Sensory descriptive analysis and consumer acceptability of selected Swiss goat and sheep cheeses

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ABSTRACT
Production and processing of goat and sheep milk is a booming sector in the Swiss milk economy. To increase understanding of the acceptance of goat and sheep cheese by Swiss consumers, the Agroscope Liebefeld-Posieux Research Station ALP conducted a sensory profile analysis and a consumer test in a national cheese market. For the investigation, two typical samples of each type of cheese were selected, one with a more intense and one with a less intense animalic aroma. These samples were investigated by the trained sensory panel, and evaluated by 688 consumers.

For both types of cheese, the sensory profile analysis indicated a significantly higher intensity of the goaty or sheepy flavours for the two animalic samples. However, this sensory difference is not recognised by the majority of consumers. In fact, consumers rated both samples as having the same intensity of goaty flavour in the case of the goat cheese and rating the less animalic sample as significantly more sheepy in the case of the sheep cheese. Despite the sensory lack of knowledge of the typical aromas, the less animalic cheese was preferred by over 70% of participants (in the case of goat cheese) and by over 80% (in the case of sheep cheese). Interestingly, the evaluation of participants’ responses when asked about their reasons for purchase emphasises the special flavour experience as the most important factor for the consumption of these products.

Overall, these results clearly underline the discrepancy between lack of knowledge, prejudice, and yet curiosity of Swiss consumers towards goat and sheep cheese and provide important initial scientific findings for producers and sellers in this new Swiss market segment.

1. Introduction
There are more than 400 cheese varieties in Switzerland, of which 10 varieties have a protected designation of origin (PDO) (Schweizerkäse, 2007; AOC-IGP, 2007). In contrast to the European area, where countries such as Greece (23), France (15), Portugal (10), Italy (6), Spain (6), but also Germany (1) have PDO products made from goat’s milk and/or sheep’s milk, in Switzerland all PDO types are produced exclusively from cow’s milk (Medina and Núñez, 2004; Univers fromages, 2007; IBO, 2007; Freitas et al., 2000; European Commission, 2007). One small exception is Tessiner Alpkäse (PDO) in which up to 30% of the processed milk may come from goats (BLW, 2005).

In Switzerland the range of cheeses made from goat’s and sheep’s milk is highly diverse and thus there are many regional or dairy-specific specialities. In addition to fresh and soft cheese, semi-hard cheese in particular plays a central role for both types of milk. There are no classical types, as for cheese made from cow’s milk.

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Production figures clearly show that Swiss goat and sheep cheese has increased greatly in recent years. For example, in the period from 2000 to 2005, production of pure goat cheese has almost doubled and the production of pure sheep cheese has more than doubled (TSM, 2006). For producers and processors this sector represents a growing alternative to the production and processing of cow’s milk.

The nutritional and health aspects, “natural” and “hand-processing”, and the typical sensory characteristics are leading goat and sheep cheese to increase in popularity with the consumer.

However, the flavour is clearly open to debate: there are customers who prefer more neutral types that taste as much like cheese made from cow’s milk as possible, whereas others are particularly fond of the typical goaty or sheeppy aroma in the products. These typical goaty and sheeppy aromas consist of complex combinations of various volatile compounds. The main compound for the characteristic flavour of goat cheeses was for a long time considered to be octanoic acid. Instead, according to Ha and Lindsay (1991a), the specific 4-ethyloctanoic acid was found by systematic assessment to be responsible for the goaty-type aromatic notes. Le Quéré et al. (1998) detected even six specific and one unidentified volatile compounds present in goat cheeses as having a specific goat cheese flavour.

