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Flavour and Acceptance of Estonian Cheeses

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Abstract. The flavour and acceptance of locally manufactured cheeses in Estonia were studied. The 36 cheeses, varying in texture, manufacturing technology, fat content, and additives, were described by 32 flavour attributes. Estonian cheese was described as milky and buttery, with sweet aromatics, occasionally with biting and butyric acid aromatics. The cheeses are usually not highly aged, and thus do not have dominant astringent or bitter sensations found in cheeses from other countries.

Based on a cluster analysis of the flavour of the cheeses, four were chosen for an acceptance study. One hundred and eleven consumers in Estonia tested the four cheeses. Cluster analysis of the consumers' liking scores indicated two clusters of consumers, one cluster preferring the younger cheeses and the second cluster preferring more aged cheeses. The study provides information concerning cheese flavour and preferences in an area of Eastern Europe which has been lacking in previous literature.

Keywords: cheese, flavour, liking, sensory

INTRODUCTION

The sensory properties of specialty cheeses from around the world, including those from specific regions or specific types have been characterized by several authors (Chambers et al., 2010; Drake et al., 2001; Ritvanen et al., 2005). Numerous studies have been conducted to develop lexicons for describing cheese flavour (Rètiveau et al., 2005; Drake et al., 2001; Heisserer & Chambers, 1993). Attributes have been categorized into seven categories including, fundamental tastes, dairy aromatics, fatty acid/animal, musty/fungal, aged/fermented, and other aromatics and mouthfeel.

However, literature is lacking on information on Eastern European cheese flavour and liking. The objective of this study was to 1) describe the flavour of Estonian cheeses and 2) determine acceptability for those cheeses among Estonian cheese consumers.

MATERIALS AND METHODS

Samples

Sample cheeses (n = 36) from eight different manufacturers were used in descriptive sensory analysis. The samples were assigned random three-digit numbers. These samples included a mould-ripened cheese (198), smoked cheeses (776, 431), reduced fat-cheeses (211, 411, 628, 836), a cheese with caraway seeds (327), with probiotic bacteria (297, 295), Gouda (408, 107), Edam (580, 819, 173), Havarti (434) and Swiss (516). The types or properties of the rest of the samples were not specified by the manufacturer. All cheeses were manufactured in Estonia from cow's milk. All samples used in descriptive analysis were available in 2009 and 2010 in grocery stores in Tallinn, Estonia. For descriptive sensory analysis the samples were shipped to the Sensory Analysis Center, Manhattan, KS, US within a week from purchasing. The samples were stored at the recommended temperature and analyzed within a month of receipt; always before the "best before"-date.

Descriptive Sensory Analysis

Six highly trained panellists from the Sensory Analysis Center at Kansas State University evaluated the samples in three repetitions in completely randomized order during 19 1.5 h sessions. The panellists had more than 120 h of training, average more than 1000 h of testing experience, and had prior experience testing cheese. For testing, the samples were cut into 1.2 cm cubes, placed into disposable 90 ml plastic cups and covered with lids, labelled with a three-digit code and held at room temperature for approximately one hour before analysis. Most attributes used had been defined and referenced in previous studies (see e.g., Retiveau, et al., 2005) and included dairy notes (buttery, cooked milk, dairy fat, dairy sour, dairy sweet), fundamental tastes (sweet, salty, sour, bitter, umami), fungal (musty, mouldy), animal (decaying animal, butyric, goaty, sweaty), aged/fermented (aged, fermented, fruity, sauerkraut), mouthfeel attributes (astringent, chalky, biting, pungent, sharp), and other aromatics (caraway, floral, green, nutty, smoky, sweet aromatics, waxy). Caraway, defined as 'the aromatics associated with caraway seeds, such as dry, slightly pungent, woody, and 'has a slight, somewhat floral aroma'; 'it may also have a slight anise aromatic', was added to the lexicon because one sample was enriched with caraway seeds. Unsalted crackers and purified water was available to panellists for palate cleansing. A 15-point intensity scale, with 0.5 point increments, where 0 would represent none and 15 very strong, was used. Compusense Five version 4.6 (Compusense, Guelph, Ontario, Canada) was used for the sensory analysis data collection.

