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QUALITY PARAMETERS OF SEMI-FINISHED SPONGE CAKE ENRICHED WITH PUMPKIN BY-PRODUCTS

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Abstract. Nowadays, there is growing demand for flour-based products that only contain natural ingredients and are highly nutritional. This tendency promotes further research to find new raw materials for their production. Using by-products of pumpkin processing is a promising way to solve this problem due to their chemical content. In this research, the physicochemical and sensory properties of sponge cake enriched with pumpkin seed powder in two different quantities (5% and 10%) have been studied. Sensory evaluation of sponge cakes with pumpkin seed powder has revealed very high consumer acceptance. It has been established that the semi-finished cake with 5% of pumpkin seed powder added decreased in volume (229.00±5.17cm^3), compared with the control (255.00±5.07 cm^3). Higher porosity was observed in the control sample (65.62±1.41%) and in the sample with 5% of pumpkin seed powder added (64.20±1.00%). The water-absorbing capacity of the control sample (312.60±3.15%) was the lowest, compared with that of the samples containing 5 and 10% of pumpkin by-products. The lowest values of the crust chroma were in the cake samples containing 10% of pumpkin seed powder. The colour of the crust and crumb in the control was similar to that in the cake with 5% of pumpkin seed powder. An increase in the proportion of pumpkin seed powder from 0 to 10% resulted in an increase in the protein content, fibre, and total carbohydrates. The cake samples with 10% of pumpkin seed powder were the highest in protein (14.77%), fibre (2.76%), and total carbohydrates (75.15%). The results of sensory evaluation have shown that the semi-finished sponge cake enriched with 10% of pumpkin seed powder had better sensory properties, a more acceptable shape, smell, texture of the crumb, colour, and taste, compared with other samples.

Key words: semi-finished sponge cake, pumpkin by-products, pumpkin seed powder, physicochemical characteristics, sensory analysis, colour, nutritional value.

Introduction. Formulation of the problem

Since recently, the idea of healthy diet has been prevailing in the world. It makes manufacturers never stop expanding the range of their products, produce environmentally friendly, natural foods and products enriched with substances that prevent nutrition-dependent disorders. Bakery products play the leading role in daily mass consumption of food. However, their biological value is reduced because of the refined composition of top-grade wheat flour – the main component of the recipe. This is so, because processing cereals into flour is accompanied by significant losses of micronutrients (vitamins and minerals) removed together with the bran and germs of grain. So, to improve people's health, it is important to increase the nutritional value of flour by increasing the content of essential nutrients (proteins) and essential micronutrients (vitamins, minerals) [1].

Addition of different flours to bakery products makes it possible to combine proper technological characteristics with health-improving biological properties. Since consumption of bakery products has become a trend in people's well-being, addition of natural components with high biological activity could enhance food quality and health-improving value. Developing sponge cakes with functional ingredients would be a response to the growing interest in the health promoting aspects and nutritional value of food.

Analysis of recent research and publications

Pumpkin belongs to the family *Cucurbitaceae* and is a vegetable widely grown all over the world. Processing pumpkins into purée, juice, candied fruit and pumpkin seed oil results in a lot of by-products. This raw material is high in protein, unsaturated fatty acids, fibre, and minerals such as zinc, phosphorus, manganese, potassium, magnesium, copper, calcium, iron, sodium, and cobalt. There are many research studies on the protective effects of the pumpkin and its parts (pumpkin seeds, pulp) against diabetes, breast cancer, and depression [2,3].

