NUTRITIONAL, SENSORY CHARACTERISTICS AND FOOD USE OF ORA-PRO-NOBIS ECOPRODUCED WITH BIOFERTILIZER FROM ANAEROBIC AND AEROBIC BIODIGESTION OF RESIDUAL BIOMASS

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ABSTRACT

The objective of this research was to collect online data on ecoproduction in the cultivation of 'ora-pro-nóbis' (OPN) fertilized with biofertilizer from anaerobic and aerobic biodigesters in the treatment of residual biomass in the Paraíba do Sul River Valley in the State of São Paulo in Brazil to support research planning and public policies. A questionnaire with 24 questions was created using a remote research management application and covered the cultivation, consumption, and commercialization of OPN. Applied to the agroecology group Rede Agroflorestal do Vale do Paraíba and food security group Roda de Saberes, made up of farmers, producers and rural owners, agriculture, health and education professionals, we obtained 52 completed questionnaires with OPN valued for its high protein and nutritional content, as a traditional food widely used by 96% of respondents who keep few plants in backyards and farms (82%) for the consumption of 0.5-1, 0kg of leaves per month in fresh form (29%), green juice (22%), cakes and breads (21%) and sautéed with meat (17%). Research should focus on pruning management (67%), necessary to maintain the low size of the plants and prevent the spikes from increasing in size as the branches age. This research provided a current overview of the growing popular interest in the consumption of OPN, which justifies investments to improve management and expand the scale of production to also serve the food and pharmaceutical industries.

BIOGRAPHY

Ederaldo Godoy Junior, Professor at University of Taubaté UNITAU, has Mechanical Engineer, Master in Environmental Sciences and Doctor in Energy, Researcher DTA CNPq and EPE, develops eco-efficient systems for environmental protection, sustainable energy, food and use of biofertilizer in agroforestry systems. Rural producer and OPN researcher to produce food where he combines biofertilizer produced in biodigesters to produce OPN in an agroforestry system. More than 22 international awards. **Raquel Marques Carriço Ferreira**, Professor at the Federal University of Sergipe. Advertising, Agroecologist, Master and PhD in Communication. Production of messages and their consumption in social and agroecological areas. Other co-authors: **Cristina Maria de Castro**; PhD Researchers in Food and Nutrition Security at APTA São Paulo, cristina.castro@sp.gov.br; **Fabricio Miguel Farinas**si, University of Taubaté

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1. Introduction

The present work aimed to present an updated bibliographical review of the nutritional and sensory advantages of ora-pro-nóbis and the challenges of its use in human nutrition.

Healthy eating is one of the beginnings of life and depends on nutritious food every day. However, the population wastes food because they are not fully aware of its benefits, thus not taking advantage of its nutrients (PAS, 2003).

The ora-pro-nóbis (Pereskia aculeata Mill. – Cactácea) is recognized as an unconventional food plant (PANC), a group of plants that includes a diversity of species with food potential for humans and animals, but which are little known and neglected and, therefore, little used. (KINUPP and LORENZI, 2014)

Regarding the nutritional values of the leaf, 100g of Pereskia aculeata Miller has approximately 22.9 g of protein, 3.6 g of lipids, 36.2 g of carbohydrates and 12.6 g of total fiber (ALMEIDA, 2012). In addition to having antioxidants that contribute positively to health, its consumption is therefore widely recommended. Phenolic compounds make up the class of phytochemicals with the highest expression present in ora-pro-nóbis (AGOSTINI-COSTA et al., 2012; PINTO et al., 2012). Figure 1 in (1) illustrates the leaves, in (2) the flowers and in (3) the fruits of the ora-pro-nóbis with the scientific name Pereskia aculeata Miller.

Figure 1 - (1) leaves, (2) flowers and (3) fruits of the ora-pro-nóbis, scientific name Pereskia aculeata Miller, native to the Atlantic Forest.

