Composition and Sensory Analysis for Quality Evaluation of a Typical Italian Cheese: Influence of Ripening Period

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Abstract


Caciottina massaggiata di Amaseno, a typical dairy product of the Lazio Region prepared from buffalo milk, was analysed for moisture, fat, protein, pH, and acidity content at different storage (0, 3, 6, and 9 months after production). Cheeses were also evaluated for various sensory attributes (taste, flavour, texture, and overall acceptability) during storage. We evaluated the flavour profile and acceptability of Caciottina cheeses of varying maturity using a descriptive analysis. Descriptive sensory profiles of selected cheeses were determined using a trained panel (n = 12) and an established cheese flavour sensory language. In quantitative descriptive analysis a trained panel rated the cheeses for colour, odour, taste and texture. In the affective tests the panellists evaluated the samples for overall quality. The results proved that months of production had significant effects on the sensory quality of the cheeses.

Keywords: buffalo milk cheese; chemical analysis; storage period; sensory profile; flavour

The basic technology for the production of all types of cheese is the same with relatively small changes resulting in significant differences in the final cheese. The art or science of cheese-making comprises five key factors: milk composition, rate and extent of acid development, moisture content, curd manipulation, and ripening conditions (LUCEY et al. 2003; WALSTRA et al. 2006; SAMEEN et al. 2010). Other factors that may influence the quality of different varieties of cheese are: composition of milk, types of milk, starter cultures and manufacturing technology (VARNAM & SUTHERLAND 1994).

Volatiles play an important role in the flavour perception of cheese. Typical cheese aroma is the result of volatiles formed by lipolysis, proteolysis, and metabolism of lactose, lactate, and citrate (McSWEENEY & SOUSA 2000; SMIT et al. 2000; MARILLEY & CASEY 2004).

During cheese ripening, the enzymatic degradation of amino acids leads to the formation of flavour-impact volatiles (VISSE 1993; McSWEENEY & SOUSA 2000; MARILLEY & CASEY 2004); flavour formation in cheese is also importantly influenced by the ripening period. As a result of the destruction of some desirable non-starter lactic acid bacteria during production, cheese made from pasteurised milk ripens more slowly and develops a less intense flavour than buffalo raw milk cheese (JOHNSON et al. 1990; GRAPPIN & BEUVIER 1997; FOX et al. 1998; SEIFU et al. 2004).

The aim of this study was to evaluate the flavour profile and acceptability of Caciottina di Amaseno cheeses of varying maturity using a descriptive analysis. Descriptive sensory profiles of selected cheeses were determined using a trained panel (n = 12) and an established cheese flavour sensory language (HEISSERER & CHAMBERS 1993).

MATERIALS AND METHODS

Cheese samples. Cheese wheels of Caciottina massaggiata di Amaseno were produced in the cheese factory located in Amaseno (Italy). The product, according to the production protocol, was periodically subjected to manipulations by
hand with a mixture of olive oil and wine and to overturning until the end of seasoning, which has a minimum duration of 60 days.

**Quality analyses.** Chemical analyses were carried out on a total of 23 cheeses. On each cheese wheel 6 slices were cut along the length: two samples (internal part) were obtained from the central slice, two samples (median part) were obtained cutting 2 slices at 2 cm from the central one, the last two samples (external part) were obtained from the remaining part.

These sampling methods were chosen in order to obtain analytical parameters of reference to be used for the evaluation of cheese with unusual fermentations or defects, which frequently occur in limited areas within the whole cheese wheel.

**Chemical analysis.** The following chemical analyses were performed: dry matter by drying in oven at 102°C (International Standard FIL-IDF 4/A: 1982); fat (ISO 3433:2008); pH by potentiometric measurement by direct insertion of the electrode in the cheese wheel; sodium chloride by titration with AgNO$_3$ (International Standard FIL-IDF 88/A:1988).

**Cheese preparation.** Cheeses were stored at refrigerator temperature until 15 min before sampling and then allowed to warm to room temperature. The cheeses were sliced into cubes using a wire slicer within 2 h of presentation; they were presented as 5 g cubes in glasses, covered with watch glasses, and assessed in individual booths under diffuse red lighting to minimise differences in appearance. The air temperature and ventilation of the sensory laboratory were also controlled. Assessors rinsed their mouths with de-ionised water between cheeses.

During sensory testing, the panelists were seated in individual booths in a sensorial room of University of Cassino’s Laboratory, and data was recorded on a computer.

Four cheeses were presented each day and the order of tasting was balanced between days and within days to account for first order, carry over and day effects (MacFie et al. 1989).

**Sensory panel.** A panel of twelve assessors, 7 males and 5 females, took part in the Descriptive Sensory Analysis. All were members of an established sensory panel at University of Cassino. The panel was recruited and screened according to the accepted international standards (ISO 8586-1: 1993, ISO 8589:1998, ISO/DIS 13299:1998). This experienced trained panel had a high level of discrimination, sensitivity, and consistency in measurement (Land & Shepherd 1988). All assessors were trained to carry out descriptive analysis and were involved in developing the descriptive vocabulary for cheese.

