Textural and Sensorial Characterization of a New Oat Based Product

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Abstract
Oat it is known as a cereal which provides numerous health benefits due to its composition. Likewise, hemp, flax and olive oils are rich in compounds required for the wellness maintenance and in prevention and treatment of various diseases. Thanks to advances of last decades in the food industry, it can be said that the rheological measurements have become indispensable in order to obtain a quality product. The aim of this work was to develop and optimize a technology for obtaining unfermented dough, respectively, to obtain oat based unleavened bread. The characterization of the final product from a sensorial point of view was performed, analysis very important for assessing the consumers acceptance. In the meantime the texture properties of all samples were instrumentally determined. Textural profile showed that samples containing higher percent of oil content had a lower hardness than those with reduced percent of oil. The most appreciated unleavened oat bread was dried at 150˚C and had a low content of oil.

Keywords: drying, oat, textural profile, sensorial analysis, unfermented dough

INTRODUCTION
Oat (Avena sativa) is a cereal which is cultivated in Europe and North America. Throughout history, oats has been used for different purposes: in medieval Britain oats were cropped for bread, biscuits and malting; in Roman period as feed for horses, medical uses etc. Currently, the biggest oat-producing countries are Russia, Canada and United States (www.kew.org/science; Stewart and McDougall, 2014).

In recent years, there has been a growing interest of consumers to healthy foods. Due to the benefits of oats compounds on the human body, its consumption plays an important role in preventing and treating different diseases. Oats are classified as a whole grain and are especially high in soluble fibers, β- glucans, lipids, protein, phytochemicals and specific micronutrients, as well as act as a unique source of polyphenols (Singh et al., 2013; Marmouzi et al., 2016). β- glucan is the main component of oat soluble fiber, which has been also considered as an important bioactive compound in obtaining of functional food (Wood, 2007; Bae et al., 2009). It was demonstrated that β-glucans have beneficial effects on satiety due to its capacity to form viscoelastic gels (Clemens and van Klinken, 2014), food intake, gastrointestinal digestive enzymes, and gastrointestinal hormones (Dong et al., 2014).

According to many studies, it can be said that olive, flax and hemp oils are beneficial for human health. Olive oil is a precious source of vitamin E, monounsaturated fatty acids and nonessential nutrients (Officioso et al., 2016; Covas et al., 2006). Flaxseed and hemp oils are rich in α-linolenic acid (ALA) and linoleic acid (LA) (Abuzaytoun and Sha-
hidi, 2006; Carus et al., 2013), and furthermore, flaxseed oil contains the highest amount of ω-3 fatty acids among the available seeds (Tawheed and Thakur, 2014; Goyal et al., 2014; Sharma et al., 2012). These types of oils have various health benefits. Olive oil consumption provides a decreased risk of cancer, diabetes and cardiovascular disease, which lead to low rate of mortality (Covas et al., 2006; Rangel-Huerta et al., 2015; Buckland et al., 2012). Also, it was demonstrated that specific components of olive oil have antihypertensive, antioxidant, antithrombotic, anti-inflammatory, blood pressure reducing actions (Buckland and Gonzalez, 2015; Wendy et al., 2016). Flaxseed oil is beneficial in several ways such as in reduction of diabetes, cancer, arthritis, cardiovascular disease, osteoporosis, autoimmune and neurological disorders (Goyal et al., 2014). Hemp oil has similar actions as olive and flax oils: anti-inflammatory, antioxidant and anticarcinogenic activities, lowering of overall blood cholesterol level and improving of metabolism because of easy digestibility (Meizer et al., 2014; Mihoc et al., 2012; Pop et al., 2009).

The aim of this work was to develop a new oat based food product - unleavened bread - by adding olive, flax or hemp oils, in order to obtain unleavened bread rich in fibers and unsaturated fatty acids. The drying technology optimization as well as the textural and sensorial characterization of the final product was performed.

**MATERIAL AND METHODS**

**Materials**

For the experiment, oat flour (produced by Pirifan) and oils: olive oil (Costa de Espania), flaxseed and hemp oils (local products) were purchased from the local market. The final product - unleavened bread - was obtained in FSTA, USAMV Cluj-Napoca pilot plants.

