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Physico-chemical and sensory evaluations of wheat bread with pumpkin (*Cucurbita maxima*) pulp incorporated

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Abstract

This study aims to asses the psysico-chemical, sensory and quality characteristics of bread obtained from wheat flour substituted with different levels (15%, 30%, 50%) of boiled pumpkin pulp. By increasing the level of pumpkin addition in wheat bread a significant ($p<0.05$) increase of ash and crude fiber content was found. Addition of pumpkin pulp to the wheat flour led to an increased water absorption and significantly raise the final moisture of the bread samples. By increasing the level of pumpkin pulp the loaf elasticity and porosity are increased. Loaf weight were significantly ($p<0.05$) different from the control bread. Sensory evaluation using hedonic scale indicated that the bread with 50% pumpkin pulp recorded the highest score. Due to their hydration and swelling capacity, the fiber content of the pumpkin changed these features of the wheat bread. Addition of pumpkin pulp up to 50% in wheat bread formulation is possible and positively influence the bread quality.

Keywords: pumpkin , bread, quality characteristics

1. Introduction

Nowadays, there is a growing demand for a new generation of healthier food products, which, at the same time, are required to have excellent sensory quality [1].

The pumpkin belongs to the family *Cucubitaceae*. It is comprised of *Cucurbita moschata*, *C. Pepo, C. Maxima, C. Mixta, C. Ficifolia* and *Telfairia occidentalis Hook*. Three of these, *Cucurbita pepo L., Cucurbita maxima Duchesne,* and *Cucurbita moschata Duchesne* represent economically important species cultivated worldwide and have high production [2].

Pumpkin is cultivated from northern Mexico to Argentina and Chile and has spread to Europe, Asia (India and China) and Western America. It is famous for its edible seeds, fruit and greens.

Fruits are variable in size, color, shape, and weight. They have a moderately hard rind, with a thick, edible flesh below, and a central seed cavity [3]. The immature fruit is cooked as a vegetable, while the mature fruit is sweet and used to make confectionery and beverages, sometimes alcoholic [4]. Pumpkin is rich in carotene, vitamins, minerals, pectin and dietary fiber [5].

The chemical composition of pumpkin varies from one cultivar or species to other. According several authors [6-8] the proximate of the pumpkin pulp ranged between 75.8 and 91.33% moisture, 0.2 and 2.7% crude protein, 0.47 and 2.1% crude ash and 3.1 and 13% carbohydrate content.

Pumpkin contains biologically active components that include polysaccharides, para-aminobenzoic acid, fixed oils, sterol, proteins and peptides.

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The fruits are a good source of carotenoid and γ -aminobutyric acid [2]. Its popular medicinal uses have focused research so far and the last few decades that have been carried out on pumpkin, using modern tools, and credited pumpkin with antidiabetic, antihypertension, antitumor, immunomodulation, antibacteria, antihy-percholesterolemia, intestinal antiparasitia, antiinflammation and antalgic [4].

Recently, functionality and composition of dietary fibre fractions obtained from pumkin were investigated [17,21], showing the potential of these fibre fractions to be used as food ingredients or additives to improve food quality.

The yellow-orange characteristic colour of pumpkin is due to the presence of carotenoids. Carotenoids, which are natural pigments responsible for the yellow, orange and red colour of many foods, are intensely investigated mainly because of their health promoting effects. Pumpkin provides a valuable source of carotenoids and ascorbic acid which have major roles in nutrition as provitamin A and as an antioxidant respectively [8].

Bread has always been one of the most popular and appealing food products due to its superior nutritional, sensorial and textural characteristics, ready to eat convenience as well as cost competitiveness [9]. Nowadays, emphasis is on healthy bread with low glycemic index, more protein and will increase the dietary fibre intake, high resistant starch.

In order to obtain bread with enhanced nutritional quality, different products have been used such as: soybeans, sesame, legume flours, sunflower seed, sweet potato flours etc. All these ingredients will impart characteristic colours, texture and nutritional value which may be favourable in bakery products, recipes and other food products.

