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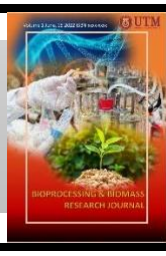

Research Article

Effect of Blanching and Drying Temperature to the Proximate, Crude Fiber and Sensory Acceptability of Pumpkin Flour in Pasta

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ABSTRACT

The incorporation of pumpkin flour in pasta improves both crude fiber and sensory attributes. However, the impact of blanching and drying processes of pumpkin flour on the crude fiber content and sensory attributes of pasta has not been reported. The study aims to determine the effect of blanching and drying temperature on the proximate values including moisture, ash, fat, and protein as well as crude fiber content in pumpkin flour and to determine the sensory acceptability of pumpkin flour in pasta. The pumpkin flour was blanched and dried at different temperatures (60 °C, 70 °C, and 80 °C). The pumpkin flour was incorporated in pasta in different concentration. The proximate value was compared with a control pumpkin flour and wheat flour. The sensory evaluation was conducted to assess consumer acceptability. It was found that blanched pumpkin flour had lower fat and protein content but significantly higher crude fiber content (10.77 ± 0.014%). Pasta formulations containing 20% pumpkin flour has the highest mean score (4.40 ± 0.50) for overall acceptability. The study found that blanching is an effective pretreatment for preparing pumpkin flour with high fiber content, and pumpkin flour exhibits good potential for use in pasta formulation without compromising its sensory acceptability.

INTRODUCTION

Pumpkin (*Cucurbita moschata*) is an angiosperm climbing plant that belongs in a large family of *Cucurbitaceae* and is cultivated as one of the important food crops in many countries with China as the leading producer (Rolnik and Olas, 2020). It is an important source of dietary fiber and antioxidants (Enneb et al., 2020). Its flesh is highly nutritious with a high concentration of carotenoids and minerals including potassium, iron, and magnesium (Gomes et al., 2020). Moreover, pumpkin is considered low in calories as it has low carbohydrates and is easily digestible (Poliszko et al., 2019). One of the bioactive compounds in *C. moschata*, *Curcumosin* has been reported to inhibit the growth of cell tumours. Its extract has also been found to be antidiabetic and antimicrobial (Rolnik and Olas, 2020). Due to the health benefits and great functional properties, pumpkin has been incorporated into processed food (Kolniak-Ostek et al., 2017; Mirhosseini et al., 2015; Novita Indrianti et al., 2021).

Pasta is a global staple food and has gained popularity due to its lower glycemic index value (Di Pede et al., 2021).

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Traditional pasta is primarily composed of refined wheat flour which lacks dietary fibers and other nutrients. To address this limitation, there is growing interest in incorporating nutrient-dense ingredients into pasta formulations to enhance both nutritional value and sensory appeal.

Notably low in carbohydrates, pumpkin flour's unique earthy flavor enhances the taste of various dishes. The positive impact of incorporating pumpkin flour into various food products, such as bakery items, sauces, instant noodles, natural coloring agents in flour mixes, and weaning mixes, has been previously reported (Dyshlyuk et al., 2017; Jesmin et al., 2016; Kolniak-Ostek et al., 2017; Novita Indrianti et al., 2021; Peksa et al., 2016; Poliszko et al., 2019). Păucean & Man (2014) reported that the addition of 50% pumpkin flour levels positively influenced bread quality and consumer preference. The enrichments also contributed to the increase of protein and dietary fiber content, along with improvements in cooking quality and sensory properties (Novita Indrianti et al., 2021). While it may not replace wheat flour in all recipes due to the lack of gluten, pumpkin flour can be creatively used in combination with other gluten-free flours or as a partial replacement to leverage its nutrient and functional qualities in bakery products.

Blanching is a pretreatment used to deactivate enzymes responsible for nutrient degradation and thereby preserving its nutritional content and preventing undesirable changes. Additionally, blanching reduces the microbial load on the pumpkin's surface, extending its shelf life by inhibiting spoilage and decay. This process also helps retain the vibrant color and firm texture of the vegetable, ensuring it remains visually appealing and suitable for a variety of culinary uses (Aydin & Gocmen, 2015). Moreover, by minimizing exposure to oxygen, blanching reduces nutrient oxidation, particularly in the case of vitamin C, contributing to the overall nutritional quality of the preserved pumpkin (Piepiórka-Stepuk et al., 2023).