In sheep cheeses the 4-methyloctanoic and 4-ethyl-2-methyl phenol appear to be responsible for the sheeppy notes (Ha and Lindsay, 1991b). In a comparison between Manchego (a Spanish sheep cheese with PDO) made from raw milk and from pasteurised milk, great differences could be detected by sensory means (Fernández-García et al., 2002). The cheese made from raw milk was found to be significantly more sheeppy. It was possible to prove a high positive correlation between esters, primary and secondary alcohols and 2-methyl ketones and the sheeppy flavour. This and further works show clearly that specific aromas can be demonstrated both chemically and by sensory means. The only question is, however, whether consumers are actually familiar with these flavours goaty and sheeppy.

According to producers, the demand for goat and in particular sheep cheese in Switzerland is growing, but as yet has not been greatly researched.

In a more recent investigation in Germany, it was shown that goat and sheep cheeses were still not widely appreciated, partly out of ignorance, but also due to their specific aroma. However, for precisely the same reasons, they are experiencing growing demand from connoisseurs as a trendy product (Roether, 2003).

In Switzerland, the majority of consumers are also sceptical about non-cow’s milk cheeses, in particular due to the possible animalic aroma. However, for precisely the same reasons, they are experiencing growing demand from connoisseurs as a trendy product (Roether, 2003).

Table 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Term</th>
<th>References (1–7) and definitions (8–11, Lavanchy et al., 1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Salty</td>
<td>Sodium chloride, 0.3% solution in water</td>
</tr>
<tr>
<td>2.</td>
<td>Sweet</td>
<td>Sucrose, 0.8% solution in water</td>
</tr>
<tr>
<td>3.</td>
<td>Sour</td>
<td>Lactic acid, 0.06% solution in water</td>
</tr>
<tr>
<td>4.</td>
<td>Bitter</td>
<td>Caffeine, 0.05% solution in water</td>
</tr>
<tr>
<td>5.</td>
<td>Creamy</td>
<td>Full fat cream, pasteurised, 35% fat</td>
</tr>
<tr>
<td>6.</td>
<td>Animalic</td>
<td>French fresh goat cheese</td>
</tr>
<tr>
<td></td>
<td>(goaty)</td>
<td>Untreated sheepskin</td>
</tr>
<tr>
<td></td>
<td>(sheeppy)</td>
<td>Butyric acid, 0.5% solution in propylene glycol</td>
</tr>
<tr>
<td>7.</td>
<td>Rancid</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Firmness</td>
<td>Resistance of the sample to a very slight opening and shutting of the jaws</td>
</tr>
<tr>
<td>9.</td>
<td>Friability</td>
<td>Capacity of a sample to break up into numerous pieces from the beginning of mastication</td>
</tr>
<tr>
<td>10.</td>
<td>Moistness in mouth</td>
<td>Perception of the degree of moistness in the sample</td>
</tr>
<tr>
<td>11.</td>
<td>Sandy</td>
<td>Perception in the final stages of mastication of thin rounded grains in the chewed mass</td>
</tr>
</tbody>
</table>
10-point unstructured intensity scales anchored on the left with “not” and on the right with “very”. Panellists were allowed to swallow the samples. The testing sessions were conducted under normal light conditions.

2.3. Consumer testing

Consumer testing took place at a cheese fair held in Huttwil, Bern county, Switzerland in the context of the Swiss Cheese Awards 2006. The test was performed outdoors over 3 days, from 10 a.m. to 5 p.m. Consumers (n = 688) were recruited among the visitors. The two goat and the two sheep cheese samples were served in randomised order, with half of the persons starting with the goat cheeses and the other half starting with the sheep cheeses. The questionnaire (FIZZ software) consisted of four parts. First, consumers had to rate the perceived intensities of the goaty and sleepy aroma respectively, on 10-point numerical intensity scales anchored on the left with “not” and on the right with “very”. Secondly, they indicated their preference between the two goat cheeses and between the two sheep cheeses respectively, by answering two paired preference tests. Then, they were asked about their intention to buy the four products in the test. Finally, demographic questions on gender, age and cheese consumption habits were asked.