A food, in addition to its nutritional value, must bring satisfaction and be pleasant to the consumer, this is the result of the balance of different sensory quality parameters. (JESUS and REGES, 2019)

Sensory analysis is defined as the scientific discipline used to evoke, measure, analyze and interpret reactions to the characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing (ABNT, 1993). Ora-pro-nóbis leaves can be used in recipes such as soups, omelettes, pies and stews, or even raw in salads (MARTINEVSKI et al, 2013)

Also, the mucilage provided from the leaves of this plant can be used in food formulations as thickening agents, gelling agents and emulsifiers, in addition to the production of biofilms. (AMARAL et al., 2018; CONCEição et al., 2014; JUNQUEIRA, 2018; LISE et al., 2021; OLIVEIRA et al., 2019)

According to Jesus and Reges (2019), despite the nutritional advantage and possibility of applicability in products, there is greater acceptance of ora-pro-nóbis when used in conventional foods in a small percentage,

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which invalidates the hypothesis of the vegetable being widely used. as a direct substitute for animal protein, due to low acceptance with the foods for which the protein was tested.

Added to this, Pereira (2018) mentions that management during harvest and post-harvest generates scheduling difficulties and the possibility of nutritional and vegetable losses.

2. Materials and Methods

A bibliographical review was carried out on the topic in scientific academic journals available online and in print, gathering and comparing the different data and information found in the consultation sources and summarizing the results found in nutritional, sensorial terms and challenges for the use and creation of the ora-pro-nóbis production chain.

The formulation and sensory analysis of protein bars made from ora-pro-nóbis leaves and ora-pro-nóbis fruit liqueur was also carried out at an in-person event of the Brazil-Germany Chamber of Commerce in 2022. They were produced, with recipe and process still an industrial secret, (1) rosemary flavored protein bar, (2) parmesan cheese flavored protein bar and (3) ora-pro-nóbis liqueur, which are illustrated in Figure 2.

Figure 2 - (1) rosemary flavored protein bar, (2) parmesan cheese flavored protein bar and (3) ora-pro-nóbis liqueur.

25 event participants were presented with the three products and their evaluation regarding the parameters of appearance, flavor, texture and overall impression on a hedonic rating scale from 1 to 10, with 1 to 4 being bad, 5 to 7 moderate and 8 to 9 good. In addition to the sensory evaluation, a purchase intention analysis was carried out with a hedonic scale from 1 to 6, with 1 to 2 being bad, 3 to 4 moderate and 5 to 6 good.

3. Results

3.1. Nutritional Analysis

The main bibliographic reference identified in relation to nutritional values was by Soares et al (2022) who summarized several scientific works in a table with the macro and micronutrients of the dried ora-pro-nóbis leaf.

Table 1. Composition of dry ora-pro-nóbis leaves (Adapted from Soares et al, 2022)

Macronutrientes	(g/100g)	% VDR**
Carboidratos	28,25 – 30,81	9,42%
Lipídeos	3,80 – 5,22	6,91%
Proteínas totais	28,00 – 29,58	56%
Fibra Alimentar	20,78 – 51,00	83,12%
Aminoácidos	**(mg/100g)***	**% VDR****
Histidina	16,23 – 24,10	***
Isoleucina	36,90 – 40,87	5,27%[4]
Leucina	66,32 – 69,00	6,77%[4]
Lisina	41,74 – 53,40	***
Treonina	29,91 – 36,64	***
Valina	46,70 – 50,09	6,67%[4]
Triptofano	5,10 – 21,22	***
Minerais, Fenólicos e Vitamina C	**(mg/100g)**	**% VDR****
P	156 – 450	22,29%
Zn	2,8 – 26,7	25,45%
Mn	2,8 – 46,4	93,33%