The aim of this study was to determine the physico-chemical attributes of fresh pumpkin and to asses the effects of adding different levels of boiled pumpkin pulp (PP) on the physico-chemical, quality characteristics and sensory properties of the bread.

2. Materials and methods

2.1. Bread Ingredients and Preparation. Wheat flour type 550 (moisture content 14,5%, wet gluten content 29,26%, ash content 0,59%), salt, pumpkin seed oil and compressed yeast (Pakmaya), were purchesed from local market.

Pumpkin fruits (*Cucurbita maxima*) were obtained from a local producer (farmer); the rind, fibrous matter and seeds were removed and than the pumpkin pulp was cut into six pieces, rinsed with tap water, boiled about of 15 minutes and mashing it by passing it through the ϕ2 mm mesh sieve with mixer.

The formulation for control bread was 500 g wheat flour, 10 g compressed yeast, 7.5 g salt, 25 ml pumpkin seed oil and the optimum quantity of tap water in order to to reach the same dough development time (8 min total) for all systems studied. The straight method for dough preparation was used. The process parameters were: mixing time 8 min, dough temperature 24˚C, fermentation time 70 min, remixing time 1 min. were mixed for 2 min at low speed and 6 min at high speed in a spiral bakery-mixer. The dough was separated in samples of 800g which were shaped by hand, placed in aluminum baking trays (rectangular) and proofed at 30°C/75% RH, 20 min and finally baked at 200°C for 60 min in a oven (Zanolli, Italy). Bread loaves were cooled at room temperature (20±1°C) and submitted to physico-chemical and sensorial analyses.

For experimental bread formulations the quantity of the wheat flour corresponding to the control bread (V0) was substituted by the boiled pumpkin pulp (PP) in three ratios (15%, 30%, 50%) resulting three types of experimental variants (V1, V2, V3). The bread making was performed in duplicate, and control breads were also prepared each time that breads with different pumpkin pulp level were processed.

2.2. Pumpkin pulp and bread chemical parameters. Moisture, ash, crude protein, crude fat and fiber content were determined according [10]. Moisture content of different breads was determined in a convection chamber at 110 °C for 1 h. Crude proteins were calculated from the nitrogen content by Kjeldahl method using factor 6.25. Crude fiber was determined according to the gravimetric procedure of AOAC. Ash was determined by incinerating at

550°C in a muffle furnace for 6 hr. Crude fat was determined in Soxhlet extraction apparatus, using extraction with ether as solvent, for 6 hr. All determination were carried out in triplicate.

The total carbohydrate content (on dry weight basis) was calculated by difference, using formula:

[100-(g, moisture+g,crude protein + g, crude fat + g, ash + g, crude fiber)].

2.3. Bread quality parameters. The quality parameters of the bread samples: total acidity, porosity, elasticity were determined according methods described by SR 91: 2007 (*Romanian settlement)*[11].

2.4. Sensory analysis. Bread samples were cooled for 1-2 h at room temperature (25˚C) and then were cut into slices (2x3x5cm). Sensory evaluation for crust color, crumb color, crumb appearance, aroma, taste, overall acceptability was carried out as per score sheet by ten trained panelists on 9 point hedonic scale (1- dislike extremely; 9-like extremely)

2.5. Statistical analysis. The results of three independent (n=3) assays performed with replicates each were expressed as mean ± SD. Data were compared by one-way analysis of variance (ANOVA) followed by Newman-Keuls test and Dunnett's Multiple Comparison. The statistical evaluation was carried out using Graph Prism Version 5.0 (Graph Pad Software Inc., San Diego, CA, USA).

3. Results and Discussion

Table 1 and table 2 show the results for the psysico-chemical parameters of the pumpkin pulp and bread sumpplimented with 15%, 30% and 50% pumpkin pulp. The pumpkin variety (*C. maxima*) used in this study exhibited high levels of dietary fiber and ash. All the chemical parameters of the pumpkin pulp are consistent with results obtained in other similar studies [6-8].

