INFLUENCE OF IMPURITIES AND HULL CONTENT IN MATERIAL FOR PRESSING ON SENSORY QUALITY COLD-PRESSED SUNFLOWER OIL

Tamara Đ. Premović, Etelka B. Dimić, Aleksandar A. Takači and Ranko S. Romanić

This paper analyzes influence of different percentage of impurities and hull in the material for pressing on sensory quality (appearance, smell, taste, aroma and colour) of edible nonrefined sunflower oil. It has been concluded that simultaneous presence of impurities and hull in the starting material, especially presence of bigger quantities of impurities, has a rather negative effect on sensory quality of sunflower oil, made by cold pressing on a screw press. Apart from sensory analysis, the effect of impurities and hull on oil colour has also been identified by transparency determining, i.e. content of total pigments – carotenoids and chlorophyll. It has been concluded that presence of bigger quantities of impurities and hull cause the increase of content of both carotenoids and chlorophyll, and at the same time, decrease of transparency value in cold-pressed sunflower oil.

KEYWORDS: cold-pressed sunflower oil; impurity; hull; sensory qualities

INTRODUCTION

Edible plant oils today make up a rather big proportion of our diet, in which they occupy a special place, due to its multifunctional importance: they are the main source of energy, liposoluble vitamins, essential fatty acids and other minor ingredients. Oils belong to the category of essential and necessary foods which are consumed directly as they are, or are applied during different preparations of food (1).

Process of oil production is permanently enhanced by developing people awareness of importance of leading a healthy life, as well as the need to consume food with positive effect on their health, i.e. food rich with protective components. Accordingly, a need for production of cold-pressed oils arose, in order to preserve and protect their existing, natural and highly valuable components (2).

New tendencies include production of edible nonrefined oils of seeds of different oleaginous plants, for example sunflower, pumpkin, soybean, rape, then flax, safflor, corn germ, etc. However, on this planet, cold-pressed sunflower oil is the most frequent, which keeps winning over the market, even in those countries in which the priority is given to

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olive oil (3, 4). Our market also has a relatively increased demand and consumption of cold-pressed oil, especially sunflower oil.

Along with the increased use of plant oils, knowledge about their quality is required (1). Although there are a lot of indicators, which can be objectively measured and which can express chemical, biological, nutritive and health quality, at quality evaluation of edible nonrefined oils very important, even the first place is given to sensory qualities (3). In comparison to refined oils, cold-pressed oils have more prominent sensory quality, therefore these oils contribute to creating a specific aroma of food and provide special gastronomic pleasure (5, 6).

It is well known that choice and quality of raw material are one of the most important quality parameters of oil made by cold pressing, apart from importance of other parameters. Some of numerous quality factors of cold-pressed oils are: technology of processing (7), storage conditions of seeds, that is oil, presence of impurities, premises, as well as hull in the material for pressing, etc. (3).

Taking into consideration the fact that cold-pressed oil is widely used on the market, and since sensory quality and content of pigments, which influence the colour, are extremely important, both from the aspect of an oil producer, as well as consumers, this paper analyzes sensory qualities and colour of cold-pressed sunflower oil, depending on the different presence of impurities and hull in the starting material for pressing.

**EXPERIMENTAL**

**Materials**

Within the scope of this paper, five samples of cold-pressed sunflower oil were prepared. Oils were made from six-month old seeds of domestic hybrid Cepko from regular growing 2009. Cold-pressed oils were produced in the mini oil plant by pressing of sunflower seeds with the given content of impurities and hull, with the use of a screw press „Anton Fries“, Germany, with the capacity of 6,1-9,5 kg/h and 35-40 min⁻¹ rotations of the screw. Oil temperature immediately after taken out of the press was 55-60ºC. Pressed oils were kept 24 hours at the room temperature (20-25ºC) for sedimentation of residue, after which the top layer of oil was decanted and filtered through an ordinary laboratory filter paper. Numbers and identification of analyzed samples are given in Table 1.

