Boletus Edulis Mushroom Flour-Based Wheat Bread as Innovative Fortified Bakery Product

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Abstract

Mushroom powder was added to bread in different proportions, namely: 3%, 6% and 9%, in order to improve the nutritional properties of bread. Thus, the new products, had increased contents of protein from 6.60% to 7.79% and fat from 0.78% to 1.43%. Moreover, the content of polyphenols also increased from 39.88 to 84.46 mg GAE/100 g, and the antioxidant activity increased from 16.81% to 27.91%. According to the sensory analysis, performed by means of the hedonic test, the most appreciated bread was that fortified with 6% of mushroom powder. In terms of texture profile, the sample with 6% of mushroom powder recorded the best results. Nowadays, this product has a positive impact on the consumers, who take a growing interest in functional products, that are rich in active compounds. Bread enriched with more than 3 % mushroom powder is a product with high nutritional value.

Keywords: bread, fortification, mushroom

Introduction

Bread is one of the basic foods in human nutrition, as it provides a major source of nutrients such as carbohydrates, proteins and some important microelements like magnesium, potassium, selenium, phosphorus, manganese, iron, etc. The process of bread production dates back 12,000 years ago when the mandatory ingredients were flour and water, to which yeast was added at a later date (Vasileva et al., 2018). Some substances such as bran, pulp, spices, plant and herb extracts, etc. If added to various foods, improve and facilitate different technological processes, provide them with functional property and extend their shelf life. The popularity of adding ingredients that are rich in micro- and macro- nutrients is due to the special interest that consumers take in "redefined" healthy foods (Gawlik-Dziki et al., 2013; Prokopov et al., 2015).

According to Codex General Principles for the Addition of Essential Nutrients to Foods, the concept of "fortification" or "enrichment" is similar to the addition of one or more essential nutrients to a food product, irrespective of whether or not that/those particular nutrient/ nutrients is/ are normally contained in foods. Fortification is used in order to prevent or correct an existing deficiency of one or more nutrients in the whole population or certain specific groups (Codex Alimentarius Commission, 1987). Historically speaking, the implementation of food fortification in highly developed countries dates back long ago. Since the early 1940s, fortification of cereal products with thiamine, riboflavin and niacin has become common practice (Allen et al., 2006). In developing countries, fortification has become increasingly attractive in recent years. Thus, the initiated fortification programs have made more rapid progress in their implementation phase than it had initially been planned (Mozaffarian et al., 2018).

According to Svetlana Popel's research, the most efficient and accessible way of providing the population with vitamins and micronutrients is the additional fortification of daily food products and consumer foods (especially that of flour and bakery products) with these substances, Food fortification should not reduce the shelf life by any means and it should not diminish the nutritional and sensory qualities of these products, by substantially altering their taste or by assimilating other nutrients contained therein (Popel et al., 2011). It is estimated that two billion people worldwide are currently suffering from micronutrient malnutrition (Liu et al., 2018).

Consumer needs and preferences regarding the type of bakery products have greatly changed in recent years. Thus, the contemporary consumer does not consider bread just an energy supplying product any more, but also a product that has functional value and adds nutritional value to their daily diet (Păucean, 2017).

Known as the "food of the gods", mushrooms are appreciated not only for their unique and subtle flavor (Beluhan et al., 2011) but also for their nutritional value (Akyüz et al., 2010), for their high fiber and protein content (Valverde et al., 2015), fatty acids, vitamins and other biologically active compounds (Heleno et al., 2012). The antioxidant compounds in mushrooms, particularly polyphenols, have become highly important due to the variety of biological activities that include the absorbtion of free radicals and inhibition of low-density lipoprotein oxidation (Keleș et al., 2011).