With the incorporation of pumpkin pulp (PP) in bread, the moisture, crude fiber and ash contents increased, while the crude protein, crude fat and carbohydrates contents decreased.

Decreasing of the protein content in breads with added pumpkin pulp is due to the higher protein content of the wheat flour comparing with the pumpkin pulp protein content. Also the lower fat content of the pumpkin pulp compared to the wheat flour fat content is responsible for the fat decreasing in bread samples (V1-V3). The decrease in carbohydrate content was due to the fact that wheat flour was the main contributor to the total carbohydrates content; by substituting 50% of the wheat flour with pumpkin pulp (1:1, w:w) the carbohydrates content was reduced by 36.86%. The ash and crude fiber content of bread with added PP were significantly higher ($p<0.05$) to the control bread. When wheat flour was substituted with 30% of pumpkin pulp the ash content increased 1.95 times while at 50% pumpkin pulp addition ash content increased 2.26 times. In the case of the fiber content the increments were about of 2.64 times at 50% pumpkin addition and 1.91 times at 30% .

Figure 1 shows the dough water absorbtion for all experimental variants (V0-V3) and the final moisture of the corresponding breads. The values for the water absorbtion are obtained by measuring the water absorbed by the mixtures of wheat flour and pumpkin pulp without quantifying the contribution of the boiled pumpkin pulp moisture. It can be observed that by increasing the level of the PP the bread moisture is increased significantly, resulting an increased water absorption (holding) capacity.

This parameter is interesting because it can be associated to the amount of water retained by the fiber, during kneading of dough where pumpkin-fractions participate as ingredient [12]. According to [13], pumpkin contains high insoluble dietary fiber (cellulose, hemicelluloses, pectines and lignin) which strongly absorbe the water [12]. Also, according to [14], fruit fibers, which contain more pectin, have a higher water binding capacity than those of the cereal and legume fibers. Hydration properties were dependent on chemical composition: presence of hydrophilic pectins with side chains were related to higher water absorption and swelling, while high content of lignin produced fiber-particle impermeabilization and stiffness [12]. Increasing levels of PP (15-50%) significantly ($p<0.05$) affect the weight of the bread samples (table 3). This result can be correlated to the higher fibre content of the samples with added PP and to the increased water absorption capacity, respectively.

Table 1. Mean values for some chemical parameters of fresh pumpkin pulp

Parameters	**Moisture (%)**	**Protein (%)**	**Fat (%)**	**Ash (%)**	**Crude fiber (%)**	**Carbohydrates (%)**
Fresh pumpkin pulp	82.75(±0.01)	1.46(±0.03)	1.26(±0.07)	0.98(±0.04)	1.06(±0.08)	12.49(±0.13)

**Data represent means values± SD for three independent replications*

Table 2. Mean values for some chemical parameters of control bread and bread with boiled pumpkin pulp added at different levels (15%, 30%, 50%)

Composition	**V0 (0 % PP)**	**V1 (15% PP)**	**V2(30% PP)**	**V3(50% PP)**
Moisture	41.2(±0.1)	43.8(±0.2)	46.6(±0.15)	51.2(±0.2)
Fat	4.98(±0.03)	4.21(±0.01)	3.98(±0.05)	3.52(±0.11)
Protein	14.65(±0.09)	13.73(±0.08)	12.56(±0.1)	11.88(±0.15)
Ash	1.83(±0.01)	2.54(±0.01)	3.57(±0.03)	4.15(±0.01)
Crude fiber	1.68(±0.02)	2.27(±0.03)	3.21(±0.01)	4.45(±0.01)
Carbohydrates	36.44(±0.01)	32.52(±0.01)	28.87(±0.01)	23.01(±0.01)