Numerous studies have shown the prospects of using pumpkin by-products to increase the nutritional value of food [4]. This has resulted in much attention pumpkin seed has received in recent years because of its nutritional and health-protective characteristics. The seed is an excellent source of protein and are pharmacologically active producing anti-diabetic, antifungal, antibacterial, anti-inflammatory, and antioxidant effects. It also contains omega 3 & omega 6 fatty acids needed for the balance of hormones, brain function, and skin health. Tryptophan present in this seed helps lactating mothers produce milk and reduces postpartum oedema of the hands and feet. Thus, pumpkin seed is a good nutritious and health-promoting snack. Pumpkin seed is one of the highest in antioxidants among all nuts, seeds, or foods [4,5]. Fresh seeds of *Cucurbita moschata* contain moisture (28.5%), protein (37.7%), and ash (4.4%), whereas in dried pumpkin seeds, the moisture content is 5.6%, the protein content 37.4%, and the ash content 4.4% [6]. Pumpkin seeds are rich in exogenous amino acids (e.g. lysine, tyrosine, tryptophan, methionine) and in iron (96±33ppm), thus being recommendable to children and adolescents often prone to iron deficiency-caused anaemia. In recent years, in vitro, in vivo, and pre-clinical studies have proved that consumption of pumpkin by-products positively effects on blood glucose, cholesterol, immunity, liver function [2,3].

Adding pumpkin seed flour to bread recipe increased total essential amino acids, protein, fat and mineral content, making it clear that pumpkin seed flour is a good source of protein and fortifying nutrients [7]. Pumpkin powder incorporated into the cupcake recipe decreased the peroxide value, which was due to the high content of antioxidants in pumpkin seed. Besides, the baked goods were higher in phenolic compounds and carotenoids. Also, products enriched with 5–10% of pumpkin powder had better sensory characteristics (colour, taste, texture), higher specific volume, and their quality during storage was more stable compared with the control samples [8]. A number of scientists have studied the effect of pumpkin powder on the quality characteristics and nutritional value of muffins. Replacing 20% of wheat flour with the raw materials suggested resulted in positive changes in the colour and overall acceptability of the final products. The products developed contained by 1.3% more protein, by 6.5% more dietary fibre, and by 0.27% more ash and minerals (iron and phosphorus) than the control [9]. The data obtained show a significant increase in minerals and dietary fibre in the biscuits fortified with powder of germinated pumpkin seeds, compared with the control samples. So, the content of calcium, zinc and iron, respectively, of the biscuits enriched with pumpkin by-products was 84.46, 5.50, and 8,63 mg/100g of product, compared to 36.59, 0.38, and 1.63 mg/100g of biscuits based on wheat flour [10]. It was also suggested to use raw and roasted pumpkin seed flour in the biscuit technology. Sensory evaluation of the samples developed showed that the recommended mass fraction of processed pumpkin by-products in the recipe was 30%. It was found that these samples also manifested high antioxidant activity, which led to a decrease in the peroxide value during their storage [11].

The growing demand for sponge cakes makes them a promising object of consumer diet that can be enriched with nutrients according to the healthy diet requirements. It is important to note that preserving the traditional consumer characteristics in pastry with increased nutritional value is still a topical task for manufacturers. That is why, in recent years, scientists have suggested technological solutions that allow developing and stabilising the quality of gluten-free sponge cake and ensure its balanced chemical content. So, for the technology of this product, it was suggested to use amaranth flour, which is high in protein, dietary fibre, vitamins, and minerals. The organoleptic qualities of the product obtained indicated that adding 27% of amaranth flour resulted in more uniform and more elastic sponge cake crumb than in the control sample. The results allowed establishing that the quality of the product fortified with the functional ingredient was more stable during storage [12]. It was studied how broccoli leaf powder (BLP) effected on the content of bioactive compounds and the antioxidant capacity of gluten-free sponge minicakes. It was shown that introducing 2.5% of broccoli leaf powder instead of starch was an effective way to increase the nutraceutical potential of this product [13]. Iorgachova *et al.* [14] presented their findings on how the quality of batter and sponge cakes depended on oat and barley flour and on the method and stage of adding them. Replacing up to 25% of mélange with glucan-containing flour blends had a positive effect on the porosity structure and flavour of these products, and significantly increased their nutritional value. It was also suggested to use husks of psyllium seed in sponge cake production to increase the content of minerals and dietary fibre. The research results allowed establishing the optimum mass fraction of this raw material in the production of foamy pastry. Adding more than 5% of psyllium seed husks to the product's recipe adversely affected the density of the batter, thereby reducing the quality of the finished product, compared with the control [15].