Meanwhile, dehydration is a process of removing moisture which can lower the water activity thus extending the shelf life of the food (Márquez-Cardozo et al., 2021). Many studies have been done to determine the effect of the drying method on the functional properties and bioactive compounds in pumpkin (Márquez-Cardozo et al., 2021; Przetaczek-Rożnowska et al., 2018; Wongsagonsup et al., 2015; Yuan et al., 2022). However, the effect of blanching as a pretreatment before drying on pumpkin flour has not been reported. Thus, the objective of the study is to determine the effect of blanching and drying temperature on the proximate value and crude fiber of the pumpkin flour and the sensory acceptability of pasta incorporated with pumpkin flour.

MATERIALS AND METHOD

Materials

Fresh matured pumpkin fruit (*C. moschata*) and other ingredients for making pasta such as wheat flour (Cap Sauh, FFM Berhad, Malaysia), eggs and salt were purchased from the local market in Skudai, Johor, Malaysia. Chemicals for the nutritional value analysis such as sodium hydroxide, sulfuric acid and petroleum ether were purchased from Sigma Aldrich, Malaysia.

Preparation of pumpkin flour

The pumpkin flour was prepared according to the method by Márquez-Cardozo et al. (2021) with modifications. **Figure 1** shows the process in making the pumpkin flour. The rind, fibrous strands and seeds were removed, and the flesh was cut into uniform size (approximately 7 cm diameter) followed by soaking in 0.2% salt solution for 30 minutes and then rinsed with tap water. Then, the pumpkin was blanched in boiling water (100 °C) for 5 minutes and drained. The unblanched and blanched pumpkin was then cut into thin slices with a thickness of about 2 – 3 mm and arranged in a drying tray and dried in a drying oven at different temperatures of 60, 70 and 80 °C for 24 hours. The range of drying temperatures were chosen as it is suitable in preserving nutrients and practical applicability in the context of pumpkin flour production for pasta. Then, the dried pumpkin slices were ground with a food grinder and sieved through a 40 mesh siever to obtain a homogenous powder. The pumpkin flour was then kept in an airtight container and stored in a cool and dry place for further use and analysis.

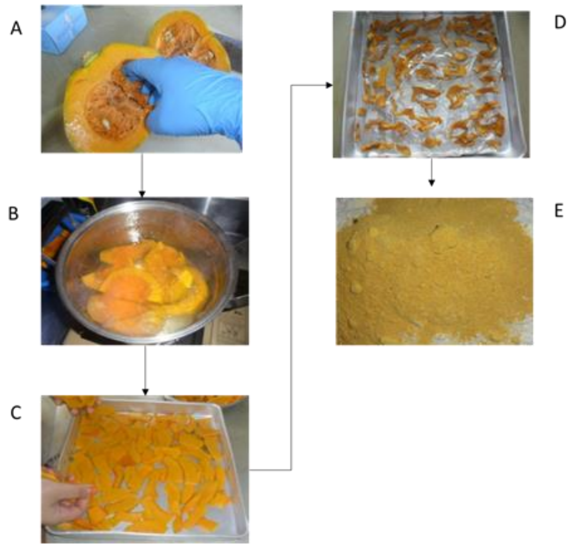

Figure 1 The processing of pumpkin flour. A: cleaning and peeling, B: blanching, C: slicing and arranging in drying tray, D: dried pumpkin chips, E: pumpkin flour.

Proximate Analysis

The proximate analysis of the pumpkin flour was determined according to AOAC (2000) standard method. Briefly, the moisture content was determined using a convection oven at 105 °C for 5 hours and its constant dried weight is recorded. Protein content was determined using macro-Kjedahl method. The nitrogen value obtained was multiplied by the conversion factor of 6.25 to determine the protein value. Total fat was obtained using solvent extraction using a soxhlet semi-continuous extractor and the total oil was calculated as percent. 5 g of sample with 75 mL petroleum ether was added into the 250 mL boiling flask in 6 hours of extraction time at 45 – 60 °C of petroleum ether boiling point. For ash analysis, the sample was placed in a muffle furnace at 550 °C for 5 hours. Then it was cooled until the constant weight is achieved and recorded. All analyses were carried out in triplicates.