Consumer Study

For the consumer study four samples (150, 201, 408, and 516) were chosen based on Principal Component Analysis (PCA) results. Sample 381 was used as a warm-up sample to reduce the first sample bias often noted in consumer studies, and results for this sample were not used in data analysis. The samples were purchased from grocery stores in Tallinn in August 2010, and the study was carried out in September 2010 in Tallinn, Estonia. The cheeses were cut into 1.2 cm cubes and placed into covered 40 ml disposable plastic cups, labelled with three-digit codes. The samples were served at room temperature.

One hundred-and-eleven adult consumers (33 men and 78 women), who identified themselves as cheese consumers, were recruited via e-mail and fliers in Tallinn, Estonia. The consumers tasted the cheeses in a single session. A break of 2-3 min was provided between samples, and consumers were encouraged to take a bite of unsalted cracker and drink the purified water that was provided during these breaks. The cheeses were presented individually in a randomized order. The ballot for each cheese included questions on cheese liking (overall liking, flavour liking, dairy flavour liking, sweet, sour, and bitter taste liking) on a 9-point hedonic scale, where 1 = dislike extremely and 9 = like extremely.

Statistical Analysis

XL Stat version 10.0 (AddinSoft 2010, New York, NY, USA) was used for clustering the descriptive sensory analysis data, correlation analysis (using Pearson correlation coefficients, $P = 0.05$), and for PCA. Caraway and smoky attributes, and sample 198 were removed from the data before PCA analysis was performed. Significant differences ($P = 0.05$) between samples and consumer clusters were detected with Analysis of Variance (ANOVA). The samples and consumers were clustered using Agglomerative Hierarchical Clustering (AHC). All samples and attributes were included in the clustering, as were all the consumers.

RESULTS AND DISCUSSION

The Flavour of Estonian Cheese

The mean scores of the descriptive sensory analysis suggested that the majority of Estonian cheeses have a mild, dairy-like character. The cooked milk, buttery, dairy fat, dairy sour, and dairy sweet attributes were scored low (0.5 – 5.0) for all samples. The fundamental tastes – salty, sour, bitter, umami, and sweet were all present in the flavour composition. The cheeses were evaluated as having sweet aromatics but also as being biting and sharp and causing an astringent mouthfeel. Other aromatics such as nutty, musty, and butyric acid were found for all samples, but the scores for most samples were low. The aged attribute (defined as a clear, distinct aromatic edge sometimes described as sour, astringent, and pungent), frequently seen in aged cheese, was scored in the low range for most cheeses, and in the moderate range (scores 5.5 – 10) for nine of the cheeses.

The nature and flavour of real Estonian cheese and disputes on which manufacturers should be able to use the label 'Eesti Juust' (not a European Protected Designation of Origin label) has occurred on several occasions. Five samples in this study (201, 348, 381, 606, and 769) were labelled as 'Eesti Juust' (i.e., 'The Estonian Cheese' or 'Cheese of Estonia'). Those five samples were manufactured by three different companies; two of the cheeses made by a single manufacturer were in different clusters suggesting that what is considered 'Eesti Juust' is not consistent in flavour within a manufacturer. Based on mean scores, the samples were different in sweet aromatics and the butyric acid aromatics. Sample 606 was found significantly higher in the butyric acid attribute and was different in dairy notes from the rest of the samples. Samples 348 and 381 did not differ in the sweet aromatics but had a difference in aged aromatics. However, a clear profile differentiating these cheeses from the remaining samples was not found.

Four samples (211, 411, 628, 836) were labelled as light products with a fat content of 15–19%. None of the reduced fat cheeses were scored similarly to other mild, dairy like cheeses, and all had some strong character notes.

Two samples (295, 297) were claimed as having functional properties based on enrichment with probiotic bacteria, either *Lactobacillus plantarum* TENSIA^{TM} or *Lactobacillus fermentum* ME-3. The flavour properties of these two cheese samples were different from each other. Sample 295 had higher levels of sweet aromatics, and sample 297 was more biting, higher in butyric acid aromatics, and had a stronger fermented flavour.

