

FREE CHOICE PROFILING OF CHILEAN GOAT CHEESE

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ABSTRACT

Different goat cheeses from Chile were studied by Free-Choice Profile (FCP) analysis. Generalized Procrustes Analysis (GPA) applied to FCP data permitted differentiation between samples and informed on the attributes responsible for the observed differences. Appearance was a dominant factor in discriminating samples and to a lesser degree textural variables were also correlated with GPA dimensions. In acceptability the fresh cheeses were significantly preferred over the ripened ones.

INTRODUCTION

Goat's cheese has been considered as a product of debatable quality associated with intoxication and illness in Chile, especially handmade products. However, nowadays production has increased, it has been industrialized and new technology has been applied, producing better and more varied products.

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Due to the production increase of Chilean goat cheese, sensory characterization of the traditional products found in the markets has been necessary in order to understand traditional products made with 100% goat's milk. Sensory analysis is currently an essential tool for determining the sensory quality of foods and classifying them.

Descriptive analysis in its various forms has been a popular sensory technique for many years. The original Flavor Profile Method, described by Cairncross and Sjöström 1950, used a group of highly trained assessors working with an agreed vocabulary to examine and describe characteristics of products. This technique has been modified by a number of authors and current practice is most often based on the Quantitative Descriptive Analysis procedure of Stone *et al.* 1974.

These procedures emphasize the importance of sufficient assessor training, correct experimental design and statistical evaluation of results and it is assumed that assessors are using the descriptors in the same way. However, there are a number of resources of variation which might not be eliminated completely by training (Arnold and Williams 1986).

To overcome some of these problems the Free Choice Profile (FCP) procedure was developed (Williams and Langron 1984). This allows the assessors to choose their own vocabularies, thus eliminating the need for extensive training in descriptor use. In combination with Generalized Procrustes Analysis (GPA) it eliminates some of the sources of variation cited above (McEwan *et al.* 1989a; Oreskovich *et al.* 1991). FCP technique has been successfully applied to analyze cheeses and milk (Piggott and Mowat 1991; Raats and Sheperd 1992; Jack *et al.* 1993), flavor of cider (Piggott and Watson 1992), texture of sweet orange gels (Costell *et al.* 1995) and toasted almonds (Guerrero *et al.* 1997). FCP could be applied to describe the sensory characteristics of goat's cheese from Chile. Also, texture, flavor, odor and appearance together define the sensory quality of a food, directly influencing the acceptability of the product (McEwan *et al.* 1989b).

The aim of this work was to investigate the differences between goat's cheeses from several Chilean cities, and also evaluate the acceptability of the fresh and matured industrial cheeses.

MATERIAL AND METHODS

Samples

Five goat cheeses were used, mainly purchased through Santiago de Chile retail outlets (Table 1). The samples were stored at 4C and served to the assessors at ambient temperature (20C) and identified by 3-digit random

numbers. Samples were cut into homogeneous cubes of 2 cm³ (Cardello and Segars 1989) and were served in odor-free, plastic cups, covered with a watch glass.

TABLE 1.
TYPE OF MILK, CHARACTERISTICS AND ORIGIN OF SAMPLES OF COMMERCIAL
GOAT MILK CHEESES

Goat Milk Cheese	Type of Milk	Characteristics	Origin
A	Raw	Traditional ripened cheese	Central zone (Colina)
B	Pasteurized	Fresh cheese	North zone (Ovalle)
C	Raw	Ripened cheese	Central zone (Melipilla)
D	Pasteurized	Fresh cheese	North zone (Ovalle)
E	Raw	Fresh cheese	North zone (Ovalle)

Assessors

A group of 14 assessors were recruited from among the staff and students of the University of Chile. None had previous experience in FCP, their participation in the sessions was not rewarded.

Free Choice Profiling

The assessors were given a brief outline of the FCP concept and procedure in an initial session. They were asked to smell and taste the samples and to describe, using their own terms, the color, flavor, aroma, texture and mouthfeel of the cheeses.

Individual score cards were prepared and during additional training sessions the assessors evaluated the intensity of each sensory attribute in the five goat cheese samples (three samples per session) placing a mark in unstructured 100 mm line scales anchored at the ends with the terms "weak" and "strong".

FCP assessment was performed following the above mentioned testing protocol. Each assessor evaluated five samples per session over three sessions to provide three replicate assessments (except sample C that was evaluated twice). Each sample appeared in each serving position the same number of times.

