Introduction

The spelt wheat (Triticum spelta) is one of the oldest cultural cereals, which is originated from crossing of Aegilops squarrosa (L.) with Triticum dicoccon (Schrank.). Popular in Europe for centuries, spelt is used in a wide variety of cereals, pastas, crackers, baked goods, and beers.

Cereal grains contain a wide variety of biologically active compounds, including dietary fibre, microelements, sterols, phenolic compounds, peptides, vitamins, and the effects of these have been associated with antioxidant properties [14,1].

Natural antioxidants have been of interest for many years. However, an upsurge in interest in these components has occurred in recent years because of their importance for the prevention of diseases mediated by free radical reactions in vivo. The onset of a variety of major health problems, including cancer, atherosclerosis, rheumatoid arthritis, inflammatory bowel disease, immune system decline, brain dysfunction, cataracts, and malaria may be delayed by natural antioxidants. Natural antioxidants can be found in a wide range of food raw materials [6]. Considerable scientific evidence suggests that whole grains, as commonly consumed in the United States and Europe, reduce risk for chronic disease including cancer and heart disease. Whole grains provide a wide range of nutrients and phytochemicals that may work synergistically to optimize human health [9].

The objective of the study was to evaluate the antioxidant properties of selected spelt wheat bioproducts (products from Triticum spelta).

Materials and methods

Three sort of bioproducts were obtained directly from trade network in Slovak Republic: spelt groats, whole spelt groats and spelt bread (steamed grains – produced by means of steam).

Antiradical activity of ethanolic extracts of samples was determined using the free DPPH radical. The modified method by Brand-Williams et al. [2] and Sanchéz-Moreno et al. [12] was used. Absorbance at 515.6 nm was measured at different time intervals using Shimadzu 1601 UV/VIS spectrophotometer (UV-1601, Shimadzu, Tokyo, Japan) until the reaction reached a plateau. The absorbance of the 2,2-diphenyl-1-pikrylhydrazyle radical (DPPH*) without an antioxidant (i.e. the control), was measured first. The percent of inhibition of the DPPH radical by the sample was then calculated according to the formula:

\[
\%\text{ inhib} = \left[\frac{A_{C0} - A_t}{A_{C0}}\right] \times 100,
\]

where \(A_{C0}\) is the absorbance of the control at \(t = 0\) minute, \(A_t\) is the absorbance of the antioxidant at time \(t\) minutes, \(\%\text{ inhib}\) equals percentage of free DPPH* radicals.

Reduction power of compounds was evaluated spectrophotometrically by the modified method according to Prieto (1999). A spectrophotometric method has been

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Bioproducts made from spelt wheat (Triticum spelta) and their antioxidant properties

Słowa kluczowe: ziarna pszenicy, kasze, ekosystem, bioprodukty

Key words: spelt wheat, cereals, ecological system, bioproducts
developed for the quantitative determination of antioxidant capacity. The phosphomolybdenum method is according to Prieto [10] routinely applied in the laboratory to evaluate the total antioxidant capacity of plant extracts. This method is established on reduction of Mo (VI) to Mo (V) with an effect of reduction parts in the presence of phosphor under formation of green phosphomolybdenum complex. Solution absorbance of reducing sample was measured at 705 nm (UV-1601, Shimadzu, Tokyo, Japan) toward black experiment (distilled water). Reduction power of compounds (RPKA) expressed as quantity of ascorbic acid necessary to achieve the same effect in (mg.l⁻¹) was calculated using the equation:

\[ RPKA = \frac{(A705 \text{ nm} - 0.0011)}{0.00236}. \]

**Results and Discussion**

The antiradical activity was in the particular samples in range from 48.94% to 72.00% (average 59.24 ± 0.47%). Testing of antioxidant effect of our samples showed the best result at sample of spelt bread (71.57 ± 0.43%), followed by whole spelt groats and spelt bread with very good scavenging ability as well (Table 1). The value of antiradical activity for spelt bread was by 44.56% higher than that for spelt groats and by 26.38% versus whole spelt groats.

