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EFFECT OF PUMPKIN POWDER INCORPORATION ON COOKING AND SENSORY PARAMETERS OF PASTA

Lucia Minarovičová, Michaela Lauková, Zlatica Kohajdová, Jolana Karovičová, Veronika Kuchtová

ABSTRACT
Pasta is commonly consumed and low glycaemic cereal-based food with long shelf life, which is suitable food matrix for substitution with functional ingredients. Pumpkin powder can be considered as suitable component in pasta making. The effect of addition of pumpkin powder at different levels (5, 7.5, and 10%) on wheat dough rheology, cooking quality of pasta as well as on sensory properties was evaluated. Pumpkin powder included: 6.1% moisture, 8.2%, protein, 0.7% crude fat, 2.3% ash, 27.4% total dietary fiber which is included soluble (10.2%) and insoluble (17.2%) dietary fiber. Farinograph properties of pumpkin powder incorporated dough showed increase in water absorption and dough development time while dough stability and mixing tolerance indes were decreased. It was also observed that addition of pumpkin powder significantly altered cooking quality of pasta. Generally, pasta incorporated with pumpkin powder had shorter optimal cooking time. The shortest optimal time (5.9 min) was after addition of 10% of pumpkin powder compared with control pasta (7.0 min). From the results also concluded that addition of pumpkin powder significantly increased cooking loss. The highest cooking loss (6.6%) was after addition 10% pumpkin powder. Furthermore it could be stated that incorporation of pumpkin powder in pasta increased water absorption of pasta from 181.0% (control) to 211.2% (10% of pumpkin powder). From sensory evaluation resulted that pumpkin powder incorporated pasta were characterized by lower colour, flavor and grain taste. On the other hand vegetable taste and granular structure of pasta increased with higher addition level of pumpkin powder. Moreover, it was concluded that pasta with addition level 10% were the most acceptable for accesors.

Keywords: pumpkin powder; pasta; farinograph; cooking quality

INTRODUCTION
Pasta is a very popular food in several countries around the world **(Tazrart et al., 2016)**. It is favored by consumers for its ease of transportation, handling, cooking, and storage properties. In recent years pasta has become even more popular due to its nutritional properties, being regarded as a product "with low glycemic index" **(Tudorica et al., 2002)**.

As it contains predominantly starch, many studies have attempted to improve the nutritional properties of pasta. These include supplementation with protein, dietary fibre, vitamins and minerals or substituting (partially or completely) the durum wheat semolina with nonconventional flours. A problem with the incorporation of such fibres into conventional pasta is that they can alter its sensory and cooking properties in an undesirable way **(De Pilli et al., 2013)**. The consumption of vegetables and seeds-enriched pasta could be used to create potentially functional food that may help to reduce chronic diseases such as heart disease **(Abdel-Moemin, 2016)**.

Pumpkin (Cucurbita moschata) is a gourd-like squash of the genus Cucurbita and the family Cucurbitaceae. It is an economically important species cultivated worldwide, has high production. Pumpkin has received considerable attention in recent years because of the nutritional and health benefits of the bioactive compounds obtainable from its seeds and fruits **(Wang et al., 2012)**. This cultivar is extremely variable in their fruit and seeds morphology **(Jacobo-Valenzuela et al., 2011)**. The flesh colour of ripe squash fruits can vary considerably from greenish yellow to dark orange and intense orange flesh is an especially attractive quality in winter squash. The carotenoid composition of C. moschata fruits includes α-carotene, β-carotene, lutein, violaxanthin, while the linear carotenoids such as phytoene and lycopene are absent or present only in trace amounts **(Conti et al., 2015)**. The nutritional value of pumpkin fruits is high but varies from one species or cultivar to another. Thus, in the fresh mass of the fruit, total content of carotenoids, a major contributory factor in the high nutritional value of pumpkins, ranges from 2 to 10 $mg.100\ g^{-1}$, the content of vitamins C and E accounting for

9 – 10 mg.100 g^{-1} and 1.03^{-1}.06 mg.100 g^{-1}, respectively. Pumpkin fruit is also a valuable source of other vitamins, e.g., B6, K, thiamine, and riboflavin, as well as minerals, e.g., potassium, phosphorus, magnesium, iron, and selenium **(Rakcejeva et al., 2011)**. In particular, pumpkin is a rich natural source of protein and dietary fiber **(Choi et al., 2012)** and has low energy content (about 17 Kcal.100 g^{-1} of fresh pumpkin **(Jacobo-Valenzuela et al., 2011)**. Pumpkin flesh is a delicious and fully appreciated additive in a diversity of products for children and adults. Pumpkin fruits mainly are being processed to obtain juice, pomade, pickles and dried products **(Rakcejeva et al., 2011)**. Pumpkin can be processed into flour which has a longer shelf-life. Pumpkin flour is used because of its highly-desirable flavour, sweetness and deep yellow-orange colour. It has been reported to be used to supplement cereal flours in bakery products like cakes, cookies, bread, for soups, sauces, instant noodle and spice as well as a natural colouring agent in pasta and flour mixes **(Bhat and Bhat, 2013)**.