Mineral water was provided for mouth-rinsing between samples. All sessions were carried out in a standardized panel test room with separate booths for each assessor (ISO 8589-88).

Acceptability

The acceptability of goat's cheeses was evaluated using a hedonic scale of nine points (1 = I dislike extremely to 9 = I like extremely).

Data Analysis

FCP data were analyzed by Generalized Procrustes Analysis (GPA) using Procrustes PC version 2.2 (Oliemans, Punter and Partners, P.O. Box 14167, 3508 SG Utrecht, The Netherlands). In this work, replicate assessment of samples by each assessor were included as data providing 14 individual matrices all of them with 14 rows (5 samples \times 3 replicates, except sample C that was evaluated twice) and different number of columns, ranging from 18 to 29 according to the number of descriptors used by each assessor.

The dimensions of the average space obtained were interpreted considering the descriptors most highly correlated with each dimension for each assessor (Gains and Thomson 1990a, b; Costell *et al.* 1995).

The acceptability scores based on 9-point hedonic scale were analyzed by analysis of variance using the Statgraphics Plus program.

RESULTS AND DISCUSSION

The 14 assessors generated individual vocabularies ranging from 18 to 29 terms with an average of 23. There were many common terms across the group of assessors, but this did not mean that such terms were necessarily being used in the same way.

Selection of Dimensionality

The total amount of variance explained by the first ten dimensions of the average configuration was 71.81%. The percentage variance explained by each of these ten dimensions suggested that a three dimension solution adequately described most of the variation in the data (46.58%). These dimensions accounted for 22.5%, 16.06% and 7.97% of the variance, respectively, and further dimensions explained only a little proportion of variance (< 6%) and were more difficult to interpret.

Evaluation of Assessor's Performance

Assessors plots (Fig. 1) showed that the consumer group was generally homogeneous with no obvious clustering. This observation must be interpreted with caution since in this plot it is difficult to know how big a difference between assessors should be for it to have a significant effect on the results.

Complementary information can be obtained considering the assessors residual values and the sample plot for each individual assessor.

In Fig. 2 it can be observed that all assessors had a low residual variance ($<0.9\%$) and this indicated that the group was homogeneous. Assessors residuals provide a measurement of goodness of fit of the consensus space for each assessor.

Sample Analysis

The first three dimensions of the sample space are shown in Fig. 3 and 4. Interpretation of the dimensions of the average space is aided by Table 2. Sensory descriptors from assessors showing higher correlation with the three dimensions of the average space are given in this table (only descriptors having correlation coefficients greater than 0.7 with these dimensions are shown in Table 2).

There were four clearly differentiated groups: a first group including cheese A (traditional ripened cheese), the second group containing cheese C (ripened cheese), in the third group cheese E (artisan fresh cheese) and in the last group were cheeses B and D (pasteurized milk fresh cheeses). The cheese samples were grouped in the same way, when Dim 1 was plotted versus Dim 3 (Fig. 4).

Appearance was a dominant factor in discriminating samples, in particular color and superficial aspect. Cheeses A and C were close to the extreme positive end of Dimension 1 (Fig. 3) having a yellow color. The others samples (B, D and E) were evaluated by assessors as uncolored or white, probably due to less ripening time, being situated at the extreme negative of Dimension 1. The more matured colored cheeses A and C, were associated with terms such as consistency and cohesiveness, cheeses B, D and E were associated with terms such as porous and granularity. Cheese A obtained the higher scores for firmness and was situated at the extreme positive of Dimension 2. Finally, cheeses C and E presented the higher scores for acid, spicy and bitter probably due to have been elaborated with raw milk. These results are according, in terms of texture attributes, with others studies of Cheddar cheese (Jack *et al.* 1993; Piggott and Mowat 1991).

Acceptability

Data obtained from acceptability tests using a 9-point hedonic scale were evaluated by analysis of variance (Table 3). The results showed significant differences among assessors ($p = 0.0001$) and cheese samples ($p = 0.0000$), and no differences among replicates.