Boletus edulis is a mushroom species with many nutritional properties. In a comparative study of the most used 5 mushroom species in Romania, carried out by Fogarasi et al., (2018), *Boletus edulis* was reported as having the highest protein content of 36.24 g/100g. It also has a very low fat content (1.92 g/100 g) as well as a small amount of carbohydrates (46.23 g/100g). Fourteen mineral elements were also found in the *Boletus edulis* mushroom content - Ba, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Na, Ni, Sr, V and Zn. Vitamins such as those in complex B (B1, B2, B3, B6), vitamin C, E, β-carotene, lycopene and significant amounts of total phenols 446 mg/100g and total flavonoids 32 mg/100g were also reported (Jaworska et al. , 2015). Although there are studies reporting rare cases of allergy caused by digestion-stabile protein at 75 kDa in *Boletus edulis* (Helbling et al., 2002), this type of mushroom is recommended for its nutritional properties and for its anti-tumour effect in kidney cancer (Wang et al., 2014), colon cancer (Lemieszek et al., 2013) and for the fact that it inhibits selectively the proliferation of several malignant cell lines (Bovi et al., 2011).

The fortification of bread and bakery products with various protein additions has also been studied by other authors because of the impact proteins have on the human body. Thus, the bakery industry has produced varieties of bread such as: soybean bread with chickpeas (Serventi et al., 2018), bread fortified with cobia (*Ragycentron canadum*) (Fagundes et al., 2018), gluten - free bread with soybean isolate and calcium caseinate (Villanueva et al., 2018), protein fortified bread with cumin and (*Cumin cyminum*) and caraway seeds (*Carum carvi*) (Sayed et al., 2018). Since white bread is less nutritious, due to the use of refined flour in the production process to the detriment of whole grain flour, the aim of this study is to improve the nutritional properties of an assortment of white bread fortified with *Boletus edulis* mushroom and to analyze the proposed assortments.

Materials and Methods

Materials

The raw and auxiliary materials used in the study were as follows: 550 wheat flour, *Boletus edulis* mushroom powder (lyophilization and ground mushrooms purchased as a powder from Aorex Grup Srl – Figure 1), fresh yeast, salt and water. The products, namely: a control sample and 3 samples with different percentages of mushroom powder, were produced in the pilot station of UASVM-CN (Table 1). The obtained products are presented in Figure 2.

Physico-chemical analyses

Physico-chemical characteristics (moisture, ash, protein, crumb porosity and elasticity) were determined according to Romanian official methods SR 91:2007. Nitrogen (N) content was determined by Kjeldhal apparatus and crude protein was calculated utilizing 5.7 as N conversion factor for vegetable products protein (SR ISO 1871/2002), the fat content was determined according to SR ISO 6492:2001, and the acidity