The aim of this study was to evaluate the effect of pumpkin powder addition on rheological properties of wheat dough and cooking properties of pasta. Sensory evaluation of cooked pasta was also performed.

MATERIAL AND METHODOLOGY

Material

The pumpkin (Cucurbita moschata), wheat flour (Penam Slovakia, a.s., Slovak Republic) and other ingredients (eggs and salt) were purchased in local marked.

Preparation of pumpkin powder (PP): clean pumpkins were peeled, cut into slices and seeds were removed. Sliced pumpkins were dried at room temperature for 7 days, ground and siewed to obtain powder particle size of 250 µm and packed in polyethylene bags.

Chemical composition

Proximate analysis including content of: moisture (AACC method 44-19.01), protein (AACC method 46-13.01), crude fat (AACC method 30-25.01) and ash (AACC method 08-01.01). Total dietary fiber (TDF), insoluble (IDF) and soluble dietary fiber (SDF) contents were evaluated by Enzymatic - gravimetric method (AOAC Method 985.29-1986).

Dough characteristics

Rheological parameters of dough were determinated using Farinograph Brabender (Duisburg, Germany) according to method ISO 5530-1:2013. The measured parameters were: water absorption (WA), dough development time (DDT), dough stability (DS) and mixing tolerance index (MTI).

Pasta preparation

Pasta was prepared according to recipe described by **Hrušková and Vítová (2007)** using laboratory pasta maker Häussler LUNA (Heiligenkreuztal bei Riedlingen, Germany) and dried at laboratory temperature for 3 days. PP was used as flour replacement at level 5, 7.5 and 10%. Pasta without PP was also prepared as control sample. Dried pasta is shown in Figure 1.

Cooking properties of pasta

Qualitative parameters of pasta were determinate according to methods **Rosa-Sibakov et al. (2016)**. Optimal cooking time (OCT): Dried pasta (10 g) was cooked in distilled water (250 cm^3) and OCT was indicated when the white core of the pasta disappeared when squeezed between two glass plates. Cooking loss (CL) was determined by weighing the residue (cooking water) after drying in an oven at 105°C for 2 h. Water absorption of pasta (PWA): cooked pasta were weighed soon after removing the excess water and dried in an oven at 105°C for 2 h. Moisture content of uncooked pasta samples was determined by drying 2 g of sample for 2 h at 105°C.

Sensory evaluation

Sensory evaluation of cooked pasta was carried out according to modified procedure reported by **Abdel-Moemin (2016)** using 5 – point hedonic scale (1 = dislike very much, 2 = dislike moderately, 3 = neutral, 4 = like moderately and 5 = like very much). The panel was made up of 13 trained judges. The pasta were cooked in boiling distilled water for the optimal time, cooled in tap water for 20 s and died before serving. The attributes evaluated were: shape, colour, flavour, taste (grainy, vegetable) firmness, stickiness and overall acceptability.

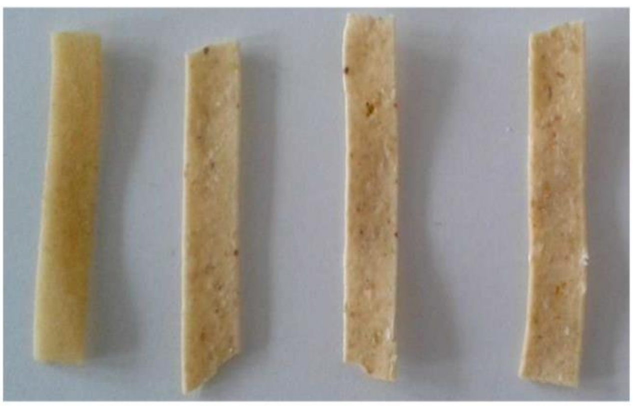

Figure 1 Dried pasta, PP - pumpkin powder.

Table 1 Proximate composition of pumpkin powder and wheat flour.

