INFLUENCE OF RIPENING ON THE PHYSICOCHEMICAL AND SENSORY PROFILE OF SEMI-HARD CHEESE

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Abstract: The aim of this paper deals with the physicochemical changes and sensory profile of semi-hard cheese during ripening. Accurate cylindrical samples of cheese with different surface treatment (wax vs. oil) were prepared. The first group of cheese was treated by wax and second group was oiled. From these groups, there were picked parts of cheese after 10, 20, 30, 40, 60 and 85 days of ripening to physicochemical analysis. Dry matter was determined by drying the sample to a constant weight at 102 °C, content of fat, protein content by Kjeldahl method, content of salt and titratable acidity, water activity (25 °C) and pH. It was evaluated colour, texture and overall appearance by sensory evaluation at Department of Food Technology Mendel University in Brno. There were statistically significant differences in all physicochemical parameters during ripening between waxy and oiled cheese. Similarly, there were statistically significant differences between each group (waxy vs. oiled) in different stages of ripening. Statistical differences were caused by different water content during ripening which has influenced content of fat, protein and other components. The wax keeps whey in the cheese which caused better ripening in the entire volume of cheese. The wax did not have any negative influence on ripening of cheese. The oiled cheese were gradually drying and thus was influenced ripening which was negatively assessed evaluators.

Key Words: cheese, sensory evaluation, physicochemical analysis, surface treatment of cheese

INTRODUCTION

The group of semi-hard cheeses is very large group, which is divided into a few smaller groups of cheeses. Into these groups belong semi-soft cheeses, white cheeses, pasta filata cheeses, blue-veined cheeses and etc. (Keresteš et al. 2016). A wide variety of semi-hard pasta filata cheeses, including Italian “Caciocavallo Silano” – obtained PDO, “Caciocavallo Podolico” etc., Russian “Kashkaval” and Balkanian types “Kashklaval Balkan” fall under the common name “Caciocavallo”. Other pasta filata cheeses, which are made by using a similar method, are marketed under different names including the PDO “Provolone Valpadana” (Piraino et al. 2005). Between pasta filata cheeses that obtained PGI in Slovak Republic belong “Klenovecký syrec”, “Oštiepok” etc. (Keresteš et al. 2016).

Ripening of cheeses includes all chemical changes processing in the cheeses. Some of these changes start before the curd making is stopped. During cheese ripening are changed organoleptic properties – as a structure, colour and composition of cheese (Jarošová and Cwiková 2014, Cwiková and Nedomová 2007), biochemical and microbial aspects, chemical and physical properties (Walstra et al. 2006, Nedomová 2009, Nedomová 2010a, Nedomová 2010b). Jarošová and Cwiková (2014) say that the best sensory quality of smear-ripened cheeses (smell, colour and appearance, degree of ripeness, consistency and taste) is in storage at 4–8 °C until the end of their shelf-life.

Cheese wax was used for surface treatment and preservation of cheese blocks. Cheese wax is suitable for waxing semi-hard and hard cheeses. Wax had a good adhesion, does not crack and sets quickly. Cheese wax protected the cheese from mould and moisture loss, and therefore weight. It can be applied at all stages of ripening. Under the wax, cheese ripened further. The aim of waxing semi-hard and hard cheeses is to give clean and nice appearance to cheeses, prevent water loss to reduce waste and prevent the development of microorganisms on the cheese surface (Çetinkaya and
Atasever 2015). The next technique for ripening is ripening in plastic films produces cheeses without a rind, but this technique does not allow surface water evaporation (Bertola et al. 2000).

The aim of this paper was a comparison of the physicochemical changes and sensory profile of semi-hard cheeses during ripening, where was used a different surface treatment of cheese (wax vs. oil).

**MATERIAL AND METHODS**

**Cheese making**

Cheese was made in manufacture place in Mendel University in Brno at Department of Food Technology. Cheese was made from the milk of Holstein dairy cows from South Moravian region. This milk had a composition: dry matter 12.68% (gravimetry) (ISO 6731:2010), fat content by Gerber 3.6% (ISO 2446:2008), protein content by Kjeldahl 3.19% (EN ISO 8968-1:2002), lactose by polarimetry 4.92% and titratable acidity 6.5 SH (ČSN 57 0530). This milk fulfilled all the requirements for total bacterial count and somatic cells count.