Crude Fiber Analysis

The crude fiber content in the pumpkin flour was analyzed according to the method by AOAC (2000). 2 – 5 g of sample was weighted and placed in a 1-L beaker. Then, 200 mL of 1.25% H_2SO_4 was added. The sample was heated until boiling and boiled for exactly 20 minutes. Then, the contents were filtered through a pleated ashless filter paper number 40 placed in the filter funnel and rinsed with hot water until free from acid tested by using litmus paper. 200 mL of 1.25% NaOH was added and heated until boiling and boiled for exactly 30 minutes. The contents were filtered through wet pre-weighted ashless filter paper and rinsed with hot water until free from alkali tested by using litmus paper. Then, the sample was dried for 2 hours at 130 °C. Then, it was cooled and weighed. The sample was then ignited at 550 °C for 8 hours, cooled and weighed. The same analysis method is repeated with a blank sample and was used in the calculation.

Preparation of Pasta

The pasta is prepared according to the method by Mirhosseini et al. (2015) with modifications. The pasta was prepared according to the formulation in **Table 1**. The percentage of eggs and water were kept constant with a total sum of a formulation at 100%.

Table 1 The formulation of pumpkin pasta and control pasta (without pumpkin flour)

Ingredients	Control (%)	10%	20%	30%
Wheat flour	69	62.1	55.2	48.3
Pumpkin flour	-	6.9	13.8	20.7
Eggs	25	25	25	25
Water	6	6	6	6

The substitute of pumpkin flour used was calculated based on the percentage of wheat flour in control which is 69%. Initially, the dry ingredients were mixed thoroughly, then eggs and water were added to form a dough. The dough was kneaded manually for 5 minutes and let to rest for 2 hours to allow starch hydration. Then, the dough was divided into smaller portions and molded to a consistent thin sheet with a thickness of 2 mm using a roller pin manually. Then, the sheet was cut into fettuccine size strips with 5 mm width and 30 cm long. The strips were hung dried on racks in the drying oven at 60 °C for 24 hours. **Figure 2** shows the pasta obtained. The dried pasta was sealed in a plastic wrap and kept at ambient temperature for further use.

Figure 2 Dried pumpkin pasta

Sensory Evaluation

Sensory evaluation was carried out following the method described by Mirhosseini et al. (2015) at the Institute Bioproduct Development (IBD) within Universiti Teknologi Malaysia, in Johor, Malaysia. The panelist consisted of 20 postgraduate students and staff members aged between 24 to 40 years old, who had no direct involvement in the research. The objective of this sensory analysis was to assess the acceptability of pumpkin pasta based on five sensory attributes: appearance, taste, texture, aroma, and overall acceptability. The evaluation was conducted using a hedonic scale, which included five scores, ranging from 5 for "liked extremely" to 1 for "disliked extremely." To prepare the pasta for testing, it was boiled for 3 minutes, promptly cooled with cold water, drained, and patted dry to remove excess moisture. Each panelist received approximately 30 g of the pasta sample, which was randomly labeled with three-digit numbers, and the samples were served on white plates to prevent any potential bias. In addition to the pasta samples, each tester was provided with 250 mL of plain water for mouth rinsing before conducting the sensory analysis.

Statistical analysis

The experiment was conducted in triplicate, and the outcomes were presented as the average values with standard deviations. Statistical analyses, including analysis of variance (ANOVA), subsequent post-hoc Tukey tests, and T-tests, were executed utilizing SPSS software version 16.0 to establish the significance level at $p < 0.05$.

RESULTS AND DISCUSSION

Effect of blanching and drying temperature

The nutrient composition consists of moisture, ash, fat, protein, and crude fiber content of the pumpkin flour dried in different temperature and wheat flour is presented in **Table 2**. The moisture content of pumpkin flour is significantly lower than the wheat flour at $p<0.05$. This might be due to the drying condition used to prepare the pumpkin flour not similar to the drying condition of the commercial wheat flour. Lower moisture content in flour is desirable as it improves the shelf life of the flour by reducing the risk of spoilage and clumping and better flowability. It is also less prone to oxidation (Mahloko et al., 2019).

An unblanched pumpkin dried at 60 °C has the highest moisture content and an unblanched pumpkin dried at 80 °C has the lowest moisture content. As the drying temperature increases, the heat energy enhances the rate of water evaporation, leading to a reduction in moisture content. The results also showed that the moisture content of blanched and dried at 60 and 70 °C are lower than the unblanched but not at 80 °C. The result is similar to a study reported by Wickramasinghe et al. (2020). At higher temperatures, water evaporates more rapidly from the food matrix and increased in the drying rates at high temperature causes the effect of blanching to becomes less significant. The unblanched sample also did not have any extra water added into the cell causing the drying rate to more rapid.

