

COMPARING SENSORY QUALITY OF FULL AND REDUCED FAT COMMERCIAL CHEESES

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The aim of the study was to compare the sensory quality of commercial semi-hard type cheese and its reduced fat version. In quantitative descriptive analysis (QDA) a trained panel rated the cheeses for colour, odour, taste and texture. In the affective tests the panelists evaluated the samples for overall quality. The results proved that both fat content and years of production had significant effects on the sensory quality of the cheeses. The reduced-fat cheeses from 2004 and 2006 years obtained the lowest scores – 3.8 and 3.7 units respectively, whereas the other products (full-fat 2004, 2005, 2006 and reduced-fat 2005) obtained 6.5; 5.9; 8.6 and 6.2 units respectively. The QDA demonstrated significant differences ($p < 0.05$) between the cheeses for the following attributes: yellow colour, salty taste, bitter taste aftertaste, hardness, chewiness, rubbery, dryness, and grainy caused the type cheese. The principal component analysis (PCA) indicated that the first (PC1) and the second (PC2) component together explained 75.85% of the variation of sensory quality of the samples.

INTRODUCTION

Research has shown that high-fat diets increase the risk for cardiovascular disease, obesity, and some types of cancer [Cotugna, 2000]. Reducing fat in every-day's diet has become a public health issue and concern for most consumers. As a result of the growing tendency to consume low-fat foods the dairy industry produces various kinds of low fat cheeses. Unfortunately, fat plays a key role in the flavour, texture and aroma of cheese. Many commercial reduced- and low-fat cheeses as a result exhibit poor flavour and texture. It can be one of the most substantial reasons for their limited use. Several studies have shown that consumers based their choices more on pleasantness than perceived healthiness [Tuorila & Cardello, 2002; Luckow & Delahunty, 2004]. Although, the low-fat cheeses market in Poland is rapidly growing there is still little information which sensory attributes make these products pleasant – or unpleasant for the consumers. Thus the aim of this work was to compare the sensory characteristics of Polish commercial semi-hard cheeses with different fat content produced in the three subsequent years.

MATERIAL AND METHODS

Full fat semi-hard type cheese and its reduced fat version produced in subsequent years: 2004, 2005, 2006 were used in this study. The first one – full characterised by 45% of fat content, and the second – reduced, with 27% fat content. Both varieties of cheese originated from the same producer (north-western part of Poland) and had the same maturation period. After ripening, the cheeses were stored under the tradi-

tional conditions (refrigerator 4°C) and next submitted to the sensory analysis after 50 days.

Sensory panel. The sensory panel was trained and monitored according to ISO standards [ISO 8586-1:1993]. Prior to their participation in the experiments, the subjects were trained to rate the perceived intensity of the following different sensations: sweetness, saltiness, sourness and bitterness using aqueous solutions of different concentration of sucrose, NaCl, citric acid, quinine sulphate and caffeine. The training sessions also included a brain-storming activity to identify descriptive terms for commercial cheese samples.

Sensory method. Quantitative Descriptive Analysis (QDA) was used to determine differences in the characteristics of the samples. As the most adequate method it is often applied to study a variety of products including cheese [Lawless & Heymann, 1998; Stone & Sidel, 1993]. The descriptive analysis is not only one of the most sophisticated methodologies in sensory evaluation, but also one of the most appreciated methods, due to its significant value in the product's development [Hannon *et al.*, 2005; Ritvanen *et al.*, 2005].

Prior to the analysis, the vocabularies of the sensory attributes were developed by the panellists together with the panel leader in round-table session, using standardised procedure [ISO/DIS 13299:1998]. Twelve attributes were selected and thoroughly defined for profiling (Table 1). 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 in-

TABLE 1. Definitions of attributes for profiling of the cheeses.