Principal Component Analysis

Principal Components (PC) 1 and 2 explained 49.26% of the variation within samples (Fig. 1). PC 1 differentiated samples with a chalky mouthfeel and sweet aromatics versus the pungent samples with butyric acid aromatics. The sweet aromatics were correlated with the chalky attribute (R = 0.83, *P = 0.05*) and negatively correlated with the pungent aromatics (R = -0.71). Samples 772, 819, 344, 150, 381, 295, 516, 327, 107, 912, and 349 were scored highest and not significantly (*P > 0.05*) different from each other for sweet aromatics. The sweet aromatics attribute also was correlated somewhat with the floral (R = 0.63) and the fruity (R = 0.40) attributes. Thus sweet aromatics could partly be caused by esters present in the samples (Gomez-Ruiz et al., 2002).

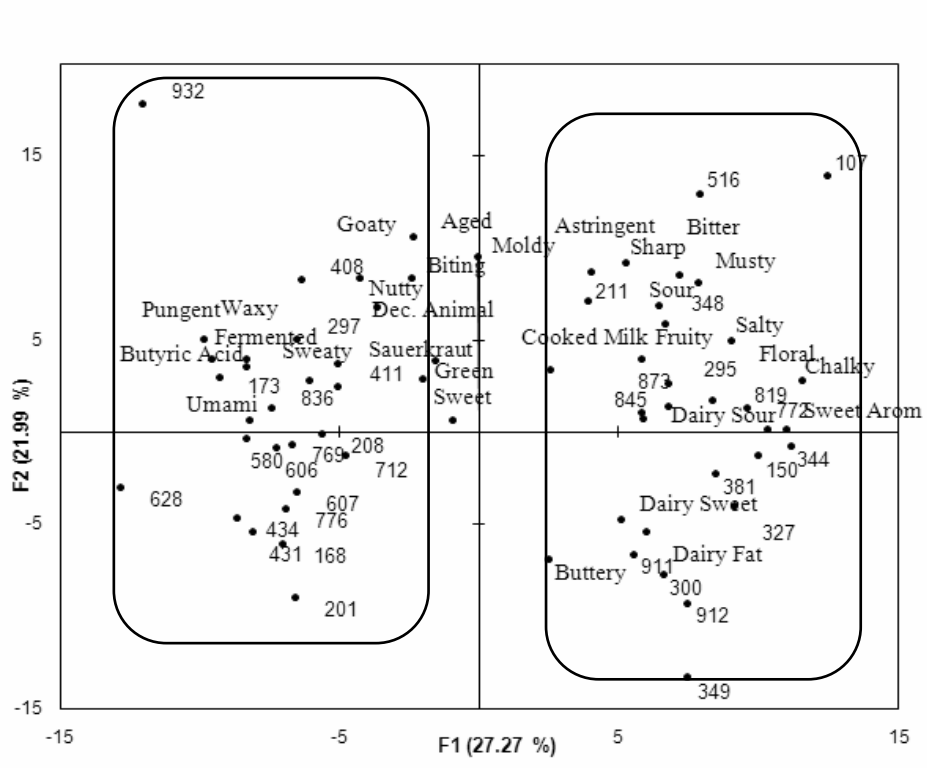

Figure 1. PCA biplot for PC 1 and 2. Sweet Arom – sweet aromatics; Dec. animal – decaying animal. Cluster 4 (except samples 776 and 431) is surrounded with a line as negative loadings of PC1 and cluster 1 as positive loadings of PC1.

Samples 198, 932, 297, 606, and 607 were highest in butyric acid aromatics. Those same samples and sample 776 were highest for pungency, indicating that short chain fatty acids probably were more prevalent in these samples (Gomez-Ruiz et al., 2002). Thus the pungent sensation could be caused by the butyric acid or other organic acids content in these samples, as these two attributes were highly correlated (R = 0.85).

PC 2 explained the aged, mouldy, sharp, biting, and astringent mouthfeel attributes. These attributes were in moderate correlation. Samples 932, 408, 107, and 516 scored in the moderate range, but still significantly higher in the aged flavour than the remaining samples. Two of these samples were labelled as Gouda cheese (408, 107) and one sample (516) as Swiss cheese.