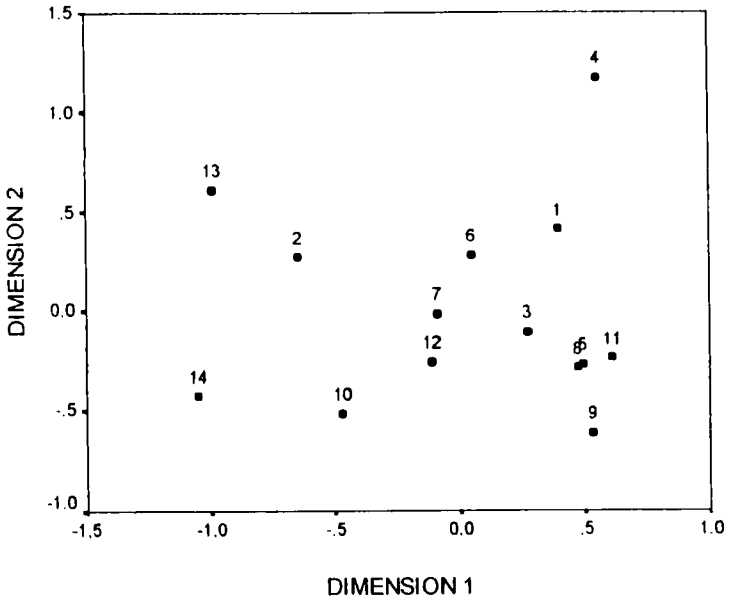


FIG. 1. ASSESSOR'S PLOT
Two first principal dimensions.

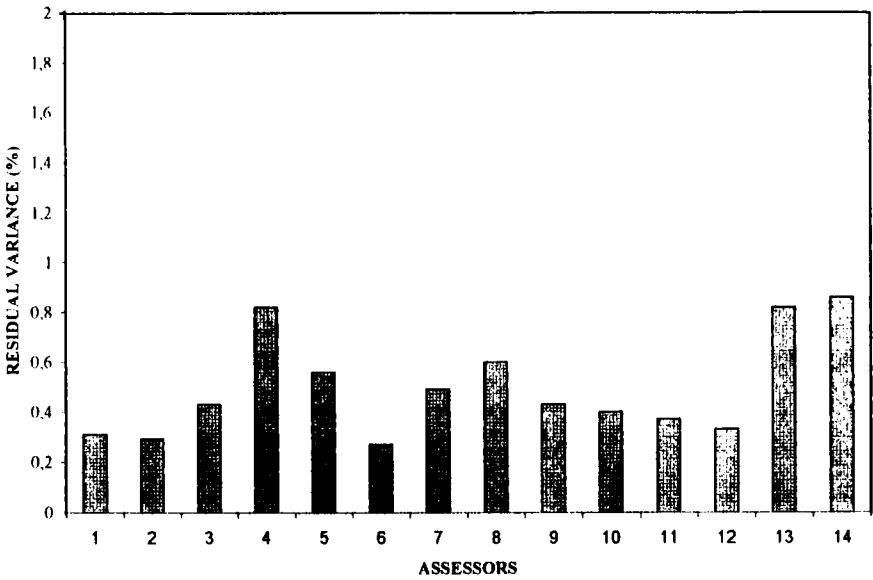


FIG. 2. DISTRIBUTION OF THE RESIDUAL VARIANCE OVER THE
FOURTEEN ASSESSORS

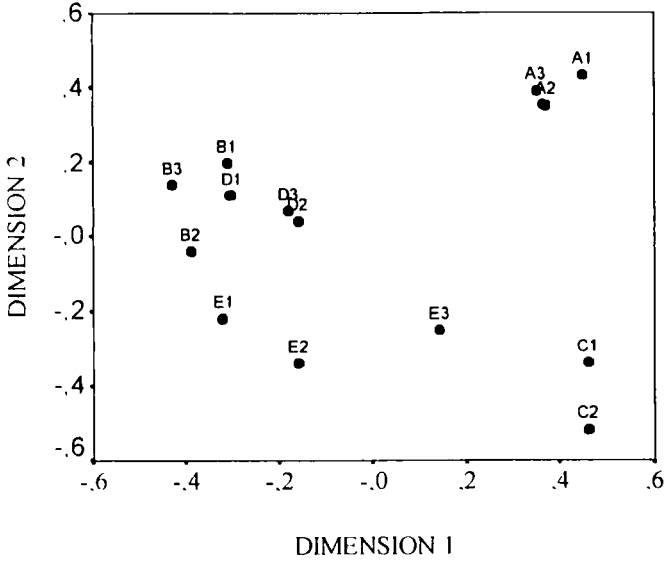


FIG. 3. CONSENSUS CONFIGURATION ON FIRST (HORIZONTAL) AND SECOND (VERTICAL) DIMENSIONS OF THE FIVE GOAT CHEESES WITH REPLICATES