	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	TDF (%)	IDF (%)	SDF (%)
WF	8.1 ±0.4	10.6 ±0.1	1.2 ±0.0	0.5 ±0.0	2.1 ±0.0	nd	nd
PP	6.1 ±0.1	8.2 ±0.1	0.7 ±0.0	2.3 ±0.0	27.4 ±0.7	17.2 ±0.1	10.2 ±0.1

Note: PP – pumpkin powder, TDF – total dietary fiber, IDF – insoluble dietary fiber, SDF – soluble dietary fiber, nd – not determined.

Statistical analysis

All measurement was carried out in triplicate and results were expressed as mean ±standard deviation. One way analysis of variance and Student`s test were used to establish significant differences between mean values at significance level p = 0.05 using Microsoft Excel version 2010.

RESULTS AND DISCUSSION

The chemical composition of PP is shown in Table 1. The studies indicated, that PP contained 27.4% TDF, which is higher than 12.1% reported by **Saeleaw and Schleining, (2011)** in pumpkin flour and lower than 44.6% found by de **Escalada Pla et al. (2007)** in dried pumpkin pulp. Moreover, total dietary fiber included 10.2% soluble and 17.2% insoluble dietary fiber. The moisture and crude fat content, 6.1% and 0.7% were in agreement with 7.82 and 0.80% described by **Kim et al. (2016)** and **Saeleaw and Schleining (2011)** in pumpkin fiber and pumpkin flour. It was also observed that puumpkin powder contained 8.2% protein which is lower value than 15.69% described by **Usha et al. (2010)**. The ash content (2.3%) was similar than those reported by de **Escalada Pla et al. (2007)** in dried pumpkin pulp (2.1%).

Rheological properties of dough are very important indices for product development in terms of product quality and process efficiency **(Sivam et al., 2010)**. The traditional instruments, which provide practical information for the cereal industry, measure the power input during dough development caused by a mixing action (farinograph, mixograph) and determine the extensional deformation of a prepared dough (extensigraph, alveograph) **(Rodriguez-Sandoval., 2012)**. The effect of the addition of PP at different levels on rheological parameters of dough is shown in Table 2.

WA absorption is the amount of water required by a given weight of flour to yield dough of a given consistency **(Shenoy and Prakash, 2002)**. It was observed that addition of PP gradually increased the WA of wheat dough from 53.2% (control) to 56.3% (10% PP). The increase of water absorption could be explained by the important number of hydroxyl groups existing in the fiber structure, which allow more water interactions through hydrogen bonding **(Lauková et al., 2016)**. Similar increase in WA was also described when carrot pomace powder **(Kohajdová et al., 2011)**, sweet potato fiber **(Amal, 2015)**, djulis flour **(Li et al., 2015)**, wheat germ flour **(Sun et al., 2015)** were added in wheat dough.

DS is the difference in time between the time when the curve first intercepts the 500 Brabender unit line and the time when the curve leaves the 500 line **(Shenoy and Prakash, 2002)**. Stability is related to the quality of the protein matrix, which is easily damaged by the incorporation of other ingredients, due to gluten dilution **(Sun et al., 2015)**. Generally, it was concluded that PP incorporation in dough significantly decreased the DS compared to control (9.6 min). The low stability time during the dough mixing period is indicative of a weak gluten **(Rodriguez-Sandoval et al., 2012)**. These observations were consistent with those determined by **Trejo-González et al. (2014)**, **Kohajdová et al. (2013)** and **El-Sharnouby et al. (2012)** when sweet potato flour, pea flour and mixture of wheat bran: date powder (1 :1) were added in wheat dough.

DDT is the time from addition of water to the development of dough's maximum consistency **(Shenoy and Prakash, 2002)**. Time of dough development depends on the amount and quality of gluten, granularity of flour and the level of grinding and is determined primarily by the process of gluten hydration. The fibers need time to absorb water and, also compete with flour components for water. It is necessary some time to realize equilibrium of water between dough components. The hydration rate for

Table 2 Farinographic parameters of dough with addition of PP.

	WA (%)	DS (min)	DDT (min)	MTI (BU)
control	45.2 ±0.1	9.6 ±0.1	2.6 ±0.1	61.0 ±1.0
PP 5%	56.2 ±0.1*	9.3 ±0.1	2.5 ±0.1	105.0 ±5.0*
PP 7.5%	56.2 ±0.0*	9.2 ±0.2*	3.1 ±0.1*	60.0 ±2.0*
PP 10%	56.3 ±0.1*	5.6 ±0.1*	3.8 ±0.1*	30.3 ±0.6*

Note: PP – pumpkin powder, WA – water absorption, DS – dough stability, DDT- dough development time, MTI – mixing tolerance index, BU – brabender units, * denotes statisticaly significan difference at p – 0.05 level.

