



Mistol-Based Vegan Beverages for a Healthy Diet [†]

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[†] Presented at the V International Conference la ValSe-Food and VIII Symposium Chia-Link, Valencia, Spain, 4–6 October 2023.

Abstract: The fruit of *Sarcomphalus mistol* (Griseb.) is from the Great American Chaco, an important wild food resource. However, its composition and potential uses are unknown to a large part of the population. In this work, two mistol and peanuts-based products were prepared (a toasted mistol product “mistol coffee” and a mistol-peanuts-based vegan beverage), and its nutritional value and antioxidant potential was investigated. The chemical composition, total phenolics compounds (TPCs), and total antioxidant capacity (TAC) of the two products were analyzed on a dry basis with AOAC, Folin–Ciocalteu, and ABTS+ radical inhibition methods, respectively. The toasted mistol product was high in dietary fiber (51.89 ± 0.65 g/100 g) and TPC (2729 ± 362 mgGAE/100 g), which was consistent with the observed high TAC (307 ± 14 mM TEAC/g). Minerals found in the toasted mistol product were mainly calcium and magnesium. The mistol-peanut-based vegan beverage presented 12.67 g/100 g of dry extract, and its main nutritional contributions are carbohydrates (8.16 ± 1.05 g/100 g db), lipids (2.33 ± 0.29 g/100 g db), magnesium (10.34 ± 1.40 mg/100 g db), and polyphenols (345 ± 4.58 mg GAE/100 g db) in agreement with their TAC in the lyophilized product (17.6 ± 5.25 mM/TEAC/g db). These products can be used according to their observed nutritional value and antioxidant potential as foods with healthy properties, especially for vegan populations.

Keywords: mistol; peanuts; vegan; nutritive beverages; antioxidants; healthy diets



Citation: Villalba, R.; Belotto, J.; Coronel, E.; Suárez, A.; Caballero, S.; Mereles, L. Mistol-Based Vegan Beverages for a Healthy Diet. *Biol. Life Sci. Forum* **2023**, *25*, 9. <https://doi.org/10.3390/blsf2023025009>

Academic Editors: Claudia M. Haros, Loreto Muñoz and María Dolores Ortola

Published: 28 September 2023



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1. Introduction

Diet drinks are recognized as sources of energy and nutrients, but may also provide health benefits due to the presence of bioactive compounds [1]. The fruit of mistol (*Sarcomphalus mistol* Griseb.) is a drupe with pasty and sweet pulp, with exquisite flavor and reddish-hazelnut color from the great American Chaco, which is appreciated by children in indigenous communities. However, its composition is unknown to a large part of the population [2]. It is consumed directly but is also used as an ingredient in other food preparations (such as “bolanchao”), as an infusion and a toasted product (“mistol coffee”). The tea has medicinal properties against biliary colic, dysentery, cough, heart diseases, hypertension, diabetes, as an antidote against snake bites and poisonous insects, and as a natural energizer [3]. They can provide 8% protein (28.3% essential amino acids of the total AA contents). Their extracts enriched in polyphenols are important source of flavonoids with antioxidant capacity, to inhibit α -glucosidase, α -amylase, and pancreatic lipase, enzymes that are related to metabolic syndrome [4]. Peanuts (*Arachis hypogaea* L.) are the most widely cultivated grain legume and are an important source of protein and oils in many countries; the content of unsaturated fatty acids is mainly in the oil (83–87%) [5].

Plant-based nutritional drinks have good future prospects, especially with the use of natural ingredients containing low sugar or with no-added-sugar drinks, rich in polyphenols, and with antioxidant properties, which may also confer additional health benefits [5].

The aim of this work was to describe the nutritional value of a mistol-peanut vegan beverage and toasted mistol product with antioxidant potential, as an alternative nutritional drink based on vegetables and low in sugar for a healthy diet.

2. Materials and Methods

Two mistol-based products were prepared: a toasted mistol product “mistol coffee” and a mistol-peanut-based vegan beverage prepared in triplicate in a laboratory. Wild mistol fruits and cultivated peanuts were harvested from Philadelphia, Chaco. The ripe whole mistol fruits were washed and dried (in the sun for 3 days), roasted over a dry heat in a pan, and ground according to the traditional procedure. The mistol-peanut-based vegan beverage was produced from the infusion of the 3% toasted mistol product substitutes in an extraction time of 1 minute. The drink was obtained by mixing 50% toasted mistol infusion with 50% “peanut milk” to which 0.3% lecithin was added as an emulsifier and 7% organic sugar.

The samples of the roasted mistol product and the lyophilized drink have been analyzed using official methods of the AOAC and AOCS [6]: moisture (AOCS Ca 2b-08), ash (AOAC 900.2), total lipids (AOAC 948.22), dietary fiber (AOAC 985.29), protein (AOAC 979.09), and total carbohydrates and sugars using the anthrone method [7]. The caloric value was determined using the Atwater method. The mineral elements sodium, calcium, magnesium, manganese, zinc, iron, and copper were determined using the AOAC 975.03 method, and phosphorus using the AOAC 970.39 spectrophotometric method. The TPC was determined using the Folin–Ciocalteu oxidation-reduction spectrophotometric method [8], and the TAC using the ABTS+ radical inhibition method [9]. The data were collected and processed using the GraphPad Prism 8.2 program (San Diego, CA, USA). To determine significant differences, Student’s test was applied with a value of $p \leq 0.05$ considered significant.