2.4. Statistical analysis

Sensory profiling data was firstly analysed with regard to panel performance (repeatability, discriminability and agreement). For this purpose, CV ANOVA, 3-way ANOVA (on factors product, judge and replication with interactions) and PCA on products/judges by attribute were calculated. Attributes were discarded whenever the interaction judge/product was significant and PCA on products/judges by attribute showed disagreement among judges.

Fisher’s LSD (p < 0.05) was applied to the samples means to determine whether there were significant differences between the samples. Regarding the consumer data, intensity ratings were analysed by Friedman test, whereas preference test results were analysed using binomial tests. Differences related to demographic data were studied using Pearson Chi-Square (p < 0.05).

Statistical analyses were performed with FIZZ (Version 2.20B, Biosystemes, France) and Systat (2004) (Version 11, SPSS, Chicago, IL).

3. Results and discussion

3.1. Sensory evaluation

3.1.1. Sensory profiles of the goat cheese samples

The sensory profiles of the two semi-hard cheeses made of goat’s milk are shown in Fig. 1. The attributes sweet, sour, bitter and creamy had to be discarded because of panel disagreement. The two cheeses showed significant differences for all attributes retained. So, sample 2, which had been selected as a representative of stronger goaty characteristics, presented a significantly stronger goaty note, as well as lower saltiness and higher rancidity (p < 0.01) than sample 1. This sample was significantly less firm, friable and sandy and significantly more moist than sample 1 (p < 0.01). Moist goat cheeses displaying stronger goaty aroma than drier ones is a phenomenon that was already observed.

3.2. Sensory profile of the two sheep cheeses

Fig. 2 shows the sensory profiles of the two semi-hard cheeses made of sheep’s milk. The attributes sour, creamy and rancid had to be discarded (because of panel disagreement). The two samples showed significant differences regarding saltiness and the animalic note (p < 0.05). So, sample 2 (selected as representative of stronger sleepy characteristics) was significantly stronger animalic and less salty (p < 0.05) than sample 1. The animalic aroma was less intense than that measured in goat cheese. As for the texture and analogue to the goat cheese, sample 2 was significantly less firm, friable and sandy (p < 0.01) and significantly stronger moist than sample 1 (p < 0.05).

Overall, the objective — the selection of a stronger animalic and a less animalic semi-hard cheese for a subsequent hedonic investigation — was achieved. However, the samples unfortunately differed in other attributes too. It can be assumed that the animalic aroma of each product played an important role in the consumer test, however an influence on the hedonic results due to the differences in texture cannot be entirely excluded.

3.3. Consumer test

3.3.1. Demography of the consumer group (n = 688)

Overall, 688 persons participated in the consumer test. Exactly half of these participants were women (Group A)
Table 2
Distribution of the participants

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Proportion of participants (%)</th>
<th>Classification into groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>49.85</td>
<td>Group A</td>
</tr>
<tr>
<td>Male</td>
<td>50.15</td>
<td>Group B</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10–24 years</td>
<td>7.92</td>
<td></td>
</tr>
<tr>
<td>25–39 years</td>
<td>18.77</td>
<td>Group C (old)</td>
</tr>
<tr>
<td>40–54 years</td>
<td>34.16</td>
<td></td>
</tr>
<tr>
<td>55–69 years</td>
<td>29.62</td>
<td>Group D (old)</td>
</tr>
<tr>
<td>&gt;69 years</td>
<td>9.53</td>
<td></td>
</tr>
</tbody>
</table>

and half were men (Group B). The age categories were of different sizes (see Table 2). The participants were divided into Group C (young) up to 39 years of age and Group D (old) over 39 years of age for the subsequent age-related analyses.

The results of buying frequency indicated that consumers were slightly more familiar with goat cheese than sheep cheese. Thus, 21.30% of the participants consume goat cheese frequently (several times a month) and only 19.50% never do, whereas the consumer proportions are precisely reversed for sheep cheese with 13.61% frequently and 24.85% never (see Table 3). This difference is not surprising because although both are growing niche products (TSM, 2006), goat cheese has a long tradition in Switzerland, in particular in the alpine farming, whilst sheep cheese is new to the Swiss market (Ryffel, 2006).

