Physico-Chemical and Sensory Properties of Wheat Bread Supplemented With Mustard Flour

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Abstract
The aim of this investigation was to incorporate mustard flour into bread in order to improve its quality. For this purpose, wheat flour 650 type for bread making was replaced with mustard seed flour at the level of 5, 7 and 10%. Bread quality through physico-chemical and sensory characteristics was analyzed and compared to those of bread without mustard flour. The protein content of mustard flour bread increased with 5.03% as a result of mustard flour incorporation, coupled with an increase in ash content. Sensory evaluation results revealed that the sample containing 7% mustard flour scored highest in most of the attributes including overall acceptability. The study reveals that incorporation of 7% mustard flour gave desirable results in terms of phisyco-chemical and sensory characteristics of mustard flour fortified bread.

Keywords: bread, flour, mustard, quality

Introduction
The industry of bakery and farinaceous products occupies an important place in the production and market consumption, mainly because the bread is a staple food that is consumed daily and reaches the mass consumer of everyone (Stoin et al., 2012). The average bread consumption per person in Romania is of about 330 grams every day, or 120 Kg per year. The consumption of white bread is still preferred in Romanian families, making up 70% of all bread consumed. It contains 2.6 percent sugar, 46.7 percent starch, 1.9 percent total fat, 8.4 percent total protein, 1.7 mg per 100 mg vitamin and 5 percent glutenin (Gadei 2012).

Nowadays spices are extensively studied in order to explore their therapeutic, nutritional and technological potential and to clarify the controversy in accepting many traditions as scientific truth. Spices enhance the taste and the appearance of bread but also it has an important contribution to the bread quality by their antimicrobial effect and by their content in bioactive compounds, such as antioxidants (Gadei 2012).

Mustard plant belongs to species Sinapis alba L., Cruciferae (Brassicaceae) family (Abul-Fadl et al., 2011). Mustard seeds are composed of protein (23- 30%), fixed oil (29-36%), carbohydrate (12-18%) and an important range of secondary metabolites such as minerals (4-6%), glucosinolates (0.8- 2.3%), phytin (2-3%) as well as phenolic compounds and dithiolthiones (Gadei 2012). Also, it is a rich source of iron, magnesium and sodium as well as flavonoids, lycopene and tocopherols, oleic and linoleic acids (Youssef et al., 2014).

Tocopherols act as a preservative against rancidity. The high tocopherol content of mustard
seeds is advantageous in the case of fat containing mustard flour being used as additive, because it contributes to longer shelf life of finished food products (Damian, 2013). Scientific literature pays important attention to special compounds from mustard seeds, namely glucosinolates (Abul-Fadl et al., 2011). These compounds characterize the flavour of mustard and mustard products. The main glucosinolate compound found in mustard is sinigrin, but it contains other glucosinolate compounds, such as sinalbin and glucobrassicin. Glucosinolates are degraded into isothiocyanates by enzymatic action of plant specific myrosinase or intestinal flora in the body. Sinigrin, the predominant glucosinolate in the mustard seed, is mainly degraded upon the enzymatic action of myrosinase under normal conditions to give allyl isothiocyanate (Schuster-Gajzágó et al., 2006, Tsao et al., 2000, Abul-Fadl et al., 2011). Allyl isothiocyanate, has shown remarkable results in inhibiting the growth of food borne-pathogens and growth of cancer cells. Therefore, it has potential for use as an antimicrobial agent in a variety of foods because of its natural origin (Tyagi et al., 2007). Even if myrosinase is inactivated by heat, the operating conditions and the time interval between the release of the enzyme and its inactivation are sufficient to initiate the hydrolysis of glucosinolates (Barba et al., 2016). Mustard seeds are functional food with beneficial physiological effects in humans. *Sinapis alba* can be used as source for a wide range of active components including isothiocyanates, phenolics, dithiolthiones and dietary fiber (Hendrix et al., 2012). By these constituents, mustard seeds could be taken into consideration as potential component of many food products.

As it could be observed from its chemical composition, the mustard seeds are rich in protein with excellent nutritional quality; mustard seeds protein are rich in lysine with adequate amounts of sulfur containing amino acids-limiting amino acids in most of the cereals and oilseed proteins (Sadeghi and Bhagya 2008). Also, the amino acid composition of mustard protein is well balanced; it is rich in essential amino acids.

The use of protein rich full-fat or defatted flour, shows promise in improving the nutritive value of the final product as well as an optimum utilization of the flour. Protein fortification of food is of current interest because of increasing awareness of consumers towards health and quality of food (Tyagi et al., 2007). Until now, mustard seeds have been used mainly for condiment production. Their advantageous chemical composition and its relatively low price offer wide possibilities for usage of this valuable seed, for example in human foods as additive and to feed animals (Damian, 2013).

We aimed to supplement wheat flour with various levels (5%, 7% and 10%) of mustard seed flour in order to obtain supplemented bread with good nutritional and quality characteristics.

**Materials and methods**

Mustard seeds were purchased from the medicinal herb market at Cluj-Napoca (Romania). The mustard seeds were ground with a laboratory mill and then sieved with a 0.8 mm sieve. A commercial wheat flour type 650 (according to ash content 0.65% by the Romanian classification), with 13.8 % moisture and 28.7 % gluten content was used. The other raw materials of the recipe (wheat flour, yeast and salt) were purchased from the local market. The *mustard flour (MSF)* was mixed with wheat flour in different portions (5%, 7% and 10%) for producing the bread with mustard flour (MSB).

