JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2017, *23* (4), 245-249

Journal of Agroalimentary Processes and Technologies

Improvement of the nutritional value of pasta by the addition of wheat bran

Flavia Pop[1*]

[1] *Technical University of Cluj-Napoca, North University Center of Baia Mare, Chemistry and Biology Department, 76A Victoriei Str., 430122, Baia Mare, Romania*

Received: 15 October 2017; Accepted: 21 November 2017

Abstract

The research was conducted in order to evaluate the physicochemical and quality characteristics of fiber-enriched pasta using wheat bran for the improvement of their nutritional value. White flour was replace with wheat bran (WB) in three proportions 40% (R4), 30% (R3) and 20% (R2) respectively, whereas R1 was kept as control (without bran). The following parameters were analized for the pasta products: acidity, humidity, mineral content, volume variations, water solubility index, water absorption index, dry matter losses on preparation. An increase in the content of wheat bran in pasta formulation caused an increase of the water solubility index value of the products. For fiber-enriched pasta, less loss in preparation was found for those with 20-30% bran addition, the losses increased proportionally to the percentage of bran in pasta products. Water absorption index increased directly proportional with bran content in the products. The increase of the bran content in pasta determined a dark color of the product and after cooking, pasta became bright. Pasta presented good physico-chemical and sensory characteristics, including to the addition of 30% wheat bran.

Keywords: pasta, bran, fiber, water solubility index, water absorption index

1. Introduction

Pasta is one of the most popular cereal foods. The use of pasta has begun in China and has spread throughout the world. Although pasta are known, appreciated and manufactured worldwide, the largest variety of pastes (shape, dimensions, colors) are produced in Italy [1].

Pastes are products made from flour, water and a number of additives that increase their organoleptic and nutritional characteristics. Pasta shows high nutritional value due to the fact that in their production are used high protein flours, the dry matter content of the final product is very high. The main components are carbon hydrates and protein, substances which have a high degree of assimilation, which recommends them in children's nutrition. Pastes are durable for preservation, can be kept for a long time under normal conditions, at room temperature, without diminishing their nutritional and taste qualities. It also shows rapidity, simplicity and diversity in cooking due to the reduced cooking time [2, 3].

Thin pastes are used predominantly in soups, long ones in the form of a ribbon are seasoned with sauces and those in tubular form, in the form of salads. Pastes that are wide enough can be filled by the consumers, and those of the ravioli type, are ready filled in the manufacturing process [1].

During the digestion of pasta, sugars are released gradually, which results in a low post-meal glycaemia and insulin response [3, 4]. A number of studies indicate a variety of factors determining a slow digestion of starch in pasta and a slow liberation of glucose [5, 6].

The flour used in the manufacture of pasta must provide certain organoleptic and behavioral

Corresponding author: *e-mail:* flavia_maries@yahoo.com

characteristics of the pasta: a smooth, uniform surface that retains its shape after modeling and drying, do not break, have a glassy look in the section, at boiling their volume increase three times and do not stick. Grated flour has a good technological behavior in pasting, because the particles are larger, swell slowly, and preserve the structure of the wheat grain. Small grain flour leads to the production of pasta that at boiling becomes viscous, are degraded, while a larger granulation leads to the white spots on pasta surface with a greater obtaining time. Durum wheat pasta is characterised by low dry matter losses in the course of cooking, high resistance to overcooking, light-yellow colour and good post-cooking texture [4, 5].

Some researchers demonstrated that enriching pasta with dietary fibre, causes a lowering of glycaemic index of the products [3, 7-9].

Dietary fibre reduces the energy density of the products, shortens the time of passage of the gastric and intestinal content, increases its viscosity and positively affects the metabolism of sugars and lipids. Bran particles in high-fibre cereal materials inhibit the formation of a continuous and regular gluten matrix during the formation of pasta dough, in the course of cooking, water penetrates the structure of pasta more easily and the uncovered starch granules are more susceptible to leaching [5, 6].

Food with high-fibre grain content are rich in vitamins, minerals and biologically active compounds, which have additional health benefits [10].

The objective of the work consisted in the preparation and appreciation of the quality of simple and fiber-enriched pasta and dough analysis during the drying process. The following pasta parameters were analized: acidity, humidity, mineral content, volume variations, water solubility index (WSI), water absorption index (WAI), dry matter losses on preparation.

