Organically Produced Grain Amaranth-Spelt Composite Flours: II. Bread Quality

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Abstract
The use of composite flours containing grain amaranth for breadmaking purposes and consumption is new in Slovenia. In this part of the study the baking performance and sensory evaluation of mould breads from spelt-amaranth composite flour were researched. Composite flours were prepared by adding wholemeal amaranth to wholemeal spelt flour at substitution levels of 0, 10, 20 and 30% (w/w). The dough was prepared only with salt, yeast and water (according to farinograph water absorption). Bread quality parameters as weight, volume, specific volume of the loaf, and hedonic sensory evaluation (scored from 1-unacceptable to 10-excellent) by 37 panellists were conducted. Product was considered acceptable when its mean score for overall acceptability was above 5. In comparison to the control, the specific volume was not influenced by 10% of substitution, while levels of 20 and 30% lowered the value for 6% and 9%, respectively. As was revealed by scoring, noticeable differences in colour and flavour appeared at 10% of substitution level, while flavour of the bread was not influenced up to 20% of amaranth substitution. Texture, aroma and overall acceptability of bread were not influenced by amaranth addition.

According to obtained results up to 10% of the wholemeal spelt flour in a formulation could be replaced by wholemeal amaranth flour with no detrimental effect on bread quality.

Key words: bread quality, composite flour, grain amaranth, spelt,

Ekološka proizvodnja mješavina brašna pira i zrnatog šćira: II. Kakvoća kruha

Sažetak
Upotreba mješavina brašna zrnatog šćira i žitarica za pečenje kruha i potrošnju je novost u Sloveniji. U istraživanjima, integralno brašno pira bilo je djelomično miješano s 10, 20 i 30% integralnog brašna zrnatog šćira i analizirano na svojstva kakvoće kruha. Tijesto je bilo pripremljeno uz dodatak soli, kvasaca i vode (farinogramska vrijednost upijanja vode). Istražena su slijedeća svojstva kakvoće kruha: težina, volumen i specifični volumen štruce kruha, kao i hedonska senzorska ocjena (ocjene od 1 – neprihvatljivo do 10 – odlično) provedena uz pomoć 37 evaluatora. Proizvod se smatra prihvatljivim, ako je prosječna ocjena ukupne prihvatljivosti bila iznad 5. U usporedbi s kontrolom zamjena brašna pira s brašna šćira nije utjecala na specifični volumen štruce kruha, ali je zamjena od 20% i 30% smanjila vrijednost navedenog parametra za 6%, odnosno 9%. Analiza senzorskih svojstava kruha ukazuje na promjenu u boji kruha kod 10% brašna šćira dok se usko kruha nije promijenio do 20% zamjene brašna pira. Zamjena nije utjecala na teksturu, aromu i sveukupnu prihvatljivost kruha.

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Introduction

On account of its excellent nutritional composition, grain amaranth represents an interesting alternative to increase the spectrum of foods in our diet (Breene, 1991; Kaufman, 1992; Berghofer and Schoenlechner, 2002; Bavec and Bavec, 2006). Because amaranth seeds do not contain gluten (Thompson, 2001), and have spicy, slightly pungent flavour or bitter aftertaste (Saunders and Becker, 1984), amaranth flour substitution of cereal by amaranth flour in blends for breadmaking is limited.

Among studies on composite flour containing amaranth there are only some reports on their baking performance and sensory characteristics (Lorenz, 1981; Breene, 1991; Ayo, 2001), but they are all based on wheat flour, and virtually no research has been reported on composite spelt-amaranth flour.

Irrespective of nutritive value, the acceptance of any product is a function of its sensory qualities and its physiochemical characteristics. Therefore the aim of the present study, which was a part of a broader national research project on amaranth, was to investigate the use of organically produced composite spelt-grain amaranth flours for breadmaking purposes and the suitability of the produced bread for consumers.

Material and methods

Wholemeal spelt flour and wholemeal amaranth flour were produced and processed in accordance with the Council Regulation (2092/91) for Organic farming. Grain milling, flour preparation and results of analysed rheological parameters are described previously in Part I. of the investigation.

