the Rota dos Butiazais, a project that attracts tourists to family farms, is an example of a strategy for environmental conservation and sustainable use of biodiversity associated with the *butiazais* that has been developed since 2016, promoting integration between Brazil, Uruguay, and Argentina (Embrapa 2017; Sosinski et al. 2019).

In the Pampa biome, six species stand out, and the most characteristic are *B. odorata*, *B. yatay*, and *B. lallemantii*. *B. yatay* and *B. lallemantii* are endemic to the Pampa (Leitman et al. 2015; Soares et al. 2014). The large intra-populational genetic variation as well as the small number of individuals within these natural populations is a challenge to the conservation and use of the butiazais. Beyond the direct use of the fruits as food, there is also unexplored potential of the compounds in the pulp and seeds of the butiá fruit. Due to the large number of publications about them and because they are more commonly explored commercially, and are even among the species processed and sold by the Cadeia Solidária das Frutas Nativas no RS (Ramos 2019), we are able to present data for *B. odorata* and *B. yatay*.

(a) Butiá

Butia odorata

The species *B. odorata* was initially described in 1826 as *Cocos capitata* and until 2010 was denominated as *B. capitata* (Noblick 2011). It is known locally as bitter small coconut, butiazeiro, or butiá and occurs in ecosystems of the Atlantic Forest and Pampa biomes. It produces fruit once a year, flowers from October to December, and bears fruit from January to April (Büttow et al. 2009). Ecologically it occurs in savannah formations, as palm or butiá groves in poor soil with low water retention capacity. Its fruits are dispersed between the summer and early fall in arrangements of dormant seeds that require the conditions found in the islands of *butiazais* to be able to germinate and thus naturally regenerate (Schlindwein 2012). Thus, like the inflorescences, the fruits of lemon yellow to fire red coloring vary considerably in size (Mistura et al. 2012). The seed bunch can be considered ripe and ready for picking when at least half of the fruits have uniform color.

Among the edible uses of the butiá we can cite manufacturing of oil from the seed endosperm, collection of the sap that flows from the apical meristem after cutting the plant, extraction of hearts of palm, and raw consumption and processing of the fruits in the form of jellies, liquors, ice cream, and sweets (Büttow et al. 2009; Rivas and Barbieri 2017). Moreover, numerous crafts are made from them, and they are elegantly used in landscaping (Büttow et al. 2009; Geymonat and Rocha 2009; Sganzerla 2010). Important projects in the agroecological movement have given value to the fruits of the species and their associated ecosystems by production of butiá juice and frozen pulp (Ramos 2019). The yield of the pulp production varies between 50 and 60% of total fruit weight, without addition of water, and the pulp

can be maintained frozen for up to 1 year, without significant sensory or nutritional changes.

Both the pulp and kernels have important nutritional properties. Although they are normally discarded after pulping, the butiá seeds have a kernel of high nutritional value. The *B. odorata* seed was found to have a high protein content (from 12 to 15 g/100 g), fat (10 g/100 g), as well as minerals such as phosphorus, magnesium, and potassium (Faria et al. 2008). Its pulp is generally acidic (pH lower than 4,5) and has high fiber (1 to 4 g/100 g) and vitamin (vitamins A and C) content as well as various minerals (including iron, zinc, and magnesium) (Table 2).

Another important factor is the presence of bioactive compounds and chemical elements with antioxidant properties, among which it is worth noting carotenoids and phenolic compounds. The maximum and minimum values available in the literature for total carotenoids in *B. odorata* are proportional to other recognized nutritional species such as cajá (3,86 mg/100 g), araticum (1249 mg/100 g), and another butiá species, *Butia eriospatha* (1,73 mg/100 g).

