Comparative studies regarding the panification performances of some wheat species used in food processing

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Abstract

In this paper are investigated in terms of panification performances, three wheat species: *T. aestivum*, *T. durum* and *T. spelta* respectively, the results were assessed by comparison. For this it was determined following characteristics: the wet gluten content and its quality expressed by deformation index, Zeleny sedimentation index, total protein content. For assessing of optimal processing destination, that three wheat varieties were recovered in three integral bread samples processing with the same form and weight, using unique recipes. Resulting products were studied comparatively in terms of physico-chemical parameters: volume, porosity and elasticity core and compositional: carbohydrates, lipids and proteins content. The determined values of the investigated parameters revealed a superior nutritional value of samples from *T. spelta*, because of 100% higher protein content than the product processed from *T. aestivum* and 50% higher than the product processed from *T. durum*. The superior physical characteristics revealed also, the samples from *T. spelta*.

Keywords: wheat, panification, performances, chemical, physical, parameters.

1. Introduction

The generic term wheat grouped several grains belonging to *Triticum* genre. They are annual plants from the gramineous family (*Poaceae*), grown in almost the entire world. In *Western Europe* and the *Middle East*, wheat and its derivatives are part of the current diet. Wheat imposes itself permanently as a base food in western culture, being on daily meals as bread, crumb, pasta, pastries, biscuits, etc [5,12].

There are many systems of taxonomic classification of wheat species, grouped by growing season (summer or winter wheat) and gluten content. *Durum* wheat (*T. turgidum, T. durum* version) has a high gluten content and is recommended for food processing pasta. *Common wheat* (*Triticum aestivum*), by far the most important, is the main source of bread flour.

Today, the species of wheat grown in the world are [15]:

- *Common wheat* - (*T. aestivum*), hexaploid specie the most cultivated in the world.
- *Einkorn* - (*T. monococcum*), diploid specie, exists both in the cultivated varieties and the wild varieties, is one of the first species of wheat, rarely planted today.
- *Emmer* - (*T. turgidum dicoccum* version), tetraploid specie, cultivated or wild. In ancient times it was very cultivated, more rarely nowadays.
- *Durum* - (*T. turgidum, T. durum* version), only tetraploid form of wheat cultivated today.
- *Alac spelt* - (*T. spelta*), other hexaploid specie cultivated on a small-scale [6,7,8,].
Cereals are the most important crops for human existence and activity, primarily due to high nutritive value (provided by the chemical composition of the grains - 60% carbohydrates, 10-16% protein substances, 1.5 - 2.2% minerals, 1 to 2.5% fat, 1.5 to 16% vitamins) long term conservation, but also because of specific attributes and adaptation to achieve a wide variety of bakery products or to obtain raw materials for other industries[1,4,14]. In current context of agricultural development worldwide, to protect biodiversity and return to an environment-friendly agriculture, and low environmental impact and because of the changes in dietary patterns of food, agricultural production diversification and consumers demands towards traditional and enhanced nutritional quality products, experts are turning attention to other less known and cultivated crops so as cereal species - spelta, alac, tenchi or pseudocereals - amaranthus, quinoa, buckwheat, wild rice, which may become an alternative to classical cultivated species. The importance of these species derive primarily from their chemical composition, implicitly from their food value, from high protein contents, in some essential amino acids, minerals, lipids and the fact that the production process does not require large inputs, are not demanding to the conditions of culture, fertilization, have tolerance to diseases and pests and can survive harsh climates [9,10,11].

2. Materials and methods

The seeds material used was represented by wheat grains of the species *T. aestivum, T. durum, T. spelta* in Western Romania, in 2007 crop year. Grains were crushed and from the resulting meal samples were processed three samples of identical weights bread, using similar manufacturing recipes. Reagents of appropriate purity imposed by standard work protocols came from Merk, Sigma-Aldrich, Promega and Chimopar companies. Determination of wet gluten content by washing dough made from 25g of wheat groats and 12,5 ml 2% salt solution until the complete elimination of starch. After drying and weighing gluten product, 5g of it was thermostat at 30°C, for 1 hour, strain index was expressed as the difference between initial and final diameter of the sphere of gluten [13]. To determine the Zeleny sedimentation index over 3,2g wheat groats were added to 50 mL solution of 4% blue bromophenol the mixture was stirred 12 times for 5 seconds 12, after which was added 25 ml Zeleny mixture (180 mL acid solution Lactic 85% and 200ml isopropyl alcohol 90% completed up to 1000ml with distilled water). Shake the entire system for 15 minutes, then is estimated the sediment height, sedimentation index [2,3]. Total protein content was determined by Kjeldahl method and consisted of sample mineralization by heating with 96% sulfuric acid in the presence of a catalyst. Following disaggregation of proteins and other compounds containing nitrogen are carried free ammonium ions that react with sulfuric acid to form ammonium sulfate acid. Ammonia released by strong alkalization with NaOH 30% was distilled and then titrated with 0,1N H$_3$BO$_3$ in the presence of phenolphthalein.

Physico-chemical properties of bread samples were determined as follows: volume with device Fornet device, or in measuring displaced volume of rapeseed by a piece of bread weighing about 300g; core elasticity with the device for determining the elasticity, by analyzing compression and relaxation behavior for 1 minute of a 6 mm thick slice; core porosity by weighing a core cylinder detached from one slice of bread with a perforated cylinder.