2. Materials and Method

2.1 Samples

White flour was replace with wheat bran (WB) in three proportions 40% (R4), 30% (R3) and 20% (R2) respectively, whereas R1 was kept as control (without bran) and the following parameters were analized for the pasta products: acidity, humidity, mineral content, volume variations, water solubility index, water absorption index, dry matter losses on preparation.

2.2 Physicochemical examination

The chemical composition of the raw materials and pasta products was determined according to the methods described by Sobota et al. and Pop et al. [11, 12].

Acidity is based on the extraction of the pasta acids and their titration with sodium hydroxide 0.1 N, using phenolphthaleine, as an indicator. The results were expressed as degree of acidity. Determination of moisture content is based on drying of a sample with known initial mass to a constant mass. The content of mineral substances is based on the calcination of a known mass of product up to constant weight.

Weight increase index was calculated by dividing the weight of the pasta after cooking by the weight on uncooked pasta. After cooking each sample, cooking loss was determined by collecting and drying the liquid in which the pasta was cooked. The strainer and saucepan were also rinsed with an extra 100 mL of water, ensuring that any residue lost from the pasta was incorporated into the solution for analysis. This solution was weighed in aluminum pans and dried in a mechanical oven for 24 h at 60 ºC. The difference in weight between the aluminum pan and the dried aluminum pan with residue is the cooking loss, which is then expressed as a percentage of the dry pasta sample's exact weight before cooking.

Water solubility index (WSI) was determined with the centrifuge method. Two gram of uncooked pasta and 4 g cooked pasta were weighted. The samples were placed in centrifuge tubes, 30 mL of distilled water was added, then the tube were stopped and shook vigorously. The suspension was left to rest for 5 min, then it was centrifuged for 15 min at 2200 g. 10 mL of the supernatant was dried to the solid mass.Water absorption index (WAI). After downloaded 10 mL of the supernatant to determine the WSI, the remaining supernatant was carefully decanted. The wet samples were weighed, and WAI was calculated [11, 12].

All analytical determinations were performed at least in triplicate. Values of different parameters were expressed as the mean ± standard deviation (X ± SD). Significant differences between mean were determined by using "Student" ("t") distribution.

3. Results and Discussion

The acidity of the pastry dough showed an irregular variation during the drying process at 80°C, presenting an increase in the first 90 minutes for R1 and R2, and in the first 120 minutes for R3 and R4, then a decrease due to enzymes inactivation (Fig. 1).

After preparation, the pastry dough had a moisture content of 25.14% for R1, 30.32% for R2, 32.89% for R3 and 35.48% for R4. In the first 90 minutes of drying, the water evaporation rate is higher, and at 150 minutes there was a slower decrease. At the end of the drying process the pasta passed from the plastic to the elastic state. The elasticity of the pastry dough decreased with the increase in the percentage of bran.

After ensuring a pause period, the following physico-chemical parameters were determined (Table 1).

Table 1. Proximate analysis of pasta

Parameters	R1	R2	R3	R4
Moisture (%)	9.12 ± 0.02	10.75^{a} ± 0.06	11.43^{ab} ± 0.04	11.87^{ab} ± 0.05
Ash (%)	0.65 ± 0.05	1.02^{ab} ± 0.01	1.29^{b} ± 0.07	1.66^{bc} ± 0.04
Fat (%)	0.54 ± 0.03	0.71^{a} ± 0.02	0.79^{ab} ± 0.05	0.87^{b} ± 0.06
Acidity (mL NaOH 0.1N/100g)	0.55 ± 0.04	0.93^{a} ± 0.02	1.52^{b} ± 0.05	1.84^{bc} ± 0.03
Alkalinity (mL HCl 0.1N/100g)	2.63 ± 0.02	2.18^{a} ± 0.01	1.73^{ab} ± 0.01	1.26^{b} ± 0.04
Dought elasticity (%)	38.23 ± 0.04	29.15^{bc} ± 0.02	26.32^{c} ± 0.06	21.58^{cd} ± 0.05

Values are means of triplicates ± standard deviation. Values with the same superscript in a column are not significantly different (P > 0.05).

