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Effect of dietary CSFA and heat treatment of milk on sensory profiles of sheep and goat cheeses during ripening

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SUMMARY – The possible effect of dietary calcium salts of long chain fatty acids (CSFA) and heat treatment of milk on flavour and texture properties of sheep Pecorino and goat cheese was assessed in two trials. Both cheese types were manufactured with two cheesemaking techniques: from raw milk and from heat-treated milk followed by addition of autochthonous lactic cultures. Within each cheesemaking treatment, animals were fed two different diets: (i) a control diet, based on mixed pasture and commercial concentrate; and (ii) the same diet as (i) but supplemented with calcium salts of long chain fatty acids. Pecorino cheese (at 1 and 6 months of ripening) and goat cheese (40 days of ripening) were sensory profiled by employing a trained sensory panel. Results were evaluated by Anova and Generalised Procrustes Analysis. In both experiments, the cheesemaking technique strongly affected the aspect, texture and a number of key flavour properties of cheeses. The effect of diet was more difficult to show. As for the Pecorino cheese, the contribution of ripening seemed to take rapidly over the effects associated to diet.

Key words: Pecorino cheese, goat cheese, sensory evaluation, cheesemaking technique, protected fat.

RESUME – "Effet des savons d'acides gras et du traitement à la chaleur du lait sur les profils sensoriels des fromages de brebis et de chèvres pendant l'affinage". L'effet d'une supplémentation en lipides et du traitement thermique du lait a été vérifié par l'analyse sensorielle sur deux types de fromage, l'un de chèvre et l'autre de brebis Pecorino. Les deux fromages ont été préparés soit en utilisant du lait cru soit du lait traité thermiquement et additionné d'une flore lactique autochtone. Pour chaque groupe, deux fabrications fromagères ont été prévues deux sous-groupes liés à la ration alimentaire des animaux : (i) témoin, caractérisé par du pâturage mixte et du concentré ; et (ii) traité, caractérisé par les mêmes aliments mais avec du concentré enrichi en lipides "protégés". L'analyse sensorielle a été effectuée par un panel entraîné après 1 mois et 6 mois d'affinage dans le cas du Pecorino et après 40 jours pour le fromage de chèvre. Les résultats ont été évalués statistiquement par les procédures "Anova" et "Generalised Procrustes Analysis". Les deux techniques de fabrication fromagère ont entraîné des différences remarquables sur l'aspect, la texture et sur la saveur. Les effets de l'alimentation ont été plus difficiles à montrer et, dans le cas du Pecorino, ont été annulés après 6 mois d'affinage.

Mots-clés : Fromage Pecorino, fromage de chèvre, analyse sensorielle, fabrication fromagère, lipides protégés.

Introduction

Among the quality assurance procedures used to maintain product quality, sensory testing plays an important role. It provides information about the presence/absence of perceptible differences, allows quantification of sensory characteristics and identifies particular problems in a product that can not be detected by classical analytical procedures. Flavour of cheese is the result of a series of enzymatic and non-enzymatic reactions, during a ripening period which varies according to the type of cheese. Both diet and management related factors are able to effect these processes and the quality of dairy products (Haouet *et al.*, 1993). In this paper the possible effect of dietary calcium salts of long chain fatty acids (CSFA) and heat treatment of milk on flavour and texture properties of sheep and goat cheese was sensory investigated.