Table 3 Cooking parameters of pasta with addition of PP.

	OCT (min)	CL (%)	PWA (%)	Moisture (%)
control	7.0 ±0.0	4.5 ±0.2	181.0 ±1.5	6.6 ±0.0
PP 5%	6.2 ±0.0*	5.1 ±0.1*	203.6 ±3.8*	6.3 ±0.0*
PP 7.5%	6.0 ±0.0*	5.6 ±0.1*	207.8 ±1.2*	6.4 ±0.1*
PP 10%	5.9 ±0.0*	6.6 ±0.1*	211.2 ±8.2*	6.9 ±0.0*

Note: PP – pumpkin powder, OCT – optimal cooking time, PWA – pasta water absorption, * denotes statisticaly significan difference at p – 0.05 level.

every fibers is different and the time to fully hydrate in dough modify the development time of dough **(Ognean et al., 2011)**. From the results concluded that addition of PP significantly increased the DDT. The highest DDT value was recorded at addition level 10% (3.8 min). Similar results were described after addition of potato fiber **(Bojňanská et al., 2014)**, pea flour **(Kohajdová et al., 2013)**, carrot pomace powder **(Kohajdová et al., 2012)** and mango peel powder **(Ajila et al., 2008)** to wheat dough.

MTI indicated a consistency difference in dough between the height at the peak and the height 5 min later **(Li et al., 2015)**. It can be also noticed that MTI significantly decreased as the substitution level of PP increased. These results were in agreement with those found by **Amal (2015)** and **Larrea et al. (2005)** after addition of sweet potato powder and extruded orange pulp to wheat dough.

Cooking quality, which includes cooking loss, cooked weight, and texture of the cooked pasta, is the most important quality attribute **(Ajila et al., 2010)**. Pasta quality depends mainly on the properties of flour raw materials, especially protein content and quality, and gluten properties; starch properties are of a lesser importance **(Dziki and Laskowski, 2005)**. The cooking quality parameters of pasta are presented in Table 3.

The OCT was achieved when the centre of the pasta was fully hydrated **(De Pilli et al., 2013)**. From the results concluded that substitution of wheat flour with PP in pasta significantly reduced OCT from 7.0 min (control) to 5.9 min (10% PP). These results were in agreement with those described by **Petitot et al. (2010)** and **Kuchtová et al. (2016)** after supplementation wheat flour in pasta with faba bean flour and pumpkin powder. Gluten is primarily responsible for the development of the starch–protein structure, which in turn is the primary determinant of pasta texture and cooking properties, so a dilution of these components will reduce the cooking time as observed **(Rakhesh et al., 2014)**.

PWA is an indication of the quantity of water absorbed by the noodles during cooking, an important characteristic in determining the cooking quality of pasta **(Li et al., 2015)**. It was observed that with addition of PP gradually increased PWA from 181.0% (control) to 211.2% (10%). These results were in agreement with those reported by when faba starch **(Rosa-Sibakov et al., 2016)**, pumpkin powder **(Kuchtová et al., 2016)**, guar gum and carboxymethylcellulose **(Aravind et al., 2012)** were incorporated in pasta.

CL is defined as the amount of solids that dissolve in water during cooking and may be an indicator of noodle structural integrity during cooking **(Li et al., 2015)**. As a result, the cooking water becomes cloudy and thick **(Ajila et al., 2010)**. CL is a commonly used predictor of overall pasta cooking performance by both consumers and industry **(Tudorica et al., 2002)**. The type of ingredients in the pasta mix influences the loss of solubles and solids during cooking, and it has been reported that a compact texture of the pasta often results in less cooking loss than the loose textured pasta **(Krishnan et al., 2012)**. From the results concluded that addition of PP increased CL. The highest CL (6.6%) was after substitution of wheat flour by 10% PP. This increase in CL could be due to a disruption of the protein-starch matrix and the uneven distribution of water within the pasta matrix due to the competitive hydration tendency of the fiber, thus preventing starch swelling due to limited water availability **(Tudorica et al., 2002)**. Similar increase in CL was reported when carrot pomace powder **(Gull et al., 2015)**, broad bean flour **(Tazrart et al. 2016)** and inulin **(Bustos et al., 2011)** were incorporated into pasta.