Composite flours were prepared by mixing wholemeal amaranth to wholemeal spelt flour at rates of 0, 10, 20 and 30% (w/w). The dough was prepared only with salt, yeast and water of 32 °C according to farinograph water absorption values. Dough was kneaded for 8 minutes (Bosch mixer), proofed for 30 minutes at a temperature of 25 °C, kneaded again for 3 minutes, hand moulded, and put into a waxed baking pans (100 × 200 mm). After 20 minutes of additional proofing bread was baked in a ventilated electric oven for 15 minutes at 200 °C and further 40 minutes at 175 °C. Baking tests were done in three replications for each treatment. The baked loaves were removed from the pans, cooled at room temperature and stored at 14 °C for sensory evaluation.

Quality analyses of cooled bread samples (6 hours after baking) were carried out by measuring weight, loaf volume (determined by displacement of millet seeds in a constructed loaf volume meter) and calculating specific volume as a ratio of loaf volume to loaf weight.

Hedonic sensory evaluation (scored from 1-unacceptable to 10-excellent) by 37 panellists were conducted the following day after baking. Uniform sized bread slices of pre-coded samples were presented to the panellists, and clean water was provided to the panellists to rinse their mouths between samples testing. The following sensory attributes were evaluated: crumb colour, bread flavour, aroma, texture, and overall acceptability. Product is considered acceptable when its mean score for overall acceptability was above 5.

Statistical analyses were performed using the SPSS statistical program, with the significance level set at P ≤ 0.05. Duncan test was used to determine significance of differences among means.

Results and discussion

The breadmaking performance of pure spelt and composite flours is presented in Table 1.

Loaf weight recorded after baking increased as spelt was substituted with amaranth flour. This was because of higher water absorption determined by farinograph for composite flours. Breads containing 10% of amaranth flour had the same loaf volume and thus the same specific volume as pure spelt samples, but further increasing of amaranth rate in formulation resulted in decreasing of volume and specific volume of the loaf.
The effects of grain amaranth flour addition on the bread sensory characteristics are shown in Figure 1. Significant differences were observed only between the colour and flavour of the control loafs and those of amaranth flour supplemented breads. In terms of crumb colour, the breads from 90:10 composite flours were evaluated as more acceptable than the control. In terms of flavour, the samples from composite flours gained statistically the same scores as control, but breads from flour where spelt was substituted with the highest rate were evaluated lower than those from 90:10 composite flour. All other evaluated sensory attributes of bread were not significantly influenced by an amaranth flour substitution. Evaluated overall acceptability of composite breads was not significantly different to control bread. The results are in accordance with both Lorenz (1981) and Saunders and Becker (1984) who described wheat-amaranth breads as being pleasant, nutty-tasting, and preferred by a taste panel over the flavour of white bread. The bread was more open, the texture not as silky, and the crumb colour slightly darker. Ayo (2001) reported a decrease of the flavour mean score at above 15%, and texture mean score at above 10% supplementation of wheat in composite flour. The crumb colour was not significantly influenced by amaranth flour replacement to 50%. The aspect of the spelt bread loaves with wholemeal amaranth flour substitution is shown in Figure 2.

Table 1. Weight, volume and specific volume of loafs made from sole wholemeal spelt and from composite flours

<table>
<thead>
<tr>
<th>Composite flour (spelt:amaranth in%)</th>
<th>Loaf weight (g)</th>
<th>Loaf volume (cm³)</th>
<th>Specific volume (cm³ g⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANOVA</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>100:0</td>
<td>728c</td>
<td>1580a</td>
<td>2.17a</td>
</tr>
<tr>
<td>90:10</td>
<td>737b</td>
<td>1617a</td>
<td>2.19a</td>
</tr>
<tr>
<td>80:20</td>
<td>747a</td>
<td>1520b</td>
<td>2.03b</td>
</tr>
<tr>
<td>70:30</td>
<td>749a</td>
<td>1477b</td>
<td>1.97b</td>
</tr>
</tbody>
</table>

Levels of significance: ** - P ≤ 0.01
Means within the column denoted with the same letter are not significantly different (Duncan, α=0.05)

Figure 1. Sensory scores of bread made from sole spelt and from composite flours. Means (± s. d.) within the evaluated characteristic denoted with the same letter are not significantly different (Duncan, α=0.05)
Conclusions

Considering the results of this study, the incorporation of amaranth into the spelt dough had a positive effect on the colour of the loaf, to a certain extent on the flavour, and on the volume and specific volume at 10% of substitution. Texture, aroma and overall acceptability of bread were not influenced by amaranth flour replacement. Therefore, according to obtained results, up to 10% of the wholemeal spelt flour in a formulation could be replaced by wholemeal amaranth flour with no detrimental effect on bread quality.

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References

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