The ash content of wheat flour is significantly lower than pumpkin flour. Pumpkin had high ash content which has been reported in many previous studies (Kuchtová, 2017; Márquez-Cardozo et al., 2021; Mirhosseini et al., 2015; Saeleaw and Schleining, 2011). The addition of pumpkin into formulation also has been found to increase the ash content in the final sample (Poliszko et al., 2019). The ash might also be contributed by the salt soaking during the pumpkin flour preparation which is not done in wheat flour production.

Table 2 The moisture, ash, fat, protein, and crude fiber content of the unblanched and blanched pumpkin flour dried at different temperature compared to wheat flour.

Treatment	Moisture (%)	Ash (%)	Fat (%)	Protein (%)
Unblanched and dried at				
60 °C	7.02 ± 0.02^{b}	6.88 ± 0.25^{a}	1.43 ± 0.03^{b}	6.89 ± 0.07^{b}
70 °C	4.93 ± 0.01^{d}	6.64 ± 0.04^{ab}	1.48 ± 0.02^{b}	4.38 ± 0.01^{c}
80 °C	3.63 ± 0.03^{g}	6.05 ± 0.12^{bc}	0.74 ± 0.02^{c}	3.49 ± 0.01^{d}
Blanched and dried at				
60 °C	6.25 ± 0.05^{c}	5.31 ± 0.07^{d}	1.12 ± 0.03^{bc}	3.38 ± 0.02^{d}
70 °C	4.50 ± 0.02^{e}	6.54 ± 0.08^{ab}	1.43 ± 0.51^{b}	4.35 ± 0.14^{c}
80 °C	4.07 ± 0.00^{f}	5.65 ± 0.27^{cd}	0.68 ± 0.03^{c}	3.37 ± 0.27^{d}
Wheat flour	12.02 ± 0.02^{a}	1.65 ± 0.12^{e}	2.34 ± 0.10^{a}	12.13 ± 0.04^{a}

The result presented is the mean value ± standard deviation (n=3). Values in the same column with different superscript letters are significantly different at *p<0.05*.

The range of fat content of the pumpkin flour is between 0.68 – 1.48% which is in agreement with previous studies reported by Saeleaw and Schleining (2011) and Yuan et al. (2022). The fat content of pumpkin flour is also significantly lower than wheat flour. The fat content of pumpkin flour dried at a temperature of 80 °C is significantly lower than other drying temperature. Due to the lower fat content, pumpkin flour is suitable to be used as a substitute flour in bread, biscuits, cakes and other products especially for person on strict fat diet consumption (Kuchtová, 2017; Kulkarni and Joshi, 2013; Păucean and Man, 2014; Pongjanta et al., 2006).

The protein content of pumpkin flour is significantly lower than wheat flour at *p<0.05*. Many studies have reported that pumpkin has lower protein content and the addition of pumpkin flour can reduce the protein content of the food (Guiné et al., 2011; Kuchtová, 2017; Kulkarni and Joshi, 2013; Yuan et al., 2022). Unblanched pumpkin dried at 60 °C has a significantly higher protein content than other treatments. Blanching significantly reduced the protein in pumpkin and the results are in agreement with studies reported by Chen et al. (2017), Das and Banerjee (2015) and Haruna, S. A. (2018) where high temperature in blanching reduced the protein content in various type of flour.

Crude fiber content in pumpkin flour

Figure 3 shows the crude fiber content in pumpkin flour dried at different temperature compared to wheat flour. The crude fiber content of pumpkin flour is significantly higher than wheat flour at *p<0.05.* Blanched pumpkin flour and dried at 60 °C has the highest crude fiber at 10.77 ± 0.42%. **Figure 3** also showed that blanching treatment increased the crude fiber content in pumpkin flour. This finding is a similar to a study reported by Rosidi et al. (2021) where blanching increases the crude fiber of red dragon fruit peel powder. Blanching helps to break down the structure of the cell wall tissue, which is composed of cellulose, hemicellulose, and pectin, thereby releasing soluble components such as sugars and some non-fibrous substances and increasing the concentration of crude fiber. Based on the highest crude fiber content, pumpkin flour prepared by blanching and dried at 60 °C was chosen to be incorporated into pasta formulation.