Sobota et al. [11] studied the effect of the addition of common wheat bran on the chemical composition, physical properties, cooking quality and sensory traits of durum wheat pasta. The study reported that pasta containing up to 30% of bran was characterised with lower losses of dry mass and higher resistance to overcooking, in comparison with the pasta made of whole-grain durum. The researchers showed that the addition of wheat bran had significantly negative effect on sensory properties of pasta. The sensory quality of products containing 35-40% of wheat bran was worse than whole-grain durum pasta.

Chillo et al. [13] found that the addition of high-fibre material to spaghetti caused a significant lowering of brightness and yellow colouring. The pasta with addition of wheat bran and buckwheat was characterised by decidedly darker and more reddish colouring, compared with the pasta from semolina.

An increase in the content of wheat bran in the pasta caused an increase of the water solubility index (WSI) value of the products (Fig. 2). Brennan et al. [14] argued that products characterized by lower values of the solubility index have a slower digestion.

Water absorption index (WAI) increased directly proportional to the percentage of bran added to the products (Fig. 3). According to Sobota et al. [11] products with higher values of the water absorption index are more effective in satisfying hunger and give a feeling of satiety.

For fiber-enriched pasta, less loss in preparation was found for those with 20-30% bran addition. The losses increased proportionally to the percentage of bran, and this finding can be explained by the fact that bran inhibits the formation of the gluten matrix during dough formation, at preparation the water gets into the paste structure more easily and the starch is more susceptible to solubilization.

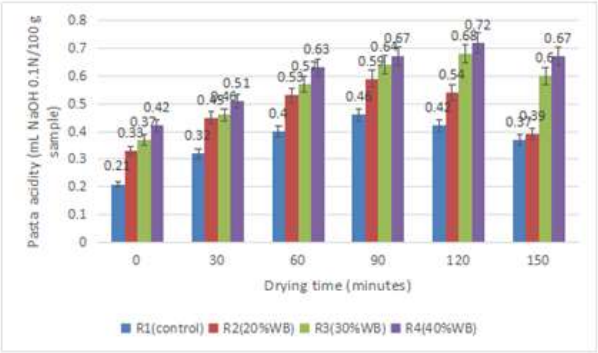

Figure 1. Acidity variation during drying process of pasta

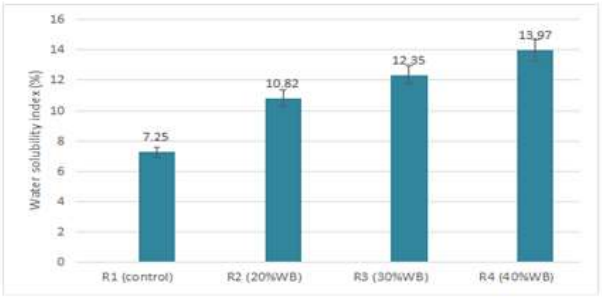

Figure 2. Water solubility index of pasta products

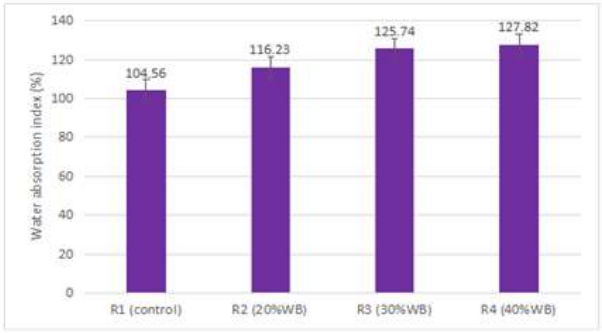

Figure 3. Water absorption index of pasta products

Higher content of water in overcooked pasta has negative influence on the consistency of products, particularly its hardness and springiness. From nutritional point of view, the products with higher content of water are characterised by lower energetic density [15].

Howard et al. [16] studied the effect of peanut flour incorporation and processing conditions on the pasta's quality and consumer acceptance. The percent peanut flour used to replace wheat flour in durum wheat pasta was found to significantly affect pasta color, cooking loss, and consumer acceptability. Increasing the level of peanut flour in the formula can lead to darker product color, higher cooking loss percentages, and possibly reduced consumer acceptance.

Conclusion

The increase of the bran content in pasta determined a dark color of the product and after cooking, pasta became bright. Bran enriched pasta showed an irregular color. The elasticity of the pasta decreased with the increase in the bran content, and had an unfavorable effect on boiling behavior.

