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Impact of plant additives: Parsley (*Petroselinum crispum*) leaves and red bell pepper (*Capsicum annuum*) on the quality of eggless wheat pasta

Eugenia Covaliov, Olga Deseatnicova, Vladislav Resitca, Natalia Suhodol, Carolina Grosu, Rodica Siminiuc*

Food and Nutrition Department, Faculty of Food Technology, Technical University of Moldova, Chisinau, Republic of Moldova

**Corresponding author: eugenia.boaghi@toap.utm.md*

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Abstract: Pasta is very popular among different groups of the population, being a healthy and cheap product. Therefore, pasta is a promising object for its enrichment with functional ingredients. The paper examined the possibility and feasibility of using red bell pepper powder (BPP) and parsley leaf powder (PLP) in order to enhance the pasta biological value. Recipes of spaghetti pasta production with the addition of red BPP and PLP were developed. The effect of powders from red bell pepper and parsley leaf incorporation on the physicochemical and culinary properties of pasta was studied. The enrichment of pasta induced a decrease in optimal cooking time, swelling index (*SI*) and water absorption index (*WAI*). The addition of plant powders decreased the lightness of pasta significantly ($P < 0.05$) compared to the control sample. On the other hand, the addition of vegetable powders has a positive influence on the total polyphenol content (TPC) and antioxidant activity of pasta. In enriched pasta, the polyphenol content has doubled (pasta with 10.0% BPP) or even tripled (pasta with 10.0% PLP). The received scores from the sensory evaluation showed that pasta fortified with PLP and red BPP can be a technological alternative to provide nutritionally enriched pasta.

Keywords: vegetable powders; swelling index; polyphenols; antioxidant activity

Globally, people's lifestyles are constantly changing and, in terms of eating habits, they are changing in an unhealthy manner (Di Cesare et al. 2019). Both developed and developing countries are facing a nutritional transition (Popkin 2015; Schifferstein 2020). This phenomenon is characterised by a decrease in physical activity and too low consumption of vegetables and grains (Shetty 2013). Eating habits are now characterised by an increase in the consumption of energy-rich foods. This lifestyle is one of the factors for the development of diseases such as obesity, which was recently recognised as a global epidemic (Schmidhuber and Shetty 2005; World Health Organization 2009).

Traditionally an Italian product, wheat pasta has become a product consumed worldwide due to its ease of transport, handling, cooking, and long shelf life (Zhu et al. 2013; Li et al. 2014). There are different types of pasta on the market, of different shapes, sizes and with different additives, from different raw materials. Among wheat botanical species, durum wheat flour

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called traditionally semolina is considered the best raw material due to its protein viscoelastic properties. The composition of durum wheat semolina can be divided into three main constituents: the main fraction being starch, followed by protein and fibre (70–80, 10–15, and 1–2% of the total weight, respectively). The remaining part is composed of small amounts of lipids, vitamins and minerals (Gull et al. 2015, 2018).

The pasta products are rich in carbohydrates, but they usually lack biologically active compounds (produced from highly extracted flour types). In this regard, the food industry pays close attention to the development and production of fortified products, for dietary and functional purposes, that contain biologically active substances or natural components that can change the biological value of food (Bigliardi and Galati 2013). Currently, an assortment of pasta products is expanding by increasing the nutritional value and creating new types of products for prophylactic purposes and with various additives. Plant raw materials are used as additives: fruits, berries, vegetables, and mushrooms, as well as their processed products (Gopalakrishnan et al. 2011; Spinelli et al. 2019). Several studies were conducted to develop pasta designed to have a therapeutic action: pasta enriched with grape skin bio-additives is designed to enhance a person's immune functions to the effects of radiation (Gaita et al. 2020). Besides, pumpkin and apple supplements in pasta formulations have a beneficial effect on the gastrointestinal system, stimulating also the activity of the heart (Mirhosseini et al. 2015; Espinosa-Solis et al. 2019).

The interest in the use of bell pepper and parsley is largely due to their content of bioactive compounds and their importance as dietary antioxidants (Chávez-Mendoza et al. 2015; de Menezes Epifanio et al. 2020). In the food industry, these raw materials are used as dyes, flavourings or as a source of biologically active substances (El-Sayed and Youssef 2019; Kaur et al. 2020).