Descriptor	Definition
Colour	visual estimation of intensity
Creamy odour	smell of market cream (30%)
Acid odour	typical note of fermented milk products such as yoghurt
Salty taste	basic taste typical of sodium chloride as diluted in water (0,2%)
Acid taste	taste of fermented milk products
Bitter taste	basic taste typical of caffeine in water (0.5%)
Aftertaste	after-taste which continued after the removal of sample
Hardness*	the force needed by the jaws to bite the sample into two pieces
Chewiness	time and multiplicity of chewing the product to prepare it to swallow
Rubbery	the ability of the sample to regain shape after pulling
Dryness	moisture that exists in the sample, mouthfeel after 4, 5 chews
Grainy	the ability of the sample to break into pieces
Overall quality	overall sensation determined in terms like and dislike

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

tensity (value 10) of the attribute. Overall quality of cheeses was assessed using the same type of scale as above anchored on both ends: unlinking (0) – extremely linking (10).

Preparation of samples and evaluation conditions.

Samples were taken out at least 1 h prior to evaluation in order to equilibrate to room temperature. The cheeses were cut in slices in standard dimensions (50x50 mm, thickness 2 mm) and placed in transparent plastic boxes with the plastic lid. All samples were coded with three digit numbers and given in random

order. With the samples the panellist received a cup of room temperature spring water for cleaning their palates. The assessments were carried out at a sensory laboratory room which fulfils the requirements of the ISO standards [ISO 8589:1998]. Scores were recorded and collected using a computerised system. Each sample was tested in two replications. Testing sessions took place in the morning, between 10 and 12 a.m.

Statistical analyses. 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. Principal component analysis (PCA) was applied for general assessment of similarity-dissimilarity of the evaluated samples and for describing their attributes. Statistical analysis was performed using software package (StatSoft, Inc. v. 7.1, Tulsa, OK, USA).

RESULTS AND DISCUSSION

Using the QDA method 12 attributes for the investigated cheeses describing colour, odour (creamy, acid), taste (salty, acid, bitter, aftertaste), and texture (hardness, chewiness, rubbery, dryness, grainy) were selected and defined (Table 1). The mean values of intensity of these attributes and the analysis of variance are presented in Table 2. 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 the type of cheese. The average overall quality of scores for the cheeses are presented in Figure 2. The results showed that reduced-fat cheeses from 2004 and 2006 years obtained the lowest scores – 3.8 and 3.7 units respectively, whereas the other products (full-fat 2004, 2005, 2006 and reduced-fat 2005) obtained 6.5; 5.9; 8.6 and 6.2 units respectively. In order to observe the above differences in the analysed samples more clearly, the sensory profiles of cheeses were displayed as spi-

TABLE 2. Mean values of intensity of sensory attributes in cheeses^a.

Attributes ^b	2004		2005		2006	
	full fat	reduced fat	full fat	reduced fat	full fat	reduced fat
Colour	4.57 ^{aA}	5.64 ^{aA}	5.71 ^{aB}	5.95 ^{aA}	4.71 ^{aA}	7.24 ^{bB}
Creamy odour	3.10 ^{aA}	3.70 ^{aA}	4.54 ^{aA}	3.09 ^{aA}	2.94 ^{aA}	2.21 ^{aA}
Acid odour	3.49 ^{aA}	2.46 ^{aB}	4.52 ^{aAB}	4.93 ^{aA}	5.75 ^{aB}	4.94 ^{aA}
Salty taste	3.95 ^{aA}	2.77 ^{aA}	2.78 ^{aA}	5.61 ^{bB}	2.68 ^{aA}	3.23 ^{aA}
Acid taste	1.77 ^{aA}	1.56 ^{aA}	1.49 ^{aA}	1.93 ^{aAB}	2.54 ^{aA}	3.19 ^{aB}
Bitter taste	1.64 ^{aA}	1.74 ^{aB}	0.78 ^{bA}	0.21 ^{aA}	1.59 ^{aA}	4.31 ^{bC}
Aftertaste	4.81 ^{bA}	3.31 ^{aA}	4.52 ^{aA}	4.12 ^{aA}	4.57 ^{aA}	5.49 ^{aB}
Hardness	2.56 ^{aAB}	4.57 ^{bA}	2.74 ^{aB}	4.04 ^{bA}	1.68 ^{aA}	6.08 ^{bB}
Chewiness	2.99 ^{aA}	5.36 ^{bB}	3.14 ^{aA}	4.04 ^{aAB}	5.40 ^{aB}	3.70 ^{aA}
Rubbery	2.33 ^{aAB}	5.31 ^{bAB}	3.49 ^{aB}	3.96 ^{aA}	2.10 ^{aA}	5.96 ^{bB}
Dryness	1.90 ^{aA}	3.43 ^{bA}	2.33 ^{aA}	3.64 ^{bA}	0.95 ^{aB}	5.16 ^{bB}
Grainy	1.97 ^{aA}	4.13 ^{bA}	3.11 ^{aA}	3.90 ^{aA}	3.02 ^{aA}	6.08 ^{bB}