The water solubility index values increased directly proportional to the bran content. An increase of wheat bran content in the pasta caused an increase of the water absorption index. Fiber-enriched pasta are very effective in satisfying the hunger. Pastes containing up to 30% bran were characterized by lower losses of dry matter in preparation.

Pasta presented good physico-chemical and sensory characteristics, including to the addition of 30% wheat bran.

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 / or animal subjects (if exist) respect the specific regulation and standards.

References

1. Mihaly-Cozmuța, A.; Pop, F., *Pasta Technology*, **2008**, Risoprint Publishing House, Cluj-Napoca, 10-35.
2. Zaharia, T., *Worker's book in the pasta industry*, **1983**, Tehnica Publishing House, Bucharest, 50-70.
3. Brennan, C.S.; Tudorica, C.M., Evaluation of potential mechanisms by which dietary fibre additions reduce the predicted glycaemic index of fresh pastas, *International Journal of Food Science and Technology*, **2008**, *43*, 2151-2162.
4. Chillo, S.; Ranawana, D.V.; Pratt, M.; Henry, C.J.K., Glycemic response and glycemic index of semolina spaghetti enriched with barley β-glucan, *Nutrition*, **2011**, *27*, 653-658.
5. Chandalia, M.; Garg, A.; Lutjohann, D.; Bergmann, K.; Grundy, S.M.; Brinkley, L.J., Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus, *The New England Journal of Medicine*, **2000**, *342*, 1392-1398.
6. Theuwissen, E.; Mensink, R.P., Water-soluble dietary fibers and cardiovascular disease, *Physiology and Behavior*, **2008**, *94*, 285-292.
7. Tudorica, C.M.; Kuri, V.; Brennan, C.S., Nutritional and physicochemical characteristics of dietary fiber enriched pasta, *Journal of Agricultural and Food Chemistry*, **2002**, *50*, 347-356.
8. Bustos, M.C.; Perez, G.T.; Leon, A.E., Sensory and nutritional attributes of fibre-enriched pasta, *LWT - Food Science and Technology*, **2011**, *44*, 1429-1434.
9. Aravind, N.; Sissons, M.J.; Fellows, C.M.; Blazek, J.; Gilbert, E.P., Effect of inulin soluble dietary fibre addition on technological, sensory, and structural properties of durum wheat spaghetti, *Food Chemistry*, **2012**, *132*, 993-1002.
10. Esposito, F.; Arlotti, G.; Bonifati, A.M.; Napolitano, A.; Vitale, D.; Fogliano, V., Antioxidant activity and dietary fibre in durum wheat bran by-products, *Food Research International*, **2005**, *38*, 1167-1173.
11. Sobota, A.; Zbigniew, R.; Piotr, Z.; Kuzawinska, E., Application of common wheat bran for the industrial production of high-fibre pasta, *International Journal of Food Science and Technology*, **2015**, *50*, 111-119.

12. Pop, F.; Semeniuc, C.A.; Mihalescu, L., Oxidative and hydrolytic stability of alimentary poultry fats under refrigeration and freezing, *European Journal of Lipid Science and Technology*, **2016**, *118(11)*, 1795-1798.
13. Chillo, S.; Laverse, J.; Falcone, P.M.; Protopapa, A.; Del Nobile, M.A., Influence of the addition of buckwheat flour and durum wheat bran on spaghetti quality, *Journal of Cereal Science*, **2008**, *47*, 144-152.
14. Brennan, M.A.; Derbyshire, E.; Tiwari, B.K.; Brennan, C.S., Enrichment of extruded snack products with coproducts from chestnut mushroom (*Agrocybe aegerita*) production: interactions between dietary fiber, physicochemical characteristics, and glycemic load, *Journal of Agricultural and Food Chemistry*, **2012**, *60*, 4396-4401.
15. Sozer, N.; Dalgic, A.C.; Kaya, A., Thermal, textural and cooking properties of spaghetti enriched with resistant starch, *Journal of Food Engineering*, **2007**, *81*, 476-484.
16. Howard, B.; Hung, Y.C.; McWatters, K., Analysis of ingredient functionality and formulation optimization of pasta supplemented with peanut flour, *Journal of Food Science*, **2011**, *76(1)*, 40-47.