The aim of the research was to produce eggless wheat pasta enriched with red bell pepper powder (BPP) and parsley leaf powder (PLP) and to determine the relationships between the technological, sensory, and nutritional properties of pasta.

MATERIAL AND METHODS

Material. In pasta production, wheat flour and tap water were used as the main ingredients. All-purpose fine-milled wheat flour (2020 production year) was purchased from a local market. According to its label, the flour chemical composition was as follows: carbohydrates 73.1%, proteins 10.7%, fat 0.9%, fibre 1.3%, and ash 0.5% (i.e. moisture content 13.5%). Parsley and bell pepper were purchased from a local market in July 2020. PLP and red BPP were obtained by drying fresh parsley leaves and red bell pepper according to the procedure described below.

Powder manufacturing. Both alternative plant materials BPP and PLP were obtained by convective drying of parsley leaves and red bell peppers (harvest of 2020 year), which were preventively washed and the inedible parts (seeds of bell peppers) were removed. The samples were dried gently at 45 ± 2 °C in an SLN75 drying oven (POL-EKO-APARATURA, Poland) in an effort not to destroy present bioactive components. Periodically during drying, small samples were taken out and weighed to calculate the moisture content. Drying continued until the moisture content reached 12–13% (the same moisture level as in the flour). The dried materials were milled in a coffee bean miller (BCG111; KitchenAid, US) and manually sifted through a sieve with 200 μm cells.

Moisture content. Moisture content was determined according to American Association of Cereal Chemists (AACC) Method 44-01.01 by oven drying (SLN75; POL-EKO-APARATURA, Poland). To determine the moisture content of wheat flour, PLP, BPP and dried pasta, 5 g of product were taken, disintegrated (in the case of pasta variants) and dried at 105 °C until a constant weight was reached.

Water holding capacity (WHC). Water holding capacity (WHC) was determined according to AACC Method 57-13.01 and expressed as the maximum amount of water that 1.00 g of material imbibes and retains under low-speed centrifugation. Vegetable powder (1 g) and distilled water (20 mL) were placed in the EBA 20S centrifuge tubes (Hettich; US) that were shaken later in a BT 926 Orbital shaker (BT Lab Systems, US). The tubes were centrifuged at 3 000 rpm for 60 min. The supernatant was decanted and the remaining precipitate was weighed. The WHC was expressed as the amount of water retained by 1.00 g of powder.

Pasta preparation. The technology of preparation of eggless wheat spaghetti with increased biological value is based on the modification of the basic recipe of pasta, prepared according to AACC Method 62-40.01. The reference pasta was prepared using 100% wheat flour. The pasta doughs were prepared using a KitchenAid (Artisan® Series 5 Quart Tilt-Head; US) dough mixer (tilt-head stand mixer). Tap water was added to the flour (35 : 100 by weight), and mixed for 25 min at speed 2 in order to obtain the pasta dough. The spaghetti of length

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250 mm and about 2.5 mm thickness was shaped using a hand pasta maker machine (Nuvantee, Italy) and then horizontally air-dried at 50 °C in an SLN75 (POL-EKO--APARATURA, Poland) drying oven (in a single layer on a baking sheet) until reaching a moisture content of 13% (i.e. time interval from 2 h to 6 h).

Enriched pasta was prepared by replacing wheat flour with 2.5, 5.0, and 10.0% of PLP and BPP. In all cases of adding BPP or PLP, the moisture content of the powder was taken into account. Further attempts were made to obtain pasta by substituting 15.0% and 20.0% of vegetable powder for wheat flour. However, the dough with normalised moisture content (35.0 ± 1.0%) could not be obtained due to the lack of 'free' water, because the water introduced into the dough with pepper or parsley powder turns into a bound state. Therefore, when studying the effect of BPP or PLP inclusion on the structure and quality of pasta, the powder was added in a maximum amount of 10.0% of the wheat flour mass. Additions under 20.0% were specified by Lu et al. (2018) and Biernacka et al. (2020).

