COMMON WHEAT DEBRANNING: PRELIMINARY STUDIES

DECORTICAZIONE DEL GRANO TENERO: STUDI PRELIMINARI

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6°Annual IAOM – EURASIA DISTRICT CONFERENCE & EXPO
FLORENCE 10 - 14 September 2011
Debranning

Mechanical elimination of husk, from the outside layers towards the more internal regions, normally used for the covered cereals.

“COVERED” CEREALS
rice, barley, oats

hulls or husks
(bracts)
strictly adherent
to the kernel

DEBRANNING

this operation allows the total removal of the outer hull layers, giving the whole kernels

“NAKED” CEREALS
wheat

bracts are removed during the harvest

MILLING
wheat
storage
cleaning
conditioning
milling
Mechanical elimination of husk, from the outside layers towards the more internal regions, normally used for the covered cereals.

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- rice, barley, oats
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- strictly adherent to the kernel

DEBRANNING
- this operation allows the total removal of the outer hull layers, giving the whole kernels

“NAKED” CEREALS
- wheat
- bracts are removed during the harvest

DEBRANNING
- storage
- cleaning
- hydration
- conditioning
- milling

DEBRANNING
- this operation allows the partial removal of bran layers
Aim of Work

Debranning of Durum Wheat (*Triticum durum*)

increase in semolina yield and quality

*Dexter and Wood, 1996*

*Pagani et al., 2000, 2002*

Debranning of Common Wheat (*Triticum aestivum*)

evaluating the effects of different debranning conditions on

the characteristics of kernels

the characteristics of flours

*both on pilot and industrial scale*

Wheat samples

Raw Materials: 2 commercial samples of cleaned common wheat

<table>
<thead>
<tr>
<th></th>
<th>hard wheat</th>
<th>soft wheat</th>
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</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>54</td>
<td>76</td>
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<tr>
<td>Moisture (%)</td>
<td>12.6</td>
<td>12.8</td>
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<tr>
<td>Ash content (% db)</td>
<td>1.61</td>
<td>1.64</td>
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<tr>
<td>Protein content (% db)</td>
<td>11.3</td>
<td>16.7</td>
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high compactness of the endosperm region

low compactness of the endosperm region

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**TECHNOLOGICAL PARAMETERS**

- **prehydration levels** of wheat kernels (0%, 2%, 3%);
- **resting times** of prehydrated kernels: 5 min or 20 min;
- **mixing** of prehydrated kernels: 5 min;
- **length of debranning passages**: 1 min (short passages) or 5 min (long passages);
- **number of debranning passages**: 1+3 passages
- **particle size** of superabrasive material (coarse and fine surface)

34 trials

**ABRASIVE ROLLS** covered by innovative material:

**SYNTHETIC DIAMOND POWDER**
Debranning with Coarse Elements

26 experimental samples

<table>
<thead>
<tr>
<th>sample</th>
<th>type</th>
<th>pre-hydration (%)</th>
<th>kernel treatment after pre-hydration</th>
<th>process time (min)</th>
<th>passage number</th>
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<td>3</td>
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</table>

Markers of debranning intensity:

- **Debranning level (DL):** amount of waste (g/100g kernels)
- **Starch content of waste (% db)**

Long passages and no mixing

DL >10%: excessive abrasion

Best conditions of debranning:
pre-hydration, mixing and short passages

Pagani et al., 2002.
Debranning with Coarse Elements

<table>
<thead>
<tr>
<th>sample</th>
<th>type</th>
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<th>process time (min)</th>
<th>passage number</th>
<th>DL (%db)</th>
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<td>resting</td>
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<td>mixing</td>
<td>5</td>
<td>3</td>
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**too strong and not homogeneous abrasive effect**

**substitution of abrasive rolls**
Debranning with Fine Elements

too strong and not homogeneous abrasive effect

substitution of abrasive rolls

DEBRANNING CONDITION

- rolls covered by finer abrasive surface
- pre-hydration of kernels (3%);
- mixing of pre-hydrated kernels (5 min);
- short and repeated passages: 1 min; 1+3 passages

8 samples (2 trials for each thesis)

<table>
<thead>
<tr>
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<th>kernel treatment after pre-hydration</th>
<th>process time (min)</th>
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<td>mixing</td>
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<td>mixing</td>
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<td>mixing</td>
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<td>mixing</td>
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</tbody>
</table>

Markers of debranning intensity:

- Debranning level (DL): amount of waste (g/100g kernels)
- Starch content of waste (% db)

smallest DL associated with hard wheat
starch loss close to that found for bran
Debranning with Fine Elements

substitution of abrasive rolls

milder and more homogeneous abrasive effect
Debranning with Fine Elements and Brushing

brushing passage

removal of bran layers raised but still lying on kernels
Debranning with Fine Elements

- **Similar protein content**: maintenance of aleurone
- **Ash decrease**: partial removal of bran layers

**Significant decrease in the microbial contamination of kernels**
Milling of Debranned Kernels

- relevant decrease in conditioning time without decreasing the flour yield
- similar technological quality of flour (Brabender Farinograph Test)

conventional soft wheat flour
Farinographic stability: 1.6 min
Water absorption: 54.6 %

flour from debranned soft wheat (conventional conditioning)
Farinographic stability: 1.8 min
Water absorption: 53.3 %

flour from debranned soft wheat (conditioning: 3h)
Farinographic stability: 2.5 min
Water absorption: 54.0 %
Industrial Milling Debranning

**DEBRANNING IN AN ACTUAL INDUSTRIAL MILLING DIAGRAM - 220 t/die**
Debranning in Industrial Milling

- 3 debranning machines in series
- 12 abrasive rolls (fine abrasive surface)
- 2000+2500 kg/h (capacity of each machine)

Markers of debranning intensity:
- Debranning level (DL): amount of waste (g/100g kernels)
- Starch content of waste (% db)

<table>
<thead>
<tr>
<th>Trials</th>
<th>Sample</th>
<th>Type</th>
<th>Crop Year</th>
<th>Debranning Trial (nr)</th>
<th>Process Conditions</th>
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<tbody>
<tr>
<td>D35</td>
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<td>2005</td>
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<td>2005</td>
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<tr>
<td>D42</td>
<td>soft</td>
<td>2005</td>
<td>4</td>
<td></td>
<td>industrial conditions</td>
</tr>
</tbody>
</table>

DL and starch content of waste:
- Equal or lower than 10%
- Only bran layers removed

Markers of debranning intensity: DL and starch content of waste equal or lower than 10%

only bran layers removed
Debranning in Industrial Milling

BRAN LAYERS REMOVED
WITHOUT NICKING ENDOSPERM REGION
Conclusions and Work in Progress

Debranning process can be successfully applied to common wheat, regardless of the hardness of kernels

- individualization of optimal debranning condition
  - improvement of chemical characteristics of kernels (↓ ash)
  - improvement of hygienic characteristics of kernels (↓ CBT)

*Bottega et al., 2009. Tecnica Mol. Intern., 1-12; Bottega et al, 2009. JFE, 94, 75-82*

**Work in progress**

- elimination of external (2-3%) layers by a rapid debranning action
- exploitation of by-product for making and separating soluble fibre
- addition of treated by-products in bread formulation
Exploitation of debranned layers

Sample A
Sample A + enzymatic treatment

Sample B
Sample B + enzymatic treatment
Acknowledgement

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A. Marti

YOU

for your attention!!!