3. Results

Toasted mistol product power was rich in dietary fiber (51.89 ± 0.65 g/100 g) and polyphenols (2729 ± 362 mgGAE/100 g), which was consistent with the high TAC observed (307 ± 14 mM TEAC/g). The main minerals found were calcium and magnesium (Table 1). The mistol-peanut-based vegan beverage lyophilized presented higher total carbohydrates content, lipids, magnesium, and polyphenols (547 ± 95 mg GAE/100 g) in agreement with their TAC (17.6 ± 5.25 mM/TEAC/g). The dry extract of mistol with peanuts presented a higher carbohydrate content (64.40 ± 4.35 g/100 g) than the mistol coffee (21.91 ± 0.65 g/100 g), composed mostly of simple sugars. The lipids detected (18.38 g/100 g) come from the peanuts used as a raw material to make the drink. The total polyphenol content in the toasted mistol was significantly higher (t test, $p < 0.05$). Both products presented great antioxidant capacity on a dry basis (Table 1).

Table 1. Chemical composition of toasted mistol product and lyophilized mistol-peanuts-based vegan beverage on a dry basis.

	Toasted Mistol Product	Mistol-Peanuts-Based Vegan Beverage
	Centesimal composition	
Moisture (g/100 g)	3.23 ± 0.27^a	1.60 ± 0.13^b
Protein (g/100 g)	13.00 ± 1.3^a	11.29 ± 0.31^a
Total carbohydrates (g/100 g)	21.91 ± 0.65^a	64.40 ± 4.35^b
Sugars (g/100 g)	19.53 ± 0.39^a	61.4 ± 0.68^b
Total lipids (g/100 g)	Tz	18.38 ± 0.49^b
Ash (g/100 g)	5.69 ± 0.12^a	1.51 ± 0.06^b
Dietary fiber (g/100 g)	46.64 ± 0.65^a	3.19 ± 0.85^b
Caloric value (Kcal/100 g)	140 ± 9^a	468 ± 21^b

Table 1. Cont.

	Toasted Mistol Product	Mistol-Peanuts-Based Vegan Beverage
Minerals		
Calcium (mg/100 g)	223 ± 4 ^a	21.74 ± 1.97 ^b
Phosphorus (mg/100 g)	174 ± 5 ^a	182 ± 2 ^a
Magnesium (mg/100 g)	95.77 ± 7.02 ^a	81.58 ± 6.40 ^a
Iron (mg/100 g)	7.83 ± 0.22 ^a	1.85 ± 0.7 ^b
Sodium (mg/100 g)	27.58 ± 4.51 ^a	27.23 ± 3.89 ^a
Zinc (mg/100 g)	0.95 ± 0.76 ^a	0.74 ± 0.15 ^a
Copper (mg/100 g)	0.38 ± 0.01 ^a	0.53 ± 0.02 ^b
Manganese (mg/100 g)	<0.010	0.10 ± 0.07 ^a
Antioxidants		
TPC (mgGAE/100 g)	2729 ± 362 ^a	547 ± 94 ^b
ABTS (mM TEAC/g)	307 ± 14 ^a	17.6 ± 5.25 ^b

Results are expressed as the mean ± standard deviation of three independent tests. Values with the same letters indicate that there is no significant difference (Student's *t* test, *p* < 0.05). Tz: traces.

4. Discussion

The results show a potential nutritional contribution of the formulated beverage with mistol and peanuts with a dry extract of 12.67 g/100 g. The contribution of carbohydrates and lipids in the reconstituted drink was 8.16 ± 1.05 and 2.33 ± 0.29 g/100 g, respectively. A serving of drink is considered to be 200 mL, which in addition to being a nutritious drink (16.32 g of carbohydrates), would provide antioxidant compounds and a low sodium content (6.9 mg/serving). One of the most consumed vegetable drinks is soy milk, which provides 6–12% carbohydrates in a 200 mL portion. On the other hand, the recommendation is to choose fortified drinks that contain at least 4.8 g of protein per 200 mL. However, we observe that the drink prepared in this study provides a much higher sugar content (16.32 g/200 mL) and lower protein (2.86/200 mL per serving) compared to soy milk [10]. Regarding minerals, a serving of drink provides 15% of the recommended daily intake of copper. The information provided here is relevant for the development of new products, the commercialization and promotion of the consumption of foods derived from native resources, within the framework of food security and environmental sustainability towards better nutrition. The mistol and peanuts seeds are important foods with great nutritional potential in the regional diet as ingredients of beverages. Extremely high levels of resistance or immunity make wild *Arachis* species a highly valuable genetic resource [11]. The mistol tree is a deciduous honey plant that also provides a significant contribution to the environment by fixing carbon and protecting soils and biodiversity [3]. Peanut species and their varieties, as well as mistol trees, are of great importance for conservation as resources for food security.