Cooking time. Determined according to AACC Method 66-50, the cooking time is an indicator of pasta quality – the longer the time, the higher the cooking loss of starch, vitamins, and proteins from pasta into boiling water. In order to establish the optimal cooking time, 20 g of pasta were immersed in 250 mL of boiling distilled water. At intervals of 30 s, up to three pasta pieces were removed from the water and placed between two glass slides. A light press was applied to the glass slides and the inside appearance of cooked pasta was analysed visually. The point at which the white core of the sample disappeared indicating the total water uptake by the pasta was then established the optimal cooking time.

Swelling and water absorption indices. Swelling that occurred during the optimal cooking time was determined according to the procedure described by Cleary and Brennan (2006) and expressed as a weight percentage [g H_2O (g dry pasta)$^{-1}$]. One hundred grams of pasta was weighed after cooking and dried at 105 °C until constant weight (SLN75; POL-EKO-APARATURA, Poland). The swelling index (*SI*) of cooked pasta was calculated as follows:

$$SI = \frac{W_c - W_d}{W_d} \text{ (wt\%)} \quad (1)$$

where: W_c – weight of cooked pasta (g); W_d – weight of pasta after drying (g); wt – weight per cent.

Water absorption index (*WAI*) as a portion of water absorbed was determined according to the equation:

$$WAI = \frac{W_c - W_u}{W_u} \text{ (wt\%)} \quad (2)$$

where: W_u – weight of uncooked pasta (g).

Colour evaluation. The colour of uncooked pasta was analysed in the CIELab space, using a Konica Minolta CR-400 (Japan) colourimeter. Prior to determinations, dry uncooked pasta was milled and sifted through a 250 μm sieve. For each sample of pasta, values of L^*, a^*, and b^* colour coordinates were measured in three replications. Colour difference ΔE was calculated for each pasta variant.

Total polyphenol content (TPC) and antioxidant activity. The total polyphenol content (TPC) was determined using Association of Official Analytical Chemists (AOAC) Folin-Ciocalteu assay (Blainski et al. 2013).

To assess the antioxidant activity of researched powders and pasta samples, 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical method was used (Sharma and Bhat 2009). For both determinations, a DR-5000 spectrophotometer (Hach Lange, United Kingdom) was used.

Sensory analysis. The sensory evaluation of pasta was performed within the Food and Nutrition Department of Technical University of Moldova, which was attended by 24 panellists (aged 30 to 65 years old). They were offered a tasting sheet, in which the main quality parameters of the pasta and its grading scale were indicated. The evaluated quality parameters were appearance, colour, aroma, texture, flavour, and taste. The quality of pasta was evaluated using a 5-point hedonic scale from 'dislike extremely' to 'like extremely', ranging from 0 points to 5 points, respectively.

Statistical analysis. All determinations were carried out in triplicate with the exception of sensory analysis as mentioned above. The results are shown as mean ± standard deviation (SD). Student's *t*-test was used for comparison between two means. The data were statistically analysed by analysis of variance (ANOVA) and Tukey's tests (α = 0.05). In order to establish the correlation between some parameters, regression analysis was performed.

RESULTS AND DISCUSSION

According to the standards, the moisture content of pasta should not exceed 13%, and for the products transported over long distances, 11% is the maximum allowed. An increase in moisture content can cause an acceleration of biochemical and microbiological processes, leading to a depreciation of product qual-

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ity. The results indicate that none of the samples exceeds the permissible humidity standards (Table 1), however, there is a tendency, especially for the BPP pasta (BPPp), to increase the moisture content as the amount of BPP has risen. This can be correlated with WHC as discussed later. Consequently, the highest level of moisture was recorded correspondingly for the most enriched pasta with 10% of BPP (12.90%).

