Sensory Evaluation of Wheat Bread with Flax Seed Marc Additive

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The aim of the research was to evaluate the sensory properties of wheat bread with flax seed marc additive and to find out consumers’ acceptance of the new product.

The main sensory properties (colour of the breadcrumb, flavour, texture, porosity) were evaluated by a line scale, besides a nine point hedonic scale was used to determine the degree of acceptance.

The sensory data were analysed by means of the analysis of variance (ANOVA) and t-test.

The testing included three reiterations.

Evaluation of the sensory properties shows that the use of flax seed marc in making wheat bread affects the colour and porosity of the breadcrumb. It does not influence the flavour and texture. The results of hedonic rating proved that the panellists preferred the wheat bread with flax seed marc to the control wheat bread sample.

Keywords: flax seed marc, biological value, sensory evaluation.

Introduction

Flax seed has been used in the human diet since ancient times. The flax seed Linum usitatissimum L. has a relevant nutritive value compared with other flax varieties in agriculture [1–3]. Warm climate is suitable for seed production, therefore the nutritive value of flax seed is higher in the northern part of the world [4]. The whole seeds are used as additives in bread and confectionary industry, but the common field of usage is flax seed oil production. Flax seeds are rich in omega-3 alpha-linolenic acid and dietary fibre. There has been data found about the addition of flax seeds – as whole seeds – to baked products, which provides a healthy appearance and increased texture quality to the ready-made product. However, flax seeds should be ground prior to application and before the potential health benefits from the omega-3 fatty acids, lignan and fibre are obtained [5, 6]. The chemical composition of flax seeds is shown in Table 1.

Table 1. Chemical composition of flax seeds, g in 100 g of product [6]

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Water</td>
<td>7.0</td>
</tr>
<tr>
<td>2.</td>
<td>Albumen</td>
<td>18.3</td>
</tr>
<tr>
<td>3.</td>
<td>Lipid</td>
<td>42.2</td>
</tr>
<tr>
<td>4.</td>
<td>Carbohydrates</td>
<td>28.9</td>
</tr>
<tr>
<td>5.</td>
<td>Dietary fibre</td>
<td>27.3</td>
</tr>
<tr>
<td>6.</td>
<td>Sugars</td>
<td>1.6</td>
</tr>
</tbody>
</table>

In Latvia, the most likeable wheat and rye bread varieties not only contain whole grain, sesame seeds, sunflower seeds, but also flax seed additives. As a result, the breads have not only an excellent taste, but also a higher biological value, i.e. a higher content of vitamins, dietary fibre, and proteins compared with breads without seed additive.

The data about flax seed marc suitability for wheat bread production in Latvia was not found. Therefore the idea to add flax seed marc to wheat dough, thus making a new wheat bread making technology and evaluate the sensory properties of the new bread product was developed.

The sensory quality of food products plays an important role in the choice of food. Hedonic testing is often used to determine consumers’ attitude toward the food by measuring a degree of acceptance of a new or improving the existing food product [10].

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The impact of the addition of flax seed marc on the main sensory properties (flavour, texture, porosity, and colour of the breadcrumb) of wheat bread and its acceptance had not yet been carried out in Latvia.

The aim of the current research was to evaluate the sensory properties of wheat bread with flax seed marc additive and to ascertain consumers’ acceptance of the new product.

**Methods and materials**

The research was carried out in the scientific sensory laboratory of the Department of Food Technology, of Latvia University of Agriculture (LUA).

The following ingredients were used for making wheat bread: wheat flour, water, yeast, salt, sugar, oil, flax seed marc after flax seed oil production in Latvia. A new bread making technology was developed (Fig. 1).

For determining the optimal flax seed marc additive to wheat dough, wheat bread samples with 15, 20, 25, 30 and 35% of total flour amount were prepared. As a result, the best wheat bread sample was that with 20% flax seed marc additive of the total flour amount.

The sensory data were analysed using the analysis of variance (ANOVA) and t-test [11–13]:

- the main sensory properties (colour, flavour, texture, porosity) were evaluated by a line scale (using ISO 4121:1987 standard method);
- a nine point hedonic scale were used to find out the degree of acceptance (ISO 4121:1987 standard method).

Two bread samples were prepared for the sensory evaluation:

A – wheat bread with flax seed marc additive;

B – control wheat bread sample, without flax seed marc additive.

24 panellists selected and trained according to ISO 8586-1 (third year students of Faculty of Food Technology of LUA), participated in the evaluation of bread samples. The panellists received encoded samples and questionnaires as well as instructions for the evaluation of the samples.

Testing included three reiterations.

![Fig. 1. The wheat bread preparation technology with flax seed marc additive](image-url)

**Results and discussions**

The results of hedonic rating show that the panellists preferred the wheat bread with flax seed marc additive to the control bread sample (Fig. 2). The degree of acceptance of wheat bread with flax seed marc addition is 6.8 and that of control bread sample, 5.4.

Two bread samples were analysed using hedonic rating with the aim to determine which bread sample has a better taste. For the experiments, data analysing t-tests were used. It was determined after mathematical data processing that the \( t_{\text{crit.}}=2.07<t_{\text{cal.}}=6.05 \) (\( \alpha=0.05; \text{df}=24–1=23 \)), which means that there are differences in the degree of acceptance between the two bread samples (\( \alpha\leq0.05 \)).
As an alternative method, a test for comparing the two samples was conducted ($n=24$, $x=19$; $\alpha=0.05$). As a result, the sample with flax seed marc additive was found to be of better taste than the control bread sample.