(b) Butiá-jataí

Butia yatay

B. yatay has many botanical similarities with *B. witeckii*, *B. quaraimana*, and *B. paraguayensis*, which generates controversies among researchers, including hypotheses that the natural populations are the result of plantings. *B. yatay* has its etymology linked to its small hard fruit and is known as butiá-jataí, jataí, or yatay in Spanish. It is widely distributed in Argentina and Uruguay but in Brazil occurs only in two specific regions of Rio Grande do Sul, one in a typical Pampa region and

Table 2 Nutritional composition of butiá (*Butia odorata*) per 100 g of fruit pulp with natural moisture content^a

Nutrient	Min.	Max.	Med.	%RDI
Carbohydrates (g/100 g) ^b	6,58	14,84	10,71	8,24
Proteins (g/100 g) ^d	0,60	5,28	2,94	5,25
Fats (g/100 g) ^c	0,11	2,41	1,26	2,29
Food fiber (g/100 g) ^b	0,84	4,89	2,87	20,46
Carotenoids (mg/100 g)	2,80	5,50	4,15	–
Anthocyanins (C3Gmeq/100 g)	1,05	25,13	13,09	–
Vitamin C (mg) ^b	23,00	63,84	43,42	48,24
Vitamin K (mg) ^c	165	462	313,50	9,22
Mg (mg) ^b	4,0	12,0	8,00	1,90

Caption: Min, minimum amounts; max, maximum amounts; med, medium of the minimum and maximum amounts found in literature; % RDI, percent of recommended daily intake

^aConversion was realized, when necessary, from a dry base (dehydrated food) to food with its natural moisture content

^bInstitute of Medicine (2006), to adult men

^cRDC 269/2005 Brasil (2005); g, gram; µg, micrograms; mg, milligrams

^dCalculated to a man of 70 kg

^eInstitute of Medicine (2019)

Sources: Hoffman et al. (2014), Ferrão et al. (2013), and Fonseca (2012)

another in Giruá, a municipality in the Atlantic Forest (Marchiori et al. 1995; Patterer et al. 2019).

In the Pampa, it is found in the well-known Palmar de Coatepe palm grove, in the municipality of Quaraí, which occupies 60 km² and is a disjunction from its center of distribution in Argentina, the “Palmar Grande” (Marchiori et al. 1995; Marchiori and Alves 2011). This natural population with 4–8-m-tall solitary stems that are 20–30 cm in diameter has low densities of individuals due to cattle grazing, which compromises natural regeneration and population viability (Marchiori et al. 1995; Marchiori and Alves 2011). The flowers may be yellow, green, or purplish and the fruits yellow and purplish when ripe (Soares et al. 2014).

Considering its phytochemical composition, four classes of phenolic compounds stand out, coumarins, flavonoids, saponins, and tannins (Matos and Muller 2019), with potential for multiple uses. From a nutritional perspective, Martins and collaborators (2019) identified a significant presence of food fiber (9,0 g/100 g in the fruit and 4,7 g/100 g in the pulp) and vitamin C (72,8 mg/100 g in the pulp in 100 grams of butiá-yatai). These amounts allow categorizing this food as rich in food fibers and vitamin C, to the degree that consumption of 100 g of the fruit represents more than 15% and 100%, respectively, of RDI of these nutrients by the Ministry of Health (Martins et al. 2019).

Cerejeira-do-rio-grande

Eugenia involucrata

The Myrtaceae family is a broad family with 27 genera and 1026 species in Brazil, with 73% of these endemic (Sobral et al. 2015; Vasconcelos et al. 2017). In the Pampa biome, 8 genera and 17 species are described (Flora do Brasil 2020a) and, as in the other biomes where it is found, have important value in the floristic component of the arboreal stratum with a large vector of diversity because of their endemism. One characteristic of the seeds of this family is a low tolerance to drying; thus, the production of seedlings must be conducted soon after pulp removal or collection. The Myrtaceae have aromatic flowers and many glands, normally trichomes, which store essential oils (Oliveira 2018). Among the genera in the family, *Eugenia* stands out as the most representative in Brazil, with 392 species, 303 of which are endemic (Flora do Brasil 2020b), with strong food potential due to their fruits with a marked flavor.

One of the important species of this genus is *Eugenia involucrata*, whose center of diversity is the Atlantic Forest with dispersal to the Pampa. It is known as cerejeira-do-mato, cerejeira-do-rio-grande, cerejeira-da-terra, pitanga-preta, cereza-del-monte (espanhol), and îwîrá-yepiró (guarani) and occurs at a range of altitudes and latitudes (Carvalho 2008; Martinez-Crovetto 1968; Praderi 1959). The average trees are from 10 to 15 meters tall, and it is considered a rare species, with low densities per area (Pase do Prado 2009). It is commonly found in backyards on farms in the Pampa. Its fruit production is intense and for this reason is highly sought by animals, which are its natural dispersers, and generates an important bank of plantules for regeneration. In addition to consumption of the raw fruit, the tea from an infusion of the leaves has popular local use for gastric problems, diarrhea, ulcers,

and inflammations. It has proven antioxidant, anti-inflammatory, and antinociceptive effects (Barzotto 2019; Marin et al. 2008; Nicácio et al. 2017).