Tabela 1. Continuação

Minerais, Fenólicos e Vitamina C	(mg/100g)	% VDR**
Mg	680 – 1900	162%
K	1632 – 4425	46,63%
Ca	2160 – 6623	216%
Fe	9,4 – 28,2	67,14%
Cu	0,8 – 1,4	88,89%
Compostos fenólicos	627 – 2074	Não definido
Vitamina C	42,35 – 200,1	42,35%

* Desconsiderados aminoácidos de uma das referências por ser muito divergente das demais
** Valores Diários de Referência. Cálculo feito com menor teor encontrado
*** Não há valores de referência, mas são todos essenciais
[4] Valor com base em adultos saudáveis de 70kg

It is noted that the ora-pro-nóbis vegetable has several interesting nutrients, the highlights being the high levels of protein and essential amino acids that are not characteristic of vegetables, in addition to having excellent levels of minerals, vitamin C and phenolic compounds.

3.2. Sensory analysis
Several scientific studies have applied ora-pro-nóbis to the preparation of conventional foods using the vegetable as a supplement or additive ingredient in the preparation. Of the studies researched, the vast majority of them demonstrated that in the preparations used, the acceptance rate of the product obtained was satisfactory, however, some of them were unsatisfactory. Acceptance rates above 70% are considered satisfactory (JESUS and REGES, 2019).

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Table 2. Foods prepared with ora-pro-nóbis and acceptance in sensory analysis.

Alimento	Índice de Aceitação	Referência
Arroz	89%	
Macarrão	83%	
Frango	89%	
Polenta	79%	Jesus e Reges (2019)
Bolo de chocolate	90%	
Brigadeiro	90%	
Bolo tradicional	85%	
Pudim	89%	
Sorvete	71%	Jesus e Reges (2019)
Pão	67%	
Suco Verde		Santos, Novaes e Silva (2021)
Omelete	> 90%	
Pão		
Chips		

3.3. Sensory analysis of protein bar and ora-pro-nóbis liqueur samples

Table 3. Analysis of food produced at the event

Produto	Ruim (1 a 4)	Moderado (5 a 7)	Bom (8 a 10)
Barra proteica Sabor Alecrim	1	17	7
Barra proteica Sabor Parmesão	0	18	6
Licor de Fruto de Ora-pro-nóbis	1	10	14

Table 4. Intention to purchase food produced at the event

Produto	Ruim (1 a 2)	Moderado (3 a 4)	Bom (5 a 6)
Barra proteica Sabor Alecrim	1	4	19
Barra proteica Sabor Parmesão	1	6	12
Licor de Fruto de Ora-Pro-Nóbis	5	10	5

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It is observed that most tasters evaluated the samples as moderate for the protein bars and good for the fruit liqueur, however, the majority would buy both protein bars and could buy the fruit liqueur.

These results show the potential of the products under development, however, with opportunities for improvements, according to the results identified.

3.4. Challenges in the production chain

According to Ribeiro et al (2014), the first major challenge inherent to the ora-pro-nóbis production chain is raising awareness among the population about the cultivation and consumption of the vegetable, since in a globalized world the consumption of native vegetables has been replaced by the system global consumption of standardized vegetables around the world. It was noted that there is good acceptance of the products of bibliographical research and that the products developed in the present work have good potential, but still require adjustments.

According to Stroparo and Possobam (2022), another challenge related to ora-pro-nóbis is the use of large labor forces that end up occupying the resources of rural properties and preventing large expansions of cultivation.

Sousa (2021) adds management of the plant as a major challenge, as the plant has spikes and thorns that make pruning and harvesting difficult.

Caixeta (2020) notes that post-harvest preservation needs to be better developed to reduce the loss of the harvested vegetable, with pre-processing in the rural unit being interesting.

4. Conclusion

It can be concluded that ora-pro-nóbis is a vegetable of great nutritional value that has enormous potential for application as a food ingredient as it does not have negative sensory aspects.

It can still be concluded that there is a need to develop the production chain to attack the negative aspects related to the lack of knowledge about the plant, its cultivation, management and conservation.

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