The evaluation of the sensory properties shows that the use of flax seed marc in making wheat bread does not affect the flavour and texture of the product (Table 2 and Table 3).

**Table 2. Results of analysis of variance of flavour**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>Variance ratio F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread samples</td>
<td>1.00</td>
<td>9.05</td>
<td>9.05</td>
<td>2.25</td>
</tr>
<tr>
<td>Panellist</td>
<td>22.00</td>
<td>105.01</td>
<td>4.77</td>
<td>1.19</td>
</tr>
<tr>
<td>Error</td>
<td>22.00</td>
<td>88.48</td>
<td>4.02</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>45.00</td>
<td>202.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\alpha\leq 0.05$

**Table 3. Results of analysis of variance of bread texture**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>Variance ratio F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread samples</td>
<td>1.00</td>
<td>2.54</td>
<td>2.54</td>
<td>1.24</td>
</tr>
<tr>
<td>Panellist</td>
<td>22.00</td>
<td>88.48</td>
<td>4.02</td>
<td>22.00</td>
</tr>
<tr>
<td>Error</td>
<td>22.00</td>
<td>45.16</td>
<td>2.05</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>45.00</td>
<td>162.76</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\alpha\leq 0.05$

There was no differences found in the flavour of bread with flax seed marc additive and control bread sample ($F_{cal}=2.25<F_{crit}=4.28$ ($n_1=1$, $n_2=22$); Table 2). It may be supposed that the new bread samples not only have a high nutritive value but also can be highly demanded, which is a very important factor for bread makers.

The results of analysis of variance (Table 3) show that $F_{cal}=1.24<F_{crit}=4.28$ ($n_1=1$, $n_2=22$), which implies that there was no difference in bread texture between the studied bread samples. The fermentation process of wheat dough with flax seed marc additive was increasing intensively, therefore the texture of the ready product is well formed.

The following study was focussed on the colour and porosity of wheat bread with flax seed marc additive and that of the control bread sample (Table 4 and Table 5).

As the results of the experiments show there is difference in the colour of bread soft part between the two samples of bread ($F_{cal}=9.09>F_{crit}=4.28$ ($n_1=1$, $n_2=22$).
The results of the statistical analysing show that wheat bread sample with flax seed marc additive has a more intensive brown colour in the breadcrumb compared with control bread sample. It could be explained by a brown colour of flax seed marc and by a high amount (20% from total flour amount) of flax seed marc added to wheat dough.

Wheat bread with the flax seed marc additive was found to have the most intensive porosity (\(F_{cal}=18.99>F_{crit}=4.28\) (\(n_1=1, n_2=22\)) (Table 5). It could be explained with more intensive dough fermentation process, as the result, the bread porosity is well developed, which means that all dough fermentation processes occurred correctly.

The sensory properties of wheat bread sample with flax seed marc additive and control bread sample are summarized in Figure 3.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>Variance ratio</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread samples</td>
<td>1.00</td>
<td>56.77</td>
<td>56.77</td>
<td>9.09</td>
<td></td>
</tr>
<tr>
<td>Panellist</td>
<td>22.00</td>
<td>79.13</td>
<td>3.59</td>
<td>0.58</td>
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</tr>
<tr>
<td>Error</td>
<td>22.00</td>
<td>137.42</td>
<td>6.25</td>
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</tr>
<tr>
<td>Total</td>
<td>45.00</td>
<td>273.31</td>
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<td></td>
<td></td>
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<tr>
<td>(\alpha \leq 0.05)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>Variance ratio</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread samples</td>
<td>1.00</td>
<td>56.10</td>
<td>56.10</td>
<td>18.99</td>
<td></td>
</tr>
<tr>
<td>Panellist</td>
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<td>134.20</td>
<td>6.10</td>
<td>2.06</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>22.00</td>
<td>64.99</td>
<td>2.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>45.00</td>
<td>255.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\alpha \leq 0.05)</td>
<td></td>
<td></td>
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</tbody>
</table>

**Fig. 3.** Star diagram of sensory properties of bread samples
Conclusions

1. The results of sensory analysis using hedonic rating showed that the highest degree of acceptance was attributed to the bread sample with flax seed marc additive (6.8) compared with control bread sample (5.4).
2. The evaluation of the sensory properties shows that bread with flax seed marc additive has a more intensive colour and porosity of the breadcrumb.
3. The results of analysis of variance show that there is no difference in the flavour and texture of the bread samples.

References


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Santrauka


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СЕНСОРНЫЕ ИССЛЕДОВАНИЯ ПШЕНИЧНОГО ХЛЕБА С ДОБАВЛЕНИЕМ ОТЖИМКОВ ЛЬЯНЫХ СЕМЯН

Резюме

Целью исследования являлось изучение сенсорных свойств пшеничного хлеба с добавлением отжимков льняных семян, а так же оценка нового хлебного продукта.

Сенсорные свойства (цвет мякиша хлеба, аромат, текстура, пористость) были исследованы с использованием линейной шкалы; для определения степени приемлемости нового продукта использовали гедонистическую шкалу.

Данные обработаны с помощью двухфакторного анализа (ANOVA) и теста “t”.

Полученные результаты показали, что при производстве пшеничного хлеба с добавлением отжимков льняных семян изменился цвет мякиша хлеба и пористость, в свою очередь экспериментальный и контрольный образцы между собой по аромату и текстуре не различались. Результаты гедонистических исследований показали, что высокую оценку получил образец пшеничного хлеба с добавлением льняных семян.