First step was dough kneading for about 8-10 minutes, after that the dough was maintained for 80 minutes at a temperature of 29-32°C for bulk-fermentation. The next step is dividing the dough in two equal weight parts and shaped them in an oval shape, after which the pieces are placed in trays and introduced into the fermentation room for 30-40 minutes at a temperature of 35-40°C and relative humidity of 75-85%. After the fermentation, the products are baked at a temperature of 220 °C for about 30-40 minutes. The final breads were submitted to the physico-chemical and sensorial exams.

The quality characteristics (moisture, ash, protein, crumb porosity and elasticity) were determined according to the 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 wheat flour protein (SR ISO 1871/2002). Sensory evaluation was performed using a 9-point hedonic test. The panel was formed by 30 semi trained judges (14 men and 16 women), with a mean age of 25. The consumer test was carried out...
out in the Sensory Analysis Laboratory of the Department of Food Engineering within University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca (Romania).

Rezults and discussion

The values of analyzed physico-chemical parameters for assortment of bread with mustard flour are presented in Tables 1.

The addition of mustard seeds flour in regular bread improved its nutritional parameters. By comparing with the control, bread supplemented with mustard seeds flour recorded higher protein content and ash content. The total variation in bread moisture is insignificant, decreasing from 40.57% to 39.48% and being determined by the variation of mustard seed flour addition. This slight decrease may be due to the fat content of mustard seeds, ranging from 28% to 32%, as was reported previously. The protein content of mustard seed flour fortified bread at different incorporation level (5-10%), increased from 11.20% to 16.23%. These results are sustained by the high protein content of mustard seeds (28-36%) with good nutritional value due to their aminoacids content (Abul-Fadl et al., 2011; Damian 2013). Sarker et al., 2015 are reported that mustard seeds are important as quality protein source.

The high ash content of mustard flour as compared to wheat flour led to an increased ash content in fortified bread. The ash content in mustard flour has been reported to be around 6% (Talati et al., 2004). It can be noticed from table 1, that the mustard seeds flour addition has a negative influence on the bread's crumb elasticity; also, the crumb porosity was uneven and decreased in parallel with raising the mustard seeds flour addition. Supplementation with 10% mustard seeds flour could be adopted in wheat bread manufacturing without affecting quality adversely, if the values of Romanian Regulation (SR 878:1996) are considered as standard parameters (humidity 45.5% max., porosity 60% min. and elasticity 78% min).

Results of sensory evaluation in terms of sensory attributes such as appearance, texture, taste, and overall acceptability are presented in Table 2.

The scores of general acceptability are found to be 7.73, 7.75 and 8.27 in control bread and

<table>
<thead>
<tr>
<th>Experimental variants</th>
<th>Quality parameters</th>
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<tbody>
<tr>
<td></td>
<td>Moisture, %</td>
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<tr>
<td>MSB</td>
<td>40.57</td>
</tr>
<tr>
<td>MSB1</td>
<td>39.65</td>
</tr>
<tr>
<td>MSB2</td>
<td>39.55</td>
</tr>
<tr>
<td>MSB3</td>
<td>39.48</td>
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</tbody>
</table>

*MSB = 100% wheat flour + 0% mustard flour; MSB1 = 95% wheat flour +5% mustard flour; MSB2 = 93% wheat flour +7% mustard flour; MSB3 = 90% wheat flour +10% mustard flour All analyses were made in triplicate and mean value was recorded

<table>
<thead>
<tr>
<th>Sample</th>
<th>Appearance</th>
<th>Texture</th>
<th>Taste</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSB</td>
<td>7.85</td>
<td>7.60</td>
<td>7.73</td>
<td>7.73</td>
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<tr>
<td>MSB1</td>
<td>7.87</td>
<td>7.63</td>
<td>7.75</td>
<td>7.75</td>
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<tr>
<td>MSB2</td>
<td>8.20</td>
<td>7.90</td>
<td>8.72</td>
<td>8.27</td>
</tr>
<tr>
<td>MSB3</td>
<td>7.90</td>
<td>7.57</td>
<td>7.72</td>
<td>7.73</td>
</tr>
</tbody>
</table>

*MSB = 100% wheat flour + 0% mustard flour; MSB1 = 95% wheat flour +5% mustard flour; MSB2 = 93% wheat flour +7% mustard flour; MSB3 = 90% wheat flour +10% mustard flour

Table 1. Effect of different levels of mustard flour bread making quality

Table 2. Effect of different concentrations of mustard flour on the sensory quality of bread
bread supplemented with 5 and 7% mustard seeds flour (MSB1; MSB2), while in the case of 10% addition mustard seeds flour (MSB3) similar scores with control bread (MSB) were obtained. The sensory evaluation results indicated that the samples with 7% mustard flour gave better results than other samples. Also, for appearance, texture, taste was observed an increase in acceptability up to an addition of 7% mustard seed flour. A pleasant mustard aroma can be felt. An increased percentage addition of mustard seeds flour led to more pronounced flavour and taste of bread. Over 7% of mustard seeds flour addition led to a decrease in all sensory characteristics. Our results are similar to Tyagi et al. 2007, that mentioned that replacing wheat flour with 15% defatted mustard flour had a good influence on the sensory attributes such as colour, flavour, texture and overall acceptability. Gadei et al., 2012 reported that 10% supplementation level of mustard flour in bread led to similar scores for odor compared with control sample. The differences between the maximum levels of supplementation with mustard seeds flour reported by authors could be determined by the type of the flour (whole or defatted, particle size) and by the mustard seeds variety related with the volatile compounds content.

From the present study it can be concluded that bread containing 10% mustard seeds flour were nutritionally rich but scored lower for sensory quality than the bread prepared from 7% mustard seeds flour. The bread prepared with mustard flour up to 7% was found to be acceptable with respect to all sensory attributes and with a significant improvement of ash and crude protein.

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