Since the wheat flour was replaced with plant powders in pasta's recipe, it would be meaningful to compare the WHC of these ingredients. The parameter WHC is often associated with the ability of a protein matrix to absorb and retain water (Traynham et al. 2007). According to the flour label, it contains 10.7% protein; at the same time, the scientific literature indicates a protein content of 3.09–4.05% for dried bell pepper (El-Ghorab et al. 2013) and 17.0% for dried parsley leaves (Prandi et al. 2019). However, the obtained results did not show any relationship between the protein content of the products and their WHC. Berton et al. (2002) stated that the increase in protein content seems to have a minor influence on the evolution of hydration capacities. The values recorded for WHC were 2.11 mL H_2O g^{-1} for BPP, 2.24 mL H_2O g^{-1} for PLP and the lowest for wheat flour (0.77 mL H_2O g^{-1}). The higher WHC level for plant powders can be explained by its dependence on the surface of the particles. Therefore, during the milling of dried parsley leaves and dried red bell pepper, hydrophilic groups of cellulose in the plant powders might have been exposed, resulting into a larger count of contact points for water molecule binding.

TPC and antioxidant activity of pasta. The purpose of adding parsley and BPP is actually to support the biological value of pasta, which is especially conferred by polyphenols and vitamins. For this reason, the total content of polyphenols and the antioxidant activity of the powders (Table 2) and pasta variants were determined. For the case of pasta, the obtained results are presented in Figure 1.

The data show that the PLP pasta (PLPp) has a significantly (P < 0.05) higher amount of polyphenols [0.44–0.63 mg gallic acid equivalent (GAE) g^{-1}] than the control variant (0.21 mg GAE g^{-1}) and BPPp (0.30–0.43 mg GAE g^{-1}). This is confirmation of the highest polyphenol content for PLP, medium for BPP and the lowest for wheat flour (values 2.02, 1.99, and 0.37 mg GAE g^{-1} as mentioned supra, respectively). At the same time, pasta production on a laboratory scale did not mean any more important heat or stress-strain damage of organic components in hand-pressed pasta. It could be supposed that the industrial extrusion of pasta (i.e. up to 12 MPa) may partially affect the final product composition including those bioactive substances independently of raw material premixing at a high vacuum.

Antioxidant activity is an excellent example of the functional benefit that plant extracts can provide. Plants are known to contain a variety of natural antioxidants that protect and maintain their physical and metabolic integrity, as well as heredity through their seeds. The antioxidant activity of the pasta variants was assessed by measuring their scavenging abilities to 1,1'-diphenyl-1-picryl-hydrazyl stable radicals. Initially, the antioxidant activity of the plant powders was determined and the values of 68.84% for BPP and 83.56% for PLP were registered. For the enriched pasta, values of 29.20–54.40% for BPPp and 42.80–77.93% for

Table 1. Physical and technological parameters of uncooked and cooked wheat pasta

Wheat pasta sample	Powder addition (%)	Moisture content (%)	*SI* [g water (g dry pasta)$^{-1}$]	*WAI* [g (100 g)$^{-1}$]	Optimal cooking time
Control	0.0	12.20 ± 0.11^{a}	3.23 ± 0.03^{a}	177 ± 1^{a}	4 min 30 s
PLPp	2.5	12.24 ± 0.15^{a}	3.17 ± 0.02^{a}	171 ± 3^{bc}	4 min 30 s
	5.0	12.29 ± 0.09^{a}	3.05 ± 0.03^{a}	168 ± 1^{bc}	4 min 30 s
	10.0	12.34 ± 0.07^{a}	2.95 ± 0.02^{a}	165 ± 2^{b}	4 min 00 s
	average	12.29 ± 0.10^{a}	3.06 ± 0.02^{a}	168 ± 2^{bc}	4 min 20 s
BPPp	2.5	12.48 ± 0.07^{a}	3.04 ± 0.04^{a}	169 ± 1^{bc}	4min 30 s
	5.0	12.72 ± 0.09^{a}	2.93 ± 0.02^{a}	165 ± 2^{b}	3 min 30 s
	10.0	12.90 ± 0.08^{a}	2.81 ± 0.02^{a}	163 ± 1^{b}	3 min 00 s
	average	12.70 ± 0.08^{a}	2.93 ± 0.03^{a}	166 ± 1^{b}	3 min 40 s

$^{a-c}$Averages in columns, signed by the same letter, are not statistically different (P > 0.05); *SI* – swelling index; *WAI* – water absorption index; BPPp – bell pepper powder pasta; PLPp – parsley leaves powder pasta; for the optimal cooking time, analysis of variance (ANOVA) could not be calculated owing to a discontinuous character of the variable