Also it was observed that moisture content in pasta significantly increased with increasing addition level of PP. The highest moisture content (6.9%) was found in pasta with addition of PP at level 10%. These results were in constituent with those found by **Abdel-Moemin (2016)** after incorporation palm kernels and purple carrot flour in pasta.

The external appearance of pasta and other attributes of sensory quality after cooking are the most important criteria of pasta quality evaluation **(Dziki and Laskowski, 2005)**. Enrichment with DF not only influences the overall properties, but also significantly affects the sensory properties of the product **(Kohajdová et al., 2011)**. The sensory parameters of pasta supplemented with PP are shown in Table 4 and Table 5.

From sensory evaluation it can be concluded that addition of PP in pasta decreased scores of flavour and grain taste while vegetable taste was significantly

Table 4 Sensory parameters of pasta with addition of PP.

	Shape	Colour	Flavour	Grain taste	Vegetable taste
control	4.9 ±0.2	4.4 ±0.2	4.7 ±0.2	4.6 ±0.2	1.0 ±0.0
PP 5%	4.7 ±0.2*	4.1 ±0.2*	4.3 ±0.2*	3.4 ±0.2*	2.0 ±0.1*
PP 7.5%	4.8 ±0.2*	4.2 ±0.2*	4.4 ±0.1*	3.9 ±0.1*	2.7 ±0.1*
PP 10%	4.9 ±0.2*	4.1 ±0.2*	4.5 ±0.2*	2.5 ±0.1*	3.0 ±0.1*

Note: PP – pumpkin powder, * denotes statisticaly significan difference at *p* – 0.05 level.

Table 5 Sensory parameters of pasta with addition of PP.

	Granular structure	Firmness	Stickiness	Overall acceptance (%)
control	3.3 ±0.1	4.2 ±0.1	3.4 ±0.2	95.4 ±4.3
PP 5%	3.4 ±0.1*	3.8 ±0.1*	3.1 ±0.1*	76.6 ±3.4*
PP 7.5%	3.5 ±0.1*	3.5 ±0.2*	3.3 ±0.1*	78.1 ±1.6*
PP 10%	3.8 ±0.1*	3.3 ±0.1*	3.5 ±0.1*	80.3 ±3.0*

Note: PP – pumpkin powder, * denotes statisticaly significan difference at *p* – 0.05 level.

increased. Moreover it was found that enrichment of pasta also affected the shape and stickiness. Pasta colour is a very important quality attribute that greatly influences consumer acceptance, and it is the only property that the consumer can evaluate when selecting a product in the market **(Tazrart et al., 2016)**. It was also found that addition of PP decreased the colour scores of pasta. The textural characteristics of pasta play an essential role in determining the final acceptance by consumers, who have shown a preference for pasta that retains texture characteristics not only with normal cooking time but also with overcooking **(Tudorica et al., 2002)**. Addition of PP significantly decreased firmness and increased granular structure of pasta at all addition levels. The reduction in pasta firmness may be associated with the role of fiber supplements in disrupting the protein-starch matrix within the pasta microstructure **(Tudorica et al., 2002)**. Sensory evaluation also revealed that most acceptable pasta was obtained at 10% addition level of PP.

CONCLUSION

The incorporation of pumpkin powder significantly affects the rheological parameters of wheat dough. It was observed that incorporation of pumpkin powder in wheat dough increased water absorption, prolonged dough development time and reduced dough stability and mixing tolerance index.

Addition of pumpkin powder caused shorter optimal cooking time, higher cooking loss, pasta water absorption and moisture of pasta.

From sensory evaluation resulted that pumpkin powder incorporated pasta were characterized by lower colour, flavor and grain taste. On the other hand vegetable taste and granular structure of pasta increased with higher addition level of pumpkin powder. Moreover, it was concluded that pasta with addition level 10% were the most acceptable for accesors.

REFERENCES

AACC:2000. *Approved methods of american association of cereal chemists, 10th ed. The Association St. Paul, MN. moisture (method 44-19.01), ash (method 08-01.01), protein (method 46-13.01), crude fat (method 30-25.01).*

Abdel-Moemin, A. R. 2016. Analysis of phenolic acids and anthocyanins of pasta-like product enriched with date kernels (*Phoenix dactylifera* L.) and purple carrots (*Daucus carota* L. sp. *sativus* var. *atrorubens*). *Journal of Food Measurement and Characterization*, no. 4, 14 p. https://doi.org/10.1007/s11694-016-9329-9

Ajila, C. M., Aalami, M., Leelavathi, K., Rao, U. P. 2010. Mango peel powder: A potential source of antioxidant and dietary fiber in macaroni preparations. *Innovative Food Science & Emerging Technologies*, vol. 11, no.1, p. 219-224. https://doi.org/10.1016/j.ifset.2009.10.004

Ajila, C. M., Leelavathi, K., Prasada Rao, U. J. S. 2008. Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. *Journal of Cereal Science*, vol. 48, no. 2, p. 319-326. https://doi.org/10.1016/j.jcs.2007.10.001

Amal, A. M. 2015. Quality evaluation of wheat-sweet potato composite flours and their utilization in bread making. *International Journal of Advanced Research in Biological Sciences*, vol. 2, no. 11, p. 294-303.