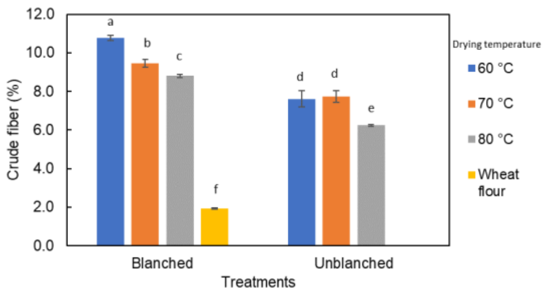

Figure 3 Crude fiber content in blanched and unblanched pumpkin flour dried in 60, 70 and 80 °C in comparison with wheat flour. The result presented is the mean value ± standard deviation (n=3). Bar with different superscript letters is significantly different at *p < 0.05*.

Sensory evaluation of pumpkin pasta

The mean scores of the sensory evaluation of pumpkin pasta are shown in **Table 3**. Attributes with a mean score of near to 5 are highly preferred or liked while a mean score less than 3 were less preferred or unacceptable by panelist. There was no significant difference at *p<0.05* for appearance, taste and texture between pumpkin pasta and control pasta (wheat pasta). This is desirable because the addition of pumpkin flour was not intended to impair the appearance, taste, and texture of pasta. Thus, the pasta can be consumed like normal wheat pasta.

On the other hand, the aroma of 20% and 30% added pumpkin pasta is significantly better than 10% and control pasta. Pumpkin flour has a highly-desirable aroma that is highly valued by consumer and studies has reported a positive effect of pumpkin flour on bakery products (Mirhosseini et al., 2015; Novita Indrianti et al., 2021; Pagliarini et al., 2010). Increasing the percentage of pumpkin flour in the formulation has been reported to give a good effect on the aroma of bread (Păucean and Man, 2014). Meanwhile, the overall acceptability of 20% pumpkin pasta with the mean score of 4.40 ± 0.50 is significantly higher and accepted by the consumer than other formulations. A study done by Păucean and Man (2014) reported that the addition of 15% pumpkin flour in bread formulation has desirable sensory and texture quality.

Table 3 Sensory score of different percentages of pumpkin flour in pumpkin paste

Pumpkin flour composition	Sensory attributes				
	Appearance	Taste	Texture	Aroma	Overall
10%	3.47 ± 0.68ᵃ	3.26 ± 0.64ᵃ	3.63 ± 0.87ᵃ	2.95 ± 0.76ᵇ	1.15 ± 0.37ᵈ
20%	3.63 ± 0.74ᵃ	3.79 ± 0.89ᵃ	4.26 ± 0.55ᵃ	4.05 ± 0.51ᵃ	4.40 ± 0.50ᵃ
30%	3.68 ± 0.98ᵃ	3.32 ± 1.34ᵃ	3.58 ± 0.88ᵃ	4.10 ± 0.45 ᵃ	3.00 ± 0.32ᵇ
Control	3.3675 ± 0.48ᵃ	3.37 ± 0.58ᵃ	3.74 ± 1.07ᵃ	3.16 ± 0.36ᵇ	2.00 ±0.65ᶜ

The result presented is the mean value ± standard deviation (*n=20*). Values in the same column with different superscript letters are significantly different at $p < 0.05$.

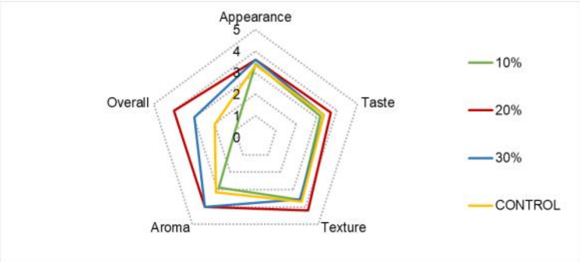

Figure 4 Sensory profile of different percentages of pumpkin flour in pumpkin pasta

The sensory profile of each formulation is illustrated in the spider web chart in **Figure 4**. From the chart, it demonstrated pumpkin pasta with 20% pumpkin flour addition has almost all attributes' scores near to the value of 5 (extremely like) and has the biggest area compared to other formulations. Studies have also reported that bakery products added with pumpkin flour have health beneficial effects and functional properties. It has a high amount of fiber compared to wheat flour which is good for gut health (Dyshlyuk et al., 2017).