**Sample preparation**

Unleavened bread dough samples were obtained by using the ingredients ratios shown in Table 1.

Dough B was sticky and hard to handle, the second type with lower content of water had better handling thus, for the next step was used the variant A. The drying process was realized in three ways in order to identify the optimal drying method: dough wrapped in aluminium foil, wrapped in baking paper and unwrapped.

Forwards, for comparison, were obtained bread samples from fluid dough and from solid dough consistency with/without addition of baking powder.

**Dynamic of dough drying method**

To monitor the decrease in moisture of the dough during drying were carried out several types of dough / drying method:
- Sample 1 (dough A): unwrapped dough;
- Sample 2 (dough A): dough wrapped in baking paper;
- Sample 3 (dough A): dough on baking paper;

### Tab.1. Ingredients ratios dough samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Flour (%)</th>
<th>Water (%)</th>
<th>Oil mix (%)</th>
<th>Salt (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dough A</td>
<td>57.1</td>
<td>34.3</td>
<td>6.9</td>
<td>1.7</td>
</tr>
<tr>
<td>2. Dough B</td>
<td>52.9</td>
<td>42.3</td>
<td>3.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

### Tab.2. Ingredients ratios used for the three types of dough

<table>
<thead>
<tr>
<th>Sample</th>
<th>Flour (%)</th>
<th>Water (%)</th>
<th>Oil mix (%)</th>
<th>Salt (%)</th>
<th>Dough condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dough C</td>
<td>36.4</td>
<td>58.2</td>
<td>4.3</td>
<td>1.1</td>
<td>Fluid dough</td>
</tr>
<tr>
<td>2. Dough A</td>
<td>57.1</td>
<td>34.3</td>
<td>6.9</td>
<td>1.7</td>
<td>Solid dough wrapped in baking paper</td>
</tr>
<tr>
<td>3. Dough A*</td>
<td>57.1</td>
<td>34.3</td>
<td>6.9</td>
<td>1.7</td>
<td>Solid dough with addition of baking powder wrapped in baking paper</td>
</tr>
</tbody>
</table>
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- Sample 4 (dough A): dough wrapped in aluminum foil;
- Sample 5 (dough C): fluid dough;
- Sample 6 (dough C): fluid dough turned after 45 minutes.

In order to assess the dynamic of drying, moisture content of the dough was determined, taking into account the moisture of the flour used and the amount of water. During the drying process weighing of the product from 15 to 15 minutes was performed, the first weighing being made 30 minutes after placing the product in the drying oven.

Drying temperature
In order to reduce the oxidative degradation of fatty acids in the product composition a reduction of the drying temperature has been attempted. For this purpose, drying operation was performed at 150°C, 120°C and, respectively at 90°C. The time necessary for drying was recorded. Given that in all tests conducted, the product of fluid dough was most appreciated organoleptic, dynamic drying at lower temperatures has been applied for it.

Texture analysis
Texture of the product is an important factor influencing the quality and sensory characteristics thereof. Given that the duration of drying samples at 90°C it was not considered cost-effective in economic terms (even in 225 minutes does not reach the required humidity), the texture analysis was performed only for samples dried at 120°C and 150°C. A total of 6 samples were carried out in four repetitions each.

The texture of the final product was analyzed by using CT3 Texture Analyzer. The device was equipped with the 10 kg load cell. The texture analysis was carried out using a cylindrical-type TA41 probe having a diameter of 6 mm, a length of 35 mm and a mass of 7 g. The diameter of the samples was 70 mm. The probe was set to penetrate the sample 3mm. Hardness of samples was considered as the required maximum load when performing the compression test.

Sensorial evaluation
Sensory analysis of the product was carried out to identify which sample is the most appreciated by the consumers. The analysis was performed by a trained panel.