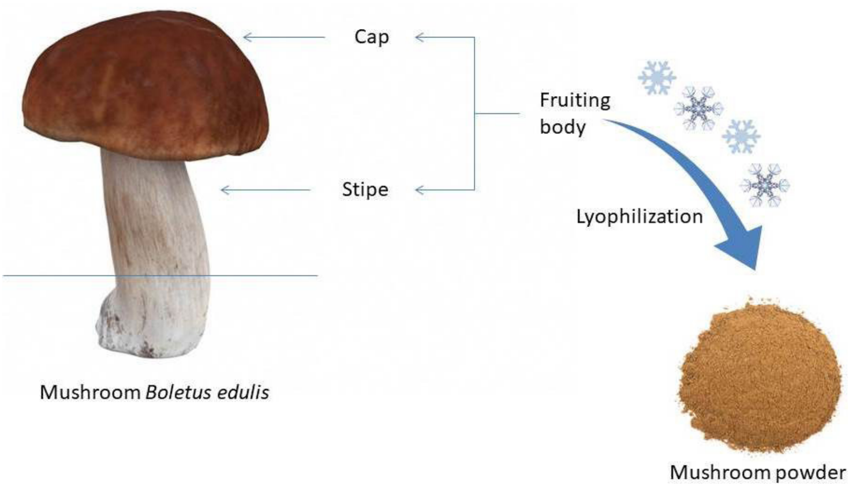

Figure 1. The process of mushroom powder production

Table 1. The recipe for classic bread and bread enriched with mushroom powder

Raw and auxiliary materials	U.M.	Leaven	Dough	Total
Classic bread (PM)				
550 wheat flour	kg	40	60	100
Yeast -1,5% out of the total flour	kg	1	0.5	1.5
Salt -1,8% out of the total flour	kg	-	1.8	1.8
Water	l	34	34	68
Bread enriched with mushroom powder 3% out of the total flour (P1)				
550 wheat flour	kg	40	57	97
Mushroom powder - 3% out of the total flour	kg	–	3	3
Yeast -1.5% out of the total flour	kg	1	0.5	1.5
Salt -1.8% out of the total flour	kg	–	1.8	1.8
Water	l	34	34	68
Bread enriched with mushroom powder 6% out of the total flour (P2)				
550 wheat flour	kg	40	54	94
Mushroom powder -6% out of the total flour	kg	–	6	6
Yeast -1,5% out of the total flour	kg	1	0.5	1.5
Salt -1,8% out of the total flour	kg	–	1.8	1.8
Water	l	34	34	68
Bread enriched with mushroom powder 9% out of the total flour (P3)				
550 wheat flour	kg	40	51	91
Mushroom powder 9% out of the total flour	kg	–	9	9
Yeast -1,5% out of the total flour	kg	1	0.5	1.5
Salt -1,8% out of the total flour	kg	–	1.8	1.8
Water	l	34	34	68

*PM – control sample - Classic bread - was made without the addition of mushroom powder; P1 – bread with 3% mushroom powder; P2 – bread with 6% mushroom powder; P3 – bread with 9% mushroom powder;

Figure 2. Final products (PM, P1, P2, P3)
*PM – control sample; P1 – sample with 3% MP; P2 – sample with 6% MP; P3 – sample with 9% MP.

content by the ethyl alcohol method 67% (v/v) according to STAS 90/1988.

Total carbohydrates were calculated based on the following equation 1 from the content of moisture, protein, lipid, and ash (Barros et al., 2008):

Total carbohydrates (g/100g) = 100 – [moisture (g/100g) + protein (g/100g) + lipids (g/100g) + ash (g/100g)] *(1)*

Energy value was calculated based on the following equation 2 from the content of protein, carbohydrate and lipid using the energy factors (Barros et al., 2007):

Energy value (kcal/100g) = 4 x (g protein + g carbohydrate) + 9 x g lipid *(2)*

Quantification of total phenolics content

In order to obtain the extract for the determination of total polyphenols and antioxidant activity, 1g of flour material was extracted with 20 ml methanol using an ultrasonication bath for 10 min and then was centrifuged at 4000 rpm for 10 min. The extract was collected and stored at -18 °C for further analysis.

The total phenol content was determined by the Folin-Ciocalteu method (Singleton et al., 1999). An aliquot of 0.1ml of extract was mixed with 6 ml of water and 0.5 ml of Folin–Ciocalteu reagent. After 4 min, 1.5 ml Na_2CO_3 solution (7.5%) was added and the sample was diluted to a final volume of 10 ml with distilled water. After incubation for 120 min at room temperature, the absorbance was read at 750 nm, using a Shimadzu UV-1700 PharmaSpec spectrophotometer, against the blank, in which the sample was replaced with methanol. The calibration curve was performed using different concentration of gallic acid standard (r^2=0.9936) and the results were expressed as mg GAE/100 g fresh weigh.

Determination of 2,2-diphenylpicrylhydrazil radical scavenging capacity (DPPH)

The DPPH scavenging activity assay was performed according to a method reported by Brand-Williams et al. (1995). A volume of 3.9 ml of methanolic DPPH (0.025g/l) solution was allowed to react in darkness, for 30 minutes with 10µl of sample and 90 µl of H_2O. The absorbance was measured at 515 nm against methanol. The antioxidant activity was calculated as follows:

$$\% \text{ DPPH scavenging activity} = [(A_d - A_s)/A_d] \cdot 100$$

where A_d was the absorbance of DPPH solution and A_s the absorbance of the sample.