CONCLUSION

The study showed that blanching influences the proximate value of pumpkin flour and its application in food. Compared to wheat flour, pumpkin flour has lower fat and protein content but significantly higher crude fiber content. Based on the crude fiber content, the best processing condition for producing pumpkin flour is blanching and drying temperature at 60 °C. The study also showed that pasta with 20% pumpkin flour obtained the highest overall sensory score and is highly acceptable by the consumer. The study provides information for the potential use of pumpkin flour in pasta formulation and its potential to increase the fiber content in food. The blanching and drying process also improved the shelf life of pumpkin and diversified its application in food.

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References

AOAC (2000). Official Methods of Analysis. Association of Official Analytical Chemists, Washington D.C.

Aydin, E., & Gocmen, D. (2015). The influences of drying method and metabisulfite pre-treatment on the color, functional properties and phenolic acids contents and bioaccessibility of pumpkin flour. LWT - Food Science and Technology, 60(1), 385–392.

Chen, X., Lu, J., Li, X., Wang, Y., Miao, J., Mao, X., Zhao, C., & Gao, W. (2017). Effect of blanching and drying temperatures on starch-related physicochemical properties, bioactive components and antioxidant activities of yam flours. LWT - Food Science and Technology, 82, 303–310.

Das, S., & Banerjee, S. (2015). Production of Pumpkin Powder and Its Utilization in Bakery Products Development: A Review. International Journal of Research in Engineering And Technology, 4(5), 2319–2322.

Di Pede, G., Dodi, R., Scarpa, C., Brighenti, F., Dall'asta, M., & Scazzina, F. (2021). Glycemic index values of pasta products: An overview. Foods, 10(11).

Dyshlyuk, L., Babich, O., Prosekov, A., Ivanova, S., Pavsky, V., & Yang, Y. (2017). In vivo study of medical and biological properties of functional bakery products with the addition of pumpkin flour. Bioactive Carbohydrates and Dietary Fibre, 12(January), 20–24.

Enneb, S., Drine, S., Bagues, M., Triki, T., Boussora, F., Guasmi, F., Nagaz, K., & Ferchichi, A. (2020). Phytochemical profiles and nutritional composition of squash (Cucurbita moschata D.) from Tunisia. South African Journal of Botany, 130(February), 165–171.

Gomes, R. S., Machado, R., De Almeida, C. F., Chagas, R. R., De Oliveira, R. L., Delazari, F. T., & Da Silva, D. J. H. (2020). Brazilian germplasm of winter squash (Cucurbita moschata D.) displays vast genetic variability, allowing identification of promising genotypes for agro-morphological traits. PLoS ONE, 15(6), 1–26.

Guiné, R. P. F., Pinho, S., & Barroca, M. J. (2011). Study of the convective drying of pumpkin (Cucurbita maxima). Food and Bioproducts Processing, 89(4), 422–428.

Haruna, S. A. (2018). The influence of drying temperature on selected properties of flour produced from orange fleshed sweet potato tubers. International Journal of Engineering Research and Technology, V7(07), 338–341.

Jesmin, A. M., Ruhul, A., & Chandra, M. S. (2016). Effect of pumpkin powder on physico-chemical properties of cake. International Research Journal of Biological Sciences, 5(4), 1–5.

Kolniak-Ostek, J., Kita, A., Pęksa, A., Wawrzyniak, A., Hamułka, J., Jeznach, M., Danilčenko, H., & Jariene,

E. (2017). Analysis of the content of bioactive compounds in selected flours and enriched extruded corn products. Journal of Food Composition and Analysis, 64(July), 147–155.

Kuchtová, V., 2017. Effect of Pumpkin Powder Incorporation on Cooking. Potravinárstvo: Slovak Journal of Food Sciences, 11, 373–379.

Kulkarni, A. S., & Joshi, D. C. (2013). Effect of replacement of wheat flour with pumpkin powder on textural and sensory qualities of biscuit. International Food Research Journal, 20(2), 587–591.

Mahloko, L. M., Silungwe, H., Mashau, M. E., & Kgatla, T. E. (2019). Bioactive compounds, antioxidant activity and physical characteristics of wheat-prickly pear and banana biscuits. Heliyon, 5(10), e02479.