E. involucrata is among the Myrtaceae species found in the Pampa with strong potential for production. Data from research and extension projects point to fruit production; however, there is a strong trend toward a multiple use of the species that includes the production of essential oils, natural extracts, and isolation of active phytochemical compounds. It is a soft, sweet, and slightly acidic fruit with yellowish-red to dark red color and is found in various sizes. It has up to four stiff and large seeds, with relatively sensitive integument. For this reason, the processing of this fruit is a bit more complex than that of butiá and guabiju, because breaking the seeds releases compounds into the pulp that are sensorially undesirable. However, after extraction of the pulp, various products can be prepared such as juices, sweets, and cakes.

Table 3 presents the nutritional data for the cerejeira-do-rio-grande. As is common in fruits, the cereja has a low energy density due to its high moisture (of about 90%) and low fat and protein content. In general, the data indicate the presence of significant quantities of iron, copper, and magnesium. The carotenoid content in the pulp of the cereja-do-rio-grande is significant and is comparable to other fruits rich

Table 3 Nutritional composition of the pulp of the cerejeira-do-rio-grande (*E. involucrata*) with natural moisture content^a

Nutrient	Min.	Max.	Med.	%RDI
Carbohydrates (g/100 g) ^b	3,46	8,27	5,87	4,51
Proteins (g/100 g) ^d	0,62	0,94	0,78	1,39
Fats (g/100 g) ^c	0,21	0,37	0,29	0,53
Food fiber (g/100 g) ^b	1,30	1,70	1,50	10,71
Fe (mg/100 g) ^b	0,41	2,43	1,42	17,75
Zn (mg/100 g) ^b	0,09	0,14	0,12	1,05
K (mg/100 g) ^c	154,80	204,68	179,74	5,29
Na (mg/100 g) ^c	0,63	1,29	0,96	0,06
Ca (mg/100 g) ^b	11,20	13,74	12,47	1,25
P (mg/100 g) ^c	5,73	6,24	5,99	0,83
Mg (mg/100 g) ^b	6,96	12,26	9,61	2,29
Mn (mg/100 g) ^b	0,09	0,16	0,13	5,43
Cu (mg/100 g) ^b	0,06	0,09	0,08	8,33
Total carotenoids (mg/100 g)	8,92	20,21	14,57	–
Vitamin A (µg.EAR/100 g) ^b	26,00	899,38	462,69	51,41

Caption: Min, minimum amounts; max, maximum amounts; med, medium; % RDI, percent of recommended daily intake

^aConversion was realized, when necessary, from a dry base (dehydrated food) to food with its natural moisture content

^bInstitute of Medicine (2006), to adult men

^cRDC 269/2005 Brasil (2005); g, gram; µg, micrograms; mg, milligrams. EAR: Retinol equivalent

^dCalculated to a man of 70 kg

^eInstitute of Medicine (2019)

Source: Camlofski (2008), Schmidt (2018b), SiBBR (2020), and Schmidt (2018a)

in this nutrient such as guabiroba (24,58 mg/100), pequi (15,28 mg/100 g), and tucumã (6,26 mg/100 g) according to the data available from the Brazilian Biodiversity Information System (SiBBR 2020).

The quantities of bioactive compounds such as phenols, vitamins, and pigments presented in this table may vary with processing factors such as light incidence, contact with oxygen, and exposure to heat, as well as agronomic factors such as production location, climate conditions, and the degree of ripeness of fruits. The levels of carotenoids and vitamin A present in the butiá pulp should be emphasized, given that they are very important elements in a healthy diet.