**Table 1. Identification of oil samples**

<table>
<thead>
<tr>
<th>Oil sample</th>
<th>Content of impurities (%)</th>
<th>Content of hull (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>32</td>
</tr>
</tbody>
</table>
Methods

Sensory evaluation of samples was done by a three-member expert committee, who evaluated the following quality parameters: appearance, smell, taste, aroma and colour (8). For evaluation of individual sensory qualities, the system of analytical-descriptive tests was used with points ranging from 0 (unacceptable quality) to 5 (optimal quality) (9, 10). Apart from sensory analysis, the oil colour was determined also by transparence measuring at 455 nm in relation to carbon-tetrachloride (8), as well as by determining of total carotenoids (as β-caroten) and content of total chlorophyll (11).

Results of determining of transparence and content of total carotenoids and chlorophyll are expressed as a mean value of three replication and their standard deviations (x̄±SD). Furthermore, statistically significant difference between samples, obtained by application of the factorial analysis of variance, are also shown (12).

RESULTS AND DISCUSSION

Results which were obtained by sensory evaluation of samples are shown in Figure 1. The results show that Sample 2 may be characterized as “delicious-gourmet oil”, i.e. as oil with extremely pleasant taste and smell. Aroma of this oil is characteristic, optimally defined as the aroma of dried and healthy raw kernels of sunflower. Sample 1 has a bit weaker aroma due to its aroma being less characteristic of the raw material, due to the fact that this oil was made by pressing totally cleaned and shelled seeds, raw kernel. Other samples have aroma far worse than the characteristic one. Sample 3 has a characteristic smell and taste of the raw material, but with weak strange smell and prominent strange taste. Samples 4 and 5 have the worst aroma of all examined samples. These oils have uncharacteristic taste with very prominent strange taste, and at the same time, uncharacteristic smell, with the presence of prominent (Sample 5), that is very prominent (Sample 4) strange smell. With these sensory qualities, these oils could not be approved for direct consumption, pursuant to valid regulations pertaining to the quality of edible oils (13).

According to the evaluation results of aromas of Sample 2 and Sample 4, that is Sample 3 and 5, it can be concluded that presence of impurities in the pressing material has the most unfavourable influence on the oil aroma. Comparing further results of aromas of Sample 2, Sample 3, Sample 4 and Sample 5, it can be seen that simultaneous presence of impurities and hull in the pressing material has unfavourable effect on oil aroma. On the other hand, however, the presence of hull has favourable effect on oil aroma (Sample 1). Sample 4 and Sample 5 have the weakest aroma, especially taste, which can be explained by the fact that presence of a certain part of impurities (in this case 10%), that is impurities and hull (32%) in the pressing material significantly lead to occurrence of unpleasant bitter taste of cold-pressed sunflower oil.

Results of this research about favourable effect of hull on aroma of cold-pressed sunflower oil, are not in accordance with available reference information. A group of authors (14) in previous research with fresh seed obtained different results about effects of impurities and hull in the starting material for pressing on aroma of cold-pressed sunflower oil,
which can be explained by a difference in age of the starting sunflower seed and difference in the amount of impurities and hull.

Figure 1 shows that two samples have maximal number of points when appearance, as a parameter of sensory quality, is concerned, namely Sample 1 and Sample 2. Contrary to these samples, which are “brilliantly” clear and transparent, Sample 3, Sample 4 and Sample 5 have noticeable mild turbidity without a visible residue, therefore receiving fewer points for appearance. By comparing appearances of Sample 1 and Sample 2, it can be concluded that the presence of total hull (32% in Sample 2), does not have a negative effect on the appearance. In Sample 3, Sample 4 and Sample 5 quantities of impurities and hull present in oils have equal negative effects on the appearance, causing reduced clarity, i.e. occurrence of mild turbidity.

![Figure 1. Score of sensory quality of cold-pressed sunflower oil](image)

Of all analyzed oil samples, two have maximal number of points when colour, as a parameter of sensory quality is concerned, namely Sample 1 and Sample 2 (Figure 1). These two oil samples have a characteristic, attractive and completely specific yellow colour, while Sample 3, Sample 4 and Sample 5 have a characteristic colour with certain deviations in shade, therefore receiving fewer points.