It should be mentioned that there is not enough information about the effect of wheat flour and pumpkin seed flour mixtures on the quality of bakery products. Based on the above-mentioned, using pumpkin by-products to make pastry (including sponge cake) is a promising solution to the problem of stabilising the quality of these products fortified with essential nutrients, and this research considering these issues is topical.

The purpose is to study the quality of sponge cake enriched with pumpkin seed powder flour (defatted) in different quantities.

For this purpose, it is necessary to achieve the following **objectives**:

– to make sponge cakes based on flour blends with different contents of pumpkin seed flour;

– to study the effect of wheat flour and defatted pumpkin seed flour blends on the physical, chromatic, and nutritional properties of the sponge cakes;

– to evaluate the sensory properties of the sponge cakes with and without pumpkin seed flour.

Research materials and methods

Preparation of sponge cake. The standard raw materials used in this study are type 500 wheat flour containing 0.5% ash (GoodMills, Sofia, Bulgaria), granulated sugar (Zaharni Zavodi - Gorna Oriahovitsa, Bulgaria), eggs (Zora, Donchevo, Bulgaria), and defatted pumpkin seed powder (Arlean 850, Sofia, Bulgaria). All of them are authorised by the Ministry of Health as manufactured in Bulgaria. The control cake was prepared according to the traditional technology and formulation [16]. The batter formulation of the control cake was as follows (based on flour weight): egg yolk 43.23%, egg white 96.77%, refined granulated sugar 83.87%, and wheat flour 100%. In particular, a double mixing procedure was applied during whipping to separate egg whites and yolks. Two different quantities of pumpkin seed powder were added into the sponge cake flour, replacing 5% and 10% of wheat flour, respectively. Each 75g portion of sponge cake batter was poured into metal baking moulds and baked in an electric oven at 180°C for 30 min.

Physical characteristics. The specific gravity of the sponge cake was calculated by dividing the weight of a standard batter cup by the weight of an equal volume of distilled water, at the temperature of the batter 24.00±0.5°C [17]. The physical characteristics of the sponge cake were determined 2 h after baking. The volume was measured by the small uniform seed displacement method [18], and the porosity was assessed according to the Bulgarian State Standard Method [19]. The porosity of the sponge cake was defined as the ratio between the volume of the air-pockets in the cake crumb and the volume of the crumb. The porosity was determined with a cylinder driller. The specific volume was expressed as the ratio of the sponge cake volume to its weight. The water-absorbing capacity of the sponge cake was measured by the extent of the cake's swelling according to the Bulgarian State Standard Method [20].

Colour characteristics of the sponge cake. The instrumental measurement of the colour of the cakes was carried out with a Color-Guide 45/0 Colorimeter (BYK Gardner Inc, USA), and the results were expressed in accordance with the CIELAB system. The colour was measured in four predetermined places of the sponge cake crust and crumb. The parameters determined were L* (L*=0 [black] and L*=100 [white]), a* (–a*=greenness and +a*=redness), b* (–b*=blueness and +b*=yellowness). Colorimeters give measurements that can be correlated with human eye-brain perception, and give tristimulus (L*, a* and b*) values directly.

Chroma, C*, is the aspect of colour by which a sample appears to differ from grey of the same lightness or brightness, as defined by the following equation:

$$C^* = \sqrt{a^{*2} + b^{*2}} \qquad (1)$$

The total colour difference (ΔE*) between the control cake and the sponge cakes with functional ingredients was calculated as follows:

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \qquad (2)$$

as: $\Delta L^* = L_1 - L_0$; $\Delta a^* = a_1 - a_0$; $\Delta b^* = b_1 - b_0$.

The values used to determine if the total colour difference was visually perceived were the following.

ΔE* < 1 – colour differences are not perceived by human eyes;

1 < ΔE* < 3 – colour differences are not appreciable to human eyes;

ΔE* > 3 – colour differences are perceived by human eyes [21,22].

Nutritional value of the sponge cake. The energy values were obtained by Atwater and Bryant's method, using the conversion factors 4, 9, 4, and 2kcal/g for protein, fat, carbohydrate, and dietary fibre respectively [23]. The nutritional value of 100g of the product was determined according to Regulation (EU) No. 1169/2011 of the European Parliament and of the Council.