Guabiju

Myrcianthes pungens

Also, in the Myrtaceae family, *M. pungens*, known as guabijú or guabijuzeiro, grow as trees up to 30 m tall and are found in the Atlantic Forest and Pampa (Lorenzi 2008; Sobral et al. 2015; Venzke 2012). There are registers of blossoming from September to January and fruit bearing from January to March (Fior et al. 2010; Guollo 2019). It is a species that ecologically occupies an advanced successional state and for this reason requires specific conditions of shade and soil quality to develop. The species is important to the promotion of local fauna because of its attractive and succulent fruits. Thus, among 181 species described as priority for recovery of typical Pampa ecosystems, *M. pungens* is indicated for forest and savannah formations (Guarino et al. 2018). Its wood is considered commercially important and can be used in civil construction and fine cabinet making and in the production of handles for tools and agricultural equipment. It is a heavy, elastic, strong, and dense wood (dos Santos and Marchiori 2014).

The guabiju stands out for its sweet flavor, and for this reason, together with *E. involucrata*, over time, it was selected for inclusion in domestic backyards in the Pampa. It is a small fruit with a quite fragile structure, with smooth skin that is easily separable from the pulp. Table 4 presents scientific data about the nutritional and phytochemical properties of *M. pungens*.

This data indicates strong nutritional potential, considering that guabiju has significant amounts of carotenoids and anthocyanins. These two compounds are responsible for the more orange-yellow internal and dark purple external color of the fruit. Fruit processing in general has significant impact on the degradation of bioactive compounds such as anthocyanins and total carotenoids in guabiju. Dalla Nora et al. (2014a) report that while the anthocyanin content in 100 g of fresh fruit is 231,2 mg, it is reduced to 13,53 mg in 100 g of dry fruit due to the sensibility of this compound to exposure to heat.

Veludinha

G. uruguensis

The Rubiaceae family is the fourth largest family among the angiosperms. Among the Rubiaceae, the *Guettarda* stands out with 21 species identified in Brazil in various types of vegetation (Pereira and Kinoshita 2013). *G. uruguensis* is the only species that occurs in Rio Grande do Sul and is also found in Uruguay and Argentina (Barbosa et al. 2015; Piaggio and Delfino 2009; Takáts and Toselli 2015).

Table 4 Nutritional composition of guabiju pulp (*M. pungens*) with natural moisture content^a

Nutrient	Min.	Max.	Méd.	%RDI
Carbohydrates (g/100 g) ^b	12,39	12,41	12,40	9,54
Proteins (g/100 g) ^d	0,55	0,56	0,55	0,99
Fats (g/100 g) ^c	0,05	0,06	0,06	0,10
Food fiber (g/100 g) ^b	6,21	6,23	6,22	44,43
Carotenoids (mg/100 g)	0,96	0,96	0,96	–
Anthocyanins (meq C3G/100 g)	13,52	295,41	154,47	–
Na (mg/100 g) ^c	16,86	52,10	34,48	2,30

Caption: Min, minimum amounts; max, maximum amounts; med, medium; % RDI, percent of recommended daily intake

^aConversion was realized, when necessary, from a dry base (Dehydrated food) to food with its natural moisture content

^bInstitute of Medicine (2006), to adult men

^cRDC 269/2005 Brasil (2005) g, gram; µg, micrograms; mg, milligrams

^dCalculated to a man of 70 kg

^eInstitute of Medicine (2019)

Source: Andrade et al. (2011), Dalla Nora et al. (2014a, b), and Seraglio et al. (2018)

This species is known as *veludinha*, due to its furry leaves and branches, or palo-cruz, in Spanish, due to the stipules that look like thorns in the form of a cross (Newton 1986).

It is described as a small tree, 3 to 10 m tall, with opposite leaves, pedunculated flowers, and drupaceous fruits with 2–9 seeds (Duarte et al. 2014; Pereira 2007). It has a caducous characteristic, losing up to 90% of its leaves in winter, blossoming peaks in November–December and fruit bearing in January–February (Athayde et al. 2009). To highlight its edible potential, it begins to fruit 2–3 years after planting (Teixeira et al. 2019). Biological studies indicate that the *veludinha* has antimicrobial and antioxidant activities (Duarte et al. 2014). Moreover, its phytochemical compounds have potential use as allelopathic products (Duarte et al. 2017).

It is an ornamental species that has aromatic flowers and is highly sought by bees, being indicated for apiculture (Duarte et al. 2017). It has strong potential in landscaping and urban tree planting, due to its fast growth, ease of pruning, the aesthetic of its architecture, white flowers, and purplish fruits. Landscapers often use the *veludinha* in clumps in large areas with harmonious results.

