



EFFECT OF VEGETABLE PEEL POWDERS ON THE NUTRITIONAL, PHYTOCHEMICAL AND SENSORY CHARACTERISTICS OF PASTA

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Abstract: This study evaluated the effect of partially substituting white wheat flour with powders derived from red beet, sweet potato, and celery peels on pasta composition, antioxidant activity, and sensory attributes. Four pasta formulations were prepared: PM – control (100% wheat flour), P1 – 5% red beet peel powder + 95% wheat flour, P2 – 10% sweet potato peel powder + 90% wheat flour, and P3 – 15% celery peel powder + 85% wheat flour, all containing egg, olive oil, and salt. Proximate analysis revealed minor variations in protein content: 10.35 g/100 g in P2, 10.45 g/100 g in P3, and 10.89 g/100 g in P1. Moisture was constant at 11.5 g/100 g. Energy values slightly decreased from 367.5 kcal/100 g (P1) to 364.5 kcal/100 g (P3). Total phenolic content rose from 20 mg GAE/100 g in the control to 58 mg GAE/100 g in P3, while DPPH antioxidant activity increased from 18% to 52%, demonstrating enhanced functional properties. Sensory evaluation showed that moderate substitutions (P1 and P2) maintained optimal acceptability, preserving texture, color, and flavor, whereas P3 exhibited a more intense color and pronounced taste. In conclusion, partial substitution of white wheat flour with vegetable peel powders significantly improved the nutritional and functional profile of pasta, offering a valuable alternative to conventional products while effectively valorizing vegetable by-products.

Keywords: pasta, vegetable peel powders, functional properties, sensory evaluation

• Introduction

The valorization of vegetable by-products represents an important approach to promoting sustainability in the food industry. The peels of beetroot, celery, and sweet potato are valuable sources of bioactive compounds, dietary fibers, minerals, and natural antioxidants. Their incorporation into pasta formulations contributes to the development of products with enhanced nutritional and functional value, while also reducing vegetable raw material losses. Moreover, the natural pigments present in these peels can provide pasta with an appealing color, eliminating the need for synthetic additives. Therefore, the use of vegetable peels in pasta production represents an innovative strategy for developing functional foods and supporting the circular economy in the agri-food sector. The aim of this study is to evaluate the potential use of beetroot, celery, and sweet potato peels in pasta formulations, focusing on their effects on nutritional quality, color, and functional properties.

• Material and method

- Ingredients:** Red beet peel powder, sweet potato peel powder, celery peel powder, eggs, olive oil, and salt were obtained from local specialized stores in Timișoara, Romania.
- Production of pasta samples:** Control and experimental pasta samples, prepared with different substitution levels of wheat flour by peel powders, were produced following the AACC International Method 10-50.05, with slight modifications.
- Sensory evaluation of pasta samples:** A panel of 15 trained panelists evaluated the pasta samples using a 9-point hedonic scale.
- The proximate composition, total phenolic content (TPC), and antioxidant activity (AA) of the pasta samples** were evaluated using standard laboratory procedures.

• Results and discussion

Peel powders from red beet, sweet potato, and celery enhance the nutritional and functional quality of pasta. Proximate composition: protein 10.35–10.89 g/100 g, energy 364.5–367.5 kcal/100 g. Moderate substitutions (5–10%) increased total phenolic content and antioxidant activity, while sensory attributes (appearance, color, and flavor) were maintained. Higher substitution (15% celery peel powder) resulted in more intense color and taste, slightly affecting consumer preference. Total phenolic content rose from 20 mg GAE/100 g in the control to 58 mg GAE/100 g in P3, while DPPH antioxidant activity increased from 18% to 52%, demonstrating enhanced functional properties.