This fact may also be explained by negative effects of impurities, that is by simultaneous presence of impurities and hull in the starting material for pressing on oil colour. The results of this research show that impurities present in the starting material for pressing have negative effects on oil colour.

Differences in oil colour of samples, determined visually, are also confirmed both by values of transparence, as well as content of total carotenoids and content of total chlorophyll, shown in Table 2.

Minimal value of transparence is obtained with Sample 5 (24.54%) and maximal with Sample 1 (61.67%). By statistical processing of results of transparence values in the analyzed oils, the existence of statistically significant differences can be noticed ($\alpha= 0.05$). Therefore, it is possible to classify oil samples in three groups (a, b, c): Sample 1 and 2 (a), Sample 2, 3 and 4 (b), and Sample 3, 4, and 5 (c) (Table 2).
Table 2. Transparency and content of pigments of cold-pressed sunflower oil

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>Transparence (% at 455 nm with CCl₄)</th>
<th>Content of total carotenoids (mg/kg)</th>
<th>Content of total chlorophyll (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61.67±0.0058ᵃ</td>
<td>4.29±0.0098ᵇ</td>
<td>0.00±0.000ᵇ</td>
</tr>
<tr>
<td>2</td>
<td>43.56±0.0153ᵃᵇ</td>
<td>6.82±0.0108ᵇ</td>
<td>0.01±0.000¹ᵇ</td>
</tr>
<tr>
<td>3</td>
<td>36.46±0.0058ᵇᶜ</td>
<td>7.82±0.0174ᵃᵇ</td>
<td>0.32±0.0053ᵃᵇ</td>
</tr>
<tr>
<td>4</td>
<td>38.84±0.0208ᵇᶜ</td>
<td>7.60±0.0100ᵃᵇ</td>
<td>0.17±0.0052ᵃᵇ</td>
</tr>
<tr>
<td>5</td>
<td>24.54±0.0058ᶜ</td>
<td>11.31±0.022ᵃ</td>
<td>0.99±0.012ᵃ</td>
</tr>
</tbody>
</table>

Different superscript letters a, b, c present significant differences (p<0.05) among oil samples

Information available in cited works show that transparency of cold-pressed sunflower oil, made by different producers, widely ranges from 15 to 70%, most often from 50-60%, which gives oil characteristic golden yellow colour (3). According to Dimić and Romanić (15), transparency of cold-pressed sunflower oil of oleic type was 41.3%, while transparency of cold-pressed olive oil was 25.2%. Virgin olive oil, by these authors, has relatively lower values of transparency, 2.1-7.7%.

In the analyzed samples of cold-pressed sunflower oil, the content of total carotenoids, expressed as β-carotene, ranges from 4.29 (Sample 1) to 11.31 mg/kg (Sample 5), Table 2, which is a bit lower content of total carotenoids if compared to values stated in related works, ranging from 6.52-15.30 mg/kg (16). By statistical analysis of results of content of total carotenoids in the analyzed oils, statistically significant differences have been detected (α= 0.05), therefore it is possible to classify the oil samples in 2 groups (a, b): Sample 3, 4 and 5 (a), and Sample 1, 2, 3 and 4 (b) (Table 2).

Different values of carotenoids in the analyzed samples of oils can be explained by an assumption that results do not represent only values of content of total carotenoids in the analyzed oils, but that impurities and hull present in material for pressing also contain a certain amount of the same or similar pigments.

Given the research results (Table 2), it has been noticed that values between transparency and content of total carotenoids in the analyzed samples of oil show negative correlation with high level of correlation ($R^2>0.9$), Figure 2, which is in accordance with the cited works (15, 16).

Higher amounts of total carotenoids are present in palm oil, oil of pumpkin seed, corn germs, sunflower, etc (3). According to the research results of Tuberoso et al. (2), the content of β-carotene in sunflower oil is 0.1 mg/kg, while the content of total carotenoids is 2-4 mg/kg. In soybean oil and rapeseed oil, the content of total carotenoids is 20-35 mg/kg and 25-100 mg/kg, respectively (8).