**Data represent means values± SD for three independent replications*

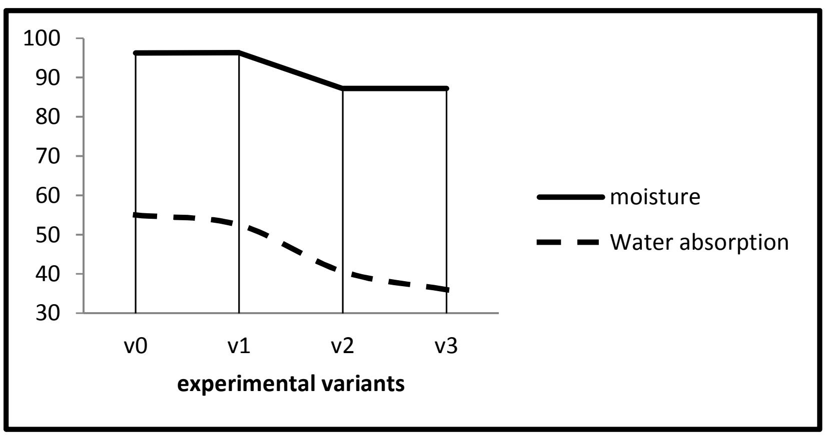

Figure 1. Comparation of the moisture (%) and dough water absorbtion (%) for the control bread(V0) and the breads with 15%, 30%, 50% PP addition (V1-V3)

Table 3. Quality parameters of control bread and breads with PP added at different levels (15%, 30%, 50%)

Parameters	**V0 (0% PP)**	**V1 (15% PP)**	**V2 (30% PP)**	**V3 (50% PP)**
Weight, g	803.45	809,21	815.09	819.31
Crumb Elasticity,(%)	95.3	96.3	97.7	98.4
Crumb Porosity, (%)	79	74	76	79
Acidity, (degree/100g product)	1	1	1.4	1.4

**Data represent means values for three independent replications*

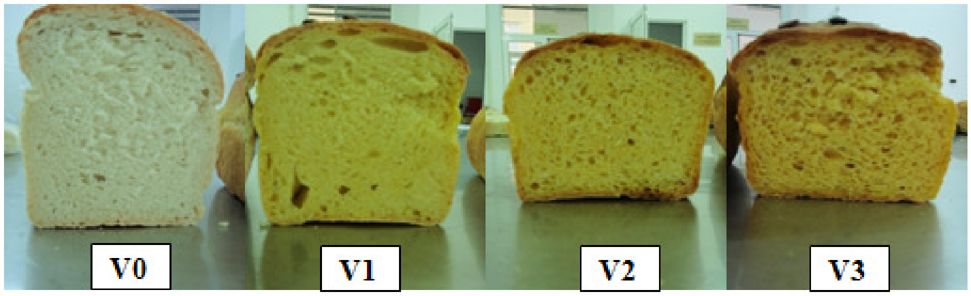

Figure. 2 Control bread (V0) and breads obtained by substituting wheat flour with pumpkin pulp at different levels (V1 (15% PP; V2-30% PP; V3-50% PP)

Table 4. Means of sensory attributes for bread with different addition level of pumpkin pulp (PP)

Bread samples	Crust color	Crumb color	Crumb appearance	Aroma	Taste	Overall acceptability
V1 (15% PP)	6.13	6.92	5.63	6.18	6.12	6.30
V2 (30% PP)	6.88	7.04	6.89	6.80	7.96	7.56
V3 (50% PP)	7.89	8.51	7.88	7.67	8.35	8.67

**Data represent means values for three independent replications*

Bread samples (V1-V3) with added PP in different levels (15%, 30%, 50%) were characterized by increased elasticity and porosity while at levels of 30% and 50% the acidity increased to 1.4 (acidity degree/100g product) comparing to control with 1 acidity degree/100g product.

The markedly increased of the porosity was reported also by [13], and their findings led to the conclusion that the increase in aeration is tentatively attributed to surface activity of the highly acetylated pectin present as a major component (~30% of the total dry-matter content) of pumpkin tissue.