For the further statistical evaluations the consumers were divided into two groups (Groups E1 and E2 as consumers and Groups F1 and F2 as non-consumers of the cheese type).

3.3.2. Consumer evaluation of the goaty aroma of the two goat cheeses

Being aware of the fact that consumers should only answer hedonic questions, the intensity rating was asked with the aim of assessing the degree of consumer knowledge regarding goaty/sheepy aroma.

The evaluation of the intensity of the goaty aroma indicated clearly that consumers rated the two cheese samples as equally intensive, with averages of 4.47 (Sample 1) and 4.57 (Sample 2). There was no significant gender-related difference in the evaluation of the goaty aroma.

Furthermore, Fig. 3 clearly shows that the age group 10–39 (Group C) rated the aroma intensity of both samples significantly higher (p < 0.001) than the age group of over 39 (Group D). However, again there is no significant difference between the two cheese samples in the intensity of the goaty aroma.

It is very interesting that the group of participants who regularly consume goat cheese (Group E1) significantly (p = 0.023) describe the less goaty cheese (mean = 4.81) as being more intensely animalic than the more goaty cheese (mean = 4.19), in contrast to the sensory evaluation. Group F1, the participants who seldom or never buy such cheese, on the other hand, are the only subgroup to recognise to a significant degree (p = 0.049) the higher proportion of goaty flavour in the sensory typical goat cheese. Overall, it is clear that consumers are not very familiar with the aroma goaty and thus the significant sensory differences are not recognised very well, or not recognised at all. Furthermore, frequent consumption without sensory education does not seem to improve the knowledge of the goaty aroma.

3.3.3. Consumer evaluation of the sheepy aroma for both sheep cheeses

In the rating of the intensity of the sheepy aroma, even clearer differences emerged between the consumer rating and the sensory profile analysis. The consumers rated the less sheepy cheese as significantly more animalic (p = 0.002), with an average of 2.74, than the stronger sheepy sample, with an average of 2.39. This result is in total contrast to the result of the quantitative sensory profile analysis.

Table 3
Distribution of consumption frequency amongst consumers and classification into consumer groups

<table>
<thead>
<tr>
<th>Consumption frequency</th>
<th>Goat cheese</th>
<th>Sheep cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Persons in %</td>
<td>Consumer groups</td>
</tr>
<tr>
<td>Several times a month</td>
<td>21.11</td>
<td>Group E1</td>
</tr>
<tr>
<td>Once a month</td>
<td>23.61</td>
<td>Group</td>
</tr>
<tr>
<td>Once a year</td>
<td>35.78</td>
<td>F1</td>
</tr>
<tr>
<td>Never</td>
<td>19.50</td>
<td></td>
</tr>
</tbody>
</table>

Groups E1 and E2 are consumers and Groups F1 and F2 are non-consumers of this cheese type.
The two gender subgroups (Group A and Group B) also rated the less animalic cheese as significantly \((p = 0.028\) and \(p = 0.035\)) more sheepy than the more animalic cheese. It is also striking that the men rated both cheeses, as significantly more animalic \((p < 0.05)\) than the women.

The age group 10–39 (Group C) did not find a significant difference in the aroma intensity of both samples, but rated the aroma intensity of the stronger sheepy cheese significantly \((p < 0.001)\) higher than the group of those aged over 39 (Group D) (see Fig. 4). Group D on the other hand, rated the less sheepy cheese as significantly more animalic \((p < 0.001)\) than the sheepier sample. This rating, which disagrees with the results from the sensory analysis, go along with the fact that the older consumers (16%) consume sheep cheese significantly \((p = 0.003)\) more frequently than the younger ones (7%). It seems clear, for sheep cheese as for goat cheese, that regular consumption leads to the typical flavour being recognised to a lesser degree than for the persons buying sheep cheese less or not at all.