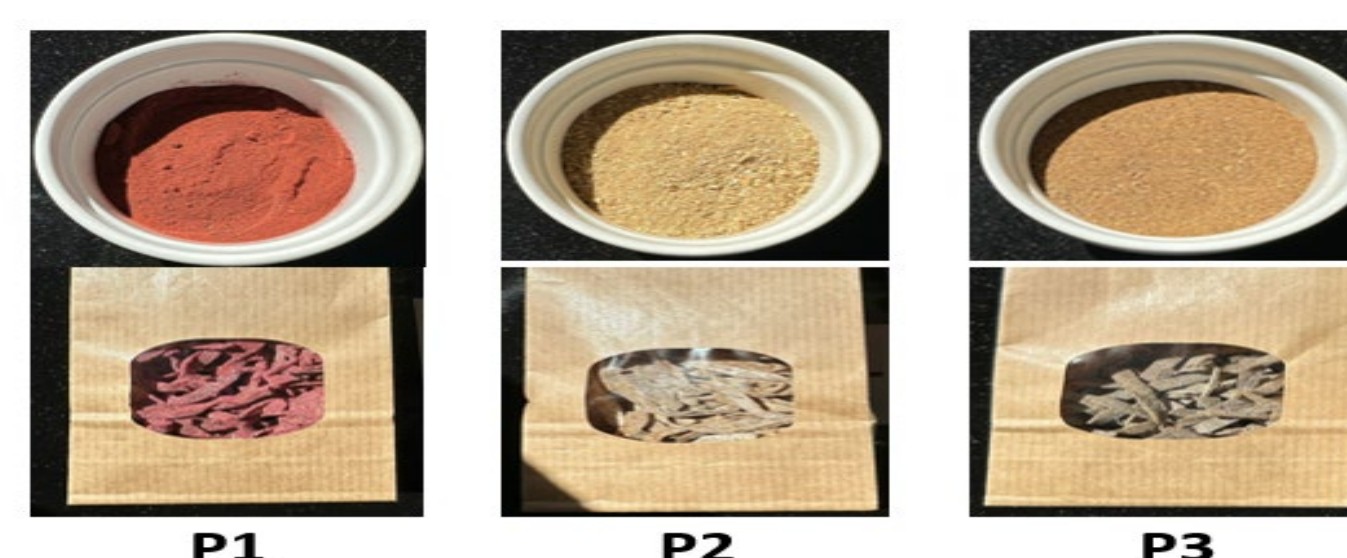


Figure 1. The pasta samples supplemented with peel powders

Table 1. Proximate composition of pasta samples

Proximate composition (%)	Pasta samples			
	PM	P1	P2	P3
Moisture	11.40 ± 0.11	11.52 ± 0.22	11.51 ± 0.09	11.50 ± 0.33
Fat	4.50 ± 0.14	4.54 ± 0.04	4.31 ± 0.11	4.22 ± 0.08
Protein	10.02 ± 0.24	10.89 ± 0.09	10.35 ± 0.14	10.45 ± 0.33
Crude fibre	2.20 ± 0.33	2.58 ± 0.22	2.59 ± 0.06	3.30 ± 0.21
Ash	0.9 ± 0.08	1.05 ± 0.03	1.07 ± 0.44	1.10 ± 0.33
Carbohydrates	71.50 ± 0.44	69.49 ± 0.22	70.25 ± 0.04	69.52 ± 0.08
Energy value (kcal/100 g)	368.9 ± 0.24	367.50 ± 0.04	366.40 ± 0.12	364.50 ± 0.22

Table 2. Sensory evaluation of pasta samples

Sensory evaluation	Pasta samples			
	PM	P1	P2	P3
Color	8.12 ± 0.07	8.96 ± 0.07	8.76 ± 0.23	7.62 ± 0.06
Appearance	7.74 ± 0.24	8.88 ± 0.24	8.72 ± 0.33	7.55 ± 0.11
Odor	7.28 ± 0.14	7.65 ± 0.33	7.84 ± 0.22	7.92 ± 0.36
Flavor	7.55 ± 0.27	8.06 ± 0.13	8.30 ± 0.24	8.48 ± 0.09
Overall acceptance	7.66 ± 0.06	8.82 ± 0.14	8.56 ± 0.22	7.37 ± 0.08

Conclusions

Partial substitution of wheat flour with red beet, sweet potato, and celery peel powders improved the nutritional and functional quality of pasta. Moderate substitutions (5–10%) maintained good sensory attributes, while higher substitution (15%) intensified color and taste, slightly affecting acceptability. This approach provides a sustainable strategy for producing nutrient-enriched, functional pasta.