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Table 2. Water holding capacity (WHC), total polyphenol content (TPC) and antioxidant activity of wheat flour, parsley leaf powder (PLP) and red bell pepper powder (BPP)

Powder type	WHC (mL H_2O g^{-1})	TPC (mg GAE g^{-1})	Antioxidant activity (%)
Wheat flour	0.77 ± 0.07^a	0.37 ± 0.01^a	11.93 ± 0.13^a
BPP	2.11 ± 0.11^b	1.99 ± 0.03^b	68.84 ± 0.38^b
PLP	2.24 ± 0.07^b	2.02 ± 0.09^b	83.56 ± 0.47^c

$^{a–c}$Averages in columns, signed by the same letter, are not statistically different ($P > 0.05$); GAE – gallic acid equivalent

PLPp were obtained. The positive effect of the incorporation of parsley or red bell pepper on TPC and antioxidant activity of fortified products has been reported in numerous studies. Sęczyk et al. (2015) outlined TPC of 0.87 mg GAE g^{-1} (compared to 0.67 mg GAE g^{-1} for the control counterpart) when fortifying the wheat pasta with parsley powder (4% wheat flour substitution). Rababah et al. (2012) mentioned the same effect of PLP in the case of potato chip fortification. Concerning red bell pepper, Kaur et al. (2020) stated this powder is a valuable supplement for developing bread with an improved nutritional and bioactive score, reporting TPC of 0.63 mg GAE g^{-1} for the bread fortified with red BPP (10% wheat flour substitution).

The relationship between TPC and antioxidant activity is presented in Figure 2. Regression analysis shows that TPC contributes to about 90% ($R^2 = 0.901$, $r = 0.949$, $P < 0.05$) of antioxidant properties in the enriched pasta samples (Mello and Quadros 2014). Several studies have shown a correlation between the elevated content of polyphenols in the diet and decreased risk of cardiovascular diseases, stroke (Lotito and Frei 2003) or diabetes (Anhê et al. 2013). In fact, polyphenols primarily act as antioxidants. Besides, they can prevent the breakdown of starch into simple sugars, lowering the likelihood of high blood sugar after meals (Hano and Tungmunnithum 2020).

Optimal cooking time. Cooking pasta by boiling could have different degrees of influence on nutritional and functional components. The impact of powder addition on the optimal cooking time was investigated. For the control sample, the optimal period was 4 min 30 s, the same value was recorded for the PLP-enriched pasta. For a triple of BPPp samples, the cooking time was shortened with the increasing addition of the powder. In the case of pasta with 10% BPP, the cooking period decreased to 3 min 00 s. This reduction in cooking time was accompanied by a lower *SI* (2.81 for 10.0% BPPp *vs.* 3.23 for the control variant and 2.95 for 10.0% PLPp). The shapes and thickness of all pasta variants were similar and could not explain this reduction of optimal cooking time. This is in accordance with the study of Petitot et al. (2010), where a reduction in optimal cooking time was observed when substituting split pea and faba bean flours for wheat flour in pasta formulations.

Swelling and water absorption indices. The addition of both plant powders was reflected in the moisture content of dried pasta. The BPPp and PLPp had an insignificantly higher moisture content. The fortified pasta samples contained smaller starch granules, and the formed fibre network could have limited water absorption. Spaghetti prepared with 2.5–10.0% plant powder showed an insignificantly lower *SI* [3.17–2.81 g water (g dry pasta)$^{-1}$, respectively] compared to the control variant [3.23 g water (g dry pasta)$^{-1}$]. Foschia et al. (2015) explained this by the competition of starch with