Márquez-Cardozo, C. J., Caballero-Gutiérrez, B. L., Ciro-Velázquez, H. J., & Restrepo-Molina, D. A. (2021). Effect of pretreatment and temperature on the drying kinetics and physicochemical and techno-functional characteristics of pumpkin (Cucurbita maxima). Heliyon, 7(4).

Mirhosseini, H., Abdul Rashid, N. F., Tabatabaee Amid, B., Cheong, K. W., Kazemi, M., & Zulkurnain, M. (2015). Effect of partial replacement of corn flour with durian seed flour and pumpkin flour on cooking yield, texture properties, and sensory attributes of gluten free pasta. LWT - Food Science and Technology, 63(1), 184–190.

Novita Indrianti, N., Sholichah, E., & Afifah, N. (2021). Pumpkin flour affects antioxidant activity, texture, and sensory attributes of flat tubers noodle. IOP Conference Series: Materials Science and Engineering, 1011(1).

Pagliarini, E., Laureati, M., & Lavelli, V. (2010). Sensory evaluation of gluten-free breads assessed by a trained panel of celiac assessors. European Food Research and Technology, 231(1), 37–46.

Păucean, A., & Man, S. (2014). Physico-chemical and sensory evaluations of wheat bread with pumpkin (Cucurbita maxima) pulp incorporated. Journal of Agroalimentary Processes and Technologies, 20(1), 26–32.

Peksa, A., Kita, A., Carbonell-Barrachina, A. A., Miedzianka, J., Kolniak-Ostek, J., Tajner-Czopek, A., Rytel, E., Siwek, A., Miarka, D., & Drozdz, W. (2016). Sensory attributes and physicochemical features of corn snacks as affected by different flour types and extrusion conditions. LWT - Food Science and Technology, 72, 26–36.

Piepiórka-Stepuk, J., Wojtasik-Kalinowska, I., Sterczyńska, M., Mierzejewska, S., Stachnik, M., & Jakubowski, M. (2023). The effect of heat treatment on bioactive compounds and color of selected pumpkin cultivars. Lwt, 175(September 2022), 114469.

Poliszko, N., Kowalczewski, P. Ł., Rybicka, I., Kubiak, P., & Poliszko, S. (2019). The effect of pumpkin flour on quality and acoustic properties of extruded corn snacks. Journal Fur Verbraucherschutz Und Lebensmittelsicherheit, 14(2), 121–129.

Pongjanta, J., Naulbunrang, A., Kawngdang, S., Manon, T., & Thepjaikat, T. (2006). Utilization of pumpkin powder in bakery products. Songklanakarin Journal of Science and Technology, 28(SUPPL. 1), 71–79.

Przetaczek-Rożnowska, I., Dyrek, K., Fortuna, T., Wenda, E., Bidzińska, E., & Jędrszczyk, E. (2018). Thermal properties and free radicals generation in starch isolated from pumpkin fruits. International Journal of Biological Macromolecules, 108, 1248–1254.

Rolnik, A., & Olas, B. (2020). Vegetables from the Cucurbitaceae family and their products: Positive effect on human health. Nutrition, 78.

Rosidi, N. A. S., Abdul Ghani @ Yaacob, A., Yusof, N., & Yusof, N. (2021). Effect of Blanching and Drying Temperatures on Physicochemical Properties of Red Dragon Fruit (Hylocereus polyrhizus) Peel Powder. Journal Of Agrobiotechnology, 12(1S), 62–73.

Saeleaw, M., & Schleining, G. (2011). Composition, Physicochemical and Morphological Characterization of Pumpkin Flour. International Congress on Engineering and Food (ICEF), 1–5.

Wickramasinghe, Y. W. H., Wickramasinghe, I., & Wijesekara, I. (2020). Effect of Steam Blanching, Dehydration Temperature & Time, on the Sensory and Nutritional Properties of a Herbal Tea Developed from *Moringa oleifera* Leaves. International Journal of Food Science, 2020.

Wongsagonsup, R., Kittisuban, P., Yaowalak, A., & Suphantharika, M. (2015). Physical and sensory qualities of composite wheat-pumpkin flour bread with addition of hydrocolloids. International Food Research Journal, 22(2), 745–752.

Yuan, T., Ye, F., Chen, T., Li, M., & Zhao, G. (2022). Structural characteristics and physicochemical properties of starches from winter squash (Cucurbita maxima Duch.) and pumpkin (Cucurbita moschata Duch. ex Poir.). Food Hydrocolloids, 122(2), 107115.