Cheese was manufactured using pasteurized milk (72 °C/30 sec), milk cooling to 33°C and adding cheeses culture TM 1 (Bulgaricus, Czech Republic) and cheeses culture MC 1 (Bulgaricus, Czech Republic). Milk was held at 32 °C during 40 min, adding 10 ml 36% of CaCl2. For the renneting was used commercial chymosin rennet Naturen 145 IMCU (CHR. HANSEN, Denmark). For vat (70 l) was used 40 ml chymosin rennet. Forty minutes later the curd was cut into small cubes 15 x 15 mm. After 15 min was separated 18 l of whey and 15 l of warm water (40 °C) was added. This mixture was heated to 40 °C and stirred for 30 min. After 30 min was curd filled into form and whey was separated. The curd was formed and pressed 45 min, then was curd turned and pressed for another 20 min. The curd was fermented 20 hours. Next day was the cheese placed into vat with warm water (85 °C) for 2 min. These cheeses got a pasta filata surface. After this step the cheeses were placed into salt brine (18% NaCl) for 20 hours at 10 °C. Then the cheeses were dried and kept in a chamber (12 °C) for 2 days. Cheeses were divided into two halves. First half was waxed by cheese wax (Driml, Czech Republic, BB: 1/2018). The second half of cheeses was oiled (rape seed oil, Czech Republic). These treated cheeses were placed in ripening chamber with condition 12 ± 1 °C and relative humidity 85% for 85 days. The oiled cheeses were oiled when was necessary as well as removing surface moulds.

A total amount of 40 samples of cheese were used to study chemical parameters and sensory evaluation during ripening. From these groups part of cheeses was picked after 10, 20, 30, 40, 60 and 85 days of ripening to physicochemical analysis and sensory evaluation. The cheeses had a cylindrical shape, which had average width 71.8 mm and average height 33.7 mm. The weights of these cheeses were in range from 112 g to 140 g.

**Physicochemical analysis**

For physicochemical analysis was used full load of waxing and oiled cheese. Dry matter was determined by drying the sample to a constant weight at 102 °C. Content of fat was determined by the Gerber-van Gulik method according to the International organization for Standardization (ISO 3433:2008). Protein content was determined by Kjeldahl method (total nitrogen multiplying by factor 6.38) (EN ISO 8968-1:2002), content of salt and titratable acidity was determined by ČSN 57 0170. Water activity (25 °C) by a LabSwift – slow program (Novasina LabSwift-AW, United Kingdom) and pH was measured by pH multi 907 PORTAVO with glass probe SE 104N (Knick, Germany). Each analysis was performed twice, water activity and protein content was performed for three times.

**Sensory analysis**

Sensory evaluation was carried out at Department of Food Technology Mendel University in Brno in the sensory laboratory, which is equipped in according of ČSN ISO 8589 (2008). The 10 assessors with Assessor`s Certificate evaluated these descriptors of colour, texture and overall appearance. Cheeses for sensory evaluation were tempered at 18 °C and served on the plastic white plate.
The sensory attributes were analysed using a method of sensory profile with line unstructured scales (100 mm, 1 mm = 1 point) with verbal descriptions of the end points (0 points the worst value, or the lowest, 100 points the best value, or the highest).

Statistical analysis

The results were statistically processed by program STATISTICA 12 (Statsoft, Praha), where was performed ANOVA (Duncan’s test) to determine influence of ripening to physicochemical properties. The results of sensory evaluation were processed by Microsoft Excel 2010.

RESULTS AND DISCUSSION

At first, there were laid down analytical characteristics of cheeses using methods which are described above. Chemical composition and physicochemical parameters are shown in the Table 1 and Table 2.

Table 1 Chemical composition of cheeses during ripening

<table>
<thead>
<tr>
<th>Days of ripening</th>
<th>Content of dry matter (%)</th>
<th>Content of fat (%)</th>
<th>Content of protein (%)</th>
<th>Content of NaCl (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wax</td>
<td>oil</td>
<td>wax</td>
<td>oil</td>
</tr>
<tr>
<td>10</td>
<td>57.85&lt;sup&gt;c&lt;/sup&gt;</td>
<td>67.74&lt;sup&gt;b&lt;/sup&gt;</td>
<td>29.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>35.50&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>20</td>
<td>59.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>69.97&lt;sup&gt;c&lt;/sup&gt;</td>
<td>29.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>39.00&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>30</td>
<td>59.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>71.75&lt;sup&gt;d&lt;/sup&gt;</td>
<td>29.00&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>38.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>40</td>
<td>57.44&lt;sup&gt;b&lt;/sup&gt;</td>
<td>73.40&lt;sup&gt;e&lt;/sup&gt;</td>
<td>26.50&lt;sup&gt;d&lt;/sup&gt;</td>
<td>38.00&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>60</td>
<td>60.27&lt;sup&gt;d&lt;/sup&gt;</td>
<td>74.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.00&lt;sup&gt;c&lt;/sup&gt;</td>
<td>39.00&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>85</td>
<td>59.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>75.39&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.50&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38.50&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