AOAC Method 985.29-1986:2003. *Total dietary fiber in foods. Enzymatic- gravimetric method.*

Aravind, N., Sissons, M., Fellows, C. M. 2012. Effect of soluble fibre (guar gum and carboxymethylcellulose) addition on technological, sensory and structural properties of durum wheat spaghetti. *Food Chemistry*, vol. 131, no. 3, p. 893-900. https://doi.org/10.1016/j.foodchem.2011.09.073

Bhat, M. A., Bhat, A. 2013. Study on Physico-Chemical Characteristics of Pumpkin Blended Cake. *Journal of Food Processing and Technology*, vol. 4, no. 9, p. 4. https://doi.org/10.4172/2157-7110.1000262

Bojňanská, T., Tokár, M., Frančáková, H. 2014. Changes of the dough rheological properties influenced by addition of potato fibre. *Potravinarstvo*, vol. 8, no. 1, p. 161-166. https://doi.org/10.5219/371

Bustos, M. C., Pérez, G. T., León, A. E. 2011. Effect of four types of dietary fibre on the technological quality of pasta. *Food Science And Technology International*, vol. 17, no. 3, p. 219-221. https://doi.org/10.1177/1082013210382303

Contia, S., Villarib, G., Amicoa, E., Carusoa, G. 2015. Effects of production system and transplanting time on yield, quality and antioxidant content of organic winter squash (*Cucurbita moschata Duch*.). *Scientia Horticulturae*, vol. 183, p. 136-143. https://doi.org/10.1016/j.scienta.2014.12.003

de Escalada Plaa, M. F., Ponce, N. M., Stortz, C. A., Gerschenson, L. N., Rojas, A. M. 2007. Composition and functional properties of enriched fiber products obtained from pumpkin (*Cucurbita moschata Duchesne ex Poiret*). *LWT – Food Science and Technology*, vol. 40, no. 7, p. 1176-1185. https://doi.org/10.1016/j.lwt.2006.08.006

De Pilli, T., Derossi, A., Severini, C. 2013. Cooking quality characterisation of 'spaghetti' based on soft wheat flour enriched with oat flour. *International Journal of Food Science and Technology*, vol. 48, no. 11, p. 2348-2355.

Dziki, D., Laskowski, J. 2005. Evaluation of the cooking quality of spaghetti. *Polish Journal of Food Nutrition Science*, vol. 14/55, no. 2, p. 153-158.

El-Sharnouby, G. A., Aleid, S. M., Al-Otaibi, M. M. 2012. Nutritional Quality of Biscuit Supplemented with Wheat Bran and Date Palm Fruits (*Phoenix dactylifera* L.). *Food and Nutrition Sciences*, vol. 3, no. 3, p. 322-328. https://doi.org/10.4236/fns.2012.33047

Gull, A., Prasad, K., Kumar, P. 2015. Effect of millet flours and carrot pomace on cooking qualities, color and texture of developed pasta. *LWT-Food Science and Technology*, vol. 63, no. 1, p. 470-474. https://doi.org/10.1016/j.lwt.2015.03.008

Hrušková, M., Vítová, M. 2007. Laboratorní těstárenský pokus (Laboratory Dough test). *Mlynářské noviny*, vol. 18, no. 2, p. 7-9.

Choi, Y., Kim, H., Hwang, K., Song, D., Park, J., Lee, S., Choi, M., Coi, J., Kim, Ch. 2012. Effects of Pumpkin (*Cucurbita maxima Duch*.) Fiber on Physicochemical Properties and Sensory Characteristics of Chicken Frankfurters. *Korean Journal for Food Science of Animal Resources*, vol. 32, no. 2, p. 174-183. https://doi.org/10.5851/kosfa.2012.32.2.174

ISO 5530-1:2013. *Wheat flour – Physical characteristic of doughs – Part 1: Determination of water absorption and rheological properties using a farinograph.*

Jacobo-Valenzuela, N., Zazueta-Moralesi, J. J., Gallegos-Infante, J. A., Aguilar-Gutierrez, F., Camacho-Hernandez, I. L., Rocha-Guzman, N. E., Gonzales-Laredo, R. F. 2011. Chemical and Physicochemical Characterization of Winter Squash (*Cucurbita moschata* D.). *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, vol. 39, no. 1, p. 34-40.