Reducing sugar was determined by the Bertrand method, by reducing an alkaline solution (CuSO$_4$ x 5H$_2$O) with reducing sugars in samples of bread, and the resulted cuprous oxide result was indirect titrated with 0,1N KMnO$_4$ solution. Total fat was determined by extraction in Soxhlet apparatus with petroleum ether [13].

3. Results and discussion

In the quantitative assessment of gluten protein content of analyzed samples was determined the content of wet gluten percentage and were made comparative studies between species figure 1.
Figure 1 reveals that different species of wheat have different gluten content, 4-10%. Major gluten content belongs to *T. spelta* wheat sample with 10% higher than the sample of *T. aestivum*, respectively by 8% than the sample of *T. durum*.

To assess the quality of wet gluten were evaluated strain deformation index of his obtained results were comparative interpreted. If we interpret the individual results, relatively large differences between them can partially distinguish species of wheat used, the significant difference was discovered for *T. spelta*.

Total nitrogen content expressed as protein nitrogen in samples analyzed by Kjeldahl method are shown in figure 4.

Figure 2 shows that the deformation index of the sample of *T. durum* wheat, is higher with 5 mm, respectively 8 mm than the determined index for *T. spelta*, respectively *T. aestivum*.

Merchandising classification of samples into categories corresponding to wheat species is related in figure 3. Analysing dependence in total protein content of analyzed wheat samples in relation to total protein content of blank (see figure 4) there is a significant difference between the amount of total protein of analyzed samples. *T. spelta* wheat sample, showed a much higher protein intake than the other two varieties studied, 8% higher than *T. aestivum* wheat, and 5% higher than *T. durum* wheat.

The three species of wheat were milled and from the resulting meal three samples of bread were processed at the same weight and manufactured under the same recipes. They were assessed in terms of physico-chemical parameters and nutritional value.

Variation of the physical parameters of bread samples analyzed according to the variety of wheat from which flour was obtained used in the manufacturing recipe is presented in the in figure 5.
Analyzing the data shown in figure 5 results that products whose composition was used flour from *T. spelta* and *T. durum* varieties have volume by 10.8% and 8.7% higher than the processed bread from *T. aestivum* wheat flour. Similar developments are recorded in the case of elasticity, the highest value being determined for *T. spelta* bread flour, 2.2% higher than that obtained from *T. durum*, respectively 6.7% for bread processed from *T. aestivum*. The product from *T. aestivum* was the most porous, with porosity value of 7.7% bigger than *T. durum* bread, respectively 9.7% than *T. spelta* bread.

Based on the content in carbohydrates, lipids and proteins to determine the energy value of the three types of bread, outcomes achieved are presented in table 1.

### Table 1. The energy value of bakery products (integral grain bread)

<table>
<thead>
<tr>
<th>Bread assortment</th>
<th>Lipids /100g</th>
<th>Carbohydrates /100g</th>
<th>Proteins /100g</th>
<th>Energy value [kJ/100g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread from <em>T. aestivum</em></td>
<td>1.05</td>
<td>44.16</td>
<td>12.2</td>
<td>235</td>
</tr>
<tr>
<td>Bread from <em>T. durum</em></td>
<td>1.85</td>
<td>42.30</td>
<td>16.5</td>
<td>255</td>
</tr>
<tr>
<td>Bread from <em>T. spelta</em></td>
<td>3.27</td>
<td>41.64</td>
<td>22.7</td>
<td>285</td>
</tr>
</tbody>
</table>

Graphical representation of variation of the calculated energetical values of the three assortments produced is presented in figure 6.

![Figure 6. The energy value of bakery products depending on flour assortment](image)

Analysis of data in table 1. and represented in figure 6, reveals that the energetical value of products depends on flour assortment accessed in the manufacturing recipe. Thus bread of *T. spelta* is the most valuable in terms of energy, with 10.86% more than the assortment of *T. aestivum*, respectively 8.7% more than of *T. durum*.

### 4. Conclusion

- Significant difference in sedimentation index was refered to the sample from *T. aestivum* variety. Samples of *T. durum, T. spelta* showed a high similarity values;
- Percentage of the total protein content in wheat has evolved significantly from one variety to another, emphasizing *T. spelta* through a high protein concentration up to 2 times greater than that of *T. aestivum*, *T. durum* wheat recording an intermediate value of the other two;
- Products whose composition was accessed flour from *T. spelta* and *T. durum* varieties have a volume of 10.8% and 8.7% higher than the bread processed with flour from *T. aestivum*. The situation was similar in elasticity, the highest value being determined for *T. spelta* flour bread, was 2.2% higher than that obtained for *T. durum* wheat bread, respectively 6.7% for *T. aestivum* bread. The product from *T. aestivum* was the most porous, with porosity value of 7.7% greater than *T. durum* bread, respectively 9.7% than *T. spelta* bread;
- Energy value of products depends on accessed flour, thus the assortment obtained from *T. spelta* is the most valuable in terms of energy, with 10.86% more than the assortment of *T. aestivum*, respectively 8.7% more than in *T. durum*.

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