Overall, the ratings of the aroma intensity show very clearly that the consumers are, on average, less familiar with the sheepy aroma than with the goaty aroma.

3.3.4. Popularity of goat and sheep cheese

In contrast to the evaluations of the intensity, the hedonic evaluation yielded a very clear result for both the goat and the sheep cheese samples: the cheeses described as

![Fig. 5. Hedonic rating “Which cheese do you prefer?” (A = female; B = male; C = young; D = old; E1/2 = consumers; F1/2 = non-consumers, see Tables 2 and 3 for definitions).](image)

less animalic by the sensory analysis were preferred \((\text{in each case} \ p < 0.001)\). In fact, over 70% \((y = 0.70)\) prefer the less animalic goat cheese and more than 80% \((y = 0.82)\) the less animalic sheep cheese. This clear preference indicates that a large proportion of people do not appreciate a strong goaty or sheepy aroma, even though they are not very familiar with these aromas.
Purchase potential for selected goat and sheep cheeses

Table 4

<table>
<thead>
<tr>
<th>Purchase potential</th>
<th>Proportion of those questioned as a percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goat cheese</td>
<td>Sheep cheese</td>
</tr>
<tr>
<td>None</td>
<td>3.49</td>
</tr>
<tr>
<td>Stronger animalic</td>
<td>23.07</td>
</tr>
<tr>
<td>Less animalic</td>
<td>48.71</td>
</tr>
</tbody>
</table>

The analyses by gender (A, B); age (C, D); and consumer groups (E1, F1 and E2, F2) did not show any significant difference with regard to preference. Only small non-significant differences were observed (see Fig. 5).

3.3.5. Reasons for consumption

According to this survey the special flavour is the main reason for the consumption of goat and sheep cheese (Fig. 6). This clear opinion emphasises once again that Swiss consumers do in fact perceive goaty and sheepy characteristics, and appreciate them, at least at low intensity.

The connection frequently made between health and naturalness are further important reasons for consumption, along with the desire for a change in the cheese varieties (“something different once in a while!”) According to this investigation, a possible intolerance to cow’s milk plays a minor role (3.38%).

3.3.6. Purchasing potential

In the question regarding the possible purchase of one or more of the four products, as in the question of preference, the less animalic cheese sample was selected significantly (p < 0.001) more often than the stronger animalic one. The fact that only 3.49% of the consumers questioned would not buy any of the four cheeses tasted underlines the high purchasing potential of “mild” goat and sheep cheese, i.e. displaying weak goaty and sheepy notes (Table 4).

4. Conclusions

The survey clearly showed that many consumers, although consciously looking for the animalic aroma when purchasing goat and sheep cheese, are not actually familiar with this in sensory terms. Furthermore, the preference for the product with the weaker animalic aroma in each case emphasises that precisely this desired special aroma is appreciated only by Swiss customers in lower intensities. This is true for the majority of consumers. No conclusions can be drawn on the basis of this initial investigation regarding minorities, who specifically look for the clearly discernable goat and sheep aroma in the products. To investigate this in more detail, consumers would have to be divided into further subgroups by further surveys. It would also be very interesting to carry out these investigations in different regions, in order to ascertain regional differences and preferences. The consumer test was carried out at a national fair, as described above, and thus it is certainly representative for the majority of the Swiss population. Nevertheless, in a niche product segment, such as the one for goat and sheep cheese in Switzerland, even small regional differences are of great economic and market-determining relevance for producers (Roether, 2003).

The sensory quantitative profile analysis of the two types of cheese strongly emphasised that a higher intensity of other aromas can mask the goaty and the sheepy aroma. These other, sometimes intensive aroma impressions, are frequently mistaken for the animalic aroma components by consumers. Therefore it would be interesting to deal specifically with this interaction between the different aromas and to conduct a chemical quantification of the substances that cause them.

Overall, this initial scientific investigation on this subject shows very clearly the great market potential of Swiss goat and sheep cheese with a mild but still animalic flavour.

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