Kim, Ch., Kim, H., Hwang, K., Song, D., Ham, Y., Choi, J., Kim, Y., Choi, Y. 2016. Effects of Dietary Fiber Extracted from Pumpkin (*Cucurbita maxima Duch*.) on the Physico-Chemical and Sensory Characteristics of Reduced-Fat Frankfurters. *Korean Journal for Food Science of Animal Resources*, vol. 36, no. 3, p. 309-318. https://doi.org/10.5851/kosfa.2016.36.3.309

Kohajdová, Z., Karovičová, J., Jurasová, M. 2012. Influence of Carrot Pomace Powder on the Rheological Characteristics of Wheat Flour Dough and on Wheat Rolls Quality. *Acta Scientarium Polonorum, Technologia Alimentaria*, vol. 11, no. 4, p. 381-387.

Kohajdová, Z., Karovičová, J., Jurasová, M., Kukurová, K. 2011b. Application of citrus dietary fibre preparations in biscuit production, *Journal of Food and Nutrition Research*, vol. 50, no. 3, p. 182-190.

Kohajdová, Z., Karovičová, J., Magala, M. 2013. Rheological and qualitative characteristics of pea flour incorporated cracker biscuits. *Croatian Journal of Food Science and Technology*, vol. 5, no. 1, p. 11-17.

Krishnan, J. G., Menon, R., Padmaja, G., Sajeev, M. S., Moorthy, S. N. 2012. Evaluation of nutritional and physico-mechanical characteristics of dietary fiber-enriched sweet potato pasta. *European Food Research and Technology*, vol. 234, no. 3, p. 467-476. https://doi.org/10.1007/s00217-011-1657-8

Kuchtová, V., Kohajdová, Z., Karovičová, J., Mešterová, E. 2016. Use of pumpkin fiber for the preparation of pasta (Využitie tekvicovej vlákniny pri príprave cestovín). *Chemické Listy*, vol. 110, no. 11, p. 808-811.

Larrea, M. A., Chang, Y. K., Martinez-Bustos, F. 2005. Some functional properties of extruded orange pulp and its effect on the quality of cookies. *LWT - Food Science and Technology*, vol. 38, no. 3, p. 213-220. https://doi.org/10.1016/j.lwt.2004.05.014

Lauková, M., Kohajdová, Z., Karovičová, J. 2016. Effect of hydrated apple powder on dough rheology and cookies quality. *Potravinarstvo*, vol. 10, no. 1, p. 506-511. https://doi.org/10.5219/597

Li, P., Lu, W., Hsieh, Ch., Li, T., Huang, D. 2015. Rheological Properties of Dough and Quality of Salted Noodles Supplemented with Djulis (*Chenopodium formosanum Koidz*.) Flour. *Journal of Agricultural Science*, vol. 7, no. 6, p. 84-92. https://doi.org/10.5539/jas.v7n6p84

Ognean, C. F., Ognean, M., Darie, N. 2011. The Effect of Some Commercial Fibers on Dough Rheology. *Bulletin UASVM Agriculture*, vol. 68, no. 2, p. 372-377, ISSN 1843-5246.

Petitot, M., Boyer, L., Minier, C., Micard, V. 2010. Fortification of pasta with split pea and faba bean flours: Pasta processing and quality evaluation. *Food Research International*, vol. 43, no. 2, p. 634-641. https://doi.org/10.1016/j.foodres.2009.07.020

Rakcejeva, T., Galoburda, R., Cude, L., Strautniece, E. 2011. Use of dried pumpkins in wheat bread production. *Procedia Food Science*, vol. 1, p. 441-447. https://doi.org/10.1016/j.profoo.2011.09.068

Rakhesh, N., Fellows, C. M., Sissons, M. 2015. Evaluation of the technological and sensory properties of durum wheat spaghetti enriched with different dietary fibres. *Journal of the Science of Food and Agriculture*, vol. 95, no. 1, p. 2-11. https://doi.org/10.1002/jsfa.6723

Rodriguez-Sandoval, E., Sandoval, G., Cortes-Rodríguez, M. 2012. Effect of Quinoa and Potato Flours on the Thermomechanical and Breadmaking Properties of Wheat Flour. *Brazilian Journal of Chemical Engineering*, vol. 29, no. 3, p. 503-510. https://doi.org/10.1590/S0104-66322012000300007