Sombra-de-touro

Acanthosyris spinescens

The Santalaceae family has 39 genera with 13 of them found in Brazil (SiBBR 2020). Among the genera occurring in Brazil stands out *Acanthosyris*, with only two Brazilian species and only one that occurs naturally in the Pampa biome: *A. spinescens* (Dettke and Caires 2015). It is known as sombra-de-touro, quebracho-rojo, or quebrachillo, in Spanish, and ñwá-he’e, in Guaraní (Martinez-Crovetto 1968).

The species flowers between October and November, and the fruits mature between January and May and are naturally dispersed by animals (Kinupp and De Barros 2007). From the perspective of use with livestock in the Pampa, native groves

with *A. spinescens* offer feed for cattle (Guarino et al. 2018) from fruits fallen on the ground, and their dense canopies offer shade in the hottest periods of the year, highlighting potential in silvopasture systems. In addition to its use as forage, its fruit with sweet pulp has high potential as a food source and its seeds for extraction of vegetable oil (Kinupp and De Barros 2007; Teixeira et al. 2019). The popular use indicates that its seeds can also be consumed raw or roasted. In the region, mainly in Uruguay, they are commonly used for pies and are crunchy, like Brazil nuts and almonds.

Since its natural populations have low rates of value of importance (0,98%) and the groves along rivers in the Pampa have been increasingly devastated, the species is now considered threatened in the biome (Ramos 2008). In the 1960s, studies found high concentration of fatty acids with high molecular weight, not common in essential oils of other local species (Powell and Smith Jr. 1966); however, it is still a neglected species in terms of scientific research. The vegetable oil of *A. spinescens* is registered as a major component oleic acid, which has high cicatrizant power (Dauber 2016). Popular knowledge also highlights that when consumed raw in a large quantity, still warm from the sun (picked from the tree), it can have laxative power.

Anacauita

Schinus molle

The Anacardiaceae family has important representatives in Brazilian food culture, such as mango (*Mangifera indica*) and caju (*Anacardium occidentale*). One of the characteristics of this family is the presence of an anatomic structure that secretes terpenes and resins, which confer a special aroma to its representatives. In Brazil, there are 13 genera, 57 described species (17 endemic), highlighted by the genus *Schinus*, with 10 Brazilian species, and among them, 9 are found in the Pampa (Silva-Luz et al. 2020).

In this context, *S. molle* stands out, known as *anacauita*, *piriquiteira*, *aroeira-salsa*, or *anacahuita* in Spanish and *aguará-ybá* in Guaraní and is quite a representative of the biome (Gomes et al. 2013). It is a perennial tree, 4 to 10 m; it has a dense, rounded, and open canopy (Gomes et al. 2013). It flowers from August to November and bears fruit from December to March. It is important to honey production, and its fruits are highly appreciated by local avifauna.

Studies demonstrate that its leaves, stems, and fruits have medicinal properties. They are composed of volatile oils with a strong odor and various biological activities (Díaz et al. 2008; Giuffrida et al. 2020). The mature berries are used as an alternative to pepper in foods. The essential oil of the anacauita is registered to have important antibacterial, antifungal, and insecticidal activity, which supports the traditional use of the species for infections (Fenner et al. 2006; Santos et al. 2010; Tomazoni et al. 2017). Due to its tannin content, it is also used to cure leather. In addition to the potential of its resins and oils, its use as food is related to its aromatic potential, and it establishes its potential for extractivism or commercial planting, as is realized with *S. terebinthifolius* (Pich 2019) for the production of red pepper, an export product.

Garupá

Aloysia gratissima

In Brazil, the Verbenaceae family includes 15 genera, 286 species with 63% of these endemic, and many with strong aromatic characteristics (Flora do Brasil 2020c). The *Aloysia* genera stands out and includes ten Brazilian species and three varieties (Moroni and O'Leary 2020), while Argentina is a possible center of dispersion (Silva et al. 2006). Among them, *A. gratissima* is found in Mexico to northeast Argentina, concentrated in the southern region of Brazil (Santos 2007). The botanic identification of the species is complex, and some authors affirm that there are two varieties: *A. gratissima* var. *gratissima* and *A. gratissima* var. *sellowi* (Moroni et al. 2016). *A. gratissima* is a bush that can reach 3 meters in height, with an irregular growth pattern. It flowers intensely through spring and summer (Ross et al. 2018). It is called garupá, alfazema-do-Brasil, mimo-do-Brasil, or cedrón-del-monte in Spanish and is well-known as a highly aromatic wild species.