Sensory characteristics. A descriptive test for quantitative sensory profiling was used to establish the sensory characteristics (shape, colour, cell size and uniformity, odour, sweetness, aftertaste, crumb tenderness) of the sponge cakes, 6 h after baking, by the ISO 8586:2014 and ISO 13299:2016 methods [24,25]. The sponge cake samples were prepared 1 h before the evaluation. Samples of different cakes were kept in coded plates covered with aluminium foil. Twelve trained panellists were selected to guarantee the evaluation accuracy. The intensity of each sensory characteristic was recorded on a ten-point linear scale after 1 h orientation sessions where the panellists had specified the terminology and anchor points on the scale. The coded samples were shown simultaneously and evaluated in random order.

Statistical analysis. All experiments were performed in triplicate. The data were analysed and presented as mean values ± standard deviation. Statistical analysis was conducted using the Statgraphics Centurion XVI software, version 16.2.04 (Statpoint Technologies Inc., USA). The analysis of variance, including Levene's test (ANOVA) and the Multiple Range Test, were used to determine significant differences at the confidence level 95% ($p<0.05$).

Results of the research and their discussion

The developed recipe composition of sponge cake with pumpkin seeds added was prepared by replacing 5% and 10% of wheat flour with defatted pumpkin seed powder. The previous study showed that replacing wheat flour with more than 20% of pumpkin seed flour in the cake recipe deteriorated the sensory characteristics (colour, tenderness of the crumb, aftertaste) [26]. The recipe compositions of the control sample and the cakes containing an additive of defatted pumpkin seed powder are presented in Table 1.

The technological stages were chosen because they were easy to perform and because the technological cycle took quite a short time. The baking mode the sponge cakes containing defatted pumpkin seed powder were processed in was constant and concurrent with that of the control sample, and the latter, according to the technological instruction, was baked for 30 min at 180°C.

Addition of pumpkin seed powder to sponge cakes improves their physical characteristics (Table 2). The specific gravity of cake batter is an indicator of the total air holding capacity of the batter. Low specific gravity values indicate good incorporation of air, yielding a higher final volume after baking. However, this quality parameter depends on many other factors, too. The difference between the specific volumes of the control cake sample and the sponge cakes with pumpkin seed powder is minimal. In this research, the volume of the cakes with pumpkin seed powder decreased compared with that of the control cake (255.00±5.07cm^3). The volume of the cake with 5% of pumpkin seed powder had the smallest volume (229.00±5.17cm^3). The greatest porosity was observed in the control (65.62±1.41%) and in the cake with 5% of pumpkin seed powder (64.20±1.00%). The water-absorbing capacity of the control cake (312.60±3.15%) was lower than that of the cakes with 5% and 10% of pumpkin seed powder.

In the fresh sponge cakes of the compositions tested, which included functional components, the colour properties of the crust and crumb have been measured (Fig. 1 and Fig. 2). The lightest samples (those with the highest L* values) were those of the control cake (56.21±2.23) shown in Fig. 1. The control cake and the one with 5% of pumpkin seed powder had the highest values of b* (yellow component) indicating a significantly brighter and more saturated yellow colour. The lightness and the a* and b* values of the control were not significantly different from those of the cake with pumpkin seed powder. The control cakes had the highest value of the chroma of the crust. The lowest values of the chroma were detected in the crust of the cake containing 10% of pumpkin seed powder as a source of fibre. According to these results, in the cakes with the functional component (pumpkin seed powder), the ΔE* was appreciable to human eyes (ΔE*>3).

Table 1 – Recipes of sponge cake batters

Ingredients	Based on:		
	wheat flour (control), %	flour blend (wheat flour and defatted pumpkin seed powder), %	
	control sample	with 5% of defatted pumpkin seed powder	with 10% of defatted pumpkin seed powder
Egg yolk	43.23	43.23	43.23
Egg white	96.77	96.77	96.77
Refined granulated sugar	83.87	83.87	83.87
Type 500 wheat flour	100.00	95.00	90.00
Defatted pumpkin seed powder	–	5.00	10.00

