The assessment of the optimum rest time in the wheat conditioning with a micromill designed to determine the grinding resistance of the wheat grain

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Received: 1 April 2010; Accepted: 10 May 2010

Abstract

In the milling process, a well wheat preparation by conditioning is at least half the battle toward mill balance, which results in the most favorable flour extraction and flour quality and also a lower energy consuming process. The conditioning is influenced by the physical and chemical state of the wheat. An optimum rest time in the wheat conditioning can provide a higher flour yield with 2-5%, a much more satisfactory flour colour and an reduced grinding energy consumption with 10-20%.

Keywords: wheat, conditioning, rest time, grinding resistance, energy.

1. Introduction

Wheat preparation by conditioning means removal or, more often, addition of water followed by a rest period. The amount of water added depends on original moisture of the wheat and the relative humidity in the mill processing space. The moistened wheat is then allowed to rest for a period of time, to let the added moisture penetrate evenly throughout the kernel parts. This tempering process is probably the only stage at which the miller can modify the physical and chemical state of the wheat. The objective is that all kernels reach the same physical condition [1].

In the Romanian mills, the kernel readiness is achieved without heat by adding cold water to the wheat and allowing the wheat to rest in bins (silos) until it reaches the optimum moisture distribution and kernel suitability for milling.

Usually, the optimum rest time for the moistened wheat is determined from diagrams (nomograms) containing the physical and chemical indicators determined in running laboratory.

Another method is using the laboratory mills (Brabender, Buhler, Miag, Chopin) for milling moistened wheat samples, in different period of time (from 0,5 to 1 hour), in few successive breaking steps and then sorting by sieving. Finally, the qualitative and quantitative analysis of these milling products can provide the establishment of the optimum rest time in the wheat conditioning. But all these methods are long lasting proceedings with high working volume. It was state by the authors [2] that there is a correlation between the grinding energy and the technological properties of the wheat (related to the conditioning steps: addition of water and rest time). That is why we propose to assess the optimum rest time in the wheat conditioning, with the micromill designed to determine the grinding resistance of the wheat grain.

2. Materials and methods

The investigations were carried out on two Romanian winter wheat varieties (*Triticum aestivum*, ssp. *vulgare*) Dropia and Pegasus, harvested in 2009.

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The preparation of the samples collected was carried out according to the chess-board pattern method, after cleaning with a Sadkiewicz Instruments Scourer. The physicochemical characteristics of the wheat were evaluated as follows: the moisture content using the SR ISO 712:2005; the wet gluten content, protein content using the NIR technique (Inframatic, model 8600, Perten Instruments AB); vitreous kernel using the STAS 6283-2/1984 (farinotomat apparatus). The quality indices of the studied wheat varieties are depicted in Table 1.

Table 1: Quality indices of the wheat varieties

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Variety</th>
<th>Dropia</th>
<th>Pegasus</th>
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<tbody>
<tr>
<td>Botanical weight [kg/hl]</td>
<td>77.6</td>
<td>77.4</td>
<td></td>
</tr>
<tr>
<td>Vitreousness [%]</td>
<td>18</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Wet gluten content [%]</td>
<td>21</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>Moisture content [%]</td>
<td>13</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>Falling number [s]</td>
<td>290</td>
<td>333</td>
<td></td>
</tr>
<tr>
<td>Protein content [%]</td>
<td>10.8</td>
<td>15</td>
<td></td>
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For this research, was used a new designed micromill which can perform in the grinding process of the wheat and of the middling too, for the appreciation of the grain resistance (specific surface energy consumption) in the milling process, in the same conditions as in the milling industry. The adjustment of the roller characteristics can be done for each type of milling product (grain, semolina, bran). The grains are in the same time under the compression and the shearing efforts. The energy consumption is represented by one single value for one pair of rollers. This single value is significant for the comparative appreciation regarding the energy consumption in the milling process, for different wheat cultivars or different batches, but also for different characteristics of the rollers: the size of the gap, roll disposition sharp-to-sharp, sharp-to-dull, dull-to-sharp or dull-to-dull, the corrugations number/cm, the differential speed ratio, profile and inclination. The appreciation of the energy consumption (kJ/kg) is made by measurements of the resistant moment of the kernel, between the rollers, in the breaking process. The micromill is equipped with corrugated break rollers measuring 50 mm in length and 90 mm in diameter, using with a fast roll speed of 500 rpm, 5 corrugations/cm, 0.6 mm roll gap, with a sharp-to-sharp roll disposition and differential speed (1:2,5). The 30 g moistened wheat samples have been grounded by the micromill.

The Dropia and Pegasus wheat varieties have been conditioned up to 16% moisture content and for different rest time period depending on variety. For the same rest time were prepared two parallel samples.

3. Results and discussion

The rest time value obtained from each parallel samples is represented in Figure 1 (for Dropia) and Figure 2 (for Pegasus). The optimum rest time value for the conditioning of Dropia variety is 5 hours. For this value it was obtained the lowest average resistant moment in the grinding process of this soft wheat variety, which it means also the lowest energy consumption. The lowest average resistant moment was obtained also for the Pegasus variety (hard wheat) for 9 hours rest time in the conditioning process.

The resistant moment of the particles grounded between the rollers (measured by a tensometric cell, connected to a PC computer and managed with a software program) has been obtained for each period of rest time for the moistened wheat. The results are confirming that for the lowest resistant moment value, the optimum rest time is 5 hours for Dropia variety and 9 hours for Pegasus wheat variety.

Figure 1. The rest time in the conditioning process of Dropia variety

Figure 2. The rest time in the conditioning process of Pegasus variety
4. Conclusions

The assessment of the optimum parameters in the conditioning process can be made by the micromill designed to determine the grinding resistance of the cereals.

The method has the same accuracy as the classical one and has the advantage to be quicker and less demanding as work volume.

It is an alternative way to describe the optimum for the conditioning process and can be used in laboratory for the benefice of students as well in the milling industry.

Acknowledgements

This research was supported by The National Programme Research Council and UEFISCSU, contract no. 411/2007-2010.

References