Cluster Analysis

Four clusters resulted from cluster analysis. Clusters 1 and 4 were composed of 16 and 17 samples, respectively (Fig. 1). Clusters 2 and 3 were composed of one and two samples, respectively. Based on the PCA results, the samples in Cluster 1 can be characterized as mild, chalky, and having sweet aromatics. The samples in Cluster 4 can be characterized as having pungent and butyric acid aromatics, and some also were fermented, mouldy, sweaty, and biting. The centroid samples for Cluster 1 (819) and for Cluster 4 (580) were labelled as Edam-type cheeses, together with sample 173. However, the descriptive sensory analysis results showed that these cheeses were rather different in flavour. The actual flavour of Edam cheese by standard is poorly described (FAO/WHO, Codex Alimentarius). All of these samples were manufactured in different facilities and different time points. Studies comparing the flavour of Edam-type cheeses manufactured in different countries may explain whether those in Estonia carry different or similar characteristics.

Cluster 2 was composed of one sample, 198, and was the only sample surface-ripened with mould. This sample was higher in the musty, mouldy, green, butyric acid, and decaying animal flavours.

Cluster 3 was composed of two samples, 776 and 431. These samples were both smoke-cured cheeses and were significantly higher in smokiness than the rest of the samples. The samples also were significantly different from each other in smokiness, with sample 776 scoring higher (6.4) than sample 431 (4.5).

Consumer Study

ANOVA within each cluster (Table 1) explained different consumer liking question scores. Cluster 1 liked samples higher in the aged, pungent, and astringent attributes (408 and 516). In Cluster 1 sample 408 was the most liked cheese. In sweet flavour liking both samples 408 and 516 were liked significantly more than samples 201 and 150. In Cluster 2 samples 150 and 201, that were low in the aged, pungent, and astringent attributes, were liked best. Both of these samples were liked significantly more than sample 516 and 408 in all questions except for bitter flavour liking. According to Drake et al. (2001) these cheeses may be described as undeveloped in flavour or young.

Consumer segmentation may occur according to cheese appearance, texture, and flavour (Young et al., 2004). Because appearance and texture, as well as imported cheeses were not the objective of this study further research may be necessary to fully understand cheese liking among Estonian consumers

CONCLUSIONS

Thirty-six cheese samples were analyzed using descriptive sensory analysis. All of the cheeses had low to moderate dairy flavour attributes. The cheeses varied in pungency and butyric properties, sweet aromatics, and more or less characteristics associated with aging. None of the cheeses (with the exception of one mould-ripened cheese) were particularly strong for any characteristics suggesting that these cheeses typically are milder than cheeses found in other countries. Further comparison with cheeses manufactured in other countries may show Estonian cheese flavour in perspective, and it may be possible to specify Estonian cheese characteristics.

Two large clusters of consumers were identified, one of which liked younger cheeses and one that liked more aged cheeses, among those cheeses studied. A study comparing the liking of cheese manufactured in Estonia versus imported cheese may clarify whether consumers in Estonia actually prefer specific flavour characteristics of Estonian cheeses or may in some cases like stronger flavours of imported cheeses.

Table 1. Average scores and differences between consumer cluster 1 and cluster 2.

	Sample	Overall liking		Fl liking		Dairy liking	fl	Sour liking	fl	Sweet liking	fl	Bitter liking	fl
C1	150	6.1	b	5.8	bc	5.6	b	5.2	c	5.6	b	5.3	bc
	201	6.0	b	5.4	c	5.4	b	5.0	c	5.4	b	4.9	c
	408	7.5	a	7.6	a	6.4	a	6.7	a	6.5	a	6.5	a
	516	6.3	b	6.2	b	5.8	b	5.8	b	6.1	a	5.8	b
C2	150	6.7	a	6.5	a	5.9	a	5.8	a	5.9	a	5.4	a
	201	6.6	a	6.2	a	5.9	a	5.6	a	6.1	a	5.6	a
	408	5.0	b	4.4	b	4.9	b	5.0	b	5.0	b	4.6	b
	516	5.3	b	4.7	b	4.9	b	5.1	b	5.1	b	5.0	ab

The means in the same column within cluster with different letters are significantly different ($P = 0.05$). C1, C2 – cluster 1 and 2, respectively. Fl –flavour.

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