For the test, 6 samples were prepared, labeled as shown in Table 3. In order to evaluate sensory profile, the hedonic test in 9 points was used. General hedonic score was calculated as follows:

\[
\text{Hedonic score} = \frac{N \times 9 + N \times 8 + N \times 7 + N \times 6 + N \times 5 + N \times 4 + N \times 3 + N \times 2 + N \times 1}{N_D}
\]

Where: N- number of tasters which gave the same appreciation, ND- the total number of tasters

RESULTS AND DISCUSSION
After drying of the dough A in three ways, it has been found that dried products wrapped (aluminum foil or baking paper) requires more time for drying, these products have a harder consistency, unlike the unwrapped breads, that are more crispy.

Similarly, drying was carried out for fluid dough C and dough B with/without addition of baking powder, and then results were compared. After this operation, it was found that products made from dough B wrapped in baking paper had a very hard consistency in comparison with the sample obtained from the fluid dough C wrapped also in baking paper, which had a crunchy consistency. It has been found that sample with

| Tab.3. Different drying temperature of samples with different oil content |
|-----------------------------|-----------------------------|-----------------------------|
| Sample | Temperature of drying (°C) | Oil content (%) |
| P1 | 120 | 0 |
| P2 | 120 | 4.3 |
| P3 | 120 | 8.3 |
| P4 | 150 | 0 |
| P5 | 150 | 4.3 |
| P6 | 150 | 8.3 |
baking powder became more voluminous after drying process.

**Dynamics of dough drying**

Moisture content of the dough was determined by taking account of the quantity of flour used and its moisture content, and the amount of water used. Drying dynamics was highlighted by plotting moisture versus time. To monitor the dynamics of drying the fluid dough C was chosen, due to its organoleptic properties, the products obtained from dough C being the most appreciated.

As shown in Figure 1 the product reached the optimal moisture (≈14.6%) in 90 minutes at a temperature of 150°C, 135 minutes at 120°C. In the case of drying at 90°C, it was found that it is not cost effective, since after 225 min of drying, moisture remained high. Moreover the product did not have the corresponding texture and organoleptic parameters.

**Texture analysis**

For each sample of unleavened bread, four repetitions were analyzed to obtain average values, after which the results of each sample were represented in a diagram.

The hardness of the samples without oil or with 4.3% oil, at 120°C and 150°C exceeded the maximum load of the cell (>10,000g to penetrate the mass of the product) showing the high consistency of these samples. On the other hand the samples with 8.3% of oil dried at the same temperature, required a load between 5000-6000g. This difference was caused by the presence of unsaturated triglycerides from the dough composi-

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**Fig. 1.** Drying dynamics of dough samples

**Fig. 2.** Unleavened bread hardness: UB - unleavened bread, UB 4.3% oil - unleavened bread with 4.3% of oils content, UB 8.3% oil - unleavened bread with 8.3% content of oils
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Sensorial evaluation
The hedonic score was calculated for each sample, and the values obtained were plotted. From Figure 3, one can note that the sample which accumulated the highest score (7.8) was dried at 150°C with 4.3% of oil, which means according to the hedonic scale that is positioned between “pleasant” and “very pleasant”. The second ranked sample was 6, dried at 150°C with 8.3% of oil.

It can be said that the products dried at 150°C are more valued by consumers than those dried at 120°C. This can be determined by drying time, as discussed above, the products have reached optimum moisture in 90 minutes at 150 °C and 135 minutes at 120°C, the additional drying time may induce changes in taste and consistency.

CONCLUSIONS
It can be concluded that drying of the dough at different temperatures, respectively at 150°C, 120°C and 90°C in order to reduce the oxidative degradation of fatty acids was hard to achieve while it was found that in terms of sensory qualities, the optimal variant was obtained at 150°C during 90 minutes.

Texture analysis showed that unleavened bread with 8.3% of oil dried at 150°C and 120°C required lower load for product penetration, which was caused by the presence of unsaturated triglycerides.

Sensorial test pointed out that the most appreciated unleavened bread by consumers was the sample with 4.3% of oil content obtained from fluid dough and dried at 150°C. This sample was crispy and with a proper consistency, which is a very important factor for consumer acceptance.

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