Materials and methods

Two separate experiments were conducted in two farms located in Umbria, Central Italy; in experiment 1 a farm of 480 Sarda ewes at the 5th-6th month of lactation was used for a study

on Pecorino cheese; in experiment 2 a flock of 40 Maltese goats at the second half of lactation was chosen. The average daily milk production was 1.17 l/head for ewes and 0.81 l/head for goats. Both cheese types were manufactured with two cheesemaking techniques: from raw milk, according to the traditional (T) method used in the farm, and from heat-treated milk (HT) followed by addition of autochthonous starter cultures [i.e., *Lactococcus lactis* ssp. *lactis* (n. 16), *L. casei* ssp. *casei* (n. 208), *L. lactis* ssp. *lactis* (n. 340), and *Streptococcus termophilus* (n. 352) in expt. 1 and *L. lactis* ssp. *lactis* (n. 16), *L. lactis* ssp. *lactis* (n. 340), *L. casei* ssp. *casei* (n. 208) and *Lactobacillus helveticus* (n. 25) in expt. 2 (Cenci-Goga *et al.*, 1995; Clementi *et al.*, 1998)]. In the HT method, the milk was heated to 65°C and maintained at this temperature for 4 min. The complete thermic cycle (55°C-65°C-55°C) lasted 14 min. When the milk reached 42°C, the starter was added in a ratio of 2% v/v. Within each cheesemaking treatment, animals were fed two different diets: (i) a control diet (C), based on mixed pasture and commercial concentrate; and (ii) the same diet as (i) but supplemented with CSFA (daily dose: 50 g/head). Pecorino cheese (at 1 and 6 months of ripening) and goat cheese (40 days of ripening) were sensory analysed by an experienced panel of assessors. Assessors were required to rate the intensity of each descriptors on unstructured line scales (from 0 to 9) using a computer registration system. In each trials, differences among samples for each sensory characteristic were analysed by ANOVA. Generalised Procrustes Analysis (GPA) (Gower, 1975; Dijksterhuis, 1996) was chosen as a method to reduce the multidimensional space of data and follow variation versus cheesemaking and feeding. The analyses were performed using SPSS (1990) for univariate analysis and Procrustes-PC (OP&P, 1995) for Procrustes analysis.

Results and discussion

In both experiments macroscopic differences were found between samples obtained by using the two different cheesemaking techniques in relation to aspect, texture and a number of flavour properties.

In expt. 1, the T cheese samples were scored as higher ($P < 0.01$) for "spotty" (3.4 vs 3.1 and 3.8 vs 2.1), "tasty" (4.8 vs 4.0 and 6.0 vs 5.3), "sheepy" (3.6 vs 2.4 and 4.5 vs 3.7) and "sharp" (3.2 vs 2.4 and 5.3 vs 4.2) when compared to the HT samples at either 1 month and 6 months of ripening, respectively. The diet had a significant effect ($P < 0.01$) only at 1 month of ripening: CSFA cheeses were scored as more "sheepy" (3.4 vs 2.6), "tasty" (4.7 vs 4.0) and less "hard" (2.2 vs 2.9) when compared to the control diet. At 6 months of ripening the dietary effect on sensory attributes was negligible. In expt. 2, both cheesemaking technique and diet had a significant effect ($P < 0.01$) on most attributes. The T samples were less "yellow" (4.6 vs 6.0), "mouldy" (2.0 vs 3.2) and "hard" (4.0 vs 4.7) than the HT samples. On the contrary, HT cheeses were less "spotty" (2.1 vs 4.8) and "goaty" (5.2 vs 5.8). "Sweet", "sharp", "goaty" and "yellow" terms were scored as lower ($P < 0.01$) when the diet was supplemented with the CSFA (2.5 vs 3.5, 2.7 vs 3.5, 5.3 vs 5.8 and 4.5 vs 6.0, respectively). CSFA samples were also scored as more acid and bitter when compared to the control samples. When the GPA was performed, the consensus coordinates of the Pecorino cheese at 1 month of ripening showed a clear splitting of the two cheesemaking groups (T and HT) along the abscissa (PA1), accounting for the 40% of the total variation; within each cheesemaking group a further clustering due to different diet was observed (Fig. 1). Sample distribution for Pecorino cheese at 6 months of ripening (Fig. 2) shows that the T and HT are still separate along the first principal axis but the two diet groups tend to overlap. As for the variable correlation, the general patterns for the 1-month and the 6-month ripened cheeses in expt. 2 were similar. Dimension 1 (cheesemaking effect) was clearly related to "spotty" (0.85 at 1 month of ripening) and to minor extent to "sheepy", "tasty" and "hard". All the other attributes had lower correlation with both the dimensions. At the end of ripening, the "sharp" perception increased and was more relevant to distinguish between the T and HT samples. In expt. 2, as in the Pecorino study, the cheesemaking technique played the major role (Fig. 3). The HT samples, grouped on the positive axis of the first dimension, were rated as "harder" and "yellow", as found in expt. 1, whereas the T samples were more "spotty" and characterised by a more pronounced "goaty" flavour and "acid" taste. The dimension 2 revealed an effect due to the dietary treatment. The control samples showed higher scores for "sweet" and "goaty" whilst the CSFA samples were characterised as more "mouldy" and "bitter". The first principal axis shows a high correlation for the attributes "yellow" (0.89) and "spotty" (-0.91). Correlations ranging from 0.30 to 0.45 for most of the other descriptors and none correlation for "salt" (0.06), "bitter" (0.10) and "soluble" (0.02) were found. The second principal axis had the attributes "sweet" (0.52), "bitter" (-0.47), "goaty" (0.43) and "mouldy" (-0.63) at the highest correlations.