By the other hand, [15] studying the effect of pectins on dough rheology using SEM microstructure analysis reported a different, more porous type of gluten matrix. These doughs were more stable and able to support a greater expansion during fermentation, reaching up to higher loaf volumes.

As it can be observed during kneading, the higher amount of PP (30-50%) in bread formulation led to an increased viscosity of the dough, feature which could be attributed both to the water holding capacity and oil holding capacity of the pumpkin pulp.

Noor Aziah A.A. *et. al.* (2009), [16] reported that pulp pumpkin flour has oil holding capacity (OHC) which was significantly different from the OHC of the wheat flour.

Food materials having high WHC and OHC can act as functional ingredients. Modification of viscosity and texture in formulated food can be achieved by adding ingredients with high water holding capacity, and the resulting changes are attributed to the gelling, bulking, and thickening effects [17].

On the other hand, ingredients with high OHC play an important role in stabilizing food systems with high fat content and can act as emulsifiers [18]. Emulsifiers in bakery products function primarily to strengthen gluten–gluten interaction, to promote formation of protein–starch complex and to improve aeration [19].

Due to the WHC and OHC of the its components, pumpkin could be an alternative emulsifying agent for use in food formulations [16].

An other possible explanation for this modification on the quality parameters of bread samples with added PP may be the presence of lignin in the pumpkin's fiber content. According [20], lignin could hinder water distribution between the amorphous phase and the gluten network, leading to more hydrophobic interactions and/or it could scavenge free radicals. M.F. de Escalada Pla *et al*., (2013) consider that these events could lead to higher stabilisation of the gas cell wall produced in the dough during fermentation and to a better gas retention during baking, resulting in greater particle size [1,12,17].

Data of sensory evaluation (table 4) indicated that bread with 50% PP was preferred and recorded the highest score for all the sensory attributes which were evaluated (crust color, crumb color, crumb appearance, aroma, taste) as well as for the overall acceptability. The crumb color of the 50% PP bread was significantly different to other samples. Also, the crumb appearance, aroma and taste of the 50%PP bread were significantly higher to other samples, probably due to the stronger pumpkin odour and taste.

4.Conclusion

The effects of the pumpkin pulp addition at different levels (15-50%) on the wheat bread quality parameters were investigated throught psysico-chemical and sensory determinations.

Addition of pumpkin pulp to the wheat flour led to an increased water absorption and significantly raise the final moisture of the bread samples. By increasing the level of pumpkin pulp the loaf elasticity and porosity are increased. Loaf weight were significantly ($p<0.05$) different from the control bread. Sensory evaluation using hedonic scale indicated that the bread with 50% pumpkin pulp recorded the highest score. Due to their hydration and swelling capacity, the fiber content of the pumpkin changed these features of the wheat bread. Addition of pumpkin pulp up to 50% in wheat bread formulation is possible and positively influence the bread quality.

Compliance with Ethics Requirements: Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

