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## Comparison of performance and quantitative descriptive analysis sensory profiling and its relationship to consumer liking between the artisanal cheese producers panel and the descriptive trained panel

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### ABSTRACT

The aim of this research was to compare the performance and sensory profiling of a panel of artisanal cheese producers against a trained panel and their relationship to consumer liking (external preference mapping). Performance was analyzed statistically at an individual level using the Fisher's test ( $F$ ) for discrimination, the mean square error for repeatability, and Manhattan plots for visualizing the intra-panel homogeneity. At group level, performance was evaluated using ANOVA. External preference mapping technique was applied to determine the efficiency of each sensory profile. Results showed that the producers panel was discriminant and repetitive with a performance similar to that of the trained panel. Manhattan plots showed that the performance of artisanal cheese producers was more homogeneous than trained panelists. The correlation between sensory profiles ( $Rv = 0.95$ ) demonstrated similarities in the generation and use of sensory profiles. The external preference maps generated individually with the profiles of each panel were also similar. Recruiting individuals familiar with the production of artisanal cheeses as panelists is a viable strategy for sensory characterization of artisanal cheeses within their context of origin because their results were similar to those from the trained panel and can be correlated with consumer liking data.

**Key words:** discrimination, confidence ellipses, Manhattan plot, multivariate multiple factor analysis

### INTRODUCTION

Artisanal cheese-making is a way to economically develop the areas where they are produced (Ramírez-Rivera et al., 2017a). According to NASS (2007, 2016), manufacture of Latin American cheeses increased 33 million kg from 2006 to 2015. The consumption of this food per capita is 20 kg/yr in European countries (i.e., Greece, France) and 2.1 kg/yr in Latin America (i.e., Mexico; Cervantes-Escoto and Villegas-De Gante, 2014). In Mexico, cheese production contributes significantly to the gross domestic product of the food sector (18.5%) and the nation as a whole (0.06%). About 9.5% of the total income was spent on purchasing dairy products, 24% of which was specifically for cheeses (Cervantes-Escoto and Villegas-de-Gante, 2014). Villegas-De-Gante and Cervantes-Escoto (2011) indicated that Mexico officially has about 1,500 artisanal cheese-making plants that employ approximately 20,000 people a year.

Artisanal cheeses have been present in the diets for decades due to their nutritional benefits (i.e., proteins, lipids, and vitamins) and sensory characteristics (Drake et al., 2009a). However, the development of regions, where manufacturing artisanal cheeses are the basis of their economy, faces several difficulties in the attempt to improve their market penetration and customer engagement, such as competition against low-price cheeses, lack of appropriate technology for processing, lack of a collective brand, lack in homogeneity of final product, and fluctuations in sensory quality (Villegas-De-Gante and Cervantes-Escoto, 2011; Cervantes-Escoto and Villegas-de-Gante, 2014). Particularly, sensory quality and homogeneity of product can be key for the development of an identity of artisanal cheeses from

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different regions. Unfortunately, the establishment of sensory quality monitoring programs using an external trained panel can be expensive and difficult to afford by artisanal cheese manufacturers (Ares and Varela, 2017). Evaluating the performance of artisanal cheesemakers in comparison with a trained panel can enable the cheesemakers to perform the sensometric characterization of their products in their own context and reduce costs.

Sensory profiles of artisanal cheeses have usually been conducted by trained panels in large companies; however, sensory tasks in small-scale industry are minimal or absent (Endrizzi et al., 2013). Studies by Bárcenas et al. (2000) and Drake et al. (2009a) used different sensory panels to generate and compare sensory profiles. However, in those studies the experience and sensory perception of artisanal cheese producers were not considered. Van-Rijswijk et al. (2008) indicated that knowledge about a product and familiarization with it can influence the generation of attributes for sensometric characterization. In this regard Ramírez-Rivera et al. (2017b) also described the influence of cultural background of panel members. Moskowitz (2017) suggested that to have a better understanding of the performance of artisanal cheesemakers it is required to compare them with a descriptive trained panel.

Knowledge about cheese-making combined with training in sensory techniques may help producers improve their performance (in terms of development of product description, use of scale, quantification of intensity, and use of sensory techniques) to score similarly to expert trained panelists (ISO standard 8586-2, ISO, 1994a; Endrizzi et al., 2013; Ramírez-Rivera et al., 2017b). However, for this to be valid, the results of a panel consisting of artisanal cheesemakers must be compared and analyzed in the same way as a trained panel in terms of (1) performance at an individual and a group level; (2) the sensory profiles in the same factorial plane; and (3) the degree of correlation of the sensory profile with data of another nature (i.e., consumer liking, physicochemical, or instrumental). These points allow detection of a lack of precision in the results, disagreements, and the inability to discriminate between products as well as to determine the intrinsic quality of artisanal cheeses (Tomic et al., 2010). Mathematically, validation can be carried out by different statistical tools such as ANOVA and graphical resources (i.e., Manhattan plot;  $F$ -values; mean square error, **MSE**) to monitor the performance of a sensory panel (Tomic et al., 2007; Dahl et al., 2008; Tomic et al., 2010). Multivariate multiple factor analysis (**MFA**) and external preference mapping (**PREFMAP**) techniques help in the comparison of sensory profiles between panels and an approach to consumer preferences based on a previously generated sensory vocabulary, respectively (Pagès

and Husson, 2001; Drake et al., 2009b). The MFA technique equilibrates the influence of each panel when searching for agreement that allows for the comparison among sensory descriptions performed by both panels (Lê-Dien et al., 2008). The PREFMAP technique uses a regression model to describe the relation between each hedonic judgment ( $Y$ ) and the principal components ( $X$  or sensory attributes; Tenenhaus et al., 2005).

For all of the above, the aim of this research was to compare the results of a panel of artisanal cheese producers with those of a trained panel in terms of individual and group performance and sensory profiling, and then complement the study by comparing the PREFMAP generated by both panels.

## MATERIALS AND METHODS

### *Origin and Preparation of Artisanal Fresh Cheeses*

Fresh cheese samples were obtained from 4 different goat production units (**GPU**) located in the central mountainous region of the state of Veracruz, Mexico, and that were affiliated with the nonprofit Goat Species Product-System of Veracruz (Sistema Producto Especie Caprino del Estado de Veracruz). Cheeses were prepared according to the procedure indicated by Ramírez-Rivera et al. (2017a) using milk from the Alpine and Saanen goat breeds. One fresh cheese sample was collected from each of the 4 GPU (Coatepec, Coatzintla, Perote, and Tatatila). A total of 4 cylindrical pieces (3 kg each) for each fresh cheese were sampled and wrapped with plastic shrink-wrap and refrigerated at 4°C.

### *Sample Preparation for the Sensory Analysis*

Prior to the analysis, cheeses were kept at  $25 \pm 2^\circ\text{C}$  for 1 h. Each panelist was presented with 20 g of cheese obtained from the middle of the cheese (pieces of 1.5 cm diameter and 3 cm thickness) in 50-mL white plastic cups identified with random 3-digit numbers. Water and unsalted crackers were provided to panelists between samples for palate cleansing (Ramírez-Rivera et al., 2017b).

### *Sensory Descriptive Panels*

The research protocol was approved by the Technical Committee of the Investment and Management Trust of Colegio de Postgraduados and by the cheesemakers of Sistema Producto Especie Caprino del Estado de Veracruz that participated in the sensory training and evaluation process. Two sensory panels were formed independently. Panel 1 was recruited from the arti-

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