It is locally used in popular medicine and is especially effective for bronchial, pulmonary, and bladder infections (Santos 2007). Moreover, the aqueous extracts of *A. gratissima* are efficient in the treatment of neurological, depressive, and inflammatory disorders, and its essential oils are effective in fighting bacteria that cause pneumonia and are used as insecticides against mosquito that carries dengue (Coelho and Coelho 2006; Santos et al. 2016; Souza et al. 2020; Zeni et al. 2013).

Its direct use is highlighted by ornamental and landscaping applications for planting in groups and by its therapeutic potential due to its intense aromatic flowering. It is also ecologically important for honey production, and in traditional Gaúcho cooking, garupá leaves are used to flavor meat dishes and are included in the popular infusion with erva-mate (*Ilex paraguariensis*), a species native to the Atlantic Forest originally used by the Indigenous Guaraní who live in southern Brazil. In contemporary cooking, it is used as flavoring for other savory dishes and for juices and sweets.

Capim-corona

Elionurus muticus

Elionurus is a small genus with three species in Brazil that is part of the large Poaceae family (Flora do Brasil 2020d). Botanic classification of the genera is controversial, and the characteristic that separates the species has been the presence or not of a citric odor (Welker and Longhi-Wagner 2007). *E. muticus*, known as capim-limão or capim-corona in Brazil and pasto-limón or colia-peluda in Uruguay, is an herbaceous plant found in sandy soils (Hess et al. 2007; Marchi and Barbieri 2015). It flowers from October to December in erect, pilose, solitary stalks 8–10 cm, which are silvery white in color with tones of pink and aromatic (Marchi and Barbieri 2015).

It is a native Gramineae that, since dominant in sandy soils of the Pampa, is not desired in cattle pasture. However, if well managed, in periods when it is more palatable to animals, it has potential use as forage. With rapid growth, its composition contains proteins, fibers, and minerals that can be combined with supplements to compose beef cattle and sheep diets (Bernardis 1998; O'Connor et al. 2011), especially the young plants, as a strategy for facing the Pampa winter. Another

contemporary use of the species is related to the production of essential oils whose products can be found for sale by companies in this sector. The volatile oils of *E. muticus* has as their principal component citral, a compound of strong interest in the food, perfume, and cosmetics industries (Fuller 2013). Beyond these uses, local communities use capim-corona to treat various diseases. Their roots are chewed for tooth and stomach pain, and their aerial portions are sudoriparous and control fever (Chagonda and Fungirayi 2016). Studies have found *E. muticus* to have strong anti-bacterial and antifungal activity (Hess et al. 2007; Puppini et al. 2018).

4 Final Considerations

The consumption of native edible plants is an important strategy for supporting sustainable food systems. These foods have an important role in the promotion of a suitable and healthy diet, given that they can contribute to the conservation of environments and cultures while simultaneously expanding the range of nutrients accessed by the individuals who consume them. In the case of the Pampa, the expansion in the offer and consumption of edible, aromatic, and medicinal plants from the biome involves innovation processes that, although underway, are still a weak element in research and extension activities in the fields of agronomy and nutrition.

The supply of these plants now available for use as food, in large part from extractivism, and research underway, creates an opportunity to diversify diets and reflect on food choices of the local population. These plants, especially the fruits presented here, represent sources of fibers, minerals, vitamins, and antioxidant compounds whose deficiency is related to countless health problems that afflict the Brazilian population. The fruits are joined by medicinal and aromatic plants that have a proven quantity of bioactive compounds that promote good health. Thus, improving knowledge and the sustainable use of this nutritionally healthy food biodiversity, including its regular consumption in daily diets, is an action that exemplifies the win-win paradigm that is so necessary in times of crisis of human and planetary health. The Pampa territory comports innovative productive designs that can promote both environmental health and conservation of ecosystems and territorial development based on sustainability.

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