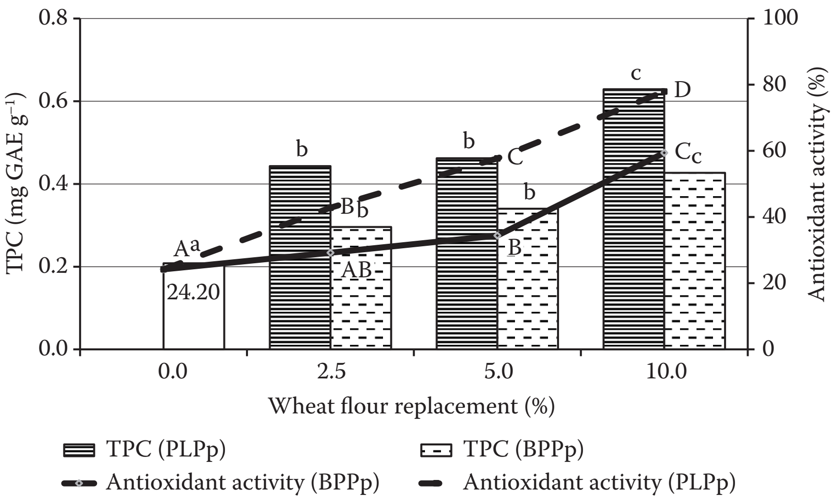

Figure 1. Total polyphenol content (TPC) and antioxidant activity of control and enriched eggless wheat pasta

A–D – columns or dots signed by the same capital letter, are not statistically different ($P > 0.05$); a–c – columns or dots signed by the same lowercase letter, are not statistically different ($P > 0.05$); BPPp – bell pepper powder pasta; PLPp – parsley leaves powder pasta; GAE – gallic acid equivalent

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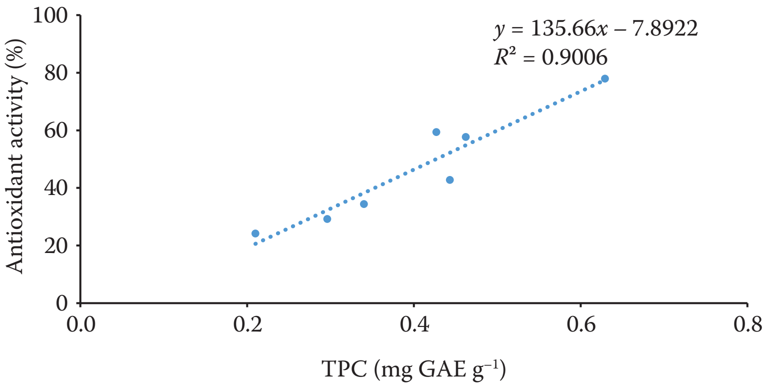

Figure 2. Relationship between total polyphenol content (TPC) and antioxidant activity of enriched pasta

GAE – gallic acid equivalent

the fibres for water during the preparation of pasta, thus reducing the swelling of starch and consequently the absorption of water. Despite the obtained results, numerous studies have shown an increase in the *SI* when fortifying pasta with dietary fibre and vegetables (Tudorică et al. 2002; Krishnan et al. 2012).

Concerning the *WAI*, Table 1 shows that the substitution of plant powders for wheat flour caused a significant decrease in the *WAI*, especially in BPPp. In the order of enrichment levels 2.5, 5.0, and 10.0%, the water absorption value ranged from 171 g (100 g)$^{-1}$ to 165 g (100 g)$^{-1}$ for PLPp, 169–163 g (100 g)$^{-1}$ for BPPp and 177 g (100 g)$^{-1}$ for the control. This reduction may occur because plant powders reduce starch swelling and pasta water absorption by competing with starch for water during pasta formation. Similar results were mentioned in numerous researches aimed at fortifying pasta with protein powder from fish, mushroom powder or split pea and faba bean flours (Petitot et al. 2010; Lu et al. 2016; Desai et al. 2018).

Colour evaluation. Colour, flavour, and texture are the three principal quality attributes that determine food acceptance (Wrolstad and Smith 2017). In this respect, the colour parameters of researched pasta samples were evaluated using a colourimeter. Table 3 shows the main chromatic parameters of studied uncooked pasta samples.