The development of a full descriptive vocabulary, to describe the sensory characteristics of the cheeses, was carried out over two group discussions for each product category, and the panel of assessors evaluated the products for flavour, texture and mouthfeel, appearance and odour (Lawless & Heymann 2010). The lexicon was modified from that previously developed for Cheddar cheese (Murray & Delahunty 2000).

The quantity of each descriptive attribute perceived was scored on a 10 cm continuous line scale.

**Methodology.** Descriptive sensory assessment of the samples was carried out using the terms and standard references developed. During each sensory session four different samples were evaluated for all the attributes, organised so that three replicates were obtained for all the assessors for every sample. The experimental design used to eliminate carryover and order of tasting bias is described in detail in Muir and Hunter (1992, 1995a,b, 1996). Using the QDA method 16 attributes for the investigated cheeses were selected and thoroughly defined for profiling (Table 1): colour, odour (creamy, acid, buttery, fruits), taste (salty, acid, sweet, bitter, aftertaste), and texture (hardness, chewiness, rubbery, dryness, grainy). The attribute intensities were rated on continuous unstructured graphical scales. The scales were 10 cm in length and verbally anchored at each end, the left side of the scale corresponding to the lowest intensity (value 0) and the right side to the highest intensity (value 10) of the attribute. Overall quality of cheeses was assessed using the same type of scale as above anchored at both ends: unlinking (0)–extremely linking (10).

**Statistical analysis.** The panel mean scores of the quantitative descriptive data were analysed by ANOVA. Statistically significant differences in the results were tested by Fisher’s protected least significant difference (LSD) test.

**RESULTS AND DISCUSSION**

**Chemical analysis**

Table 2 shows the mean values for the chemical parameters (pH, moisture, chlorides and fat content) of the internal, median and external cheese
wheel parts during 9 months. For the maturation time results, all the parameters (pH, moisture, chloride and fat content) presented during the cheese maturation, a moisture decrease by evaporation led to a progressive weight decline and afterwards there was a progressive dehydration during the following maturation phase of 35–40% (Papetti et al. 2012). The moisture content decreased in all cheeses throughout the storage period (Aly & Galal 2002). It might be attributed to degradation of proteins and fats (Zaki et al. 1974).

Statistically significant differences between all the maturation classes (P < 0.05) are shown in Table 3.

Moisture content decreased in a statistically significant way in the first maturation time, until the sixth month, while, later, a moisture decrease was less relevant in percentage. pH reached a maximum level around the third month, while afterwards equilibrium was established, as a result of the opposed proteolysis effect from which ammonia is produced and lipolysis leads to a fatty acid release.

A similar increase in the acidity of cheese was reported previously by Bilal (2000) and Warsama et al. (2006). It is probably due to the growth of lactic acid bacteria in cheese (Warsama et al. 2006). The lactic acid not only contributes to the taste of fresh cheese but also improves the cheese structure and protects it against a kind of microbiological spoilage (Ceylan et al. 2003).

Table 1. Definitions of attributes for profiling of the Caciottina cheese

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Colour</td>
<td>visual estimation of intensity</td>
</tr>
<tr>
<td>Creamy odour</td>
<td>smell of market cream (30%)</td>
</tr>
<tr>
<td>Acid odour</td>
<td>typical note of fermented milk products such as yoghurt</td>
</tr>
<tr>
<td>Buttery</td>
<td>flavour associated with butter</td>
</tr>
<tr>
<td>Flowers/fruits</td>
<td>the aromatic blend of different fruity identities, like pineapple, ripe apple, zest and red berries. May also include the aromatics associated with sweetened cultured dairy products such as fruit yoghurts</td>
</tr>
<tr>
<td>Salty</td>
<td>taste, basic taste typical of sodium chloride as diluted in water (0.2%)</td>
</tr>
<tr>
<td>Sweet</td>
<td>fundamental taste sensation of which sucrose is typical</td>
</tr>
<tr>
<td>Acid</td>
<td>taste of fermented milk products</td>
</tr>
<tr>
<td>Bitter</td>
<td>taste, basic taste typical of caffeine in water (0.5%)</td>
</tr>
<tr>
<td>Aftertaste</td>
<td>aftertaste which continued after the removal of the sample</td>
</tr>
<tr>
<td>Hardness*</td>
<td>the force needed by the jaws to bite the sample into two pieces</td>
</tr>
<tr>
<td>Chewiness</td>
<td>time and multiplicity of chewing the product to prepare it to swallow</td>
</tr>
<tr>
<td>Rubbery</td>
<td>the ability of the sample to regain shape after pulling</td>
</tr>
<tr>
<td>Dryness (moisture)</td>
<td>moisture that exists in the sample, mouthfeel after 4, 5 chews</td>
</tr>
<tr>
<td>Grainy</td>
<td>the ability of the sample to break into pieces</td>
</tr>
<tr>
<td>Overall quality</td>
<td>overall sensation determined in terms like and dislike</td>
</tr>
</tbody>
</table>

Anchoring points: non-intensive–very intensive; *low–high

Table 2. Results of chemical and nutritional analysis performed on 23 cheese samples (mean ± standard deviation)