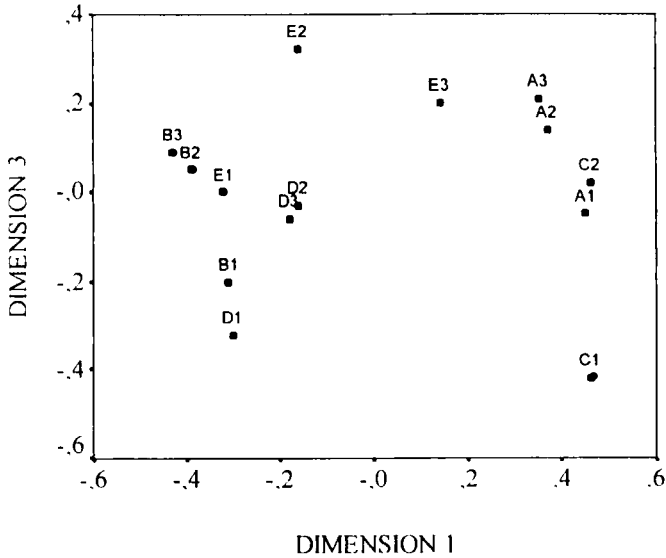


FIG. 4. CONSENSUS CONFIGURATION ON FIRST (HORIZONTAL) AND THIRD (VERTICAL) DIMENSIONS OF THE FIVE GOAT CHEESES

TABLE 2.
AVERAGE CORRELATIONS OF SAMPLE ATTRIBUTES GENERATED BY ASSESSORS
WITH THE FIRST THREE DIMENSIONS FROM FREE CHOICE PROFILE

DIMENSION 1	DIMENSION 2	DIMENSION 3
VISUAL ATTRIBUTES		
Ripened aspect (0.93) Yellow color (0.80) Clear color (-0.82) Ivory color (0.72) White color (-0.78) Consistency (0.70) Grainy aspect (-0.79)	Firmness (0.77) Yellow color (-0.80) Porous (-0.79)	
AROMA ATTRIBUTES		
Strong odor (-0.82) Typical odor of goat cheese (-0.80) Fermented milk Odor (-0.76) Acid milk odor (-0.77)	Strong odor (-0.83) Acid odor (-0.82)	Ripened cheese odor (-0.81)
TASTE ATTRIBUTES		
Ripened cheese taste (0.74) Acid taste (-0.85) Salt taste (-0.83) Sweet taste (-0.70)	Typical goat cheese taste (0.70) Acid taste (-0.81) Spicy taste (-0.75) Bitter taste (-0.70)	Soapy (-0.72)
TEXTURE ATTRIBUTES IN MOUTH		
Consistency (0.83) Cohesiveness (0.75) Crumbs (-0.86) Granularity (-0.83)	Soft texture (-0.81) Creamy (-0.73) Solubility (-0.72)	
RESIDUAL TASTE		
Acid taste (-0.90) Cheese taste (-0.81)	Salt taste (0.72) Acid taste (-0.78)	
RESIDUAL TEXTURE IN MOUTH		
Astringency (-0.76) Roughness (-0.70)	Greasy (-0.74)	Easy dilution in mouth (-0.70)

TABLE 3.
ANALYSIS OF VARIANCE OF ACCEPTABILITY DATA

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-value
Main effects					
Assessors	139.638	13	10.74	3.32	0.0001
Samples	108.735	4	27.18	8.41	0.0000
Replicates	4.641	2	2.32	0.72	0.4894
Residual	569.209	176	3.23		
Total	828.423	195			

To ascertain which sample was significantly more accepted over the rest, Tukey's test was applied to the data. The results were:

B D A C E

where the significance of the underlining is as follows: two samples which are not connected by continuous underlining are different and two samples which are connected by continuous underlining are not different. The assessors preferred the fresh cheeses (B and D) elaborated with pasteurized goat's milk.

Samples B and D were rated higher for overall acceptability. This is in agreement to FCP results, where samples B and D presented similar characteristics. They were judged as cheeses with white color, with typical odor and taste of goat cheese and moderate acid and bitter taste. Also they presented a good texture, between soft cheeses (C and E) and firm cheeses (A). In a study using different ewe milk cheeses, González Viñas *et al.* (1998) found that consumers preferred cheeses with milder attributes.

CONCLUSIONS

Generalized Procrustes Analysis applied to Free Choice Profile data of five goat cheeses permitted differentiation between samples with information on the attributes responsible for these differences. Information on behavior of each of the assessors was also obtained. It is important to note that assessors preferred the fresh cheeses to the ripened ones.

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