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EVALUATION OF THE NUTRITIONAL AND FUNCTIONAL PROPERTIES OF PUMPKIN JAM ENRICHED WITH GINGER AND LEMON



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Abstract: This study was motivated by the objective to enhance the value of an often-underutilized vegetable, the pumpkin, by processing it into a novel product that is more palatable, nutritionally superior, and readily accepted by consumers. The combination of pumpkin with functional ingredients such as ginger, lemon, and raisins led to the successful development of a jam with an improved nutritional profile and a distinct sensory identity. For the comprehensive characterization of the developed product, a series of analytical and sensory determinations were conducted. The analytical results demonstrated that the polyphenol content in the final jam product was elevated compared to the principal raw materials (pumpkin and ginger), a finding attributed to the inclusion of lemon juice. Similarly, the antioxidant activity, assessed via the DPPH free radical scavenging assay, showed superior values in the final product. This enhancement is explained by the high concentration of antioxidant compounds in the lemon juice, which are efficient DPPH radical scavengers. The addition of lemon juice also affected the jam's pH level, with the resulting values remaining consistent with published literature. Furthermore, the jam exhibited higher moisture content than values previously reported for similar products by other researchers. Consequently, the product's lower reducing sugar content resulted in a soluble solids value that was below the typical range documented in the literature. Despite the reduction in sugar content, the pumpkin jam achieved a high degree of consumer acceptance. Sensory evaluation revealed that consistency and taste were the most highly rated attributes, while appearance and aroma received comparatively lower scores, indicating areas for future formulation refinement. In conclusion, the final product is considered a success, primarily due to its favorable nutritional composition, its appealing sensory characteristics, and the utilization of a cost-effective raw material.

Keywords: pumpkin, jam, polyphenols, antiradical activity, sensory analysis.

• Introduction

The nutritional value of pumpkin (*Cucurbita* spp.) is conferred by the presence of antioxidant compounds (carotenoids, phenols, flavonoids, triterpenes) and dietary fiber (Krodika *et al.*, 2003; Siemes *et al.*, 2005; Azeveo-Meleiro & Rodriguez, 2007; Bhaskarachary *et al.*, 2008). Additionally, pumpkin is notable for its low-caloric profile. Although traditionally used in baked goods and soups, its processing into preserved products is essential for utilizing seasonal surplus and extending shelf life.

While jams are conventionally obtained through the processing of fruits, the specific combination of pumpkin with ginger and lemon adds a unique aromatic complexity. However, this also poses additional technological challenges regarding pH balance and the matrix interaction of flavors. The intrinsic characteristics of pumpkin pulp – its high moisture content and soft texture with naturally low pectin levels – often necessitate recipe optimization.

The aim of the current work was to characterize the pumpkin and ginger jam from a sensory perspective and through the determination of its antioxidant activity, total phenolic content, soluble solids content, and acidity.

• Material and method

Raw materials sourced from the local market were used to obtain the jam, according to the recipe in Table 1.

Table 1 Ingredients and recipe

Ingredients	Weight (g)
Pumpkin pulp	3000 g
Ginger	220 g
Sugar	600 g
Rinse	400 g
Lemon juice	150 g



After preparation of ingredients (washing, peeling, chopping, dosing), the mixture was homogenized and boiled until the jam thickened. Polyphenol content was determined by spectrophotometric assay with Folin-Ciocalteu reagent and the results were expressed in mg GAE/g. Antiradical activity (RSA%) was evaluated by spectrophotometric assay using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. Moisture content was determined by the drying method. The titrimetric method was used for acidity determination. Refractometric method was used for determination of soluble solids expressed in °Brix. Pumpkin jam with ginger was analyzed from the point of view of sensory characteristics by a group of 15 people, men and women aged between 16 and 65 years, using a score from 1 to 9 appreciating the external appearance, color, smell, taste and consistency.



• Results and discussions

The analysis of the total polyphenol content and RSA of pumpkin jam are presented in Table 2.

• Conclusions

Starting with pumpkin - an underappreciated vegetable, the nutritional benefits of pumpkin jam have been greatly enhanced by the addition of ginger, lemon juice and raisins. The jam obtained was also very well appreciated from a sensory point of view. Despite these promising results, the product remains open to improvement. The visual appearance and intensity of the flavor could benefit from fine adjustments – perhaps by increasing the amount of ginger or a more careful presentation of the pumpkin pieces.

Table 2 Total Polyphenol Content of Raw Materials Used and Finished Product

Sample	Total polyphenols(mg GAE/g)	RSA(%)
Ginger	0.77 ± 0.0007	14.95 ± 0.25
Pumpkin	0.64 ± 0.0007	5.49 ± 0.36
Pumpkin and ginger jam	2.13 ± 0.0015	67.98 ± 0.045

The results obtained show that the level of polyphenols in the jam was higher than the polyphenol content of the main raw materials. This fact is explained by the presence of lemon juice in the jam.

The determination of the total polyphenol content revealed significantly higher values in ginger root compared to pumpkin and pumpkin jam. In ginger, values have reached up to 1.021 mg GAE/100 g (Zancan *et al.*, 2002), and other studies even report 1.1838 mg GAE/100 g in extracts (Mishra & Nema, 2023). In contrast, pumpkin has a content of between 77.5–97.4 mg GAE/100 g (Nawirska-Olszańska *et al.*, 2011), and in processed products, such as puree or jam, the values decrease significantly, reaching around 30–60 mg GAE/100 g. This decline highlights the degradative effect of heat treatment on phenolic compounds.

In direct correlation with the level of polyphenols, the antiradical activity recorded higher values in the finished product (67.69%) than in the main raw materials (ginger – 14.95%, pumpkin 5.49%), which can be explained by the presence of lemon juice which is rich in antioxidant compounds capable of capturing the DPPH free radical. Ginger exhibits the highest antioxidant activity, with DPPH inhibitions of up to 95% and IC₅₀ values between 0.48–15.2 µg/mL, depending on the type of extract (Salehi *et al.*, 2022; Mekonnen *et al.*, 2023; Solomon *et al.*, 2023). Pumpkin has moderate antioxidant activity, with values between 48–90%, the highest being in the skin (Adnan *et al.*, 2023). Pumpkin jam, as a thermally processed product, has a reduced capacity estimated at 20–30%, due to the degradation of phenolic compounds.

The humidity of simple pumpkin jam was in the range of 34.5%–36.2%.

The highest acidity was observed in the ginger sample, while raw pumpkin showed a lower titratable acidity, similar to that reported in the literature. In the case of pumpkin, pH values ranged from 4.13 to 4.39 (Adubofuor *et al.*, 2010). Pumpkin jam, prepared by adding sugar and lemon juice, showed an estimated titratable acidity between 0.3 and 0.6%, similar to the values reported in the literature for sugary products with added citric acid (Popa *et al.*, 2019). These variations in acidity are relevant in the context of the microbiological stability and sensory acceptability of the analyzed plant products, especially in the case of canned products, where higher acidity contributes to inhibiting the development of unwanted microflora.

The jam obtained had 55°Brix. The literature recommends concentrations in the 60–75°Brix range for conservation.

Sensory analysis showed a high degree of appreciation. The best rated attributes were consistency and taste, while appearance and smell were less appreciated – something that could be improved in the future.