^a means marked in each row with the same letters do not have significant differences (LSD test, $p < 0.05$); small letters describe comparison between full and reduced fat cheese in each year; big letters describe comparison between years in each variety of cheese

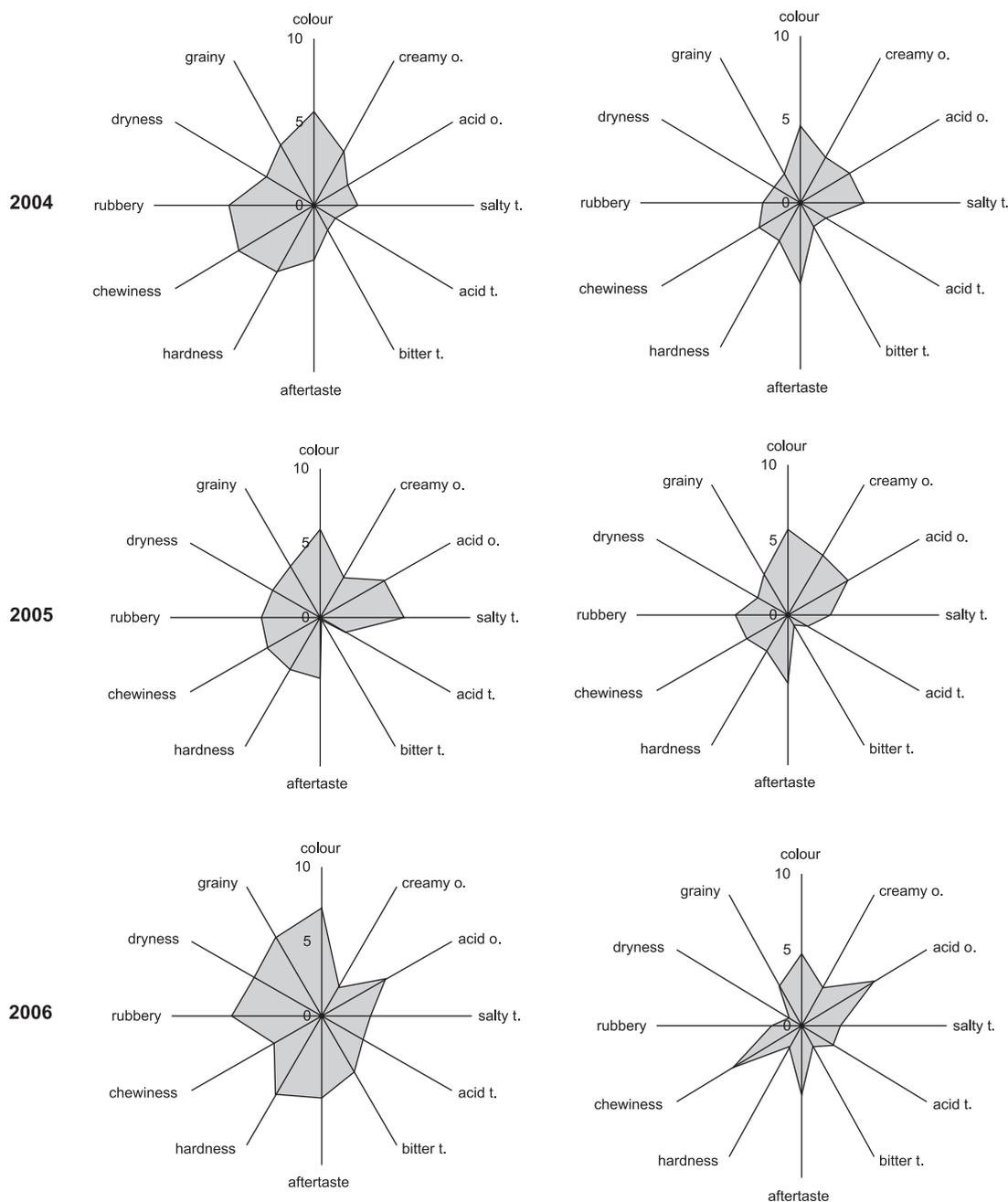


FIGURE 1. Sensory profiles of the cheeses (o. – odour, t. – taste).