<table>
<thead>
<tr>
<th>Months</th>
<th>pH</th>
<th>Moisture (%)</th>
<th>Chlorides (g/100 g DM)</th>
<th>Fat (g/100 g DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>external median central</td>
<td>external median central</td>
<td>external median central</td>
<td>external median central</td>
</tr>
<tr>
<td>0</td>
<td>5.22 ± 0.09 5.12 ± 0.14 5.07 ± 0.27</td>
<td>58.70 ± 5.41 53.06 ± 5.29 53.04 ± 6.70</td>
<td>1.37 ± 0.09 1.29 ± 0.011 1.22 ± 0.09</td>
<td>21.09 ± 0.91 19.23 ± 0.12 18.35 ± 0.18</td>
</tr>
<tr>
<td>3</td>
<td>5.59 ± 0.82 5.58 ± 0.63 5.52 ± 0.15</td>
<td>39.42 ± 3.22 38.86 ± 3.05 38.36 ± 3.11</td>
<td>2.12 ± 0.19 1.56 ± 0.12 1.47 ± 0.013</td>
<td>18.83 ± 1.11 18.53 ± 1.01 19.83 ± 0.99</td>
</tr>
<tr>
<td>6</td>
<td>5.42 ± 0.61 5.35 ± 1.01 5.39 ± 0.73</td>
<td>29.79 ± 2.02 30.42 ± 0.44 26.76 ± 0.95</td>
<td>1.64 ± 0.12 1.56 ± 0.12 1.52 ± 0.12</td>
<td>21.67 ± 0.12 21.00 ± 1.01 22.33 ± 1.21</td>
</tr>
<tr>
<td>9</td>
<td>5.12 ± 0.23 5.18 ± 0.09 5.18 ± 0.45</td>
<td>27.20 ± 1.84 29.60 ± 2.34 29.60 ± 0.94</td>
<td>1.41 ± 0.02 1.36 ± 0.09 1.36 ± 0.09</td>
<td>24.10 ± 0.53 23.90 ± 0.95 23.90 ± 1.34</td>
</tr>
</tbody>
</table>
Sensory analysis

For sensory evaluation, the quantitative descriptive analysis (QDA) was used, which is often applied to study a variety of products including cheese (Stone & Sidel 1993; Lawless & Heymann 2010). Mean intensity ratings of descriptive attributes and the analysis of variance are documented in Table 4. ANOVA showed that there were significant \( P < 0.05 \) differences in the intensity of attributes such as colour, salty taste, bitter taste aftertaste, hardness, chewiness, rubbery, dryness, and grainy caused by the maturation time.

Chemical qualities of the cheeses have a significant effect on flavour (Barlow et al. 1989; Aly & Galal 2002; Guler & Uraz 2004). The scores of sensory parameters (Table 4) such as rubbery and grainy decreased with the ripening, while scores for hardness increased. The chewiness of the cheese samples increased with the progressive ripening days and it was a highly desirable sensory attribute especially for cheese. The increase in chewiness might be due to a change in the average size of fat globules, distance between fat globules and variation in the size of globules (Richardson & Booth 1993).

It can be seen that, in the sensory profiles of cheeses, the improvement in colour from month zero to months 9 agreed with the findings of Tarakci and Kucukoner (2006), who reported that colour score increased generally during ripening. In order to observe the above differences in the analysed samples more clearly, the sensory profiles of cheeses were displayed as spider diagrams in Figure 1.

Flavour of all samples improved with storage months because during ripening the metabolic processes are responsible for the basic flavour and texture changes (Smit et al. 2005). When biochemi-
Cal reactions continued for the breakdown of fat and protein by the activity of microbial and residual rennet (McSweeney 1997), more flavouring compounds were produced in cheeses and casein was hydrolysed, which gives a smooth texture (Barbano et al. 1994). The improvement in texture from month zero to month nine indicates clearly the effect of storage time. This agrees with Aly and Galal (2002) and Topcu and Saldamli (2006), who reported that the textural attributes of white cheese were significantly ($P < 0.05$) affected by the ripening period.

The improvement in flavour was probably attributed to the effect of lactic acid development which controls the growth of undesirable organisms (Kosikowski 1997). The improvement in flavour might be due to the natural flora initially present in buffalo milk which participates in flavour production.

It is to conclude that the storage period significantly affected the weight loss, chemical composition and sensory characteristics of “Caciottina romana” cheese.

**CONCLUSION**

In this study, the flavour evolution during ripening of the investigated cheese was evaluated; these results indicate that Caciottina di Amaseno cheese is characterised by a complex sensory profile depending mainly on the heterogeneity of buffalo milk microflora and of natural starter. Due to these own peculiar characteristics of this cheese, to date it is possible to define the typical sensory profile of the cheese.

Therefore, the study of traditional products, such as Caciottina Romana cheese, can be of considerable benefit to the rural economy by improving the incomes of farmers and by retaining the rural population in these areas. Moreover, the use of the sensory profile may help to preserve the identity of “Caciottina Romana” cheese by means of sensory quality certification.

**References**


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