There were statistically significant differences in all physicochemical parameters during ripening between waxy and oiled cheese. These cheeses had a dry matter in a range 57.44% (wax, 40 days) to 75.39% (oil, 85 days). Content of fat was in range 26.50% to 31.50% for wax cheese. Content of fat of oiled cheese was higher, due to using oil for surface treatment. Average fat content of oiled cheese was 38.00%. The lowest content of protein was 20.38% (wax, 10 days) and the highest 28.09% (oil, 85 days). Content of salt was in range 3.86% to 5.53% during ripening. The values of pH were the lowest 5.20 (oil, 60 days) and the highest 5.43 (wax, 40 days). The highest titratable acidity was 66.60 SH for oil cheese (10 days) and the lowest 26.60 SH (oil, 40 days). The water activity was decreased during ripening. The wax cheese had after 10 days of ripening a<sub>aw</sub> = 0.930 and the lowest a<sub>aw</sub> = 0.822 had an oil cheese after 85 days of ripening. Similarly, there were statistically significant differences between each group (waxy vs. oiled) in different stages of ripening. Statistical differences were caused by different water content during ripening which has influenced content of fat, protein and other components.

Table 2 Physicochemical parameters of cheeses during ripening

<table>
<thead>
<tr>
<th>Days of ripening</th>
<th>pH (-)</th>
<th>Titratable acidity (SH)</th>
<th>Water activity (25 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wax</td>
<td>oil</td>
<td>wax</td>
</tr>
<tr>
<td>10</td>
<td>5.36&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>55.20&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>20</td>
<td>5.35&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>35.90&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>30</td>
<td>5.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>36.70&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>40</td>
<td>5.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td>39.60&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>60</td>
<td>5.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>32.30&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>85</td>
<td>5.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>43.20&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

The best overall appearance had a waxy cheese, which had a higher value a surface appearance,
but this cheese had a higher amount of pinholes and their size was bigger. The oiled cheese had a worse evaluation of surface appearance, but amount of pinholes was lower and their size was smaller (Figure 1).

**Figure 1** Comparison overall appearance of waxy cheese and oiled cheese during ripening

![Comparison of waxy and oiled cheese](image1)

In the Figure 2 is seen, that surface colour and inside colour of waxy cheese is balanced and colour uniformity is comparable during ripening. Oiled cheese had a worse colour uniformity. Surface colour and inside colour oiled cheese was equalized after 40 days of ripening. After 85 days of ripening was better evaluated oiled cheese inside colour, until that time was better evaluated surface colour.

**Figure 2** Comparison colour parameters of waxy and oiled cheese during ripening

![Comparison of waxy and oiled cheese](image2)

The waxy cheese was better appreciated in the texture attributes than oiled cheese (Figure 3, Figure 4). Values of firmness and elasticity of waxed cheeses were higher; however in this cause higher values mean that the cheeses are better acceptable for assessors.

**Figure 3** Comparison texture attributes of waxy and oiled cheese by hand

![Comparison of waxy and oiled cheese](image3)
The flavour and aroma of waxy cheeses was equalized all the time ripening. Salty flavour was higher at 20, 30 and 85 days after ripening (Figure 5). The aroma oiled cheeses was equalized all time ripening too. The flavour was worse at 20, 30 and 60 days after ripening. The highest value of salty flavour was perceived after 85 days of ripening. The flavour and aroma were best at the end of shelf-life of these cheeses as well as smear-ripened cheeses (Jarošová and Cwiková 2014).

Cheeses which were treated by wax were better evaluated than the oiled cheeses. The wax keeps whey in the cheeses which causes better ripening in the entire volume of cheese. The wax did not have any negative influence to ripening of cheeses. According by Çetinkaya and Atasever (2015) cheese wax and vacuum packaging did not have any adverse effect to cheese quality and did not delay cheese ripening. Hence, cheese wax is recommended as alternative material for packaging of cheeses. The oiled cheeses were gradually dried and thus the ripening was influenced and this was negatively influenced assessors.

CONCLUSION

This paper compared cow’s semi-hard cheese which was made in Mendel University in Brno. These cheeses were differed by surface treatment. The first group was treated by wax and second group was treated by oil. Cheeses were used to study chemical parameters and sensory evaluation during 85 days of ripening. Among the measured results, there was significant difference in the physicochemical analysis (dry matter, content of fat, protein and NaCl, pH, titratable acidity and water activity) during ripening. Colour, texture and overall appearance were evaluated by sensory analysis. Cheeses which were treated by wax were better evaluated than the oiled cheeses. The wax keeps whey in the cheeses which caused better ripening in the entire volume of cheese. The wax did not have any negative influence
to ripening of cheeses. The oiled cheeses were gradually dried and thus the ripening was influenced which was negatively evaluated by assessors.

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