Development and characterization of wheat breads with chestnut flour

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Introduction

• Bread is one of the oldest functional foods which health effects that has been investigated in many studies.
• Its an important staple food and the most widely consumed bakery product.
• Bread quality depends on several physical (i.e. texture, volume and colour) and organoleptic characteristics, which could be influenced by many factors, such as flour type and other ingredients, bread-making procedure, fermentation, cooking time and temperature.
• One of the main quality criteria on bread is related with texture, and the development of a desirable volume, related to alveoli formation.
Introduction

The development of bakery products using composite flour has increased and is attracting much attention for many reasons, such as:
- Reduce the importation of wheat flour or encourage the use of locally grown crops as flour with nutrition and health benefits
- A proper balance of ingredients needs to be obtained to produce high-quality bread.
- The ingredients of bread will impart influence colours, texture, and nutritional characteristic which may improve the bread quality
Aim of the study

- Produce bread from wheat and chestnut and compare it with breads produced from 100% wheat flour, with physiological effectiveness encountering consumer’s acceptance in terms of appearance, taste and texture.
Material and methods
Experimental procedure

The ingredients used for bread production were

– Wheat flour type 65,
– Chestnut flour,
– Yeast
– Salt, and
– Water.

The wheat with chestnut flour breads were produced under the same conditions as for wheat breads, with the following proportion of chestnut/wheat flours: 1/9 and 1.5/8.5.

These breads were produced with a reduced quantity of flour (5 kg), corresponding to 5 final breads.
Doughs rheological properties

**Farinographic assay**
An Farinograph 300 G Brabender was used.
The parameters obtained from the farinogram were:
- water absorption,
- development time,
- dough stability time.

**Extensographic assay**
An Extensograph – E was used.
This provides data on:
- the energy value,
- the resistance to extension,
- the dough extensibility,
- the R.E/E value at 45, 90, 135 min.
Physicochemical properties of breads

- Moisture content
- Water activity \((a_w)\)

- Density
  \[ d = \frac{m}{V} \], where \(V = a \times b \times c\) and \(m\) the mass of breads

- Colour parameters \((L, a^*, b^*)\)
Physicochemical properties of breads

- **Alveolar** characterization using the program Image J. This is enabled to determine the number and size of the alveoli, as well as the total area and the alveolar percentage.

- **Texture** profile analysis (TPA) to all the samples was performed using a Texture Analyser TA.XT.Plus, to determine hardness, springiness, cohesiveness, adhesiveness and chewiness through a compress test.
Sensorial analysis

Performed on the day of delivery of the samples;
Panel of 70 untrained tasters, aged between 18 and 64 years, who were asked to rate the following attributes:
- crumb and crust colour,
- aroma (bread and fermentation),
- taste (bread, salt, sweet and fermentation),
- elasticity,
- density, and
- the overall appreciation.

The intensity of each attribute were translated into numeric values in order to allow statistical analysis. The scale of values varied from 0 (less intense) to 10 (more intense).
Results and discussion
The dough development time were similar to all breads, meaning that breads with chestnut flour don’t need more time for bread making.

Doughs with chestnut flour were more stable, meaning strength, with high tolerance to mixing.

Farinographic characteristic

Similar farinographic profiles were found for wheat doughs with 10 and 15% of chestnut flour.

Water absorptions were similar for all the breads, but wheat Ceres dough presenting the lower value, which required less volume of water to reach the 500 U.B. This could be due to the flour components.
Generally, the energy, the resistance to extension and the extensibility of doughs decreased with the addition of chestnut flour and with the proving time.

Because resistance to extension is a measure of dough strength and of dough’s capacity to retain gas, a high resistance means that more force is required to stretch the dough.

The extensibility indicates the amount of elasticity in the dough and its ability to stretch without breaking.

### Extensographic characteristic

<table>
<thead>
<tr>
<th>Extensographic characteristic</th>
<th>WCCerealis 10%</th>
<th>WCCerealis 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fermentation time (minutes)</td>
<td>Fermentation time (minutes)</td>
</tr>
<tr>
<td>Energy (cm²)</td>
<td>26.7 17.7 15.2</td>
<td>60.9 46.0 84.4</td>
</tr>
<tr>
<td>Resistance (BU)</td>
<td>400 300 290</td>
<td>730 732 490</td>
</tr>
<tr>
<td>Extensibility (cm)</td>
<td>5.9 5.0 5.1</td>
<td>13.0 9.4 9.0</td>
</tr>
<tr>
<td>Resistance/Extensibility (BU/cm)</td>
<td>67.8 60.0 56.9</td>
<td>22.3 77.9 54.4</td>
</tr>
</tbody>
</table>
Moisture content is low, and the $a_w$ is quite high (around 0.95), remaining stable during the 5 days of storage.

Wheat breads with chestnut flours decreased significantly the water content after the first day of storage.
Breads with chestnut flour showed less density, with the wheat Ceres bread with chestnut flour showing the lower value.

Generally, the density was kept constant or decreased during the storage time.
The L parameter did not change significantly during the storage time.

Generally the addition of chestnut flour increased the a* values, meaning that those breads are more reddish, during the storage time this parameter decreased.

The b* parameter was similar for all breads, with a predominant yellow colour, even during the storage time.
The addition of chestnut flour clearly increased the alveolar parameters, producing breads with high alveolar number, % alveolar, and low mean size.

Thus chestnut breads are fluffier and less dense, corroborating the results obtained for bread density as previously mentioned.
When it was added chestnut flour the hardness, cohesiveness and elasticity remained similar to the wheat flour. Hardness increased, and the cohesiveness and elasticity decreased with storage time. The chewiness of breads increases with the addition of chestnut flours. Moreover, during bread aging the chewiness increased, in opposition to the cohesiveness parameter, meaning the ability of the product to stay as one.
The addition of chestnut flour influenced significantly the evaluation of the crust and crumb parameters, being more intense for bread with chestnut flour, scratchier, with similar alveolus characteristics as WCeres bread (biggest and uniform alveolus).

The panel lists classified the WCCerealis as less dense, with a low fermented aroma and high elasticity, when compared with the 100% wheat breads.

The addition of chestnut flour increased the bread taste and aroma, and made it sweeter. The bread with chestnut flour developed was the most appreciated.
Conclusions

The addition of 10% of chestnut flour to wheat flours to produce bread caused the emerging of different physical-chemical and sensorial properties.

Some of the evaluated properties were quite different, mainly the rheological characteristics of doughs, the density values, colour parameters, alveolar characteristics and texture properties.

The sensorial evaluation showed that the bread produced with 10 % of chestnut flours added to wheat globally are appreciated by the consumer, meaning that the majority of the encountered differences were perceptible for them and valued.
Conclusions

These results are quite optimistic since with the addition of the chestnut flour the nutritional value of the wheat bread increased, with all the related health benefits. Moreover, the addition of chestnut flours possibly will bring also economic benefits in terms of saving of hard currency, promotion of high-yielding native plant species, and a better overall use of family agriculture production.
Acknowledgment

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