Texture analysis

The texture analysis was performed using the Brookfield equipment. Test type: Texture profile analysis: target value 40% of the deformation, maximum test load 5 g; test speed, 1 mm/s; geometry used: TA11/1000 Brookfield Kit samples - Standard AOAC, cylindrical shape, diameter of 25.4 mm, transparent acrylic, weight of 21 g, 35 mm in length; waiting time between compression ramps: 5 s. Sample Dimensions: 2.5 x 2.5 x 2.5 cm middle crumb. The specific texture parameters were computed by Texture Pro CT V1.6 software.

Acceptability test performed on the 9-point hedonic test

The sensory evaluation of bread was performed by means of the hedonic test according to

ISO 13299:2016. Briefly, the samples were sliced (thickness of slices was of about 1.5 cm), encoded and served to instructed consumers. The samples were analyzed 6 hours after they were removed from the oven. Sensory characteristics of samples were evaluated by a panel of 60 trained assessors (43 female assessors and 17 male assessors), aged between 19 and 53. The degree of pleasure for different types of bread was rated based on a 9-point hedonistic scale (1 being "extreme dislike" and 9 being "greatly like"). Overall acceptability, smell, color, texture, appearance and taste were the sensory attributes that were evaluated. Water was used to rinse the mouth before and after each test.

Statistical analysis

The results of three independent assays (performed with replicates each) were expressed as mean value ± SD; for each parameter Tukey's comparison tests being performed at a 95% confidence level.

Results and discussions

Mushroom powder analysis

The mushroom powder used in the technological process of producing fortified bread was subjected to physicochemical analysis. Taking into account the results obtained in Table 2 for *Boletus edulis* mushrooms, it can be stated that they are in keeping with the literature data. For instance, in the literature, the moisture content of dehydrated *Boletus edulis* mushrooms has a value of 7.23% (Nagy, 2016) which is close to 7.05% obtained in thisstudy. The 7.38% of mineral content found in this study for lyophilisated mushrooms ranges within the literature reference values (5.26% - 8.38%) (Heleno et al., 2015; Nagy, 2016). In addition, for the same variety of *Boletus edulis* mushrooms, the protein content found in the literature varies between 10.65% and 36.90% (Heleno et al., 2015, Beluhan et al., 2011) while the lipid content between 1.92% and 3.10% (Nagy, 2016; Cheung et al., 2013). Both values found in the present study are also close to the aforementioned literature data (Table 2).

For carbohydrates, our findings (54.57 g/100 g) are closer to 51.70 g/100g which was reported by Cheung et al. (2013). A percentage of 50%-60% of the dried mushrooms is given by carbohydrates. This group of carbohydrates, also called total sugars, encompasses various compounds, such as: oligosaccharides, monosaccharides, polysaccharides and their derivatives. Of the oligosaccharide structure, mannitol and α,α-trehalose are the most representative constituents. The most important polysaccharides from mushrooms are glycogen and chitin, which can be generally found in animal products. However, it is important to highlight that they can also be found in mushrooms, although mushrooms are of vegetable origin (Kalač, 2012). The nutritional quality of mushrooms is mainly given by the content of polysaccharides, which have a prebiotic effect (Aida et al., 2009). Information on the dietary fiber content of mushrooms is divided into soluble fibers (4%-9%) and insoluble fibers (22%-30%). These fibers confer the matrix high nutritional characteristics, due to their significant values (Kalač, 2009).

Table 2. The physicochemical characteristics of the mushroom powder

Sample	MP
Moisture [%]	7.05 ± 0.01
Ash [%]	7.38 ± 0.25
Acidity [°acidity]	7.62 ± 0.49
Protein [%]	27.88 ± 1.21
Fat [%]	3.12 ± 0.05
Total carbohydrates [g/100g]	54.57 ± 0.38
Energy value [kcal/100g]	357.88 ± 3.61
Total phenols[mg GAE/100 g]	1286.30 ±7.27
DPPH inhibition [% RSA]	36.14 ± 0.20

*MP - mushroom powder

The polyphenol content found in the studied mushrooms reaches 1286.30 mg GAE/100 g, while in the specialty literature, Keleş et al., (2011) reported results (12775.56 mg GAE/kg), which are close to the content of polyphenols found in the present study.