Table 2 – Physical characteristics of the sponge cake batter and sponge cakes

Physical characteristics[a]	Sponge cake types		
	Control	with 5% of pumpkin seed powder	with 10% of pumpkin seed powder
Specific gravity (for batter)[b]	0.75±0.04[c]	0.79±0.02[d]	0.80±0.01[d]
Volume, cm^3	255.00±5.07[c]	229.00±5.17[d]	235.00±7.95[d]
Specific volume, cm^3/g	3.56±0.11[c]	3.40±0.21[c]	3.17±0.09[d]
Porosity, %	65.62±1.41[c]	64.20±1.00[c]	63.88±1.03[cd]
Water-absorbing capacity, %	312.60±3.15[c]	317.20±3.07[d]	321.37±4.00[d]

a The values are average ±SD ($p<0.05$).

b The temperature of the batter is on average 20.7±0.5^{0}C.

c–d The difference in the values in a line with identical letters is not statistically significant ($p<0.05$).

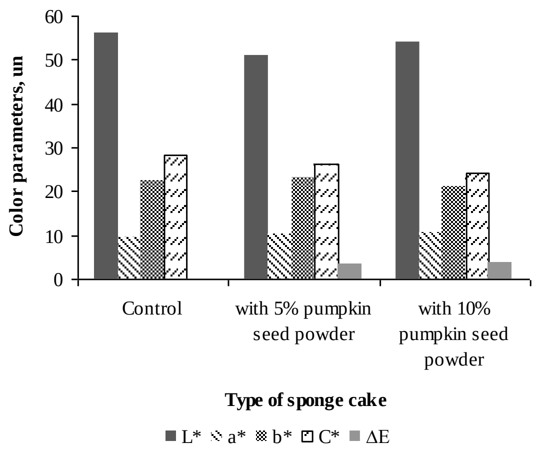

Fig. 1. Crust colour values of the sponge cakes

The variations in the crumb colour of the cakes with functional components as flour substitutes were similar to the variations in the crust colour (Fig. 2).

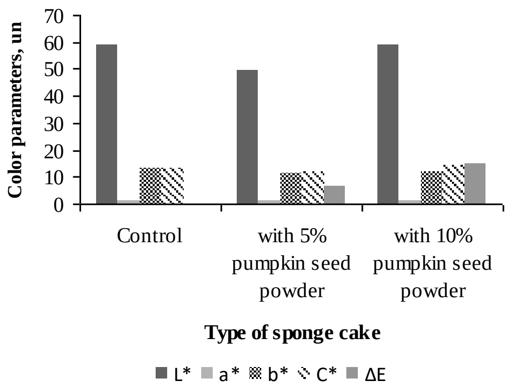

Fig. 2. Crumb colour values of the sponge cakes

The cake with 5% of pumpkin seed powder was the lightest, and its b* values showed that this sample was brighter in colour. The crumb colour of the control sample was similar to that of the cake with pumpkin seed flour. The lowest values for the colour were detected in the crumb of the cake containing 5% of pumpkin seed powder. According to these results, in the cakes with 10% of pumpkin seed powder, the ΔE* was appreciable to human eyes.

The findings on the chemical composition and energy value of the sponge cakes with pumpkin seed powder are presented in Table 3. The cake with 10% of pumpkin seed powder was the highest in moisture (31.20%), and the control cake had the lowest moisture content (30.00%). Generally, a slight increase in the moisture content was observed when the concentration of pumpkin flour increased. This might be due to the water adsorption capacity and binding ability that characterise pumpkin flour. The moisture content of the processed samples was at a reasonable level, which is an additional benefit when it comes to the samples' shelf life. These findings are consistent with the results of Nyam *et al.* and Kanwal *et al.* [27,28].

As illustrated in Table 3, an obvious increase in protein was due to an increase in the pumpkin seed flour content. The sample with 10% of pumpkin seed powder was the highest in protein (14.77%), while the lowest protein content was found in the control cake (13.19%). Similar results were recorded by Kanwal [27], who reported 12.3% for the sample enriched with 20% of pumpkin. These results are in line with the findings of Toan and Thuy [29], who explained that the protein content increased with an increase in the pumpkin flour substitute. Although the protein content of the samples enriched was low, the increase in protein might be attributed to the good amount of protein pumpkin seed flour contains. These findings indicate a positive effect of adding dried pumpkin seed flour to improve the sponge cake`s nutritional value.