References

1. Marina de Escalada Pla, Rojas, A.M., Gerschenson, L.M., Effect of Butternut (Cucurbita moschata Duchesne ex Poiret) Fibres on Bread Making, Quality and Staling, *Food Bioprocess Technol*., **2013**, *6*, 828–838
2. Fu Caili, Shi Huan & Li Quanhong, A Review on Pharmacological Activities and Utilization Technologies of Pumpkin, *Plant Foods for Human Nutrition*, **2006**, *61*, 73–80
3. Mohammed A. Alfawaz, Chemical Composition and Oil Characteristics of Pumpkin (*Cucurbita maxima*) Seed Kernels, Res. Bult., No. (129), *Food Sci. & Agric. Res.* Center, King Saud Univ., pp.(5-18) **2004**
4. Mukesh Yadav, Shalini Jain, Radha Tomar, G. B. K. S. Prasad, Hariom Yadav, Medicinal and biological potential of pumpkin: an updated review, *Nutrition Research Reviews*, **2010**, *23*, 184–190
5. Djutin, K.E., Pumpkin: nutritional properties, *Potatoes and Vegetables*, **1991**, *3*, 25-26.
6. Bhat, A.M and Bhat, A, Study on Physico-Chemical Characteristics of Pumpkin Blended Cake, **2013,** *J Food Process Technol., 4*, 262
7. Mi Young Kim, Eun Jin Kim, Young-Nam Kim, Changsun Choi, Bog-Hieu Le, Comparison of the chemical compositions and nutritive values of various pumpkin(*Cucurbitaceae*) species and parts, *Nutrition Research and Practice*, **2012**, *6*(1), 21-27
8. See, E.F., Wan Nadiah, W.A., Noor Aziah, A.A., Physico-Chemical and Sensory Evaluation of Breads Supplemented with Pumpkin Flour, *ASEAN Food Journal*, **2007**, *14*(2): 123-130
9. Giannou V, Tzia C., Frozen dough bread: quality and textural behavior during prolonged storage- prediction of final characteristics. *J Food Eng*., **2007**, *79*, 929-934.
10. AOAC - Official Methods of Analysis. (15th ed.), Washington, DC: Association of Official Analytical Chemists, 1995
11. SR 91:2007. Paine si produse proaspete de patiserie. Metode de analiza.
12. de Escalada Pla, M., Delbon, M., Rojas, A., & Gerschenson, L., Effect of immersion and turgor pressure change on mechanical properties of pumpkin (Cucumis moschata, Duch). *Journal of the Science of Food and Agriculture*, **2006,** *86*(15), 2628–2637.
13. Ptichkina, N.M., L.V., Novokreschonova, Piskunova, G.V, Morris, E.R., Large enhancements in loaf volume and organoleptic acceptability of wheat bread by small additions of pumpkin powder: possible role of acetylated pectin in stabilising gas-cell structure, *Food Hydrocolloids*, **1998**, *12*(3), 333-337

14. Chen J.Y., Piva M., Labuza T.P., Evaluation of water binding capacity (WBC) of food fiber sources. *J Food Sci.*, **1984,** *49*, 59–63
15. Correa M., Pérez G.&Ferrero C., Pectins as breadmakingadditives: Effect on dough rheology and bread quality. *Food and Bioprocess Technology*, **2011,** doi:10.1007/s11947-011-0631-6.
16. A.A. Noor Aziah and C.A. Komath, Physicochemical and Functional Properties of Peeled and Unpeeled Pumpkin Flour, *Journal of Food Science,* **2009**, *74*, 7, 328-333
17. de Escalada Pla, M., Ponce, N., Stortz, C., Gerschenson, L., & Rojas, A., Composition and functional properties of enriched fibre products obtained from pumpkin (*Cucurbita moschata Duchesne* ex Poiret). *Lebensmittel-Wissenschaft und Technologie*, **2007**, *40*, 1176–1185
18. Kuntz, L. A., Fiber: from frustration to functionality. Food Product Design, **1994**, *2*, 91-108.
19. Angello, A.J., Vercellotti, J.R., *Phospholipids and fatty acid esters of alcohols.* In: Charalambous, G., Doxastakis, G. (Eds.), Food Emulsifier Chemistry, Technology, **1989,** Functional Properties and Applications. Elsevier Publications, Amsterdam.
20. Zobel, H., & Kulp, K., The staling mechanism. In R. E. Hebeda & H. F. Zobel (Eds.), *Baked goods freshness. Technology, Evaluation, and inhibition of staling.* New York: Marcel Dekker, Inc., 1996, (pp. 1–64)
21. Gerschenson, L. N., Rojas, A. M., de Escalada Pla, M. N., & Fissore, E. Functional properties of dietary fibre isolated from Cucurbita moschata Duchesne ex Poiret through different extraction procedures. In J. N. Govil & V. K. Singh (Eds.), *Recent progress in medicinal plants*, 2009, (pp. 359–370). Houston: Editorial Studium Press LLC.