der diagrams in Figure 1. It can be seen that in the sensory profiles of cheeses with the lowest scores of overall quality the dominating attributes were as follows: hardness, chewiness, rubbery, dryness and grainy. On this basis it should be stated that mainly the descriptors of texture did affect the overall quality of the products. It was reported that cheeses with reduced fat levels are usually excessively dry and grainy, which is especially evident in the hard and semi-hard ripened varieties [Rodriguez, 1998]. Therefore a number of alternatives have been proposed to improve their quality. Another common defect in low fat cheeses is bitterness [Mistry, 2001]. Hydrophobic compounds produced by proteolysis are perceived with greater intensity of bitterness in low fat cheeses than in

full fat cheeses because those compounds are adsorbed by fat. It should be stressed that reduced-fat cheese from 2005 year, which show a high overall quality, are characterised by very low intensity of bitterness.

Results obtained from the QDA method were used to submit the principal component analysis (PCA). This method is a multivariate technique that is used to simplify and describe interrelationships among multiple dependent variables. The first two principal components were extracted which together explained 75.85% of the variation among the samples. The first factor (PC1) and the second factor (PC2) explained 60.70% and 15.15% of the variation, respectively. A biplot of the scores and loadings for these PCs are shown in Figure 3.

It can be seen that PCA technique differentiated the samples by the type of cheese and year of production. The most differentiated product from all groups is reduced fat cheese from year 2006. It is also visible on the overall quality chart (Figure 2), where it has the smallest position with 3.7 arbitrary units. That cheese is mainly correlated with descriptors of texture without chewiness, which has the smallest degree of differentiation in all cheeses. The most similar are full fat cheeses from 2004 and 2005, and reduced ones from the same years. The full fat cheeses are correlated with descriptors of creamy and acid odours which are characterised for that kind of cheeses (fat is the factor which releases the odour compounds). Both cheeses do not create characteristic groups of product concentrations.

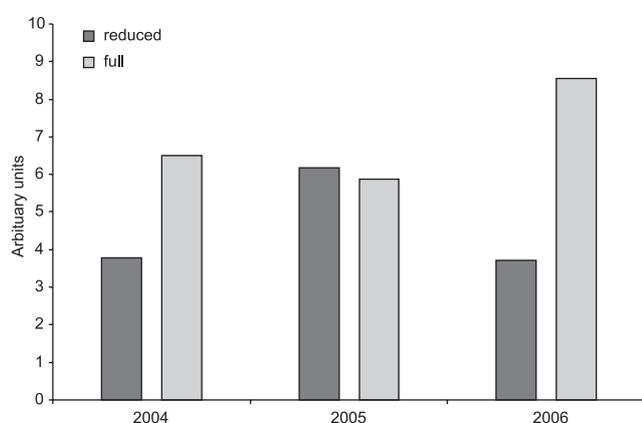


FIGURE 2. Overall quality of the investigated cheeses.

CONCLUSIONS

In conclusion we found that the sensory quality of the cheeses was affected by both fat content and years of production. Analytical sensory evaluation (QDA) and hedonic rating proved that the sensory quality of cheeses was mainly dependent on attributes of texture such as hardness, chewiness rubbery, dryness, grainy. Therefore, in order to produce reduced-fat cheeses with acceptable characteristics future studies should be focused mainly on improving the texture of products.