<table>
<thead>
<tr>
<th>Products</th>
<th>DPPH (% of inhibition)</th>
<th>RPKA (mg.l⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>average</td>
<td>SD</td>
</tr>
<tr>
<td>Spelt groats</td>
<td>49.51</td>
<td>0.57</td>
</tr>
<tr>
<td>Whole spelt groats</td>
<td>56.63</td>
<td>0.42</td>
</tr>
<tr>
<td>Spelt bread</td>
<td>71.57</td>
<td>0.43</td>
</tr>
<tr>
<td>Average</td>
<td>59.24</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Reduction power of spelt bread compounds was higher (205.30 ± 3.13 mg.l⁻¹) than of whole spelt groats. Comparison of whole spelt groats with spelt groats refers on lower values in case of spelt groats versus whole spelt groats. Reduction power for spelt bread was by 37.88% higher than that for spelt groats and by 23.01% versus whole spelt groats. Antioxidant capacity (expressed as reduction power) of compounds of selected bio-products from *Triticum spelta* was at average 163.93 ± 33.79 mg.l⁻¹.

Antiradical activity decreased also in the same order than antioxidant capacity: spelt wheat flour > dehulled spelt wheat > spelt grain “kernotto” [45].

**Table 2** Antiradical and antioxidant activity of selected spelt wheat bioproducts [5]

<table>
<thead>
<tr>
<th>Products</th>
<th>DPPH (% of inhibition)</th>
<th>RPKA (mg.l⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>average</td>
<td>SD</td>
</tr>
<tr>
<td>Spelt grain “kernotto”</td>
<td>50.97</td>
<td>1.21</td>
</tr>
<tr>
<td>Dehulled spelt wheat</td>
<td>51.22</td>
<td>0.67</td>
</tr>
<tr>
<td>Superfine spelt wheat flour</td>
<td>55.60</td>
<td>0.58</td>
</tr>
<tr>
<td>Average</td>
<td>52.60</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Fig. 1 Antioxidant properties of the spelt wheat bioproducts

Explanatory text:

DPPH – (antiradical activity) inhibition of the DPPH radical (%)

RPKA – (antioxidant capacity) reduction power expressed in equivalents of ascorbic acid (mg.l⁻¹)

Product 6 – spelt wheat flour *

Product 5 – dehulled spelt wheat *

Product 4 – spelt grain “kernotto” *

Product 3 – superfine spelt wheat flour

Product 2 – whole spelt groats

Product 1 – spelt bread

Obtained results we compared with earlier data [5] from the antioxidant evaluation of three different bioproducts made from spelt wheat: superfine spelt wheat flour, dehulled spelt wheat, spelt grain “kernotto” (peeled grain of spelt).

The antiradical activity was in the particular samples in range from 49.76 to 55.60% (average 52.60 ± 2.30%). Difference between the highest and the lowest antiradical activity was 4.63%, and the moderate value differ from the highest in 4.38%. Testing of antioxidant effect of our samples showed the best result at sample of spelt wheat flour (55.60 ± 0.58%), followed by dehulled spelt wheat and spelt grain “kernotto” with very good scavenging ability as well.

Reduction power of spelt wheat flour compounds was higher (210.30 ± 2.30 mg.l⁻¹) than of dehulled spelt wheat. Comparison of dehulled spelt wheat with spelt grain “kernotto” refers on lower values in case of spelt grain “kernotto” than in case of dehulled spelt wheat. The value of reduction power for spelt wheat flour was approximately 1.6-fold higher (i.e. by 9.08%) than that for spelt grain “kernotto”. Antioxidant capacity (expressed as reduction power) of selected bio-products from *Triticum spelta* was at average 163.93 ± 33.79 mg.l⁻¹.

Antiradical activity decreased also in the same order than antioxidant capacity: spelt wheat flour > dehulled spelt wheat > spelt grain “kernotto” [45].
Further studies of the antioxidant properties and the spelt bread disposed of the best antioxidant properties. From investigated bioproducts made from cereals, fruits and vegetables are all important dietary sources of antioxidants.

Conclusions

From investigated bioproducts made from Triticum spelta the spelt bread disposed of the best antioxidant properties. Further studies of the antioxidant properties and the antioxidant components are necessary to clarify the antioxidant effect of spelt wheat products.

Acknowledgement

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LITERATURA: