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FORTIFICATION OF PASTA: IMPACTS ON QUALITY, NUTRITIONAL VALUE AND PHYTOCHEMICAL COMPOSITION

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Abstract: The objective of this study was to develop functional pasta formulations by partial replacement of wheat flour (WF) with NLP. Five pasta samples were prepared with WF:NLP substitution ratios of 100:0% (control), 95:5%, 90:10%, 85:15% and 80:20%. Standard laboratory analyses were then employed to evaluate the proximate composition, cooking properties, sensory characteristics, total phenolic content (TPC) and antioxidant activity (AA) of the obtained pasta. The results indicated that partial substitution of WF with NLP led to improvements in the nutritional profile, evidenced by increases in protein, fiber and mineral content, concomitant with a reduction in carbohydrate. The results obtained in terms of cooking properties showed prolonged cooking time and increased cooking losses, which had a negative effect on the overall acceptability of the pasta. The results of the sensory analysis indicated that the pasta sample with a 10% incorporation of NLF was the most highly regarded by the evaluators. The paste formulations demonstrated significantly superior functional attributes in comparison to the control sample. The addition of NLP to pasta may be a promising option for the development of food products for consumers seeking a healthy and functional diet.

Keywords: *nettle leaf powder, functional pasta, sensory evaluation, nutritional profile, antioxidant activity*

• Introduction

In response to the growing demand for natural and functional foods, the food industry is implementing innovative strategies that involve the reformulation of conventional recipes by using alternative raw materials from unconventional sources. In recent years, there has been an increased effort to identify and use sustainable natural resources, such as plant powders and unconventional flours, as viable alternatives to traditional ingredients. Nettle leaf powder (NLP) contains a lot of nutrients like protein, dietary fiber, vitamins (A, C, K, and B), minerals (calcium, iron, magnesium, phosphorus, potassium, and sodium), and fats (linoleic, linolenic, palmitic, stearic, and oleic). It also has all the essential amino acids, polyphenols (kaempferol, quercetin, caffeic acid, and other flavonoids), and pigments (beta-carotene, lutein, luteoxanthin, and other carotenoids).

• Material and method

WF, NLP and the other ingredients utilized in this study were procured from local market in Timisoara, Romania.

Standard analytical methods were used to determine the proximate composition, physical and sensory properties, total polyphenol content and total antioxidant capacity of the resulting pasta samples.

• Results and discussion

The results of this study demonstrate the potential of NLP in the design and development of food products with enhanced functionality. According to the results obtained, the partial substitution of wheat flour (WF) with NLP resulted in an improved nutritional profile of the pasta, as reflected by increased levels of protein, fiber, fat and ash. Furthermore, an increase in their functional properties was observed, supporting the potential health benefits of NLP in pasta. However, it was observed that replacing WF with more than 10% NLP in the pasta recipe resulted in adverse effects on other parameters, including cooked weight, cooking loss and sensory acceptability.

The pasta formulations obtained are shown in Figure 1:

Figure 1. Dough and pasta samples supplemented with NLP

Table 1. Proximate composition of pasta samples

Pasta samples	Proximate composition (%)					
	Moisture	Fat	Protein	Fiber	Ash	CRB*
PC	8.74 ± 0.12	1.32 ± 0.22	9.68 ± 0.04	1.42 ± 0.54	1.04 ± 0.08	77.80
P5NLP	8.56 ± 0.04	1.24 ± 0.33	12.16 ± 0.22	1.96 ± 0.14	1.42 ± 0.13	74.66
P10NLP	8.44 ± 0.31	1.14 ± 0.11	12.52 ± 0.24	2.25 ± 0.25	1.89 ± 0.05	73.76
P15NLP	8.22 ± 0.04	1.09 ± 0.09	12.94 ± 0.08	2.52 ± 0.09	2.28 ± 0.08	72.95
P20NLP	8.16 ± 0.09	1.02 ± 0.41	13.36 ± 0.31	2.98 ± 0.33	2.65 ± 0.44	71.83

PC – Pasta control (100% wheat flour (WF): 0% nettle leaf powder (NLP); **P5NLP** - Pasta samples with 95% wheat flour (WF): 5% nettle leaf powder (NLP); **P10NLP** - Pasta samples with 90% wheat flour (WF): 10% nettle leaf powder (NLP); **P15NLP** - Pasta samples with 85% wheat flour (WF): 15% nettle leaf powder (NLP); **P20NLP** - Pasta samples with 80% wheat flour (WF): 20% nettle leaf powder (NLP).

Table 2. Cooking properties of pasta samples

Treatments	Pasta				
	PC	P5NLP	P10NLP	P15NLP	P20NLP
Cooking time (min)	5.25 ± 0.11	5.86 ± 0.19	6.35 ± 0.33	6.74 ± 0.32	7.13 ± 0.09
Cooked weight (g)	4.12 ± 0.04	4.42 ± 0.24	4.68 ± 0.52	4.76 ± 0.20	4.96 ± 0.26
Cooking loss (%)	3.42 ± 0.28	4.28 ± 0.33	4.49 ± 0.05	4.77 ± 0.22	4.93 ± 0.25

Table 3. Phytochemical properties of pasta samples

Pasta samples	Phytochemical properties	
	TPC (mg GAE/g)	AA (µmol TE/ g)
PC	86.44±0.06	4.66±0.06
P5NLP	94.40±0.09	5.87±0.33
P10NLP	104.67±0.28	7.94±0.44
P15NLP	113.22±0.05	9.88±0.21
P20NLP	125.52±0.39	13.47±0.03

Table 4. Sensory evaluation of pasta samples

Sensory evaluation	Pasta samples				
	PC	P5NLP	P10NLP	P15NLP	P20NLP
Color	4.24 ± 0.87	4.16 ± 0.22	4.08 ± 0.33	3.62 ± 0.02	3.24 ± 0.08
Appearance	4.39 ± 0.14	4.28 ± 0.12	4.14 ± 0.04	3.78 ± 0.14	3.27 ± 0.24
Odor	4.22 ± 0.17	4.18 ± 0.36	4.06 ± 0.01	3.43 ± 0.33	3.14 ± 0.24
Flavor	4.32 ± 0.47	4.21 ± 0.13	4.12 ± 0.04	3.56 ± 0.09	3.16 ± 0.08
Overall acceptance	4.34 ± 0.33	4.25 ± 0.18	4.16 ± 0.22	3.29 ± 0.44	3.07 ± 0.44

• Conclusions

The results obtained from this study show that the use of NLP in the production of pasta leads to a floury product with improved functionality. Sensory evaluation of WF and NLP based pasta shows that the use of up to 10% NLP in the recipe leads to increased consumer acceptance. The study also revealed a substantial increase in the content of phenolic compounds and antioxidant activity in the pastes. The overall nutritional, physical, phytochemical and sensory evaluation of the obtained pastes showed that NLP may represent a valid plant source in the formulation of new food products with improved functionality.