The highest fat content was in the samples with pumpkin seed powder. The highest value of the fat content was found in the sample with 10% of pumpkin seed powder (8.02%), whereas the lowest value of the fat content was found in the control sample (7.30%). As shown in this study, instability of the fat content could be noticed. Even though there was a slight change in the fat content in all the enriched samples of sponge cake, it was statistically similar. These results are not far from the findings obtained by Kanwal et al. [28]. In his study, he evaluated the physicochemical properties of products enriched with pumpkin seed and determined their fat content to be 28.29%. The high fat content could be due to the level of fat in the pumpkin flour. Elinge et al. [30] found that the fat content of pumpkin seed flour was 38%.

Table 3 – Chemical composition and energy value of the sponge cakes (100 g of the product)

Basic chemical composition and energy value	Type of sponge cakes		
	control	with 5% of pumpkin seed powder	with 10% pumpkin seed powder
Total moisture, %	30.00±0.08[b]	30.67±0.07[c]	31.20±0.11[c]
Protein, %	13.19±0.14[b]	13.98±0.01[c]	14.77±0.11[c]
Fat, %	7.30±0.03[b]	7.64±0.22[b]	8.02±0.32[b]
Carbohydrate[a], %	77.63±0.24[b]	76.38±0.11[c]	75.15±0.18[c]
Total dietary fibre, %	1.61±0.28[b]	2.19±0.20[c]	2.76±0.23[c]
Energy value, kJ/100 g, kcal/100 g	1265.79 302.53	1260.81 301.34	1259.01 300.91

[a] Any carbohydrate which is metabolised by the human body, with the exception of dietary fibre, according to Regulation (EU) No. 1169/2011.
[b–c] The difference in the values in a line with identical letters is not statistically significant ($p<0.05$).

As reported by Toan and Thuy [29], the fat content of high quality pumpkin flour biscuits ranged between 11.91% and 13.70%.

The highest percentage of carbohydrate was determined in the control (77.63%), and the lowest content was in the cake with 10% of pumpkin seed powder (75.15%). According to the results obtained, the carbohydrate content decreased with addition of the functional ingredients. According to the findings of this study, the carbohydrate content of all the samples enriched was significantly different from the control sample. The importance of carbohydrates for health was established earlier. However, from scientific and practical point of view, it is important to determine the total carbohydrate content of the food materials studied. Revathy and Sabitha [31] indicated that one fourth cup of pumpkin seed contained 200 calories and 15–50% of many crucial nutrients, such as protein, iron, zinc, magnesium, manganese, etc. Beneficial fatty acids, amino acids, and antioxidants are also present in abundance in these seeds. They also contain a lot of vitamins like tocopherol and carotenoids. The results indicated that there was a significant increase in the total dietary fibre content in the sponge cakes incorporating functional ingredients. The sponge cake with 10% of pumpkin seed powder had the highest amount of total dietary fibre (2.76%). Generally, the average fibre content of the cakes increased with the increase in the amount of the pumpkin seed powder. Similar observation was reported by Giwa and Abiodun [32]. This proves the benefits of adding pumpkin seed flour when making biscuits. Plenty of studies concentrated on the nutritional value of dietary fibre. A good food source high in healthy dietary fibre is pumpkin flour.

The energy value of sponge cakes ranged from 300.91kcal/100g to 302.53kcal/100g of product. In the cake with 10% of pumpkin seed powder, this parameter was the lowest.

The sponge cakes with pumpkin seed powder added have good sensory characteristics presented in Fig.3. The sensory analysis has shown that the product’s structure is fine-porous in all kinds of sponge cakes investigated. The control cake and the cakes with pumpkin seeds have approximately a similar shape. The pores in the crumb of the cakes with pumpkin seeds in the three kinds of cake analysed are with thicker walls, small and equal in size. The smell of the cakes with pumpkin seeds is perceived as more pleasant than that of the control cake (sample one). The colour of the cakes with pumpkin seeds is rated good by the testers. The intensities of the sweetness in all sponge cakes investigated are similar. However, when the pumpkin seed concentration increases, a bitter aftertaste is felt.