The results obtained in the current study are in keeping with those reported in the literature. The results reported in the literature were similar to ours for all the compounds of *Boletus edulis* that were analysed in our study. The significant amount of proteins and essential amino acids along with the low fat content in *Boletus edulis* mushrooms are the main elements that confer them real value (Vamanu, 2013; Mureşan et al., 2017). Hence, the purpose of fortification with mushroom powders is highly justified.

Analysis of bread samples

The results presented in Table 3 illustrate the variation for the three functional bread prototypes obtained from the mixture of wheat flour (type 550) with 3%, 6% and 9% of *Boletus edulis* mushrooms powder. In order to highlight the advantages and/or disadvantages of bread fortification, these samples also include bread made exclusively from wheat flour (PM), which is considered as a control sample.

A comparative analysis of the samples was also carried out in order to explain the impact that the different proportions of mushroom powder incorporated in the wheat flour had on the results variation.

The studied bread samples had the moisture content between 44.76% and 44.28%. According to these percentages, moisture decreases insignificantly statistically. A similar decrease has been recorded for bread with maize germ flour (Păucean et al., 2013). The ash content was found as slightly increased with the addition of mushroom powder, and similar minor increases were reported in the case of lentil bread (Previtali et al., 2014). The maximum value obtained in the current study, for the bread variety with 9% addition of mushroom powder was of 2.16°, this value being within the maximum limit (3° acidity) allowed by STAS 90-1988. The quality of vegetable proteins has become a highly debated issue because the consumption of products fortified with vegetable sources is increasingly promoted in the "world of nutrition" at present. Due to the importance of the presence of essential amino acids in the body, nutritionists recommend using vegetable protein sources. The low content of wheat protein in certain essential amino acids, especially lysine, makes wheat flour protein be considered as inferior quality (Păucean, 2017). Bread with mushroom powder comes with high quality protein intake, showing increases from 6.60% to 7.79%. Increases in protein content have also been reported for lentil bread (Previtali et al., 2014), for pasta with mushroom powder (from 14.2% to 18.27%) (Mureșan et al., 2017), and for soybean bread with chickpeas (Serveti et al., 2018).

Alongside with the growth of protein content, there is also a slight increase in fat content from 0.78% to 1.74%, due to the addition of mushroom powder in the bread. The lipids in the mushroom composition play a role in transporting A, D, B vitamins and ensure their absorption within the digestive tract. Furthermore, some other roles played by the lipids in the mushrooms should also be highlighted, namely: tissue regeneration, nervous system formation, functional gland (thyroid), antibody formation and normal skin functioning (Pedneault et al, 2006).

Another advantage of adding mushroom powder is the reduction in the total carbohydrate content from 46.39 g/100 g to 44.75 g/100g and the increase in the energy level from 218.98 kcal/100 g to 223.03 kcal/100 g.

The absence of gluten in the mushroom powder causes a reduction in the bread elasticity alongside with the addition increase of 94.82% to 89.04%. This addition also causes a minor decrease in porosity, which could be noticed in other types of bread - fortified with pumpkin (Păucean et al., 2014) or maize germ flour (Păucean et al., 2013).

The bread prepared without addition of mushroom powder has been found as having a polyphenol content of 39.88 mg GAE/100 g, which increased, though, to 64.46 mg GAE/100 g in the case of fortified bread. The results for classical bread are slightly higher than those in the literature (30.9 mg GAE/100 g) but they can be highly influenced by bread baking parameters (Lim et al., 2011). Alvarez-Jubete et al., (2010) reported that wheat seeds and wheat bread contained 53.1 mg GAE/100 g and 29.1 mg GAE/100 g total phenols, respectively. Depending on the addition, the polyphenol content may even reach 150.5 mg GAE/100 g for turmeric 8% (Lim et al., 2011).

As proved in literature, chronic diseases pertaining to the most serious life threatening pathology, such as: coronary heart disease and cancer, are caused by processes taking place in the cell metabolism or the peroxidation of lipids, which can result in the release of reactive oxygen species and free radicals. Antioxidants fight against free radicals to reduce the risk of chronic diseases. In the present study, the antioxidant capacity was evaluated based on DPPH free radicals, and the antioxidant activity of the fortified bread was found to have increased from 13.91% RSA to 21.91% RSA. In the case of other studies, additions, such as: fiber, oat, rice and cellulose showed that the antioxidant activity varied from about 13% to 35% RSA (Regaree et al., 2011).