Rosa-Sibakov, N., Heinio, R., Cassan, D., Holopainen-Mantila, U., Micard, V., Lantto, R., Sozer, N. 2016. Effect of bioprocessing and fractionation on the structural, textural and sensory properties of gluten-free faba bean pasta. *LWT – Food Science and Technology*, vol. 67, no. 4, p. 27-36. https://doi.org/10.1016/j.lwt.2015.11.032

Saeleaw, M., Schleining, G. 2011. Composition, Physicochemical and Morphological Characterization of Pumpkin Flour. In: *Proceedings of the ICEF11 – 11th International Congress on Engineering and Food " Food Process Engineering in a Changing World"*. Athens, Greece : National Technical University, p. 869-870. ISBN: 978-960-89789-3-5.

Shenoy, A., Prakash, J. 2002. Wheat bran (*Triticum aestivum*): composition, functionality and incorporation in unleavened bread. *Journal of Food Quality*, vol. 25, no. 3, p. 197-211. https://doi.org/10.1111/j.1745-4557.2002.tb01019.x

Sivam, A. S., Sun-Waterhouse, D., Quek, S., Perera C. O. 2010. Properties of Bread Dough with Added Fiber Polysaccharides and Phenolic Antioxidants: A Review. *Journal of Food Science*, vol. 75, no. 8, p. 163-174. https://doi.org/10.1111/j.1750-3841.2010.01815.x

Sun, R., Zhang, Z., Hu, X., Xing, Q., Zhuo, W. 2015. Effect of wheat germ flour addition on wheat flour, dough and Chinese steamed bread properties. *Journal of Cereal Science*, vol. 64, p. 153-158. https://doi.org/10.1016/j.jcs.2015.04.011

Tazrart, K., Lamacchia, C., Zaidi, F., Haros, M. 2016. Nutrient composition and in vitro digestibility of fresh pasta enriched with Vicia faba. *Journal of Food Composition and Analysis*, vol. 47, no. 4, p. 8-15. https://doi.org/10.1016/j.jfca.2015.12.007

Trejo-González, A. S., Loyo-González, A. G., Munguía-Mazariegos, M. R. 2014. Evaluation of bread made from composite wheat-sweet potato flours. *International Food Research Journal*, vol. 21, no. 4, p. 1683-1688.

Tudorica, C. M., Kuri, V., Brennan, S. 2002. Nutritional and Physicochemical Characteristics of Dietary Fiber Enriched Pasta. *Journal of Agricultural and Food Chemistry*, vol. 50, no. 2, p. 347-356. https://doi.org/10.1021/jf0106953

Usha, R., Lakshmi, M., Ranjani, M. 2010. Nutritional, Sensory and Physical Analysis of Pumpkin Flour Incorporated into Weaning Mix. *Malaysian Journal of Nutrition*, vol. 16, no. 3, p. 379-387. PMid:22691991

Wang, S., Huang, W., Liu, Ch., Wang, M., Ho, Ch., Huang, W., Hou, Ch., Chuang, H., Huang, Ch. 2012. Pumpkin (*Cucurbita moschata*) Fruit Extract Improves Physical Fatigue and Exercise Performance in Mice. *Molecules*, vol. 17, no. 10, p. 11864-11876. https://doi.org/10.3390/molecules171011864

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Contact address:

Ing. Lucia Minarovičová, PhD., Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Institute of Food Science and Nutrition, Department of Food Technology, Radlinského 9, 812 37 Bratislava, Slovakia, E-mail: lucia.minarovicova@stuba.sk

Ing. Michaela Lauková, Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Institute of Food Science and Nutrition, Department of Food Technology, Radlinského 9, 812 37 Bratislava, Slovakia, E-mail: michaela.laukova@stuba.sk

Ing. Zlatica Kohajdová, PhD., Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Institute of Food Science and Nutrition, Department of Food Technology, Radlinského 9, 812 37 Bratislava, Slovakia, E-mail: zlatica.kohajdova@stuba.sk

doc. Ing. Jolana Karovičová, PhD., Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Institute of Food Science and Nutritions, Department of Food Technology, Radlinského 9, 812 37 Bratislava, Slovakia, E-mail: jolana.karovičova@stuba.sk

Ing. Veronika Kuchtová, Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, Institute of Food Science and Nutrition, Department of Food Technology, Radlinského 9, 812 37 Bratislava, Slovakia, E-mail:veronika.kuchtova@stuba.sk