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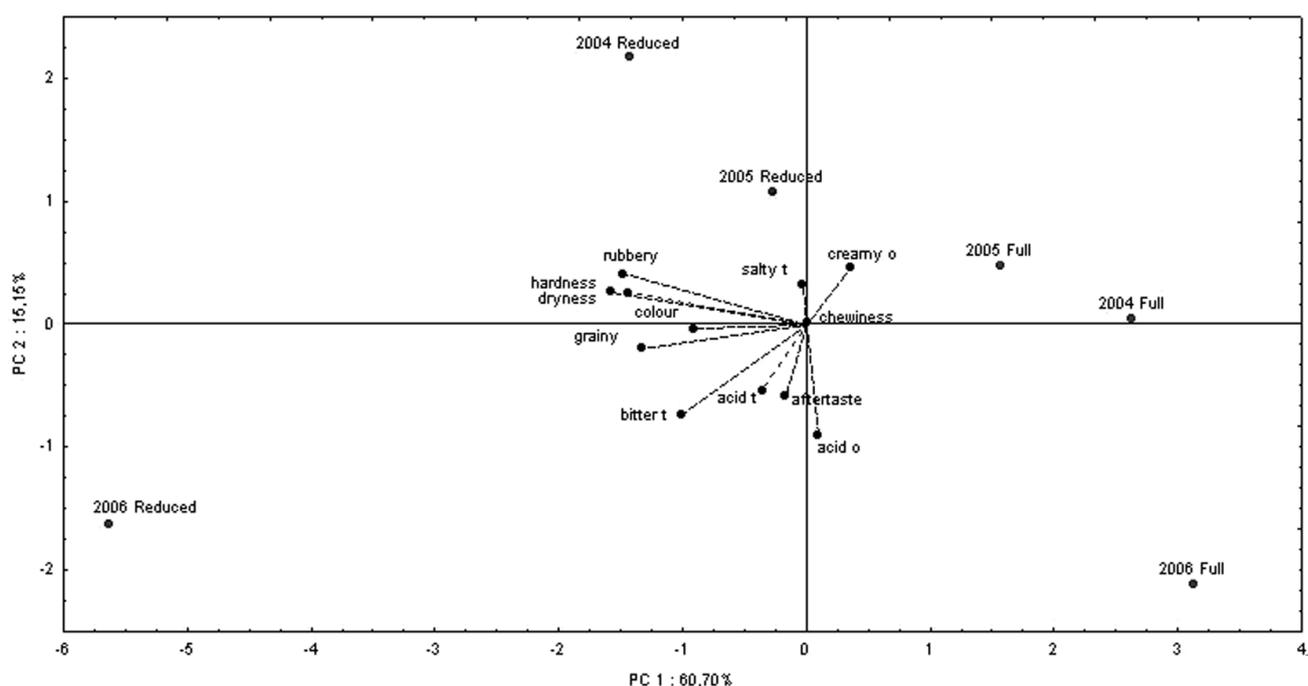


FIGURE 3. PCA plot of sensory profiling results of investigated products and their descriptors. *o - odour, t - taste.

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PORÓWNANIE JAKOŚCI SENSORYCZNEJ SERÓW HANDLOWYCH PEŁNOTŁUSTYCH I O ZREDUKOWANEJ ZAWARTOŚCI TŁUSZCZU

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Celem pracy było porównanie jakości sensorycznej handlowych serów tego samego typu, wyprodukowanych przez tego samego producenta, różniących się zawartością tłuszczu. Ocenę serów pełnotłustych i o obniżonej zawartości tłuszczu wykonano metodą profilowania sensorycznego (QDA) wyróżników barwy, zapachu, smakowości i tekstury oraz w kategoriach hedonicznych. Stwierdzono zróżnicowanie jakości sensorycznej badanych produktów, na co miał wpływ zarówno poziom tłuszczu jak i rok produkcji. Sery o zredukowanej zawartości tłuszczu wyprodukowane w 2004 i 2006 charakteryzowały się najniższą jakością sensoryczną. Wyróżnikami istotnie różnicującymi ($p < 0,05$) profile sensoryczne serów były głównie wyróżniki tekstury takie jak: twardość, przeżuwalność, gumistość, suchość i ziarnistość. Analiza składowych głównych (PCA) wykazała, że pierwsza (PC1) i druga składowa (PC2) opisały łącznie 75,85% całkowitej zmienności jakości sensorycznej badanych produktów.