Table 3. Physico-chemical characteristics and energy value of bread samples

Sample	PM*	P1*	P2*	P3*
Moisture [%]	44.76^{a} ± 0.81	44.45^{a} ± 0.13	44.32^{a} ± 0.02	44.28^{a} ± 0.04
Ash [%]	1.47^{b} ± 0.02	1.51^{b} ± 0.02	1.71^{a} ± 0.02	1.75^{a} ± 0.02
Acidity [°acidity]	1.61^{c} ± 0.02	1.88^{b} ± 0.04	1.99^{ab} ± 0.06	2.16^{a} ± 0.05
Protein [%]	6.60^{b} ± 0.14	6.82^{b} ± 0.12	7.18^{b} ± 0.15	7.79^{b} ± 0.18
Fat [%]	0.78^{b} ± 0.11	1.02^{ab} ± 0.14	1.25^{ab} ± 0.14	1.43^{a} ± 0.11
Total carbohydrates [g/100g]	46.39^{a} ± 0.27	46.24^{a} ± 0.39	45.78^{ab} ± 0.08	44.75^{b} ± 0.33
Energy value [kcal/100g]	218.98^{a} ± 2.63	221.42^{a} ± 3.3	223.09^{a} ± 2.18	223.03^{a} ± 3.03
Porosity [%]	78.39^{a} ± 0.70	81.26^{a} ± 1.01	79.39^{a} ± 0.75	78.15^{a} ± 0.81
Elasticity [%]	94.82^{a} ± 0.88	93.70^{ab} ± 0.75	91.52^{bc} ± 0.70	89.04^{c} ± 0.78
Total phenols [mg GAE/100 g]	39.88^{c} ± 0.42	42.27^{c} ± 0.58	51.51^{b} ± 0.85	64.46^{a} ± 0.92
DPPH inhibition [% RSA]	13.91^{c} ± 1.37	16.81^{bc}± 1.10	19.11^{ab} ± 0.20	21.91^{a} ± 0.77

Identical superscripts letters within rows indicate no significant difference ($p > 0.05$); *PM – control sample; P1 – sample with 3% MP; P2 – sample with 6% MP; P3 – sample with 9% MP.

Table 4. Texture profile analyses (means±standard deviations)

Sample	Sample Length [mm]	Hardness Cycle 1 [g]	Total Work Cycle 1[mJ]	Hardness Cycle 2 [g]	Total Work Cycle 2 [mJ]	Cohesive-ness [n.a.]	Springiness Index [n.a.]	Gummi-ness [g]	Chewiness Index [g]
PM	24.12^{a}± 0.46	349^{b}± 46	26.7^{b}± 3.0	326^{b}± 40	20.7^{b}± 2.2	0.73^{a}± 0.02	0.94^{a}± 0.01	253^{b}± 27	238^{b}± 28
P1	23.91^{a}± 0.20	305^{b}± 16	22.6^{b}± 0.9	283^{b}± 14	16.7^{c}± 0.4	0.68^{ab}± 0.02	0.92^{b}± 0.01	209^{b}± 5	191^{b}± 4
P2	23.87^{a}± 0.20	327^{b}± 12	23.9^{b}± 0.8	304^{b}± 11	17.8^{bc}± 0.6	0.70^{ab}± 0.01	0.91^{b}± 0.01	227^{b}± 9	206^{b}± 9
P3	23.68^{a}± 0.33	498^{a}± 18	36.7^{a}± 2.3	459^{a}± 17	26.6^{a}± 2.0	0.67^{b}± 0.03	0.91^{b}± 0.01	333^{a}± 23	304^{a}± 23

Identical superscripts letters within columns indicate no significant difference ($p > 0.05$); *PM – control sample; P1 – sample with 3% MP; P2 – sample with 6% MP; P3 – sample with 9% MP.