It was observed that the higher grades for the crumb tenderness of the control resulted in an increase in the overall acceptability values. All samples had a similar shape (Fig.3).

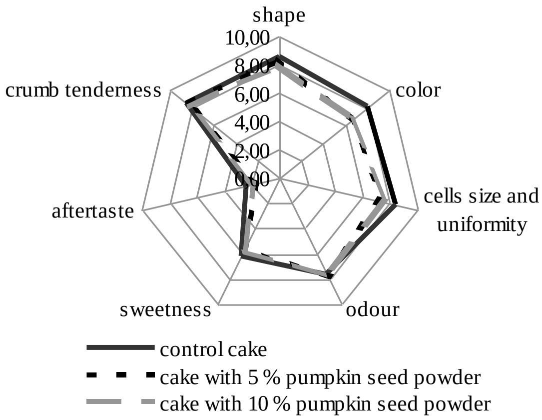

Fig. 3. Sensory characteristics of the sponge cakes

The crumb pores of the product with 5% of pumpkin seed powder had thicker walls, and they were larger and equal in size. The cells of the control sponge cake were smaller, with thinner walls, and almost evenly distributed in the crumb. The control cake had crust and crumb of a more pronounced light yellow colour due to the presence of the chromatic components in egg yolks (carotenoids). The colour of the crust and crumb of the cakes with 5% and 10% of pumpkin seed powder is light brown, with a shade of light green. The odour of the all cakes was perceived by the sensory panellists as pleasant. The intensities of sweetness of all the sponge cakes investigated are similar. The results comply with those reported by Kanwal *et al.* [28]. Similar findings were obtained by Siddiqui *et al.* [33], who found that the increase in the colour rating correlated with the increase in the level of enrichment. An increase in the colour score of the biscuits was attributed to sugar caramelisation and Maillard reactions between sugars and amino acids. Other factors that might contribute to the colour of final products were ingredients, composition, and time of baking. A similar tendency to an increase in all sensory attributes was recorded by Kanwal *et al.* [28], who evaluated the nutritional composition and organoleptic characteristics of biscuits supplemented with different ratios of defatted pumpkin seed flour. The same author concluded that pumpkin seed flour could be successfully used to replace part of wheat flour to obtain highly nutritious and wholesome biscuits without affecting their overall acceptability. The development of smell could be attributed to the roasting of pumpkin seeds during processing, which is necessary for the development of aroma characteristics in seeds, as stated by Siegmund and Murkovic [34]. These aromatic seeds improve the smell in biscuits produced. Moreover, Atuonwu and Akobundu [35] noticed enhancement in the texture of cookies fortified with pumpkin seed flour.

Conclusion

This study has investigated the potential of pumpkin by-products in sponge cake production. The physical and sensory characteristics of the sponge cakes with 5% and 10% of pumpkin seed powder are compared with those of the control sample. The colour on the control was similar to that of the cake with 5% of pumpkin seed powder. The lightness, a* and b* values of crust of the control were not significantly different from those of the cake with 5% of pumpkin seed powder. The crumb colour of the control sample was similar to that of the cake with pumpkin seed powder. According to these results, in the cakes with 10% pumpkin seed powder, the ΔE* was appreciable to human eyes. This allows us to conclude that newly prepared products have good quality characteristics and can be used as intermediate products in confectionery intended for rational and functional nutrition. The results of this study illustrate the potential of supplementing cakes with different ratios of pumpkin seed powder. The proximate analysis of the enriched cakes has revealed a significant increase in protein, ash, fibre, and total carbohydrates as the levels of pumpkin seed powder increased. The sample supplemented with 10% of pumpkin seed powder had the highest values of the nutrient content. In terms of consumer acceptability, the panellists gave preference to the sample supplemented with 10% of pumpkin seed powder over the control sample with 0% of pumpkin seed powder. Thus, we could use different ratios of pumpkin seed powder to produce cakes with good quality and sensory properties. This could expand the industrial utilisation and nutritional value of pumpkin seed powder.

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