5. Conclusions

Regional food resources, such as mistol fruits and peanut seeds, which are rarely used as ingredients in beverages, would be valuable for the development of this type of plant-based nutritional product, with an important contribution of macro and micronutrients as well as polyphenols with recognized properties and antioxidants, especially the roasted mistol product called “mistol coffee” and peanut-based formulations.

Author Contributions: Conceptualization, L.M. and R.V.; methodology, S.C. and L.M.; software, E.C.; validation, J.B. and L.M.; formal analysis, R.V., A.S. and J.B.; investigation, R.V.; resources, S.C.; data curation, L.M.; writing—original draft preparation, L.M.; writing—review and editing, L.M.; visualization, J.B. and R.V.; supervision, L.M.; project administration, L.M. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by grant Ia ValSe-Food-CYTED (119RT0567), COOPI (Euro-peAid/154653/DD/ACT/Multi, UE), and Adeline Friesen -Tucos Factory E.I.R.L., Paraguay.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Ia ValSe-Food-CYTED (119RT0567), COOPI and Adeline Friesen.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lodhi, S.; Vadrone, G.P. Health-Promoting Ingredients in Beverages. In *Value-Added Ingredients and Enrichments of Beverages*; Elsevier: Amsterdam, The Netherlands, 2019; pp. 37–61; ISBN 978-0-12-816687-1.
2. Cardozo, M.L.; Ordoñez, R.M.; Alberto, M.R.; Zampini, I.C.; Isla, M.I. Antioxidant and Anti-Inflammatory Activity Characterization and Genotoxicity Evaluation of Ziziphus Mistol Ripe Berries, Exotic Argentinean Fruit. *Food Res. Int.* **2011**, *44*, 2063–2071. [\[CrossRef\]](#)
3. Cittadini, M.C.; García-Estévez, I.; Escribano-Bailón, M.T.; Bodoira, R.M.; Barrionuevo, D.; Maestri, D. Nutritional and Nutraceu-tical Compounds of Fruits from Native Trees (*Ziziphus mistol* and *Geoffroea decorticans*) of the Dry Chaco Forest. *J. Food Compos. Anal.* **2021**, *97*, 103775. [\[CrossRef\]](#)
4. Orqueda, M.E.; Zampini, I.C.; Torres, S.; Alberto, M.R.; Pino Ramos, L.L.; Schmeda-Hirschmann, G.; Isla, M.I. Chemical and Functional Characterization of Skin, Pulp and Seed Powder from the Argentine Native Fruit Mistol (*Ziziphus mistol*). Effects of Phenolic Fractions on Key Enzymes Involved in Metabolic Syndrome and Oxidative Stress. *J. Funct. Foods* **2017**, *37*, 531–540. [\[CrossRef\]](#)
5. Zahran, H.A.; Tawfeuk, H.Z. Physicochemical Properties of New Peanut (*Arachis hypogaea* L.) Varieties. *OCL* **2019**, *26*, 19. [\[CrossRef\]](#)
6. Horwitz, W.; Chichilo, P.; Reynolds, H. *Official Methods of Analysis of the Association of Official Analytical Chemists*, 17th ed.; AOAC: Gaithersburg, MA, USA, 2000.
7. Dreywood, R. Qualitative Test for Carbohydrate Material. *Ind. Eng. Chem. Anal. Ed.* **1946**, *18*, 499. [\[CrossRef\]](#)
8. Singleton, V.L.; Orthofer, R.; Lamuela-Raventós, R.M. [14] Analysis of total phenols and other oxidation substrates and antioxi-dants by means of folin-ciocalteu reagent. *Methods Enzymol.* **1999**, *299*, 152–178.
9. Re, R.; Pellegrini, N.; Proteggente, A.; Pannala, A.; Yang, M.; Rice-Evans, C. Antioxidant Activity Applying an Improved ABTS Radical Cation Decolorization Assay. *Free Radic. Biol. Med.* **1999**, *26*, 1231–1237. [\[CrossRef\]](#) [\[PubMed\]](#)
10. Sethi, S.; Tyagi, S.K.; Anurag, R.K. Plant-Based Milk Alternatives an Emerging Segment of Functional Beverages: A Review. *J. Food Sci. Technol.* **2016**, *53*, 3408–3423. [\[CrossRef\]](#) [\[PubMed\]](#)
11. De Egea Elsam, J.; Céspedes, G.; Peña-Chocarro, M.d.C.; Mereles, F.; Rolón Mendoza, C. *Recursos Fitogenéticos del Paraguay: Sinopsis, Atlas y Estado de Conservación de los Parientes Silvestres de Especies de Importancia para la Alimentación y la Agricultura (Parte I)*; Universidad Autónoma de Asunción (UAA): Asunción, Paraguay, 2018; p. 232.

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