The quality of a food product is selected by its texture, by analysing it from various standpoints such as: sensory, shelf life, total appearance or nutritional value (Day et al., 2016). To evaluate the organoleptic and textural properties of bread samples, after the fortification with different percentages of mushroom powder, their textural profile after baking, was thoroughly studied. Figure 1 shows sectional samples compared to the control sample. Table 4 shows the main textural parameters which compare the bread samples objectively. As expected, the control sample had the lowest values of hardness, gumminess and chewiness, while having the highest springiness index (0.94) and cohesiveness (0.74). The P3 sample showed the highest hardness compared to the control sample, because of the addition of mushroom powder while the closest values of springiness index (0.91) and cohesiveness (0.70) to the control sample were shown by P2, which is considered the most suitable fortified sample in terms of texture (Figure 3).

Sensory analysis was performed for all the four bread samples. The sensory quality of food products is a key factor in the consumer's decision-making process for the acceptance and purchase of products. The hedonic test is often used in order to determine the consumer's attitude towards

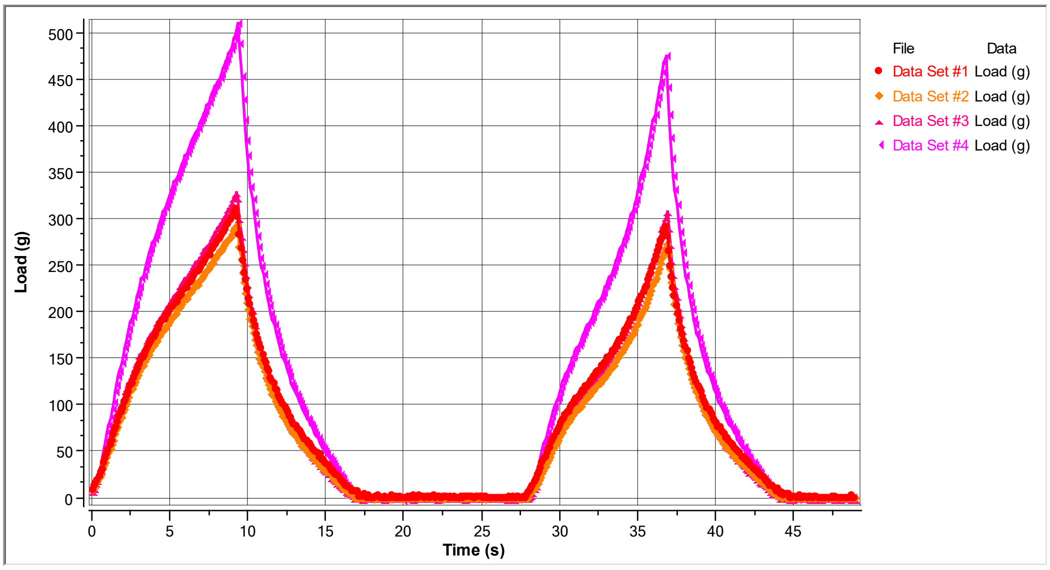

Figure 3. Analysis of the textural profile for 1-PM, 2-P1, 3-P2, 4-P3
*PM – control sample; P1 – sample with 3% MP; P2 – sample with 6% MP; P3 – sample with 9% MP.