The content of chlorophyll in the analyzed samples ranges from traces to 0.99 mg/kg (Table 2). Sample 1 contains total chlorophylls in traces, Sample 2 and 4 have a bit higher amount of total chlorophylls, respectively: $0.01± 0.0001$ mg/kg and $0.17+0.005$ mg/kg. Their highest content is in Sample 3 ($0.32±0.005$ mg/kg) and Sample 5 ($0.99±0.012$ mg/kg). Comparing the values of content of total chlorophylls in the analyzed samples, it
has been concluded that the presence of impurities in the pressing material gives higher content of total chlorophylls in oil than the presence of hull, and that simultaneous presences of impurities and hull in the pressing material cause the highest content of total chlorophylls.

![Figure 2](image-url)  

**Figure 2.** Correlation of carotenoids content and transparence of cold-pressed sunflower oil

By a statistical analysis of results, it has been established that there are statistically significant differences in the content of total chlorophylls in the analyzed oils ($\alpha = 0.05$), which can be therefore classified in 2 groups (a, b): Sample 3, 4 and 5 (a), and Sample 1, 2, 3 and 4 (b) (Table 2).

By further comparison of these results with the colour results obtained by sensory analysis, it has been established that oil samples with lower and minimal content of total carotenoids and chlorophylls have the maximal point for colour as a parameter of sensory quality.

Higher amounts of total chlorophylls are mainly present in nonrefined olive oil and grape seed oil (3). According to information taken from the cited works (15), content of total chlorophylls in virgin olive oil from the Mediterranean countries ranged from 7.73-15.08 mg/kg.

Content of total chlorophylls in sunflower oil ranges from 0.5-0.8 mg/kg (8). Content of total chlorophylls in cold-pressed sunflower oil ranges from traces to 1.208 mg/kg (16), while content of total chlorophylls in cold-pressed sunflower oil of oleic type is 5.15 mg/kg (15).
CONCLUSION

It has been concluded that both presence of impurities, as well as simultaneous presence of impurities and hull in the pressing material, have negative effects on sensory qualities of cold-pressed sunflower oil; the presence of impurities causing worse sensory quality of cold-pressed oils.

By comparing results of sensory analysis of oil, it can be established that aroma, i.e. smell and taste of oil, more heavily depend on presence of impurities, and simultaneous presence of impurities and hull than appearance and colour of oil. Apart from this, presences of impurities and hull in the starting material for pressing have almost identical effects on appearance and colour of oil.

Summing up the results of determining of sensory quality, it can be concluded that by pressing of seed with the presence of hull (at the amount of 32%), the highest-quality cold-pressed oil is produced in relation to aroma, i.e. smell and taste.

Furthermore, presence of impurities and hull in the starting material for pressing in higher amounts, causes higher content of total carotenoids and chlorophylls, as well as lower value of transparence in cold-pressed sunflower oils.

REFERENCES


УТИЦАЈ САДРЂАЈА НЕЧИСТОЊА И ЉУСКЕ У МАТЕРИЈАЛУ ЗА ПРЕСОВАЊЕ НА СЕНЗОРНА СВОЈСТВА ХЛАДНО ПРЕСОВАНОГ УЉА СУНЦОКРЕТА

ТамараЂ. Премовић, Етелка Б. Đимић, Александар А. Такачи и Ранко С. Романић

У овом раду је испитан утицај различитог удела нечистоћа и љуске у материјалу за пресовање на сензорски квалитет (изглед, мирис, укус, арому и боју) јестивог нерафинисаног уља сунцокрета. Утврђено је да истовремено присуство нечистоћа и љуске у полазном материјалу, а нарочито присуство већих количина нечистоћа, веома неповољно утиче на сензорски квалитет сунцокретовог уља, добијеног постепеном хладног пресовања на пужној преси. Утврђено је, такође, да нечистоћа и љуска утичу на повећање садржаја како каротеноида тако и хлорофила, а самим тим и на смањење вредности транспаренције уља.

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