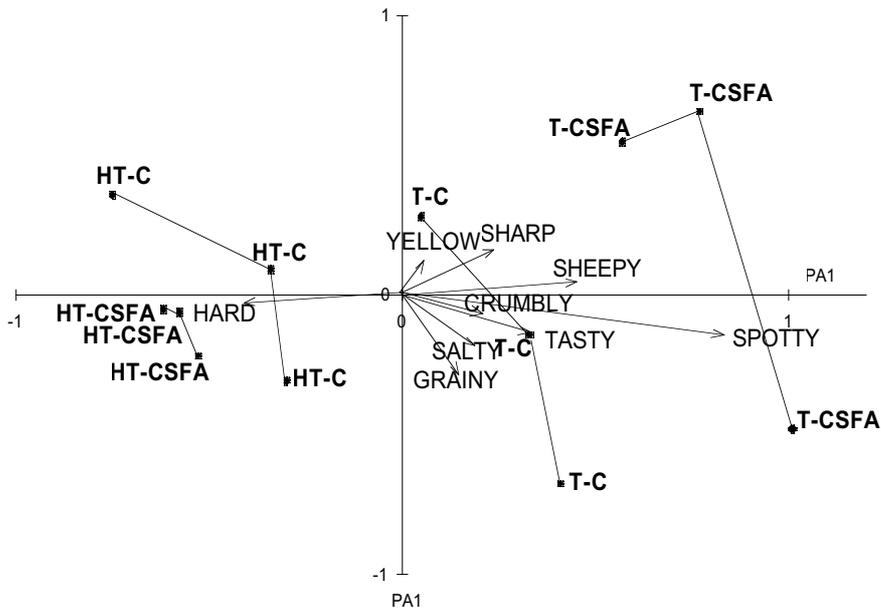


Fig. 1. Group average samples and attributes space of the 1 month ripening Pecorino cheese data.