As expected, the control pasta and counterparts with 2.5% powders showed significantly higher lightness (L^*) values than the products with 5.0% and 10.0% of wheat flour substitution. The lightness decreased significantly up to values 19.20 (i.e. about 76%) and 22.31 (i.e. about 73%) in the case of 10% PLPp and BPPp, respectively. The a^* (i.e. redness) values of BPPp showed a major upward trend along the addition. The highest redness and reversely the lightness were found due to the incorporation of BPP anthocyanins. The same results were published by Sant'Anna et al. (2014) – they associated an increase of a^* tint with grape marc powder inclusion in fettuccini pasta. For samples with added PLP, on the contrary, a decrease of the a^* component was observed, reaching negative values indicating a shift into the green part of visible spectra due to a higher concentration of chlorophyll compounds. The yellowness b^* showed

Table 3. Colour parameters (L^*, a^*, b^*) and total colour difference ΔE of uncooked pasta

Wheat pasta sample	Powder addition (%)	L^*	a^*	b^*	ΔE
Control	0.0	81.58 ± 1.85^a	–0.43 ± 0.01^a	20.46 ± 0.23^a	0.00
PLPp	2.5	32.85 ± 1.56^b	–1.23 ± 0.03^b	17.24 ± 0.12^b	48.84 ± 1.84^a
	5.0	25.29 ± 0.97^c	–3.46 ± 0.06^c	17.09 ± 0.27^b	56.47 ± 2.31^b
	10.0	19.20 ± 0.77^d	–3.87 ± 0.05^c	12.71 ± 0.21^c	62.95 ± 2.14^c
	average	25.78 ± 1.10^b	–2.85 ± 0.04^b	15.68 ± 0.20^a	56.08 ± 2.10^c
BPPp	2.5	35.23 ± 1.01^b	19.99 ± 0.11^b	35.35 ± 0.16^b	52.79 ± 2.16^a
	5.0	34.31 ± 1.12^c	20.65 ± 0.21^c	33.28 ± 0.27^c	53.32 ± 2.41^b
	10.0	22.31 ± 0.87^d	21.12 ± 0.17^d	27.25 ± 0.13^d	63.43 ± 2.43^c
	average	30.61 ± 1.00^b	20.59 ± 0.16^d	31.96 ± 0.18^b	56.51 ± 2.33^{ab}

$^{a-d}$Averages in columns, signed by the same letter, are not statistically different ($P > 0.05$); BPPp – bell pepper powder pasta; PLPp – parsley leaves powder pasta

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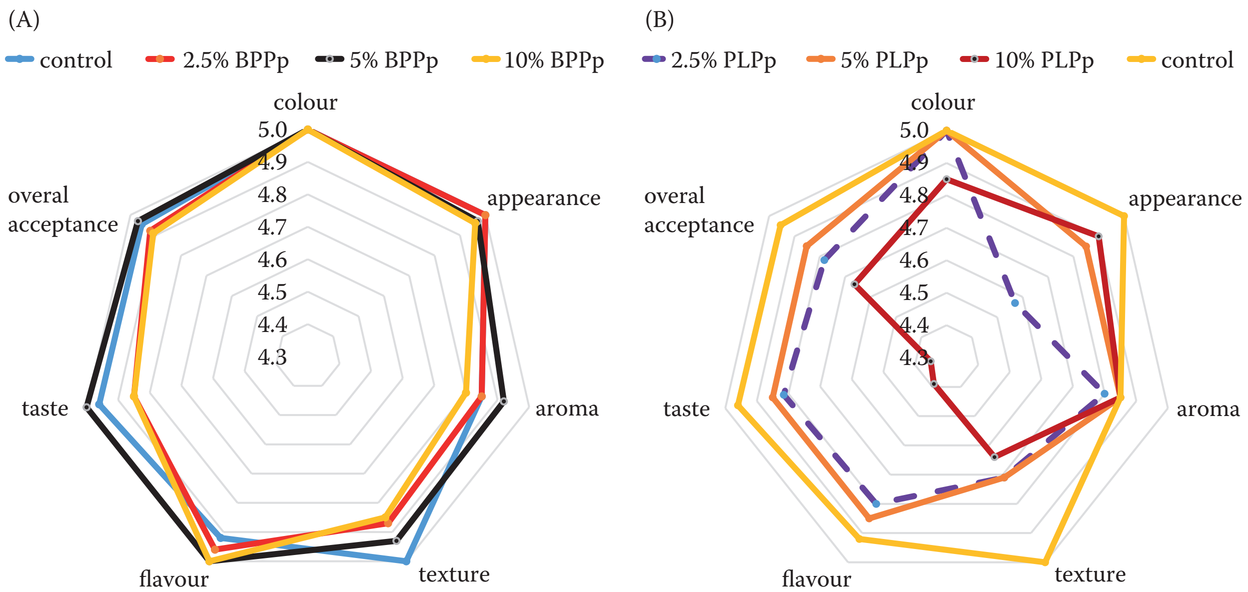