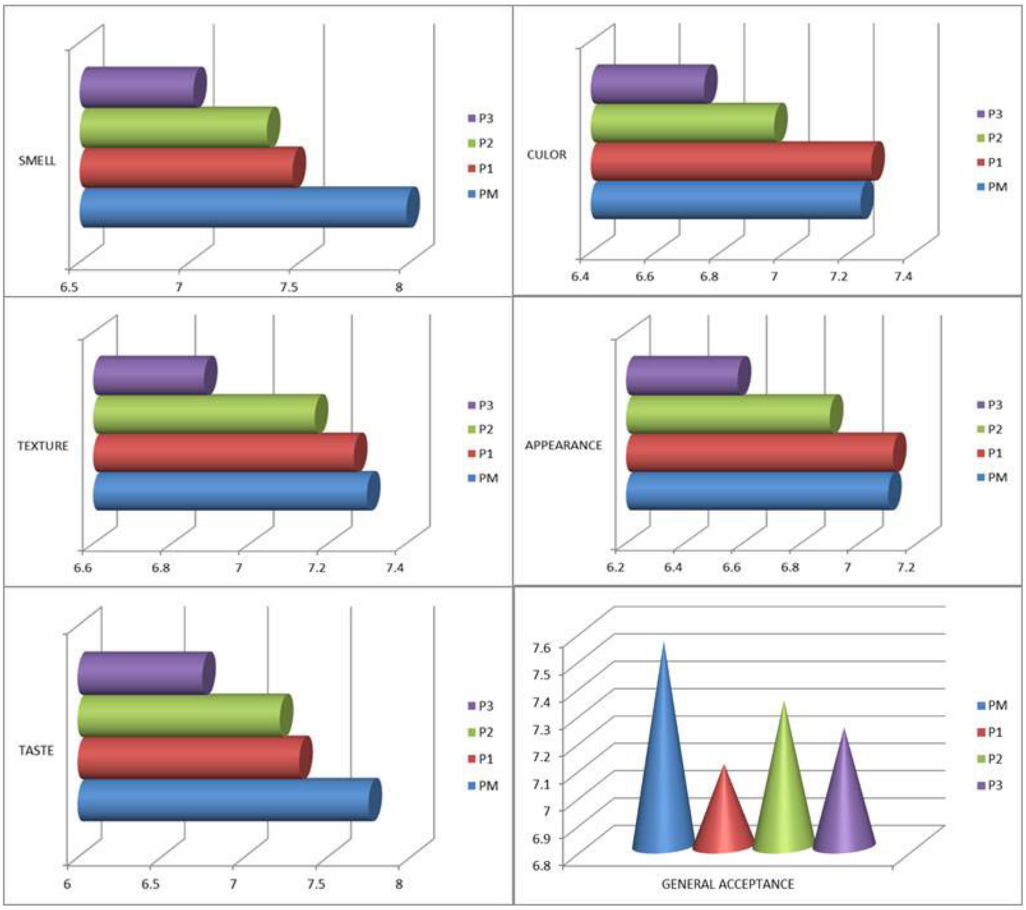

Figure 4. Acceptability test performed on the 9-point hedonic test
*PM – control sample; P1 – sample with 3% MP; P2 – sample with 6% MP; P3 – sample with 9% MP.

food by measuring their level of acceptance of a new product or in order to improve an existing product (Meilgard et al., 1991).

The appearance, colour, texture, smell, taste and general acceptance presented in Figure 4 were evaluated by the hedonic test for the sensory analysis.

In terms of appearance and colour the most appreciated sample was P2 with a score of 7.33, and 7.43, respectively. The texture of the fortified samples was less appreciated than that of the control sample (PM), P1 obtaining the highest score: 7.31.

The addition of rich fibre ingredients has generally led to an increase in the texture of crumbs by crosslinking gluten proteins (Fărcaş et al., 2014). Thus, high consumer reticence to stronger odour can be justified, because it becomes higher as mushroom powder is added. The most appreciated sample with regard to odour was P1, with a score of 7.46. The same preference was reported for taste.

Regarding overall acceptance, the sensory evaluation revealed that the sample of bread with 6% mushroom powder fortification (P2) obtained the highest score, being the most appreciated sample of all.

Conclusions

To conclude, this study has demonstrated that the addition of increasing amounts of mushroom powder into bread has improved its quality characteristics. In the present study, four samples of bread were used, three of which were fortified with mushroom powder in different percentages, namely: 3%, 6% and 9% while the fourth one was the control sample. This fortification process led to an increased nutritional content (high protein, fibre, minerals, polyphenols, antioxidant activity) in the bread samples. Overall acceptance was assessed by means of sensory and texture analysis. The results of this study show how appropriate and significant the use of the *Boletus edulis* mushroom powder is. Thus, when used as a source of fortification in the bakery industry, it helps diversify the assortment range and obtain innovative and nutritionally superior products.

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