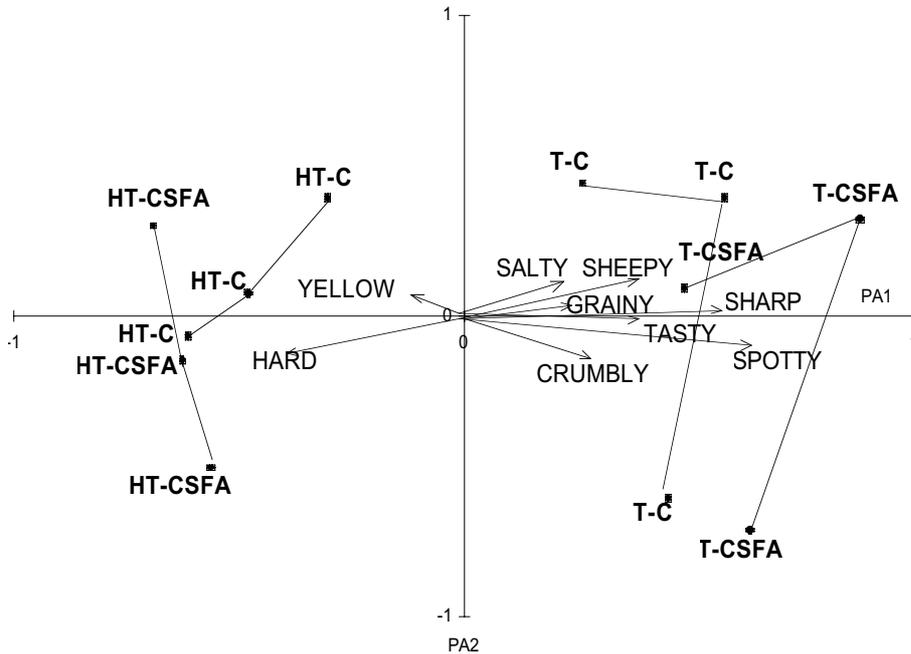


Fig. 2. Group average samples and attributes space of the 6 month ripening Pecorino cheese data. These results highlight in both the experiments a strong effect of the cheesemaking technique on aspect "spotty", texture and a number of key flavour properties. The effect of diet was more difficult to show. As for the Pecorino cheese, the contribution of ripening seemed to take rapidly over the effects associated to diet.

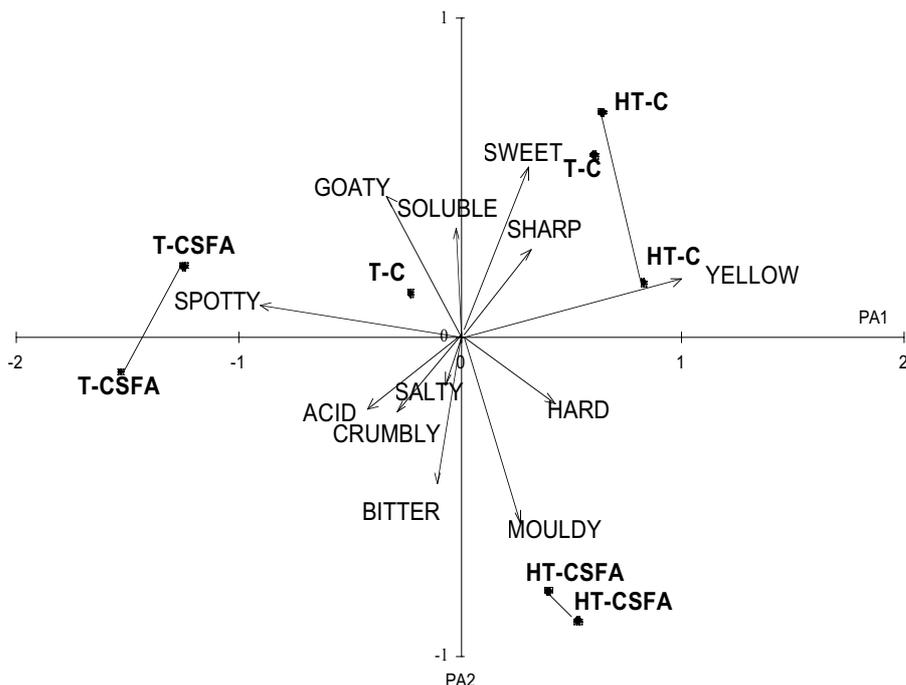


Fig. 3. Group average samples and attributes space of the goat cheese data.

Conclusions

Organoleptic properties are considered as basic traits in product characterisation and qualification. In this experiment both cheesemaking technique and diet were able to affect the sensory profile of sheep and goat cheeses. Results suggest that caution is needed when promoting treatments have to be applied to typical products.

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