Figure 3. Results of sensory analysis of control wheat pasta and variants enriched with (A) bell pepper powder (BPP) and (B) parsley leaves powder (PLP)

BPPp – bell pepper powder pasta; PLPp – parsley leaves powder pasta; number 5 means the best quality

different trends: in the case of PLPp, b^* decreased to 12.71; in the case of BPPp, it reached approximatively twofold values in maximum. At the same time, they were higher compared with the control (27.25 *vs.* 20.46, respectively). For both types of fortified pasta, PLPp and BPPp, the calculated averages demonstrated a linear shift in the colour space (simple addition of colour components). The averages roughly correspond to the values determined for the medium addition level (5%).

In order to evaluate the colour differences between pasta variants, the total colour difference ΔE was determined within the CIELab space, it expresses the Euclidean distance of enriched pasta samples in relation to the control one. The ΔE values of plant powder pasta increased with the addition levels as expected. In addition, BPPp exhibited a higher total colour difference compared to PLPp; the main factor could be considered the redness a^* (difference between the BPPp and PLPp averages over 20) (Table 3). There is an experimental knowledge of just noticeable difference (JND) in the colour of two objects (ΔE^*_{00}) equals to 1 (Maji and Dingliana 2018). Summarised, all prepared pasta variants fulfil this theorem and could be verifiably distinguished according to colour by eyes only.

Sensory evaluation. Figure 3 shows the results of the sensory analysis of BPPp and PLPp, where a higher score is related to better acceptance of the evaluated attribute.

Pasta samples with the addition of BPP were more appreciated than counterparts enriched with PLP. The lowest overall acceptance was attributed to the sample in which 10.0% of wheat flour was replaced with PLP. The samples obtained the presented values of the sensory parameters for the following reasons:

i) The samples do not have a glassy appearance;

ii) The samples with 10% BPP or PLP have too dominant taste, as well as the aroma of powders is too dominant;

iii) The sample with 10% PLP does not have a homogeneous consistency, sandy powder particles are felt.

Thus, the most appreciated sample was the one with the addition of 5% BPP, followed by the other BPPp samples and then finally by the sample with 5.0% PLP. The lowest score was accumulated by the sample with 10.0% parsley, largely due to the parsley particles that gave a feeling of sand in the mouth, even if the same equipment was used in the preparation of both vegetable powders.

CONCLUSION

In this study, recipes of pasta with elevated content of biologically active compounds were developed in the extent accessible in a home kitchen. It has been established that the addition of powders from red bell pepper and parsley leaves influenced positively the culinary properties of pasta. With the increase of the powder amount, the optimal cooking time became shorter; the same tendency was manifested by the swelling and water absorption indices. The addition of plant pow-

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ders also enhanced the total content of polyphenols and the antioxidant activity of pasta, the highest values of 0.63 mg GAE g^{-1} and 77.93%, respectively, being exhibited by the pasta samples with 10% PLP. After plant powder addition, the pasta colour became darker and lower a^* and b^* values were observed, indicating a significantly darker and more saturated green or red colour (in the case of wheat pasta enriched with PLP or red BPP, respectively). At the same time, the average of total colour difference in both enrichment cases was higher than 56, i.e. the variant triple in both pasta subsets could be simply distinguished in colour by the human eye. The enrichment with non-traditional raw materials at a level of 5–10% is usual in the food industry; consequently, the results of the organoleptic examination play a dominant role. Sensory scoring of enriched pasta elucidated that the optimal amount for wheat flour substitution is 5%. For such a sample, the polyphenol content reached more than 73% of the highest measured level.

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