Identifying the ideal profile of French yogurts for different clusters of consumers

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ABSTRACT

Identifying the sensory properties that affect consumer preferences for food products is an important feature of product development. Different methods, such as external preference mapping or partial least squares regression, are used to establish relationships between sensory data and consumer preferences and to identify sensory attributes that drive consumer preferences, by highlighting optimum products. Plain French yogurts were evaluated by a sensory profiling method performed by 12 trained judges. In parallel, 180 consumers were asked to score their overall liking and complete a cognitive restraint questionnaire. After hierarchical cluster analysis on the liking scores, preference mapping using a quadratic regression model was performed. Five clusters of consumers were identified as a function of different preference patterns. Contrary to our expectations, fat levels were not discriminating. For each cluster, the results of preference mapping enabled the identification of optimum products. A comparison of the 5 sensory profiles revealed numerous differences between key sensory attributes. For example, one consumer cluster had a strong preference for products perceived as very thick, grainy, but with a less flowing texture, less sticky, whey presence and color, in contrast to other clusters. In addition, each segment of consumers was characterized according to the results of the cognitive restraint questionnaire.

Key words: preference mapping, sensory profile, drivers of preference

INTRODUCTION

The market for dairy products has seen sustained growth and it continues to expand each year with the emergence of new fresh dairy products. In France, for example, the consumption of yogurts has reached 21 kg per capita per year (CNIEL, 2012) and many new products are introduced each year. Formulations (composition and process) vary between different products on the market and affect their structure and rheological and sensory properties, as has been highlighted by numerous studies and reviews (Sodini et al., 2004; Chandan and O'Rell, 2006). In the literature, properties of yogurts have been studied relative to consumer appreciation in target markets (Barnes et al., 1991; Harper et al., 1991; Pohjanheimo and Sandell, 2009). The main interest of these studies is to reduce the gap that may exist between product development and consumer expectations, and consequently to reduce the number of failed new products that may disappear each year from the market. As a result, improving the identification of drivers of liking appears to be a necessary part of the development of new yogurts that will account for these drivers.

Identifying the sensory properties that affect consumer preferences for food products can provide useful information for product development. The sensory properties of products are generally evaluated using descriptive methods, such as conventional profiling. In parallel, determining hedonic responses to products involves asking consumers to identify their preferences. To establish relationships between sensory data and consumer preferences, different multivariate statistical methods such as external preference mapping (Chang and Carroll, 1972) or partial least squares (**PLS**) regression (Wold et al., 1984) can be used. Optimized products can also be identified by highlighting sensory attributes that drive liking. In the literature, external preference mapping has been applied to various food products (Hough et al., 1992; Munoz and Chambers, 1993; Daillant-Spinnler et al., 1996; Arditti, 1997; Helgesen et al., 1997; Hough and Sánchez, 1998; Elmore et al., 1999; Guinard et al., 2001; Faber et al., 2003; Dooley et al., 2010; Bonany et al., 2014). In these studies, principal component analysis (**PCA**) was first performed

Table 1. Composition and texture characteristics of the 8 yogurts studied

Yogurt	Brand[1]	Starter	Texture	Lipid content (g/100 g)	Three-letter code
Product 1	Danone	Standard	Set	>0	Y-F-S
Product 2	Danone	Standard	Set	0	Y-F-A
Product 3	Danone	Standard	Stirred	>0	Y-B-S
Product 4	Danone	Standard	Stirred	0	Y-B-A
Product 5	Danone	Bifidus	Set	>0	B-F-S
Product 6	Danone	Bifidus	Set	0	B-F-A
Product 7	Danone	Bifidus	Stirred	>0	B-B-S
Product 8	Auchan	Bifidus	Stirred	0	B-B-A

[1]Danone, Paris, France; Auchan, Croix, France.

on sensory data. Liking scores were then regressed on the axes of the PCA for each consumer. Four types of regression model can be used; vector, circular, elliptic, or quadratic (Schlich, 1995). Individual models could thus be estimated. This approach made it possible to find an optimum area on the plane to define the sensory characteristics of optimum products.

When focusing on dairy products, the relationships between sensory data and consumer preferences have been investigated using different methods: (1) PLS regression; for example, on Greek yogurts (Desai et al., 2013); (2) a vector regression model; for example, on strained yogurt in the Lebanese market (Kaaki et al., 2012); and (3) a quadratic regression model; for example, on dulce de leche (Gaze et al., 2015). In this last study, the authors emphasized the existence of an ideal product that could be useful to optimize the sensory quality of products and thus increase the probability of their acceptance by consumers. As suggested by the authors, this could also ensure improved profits for manufacturers. But apart from these studies, an ideal profile has rarely been addressed because of the confidentiality of data, and, more importantly, certain methodological limitations such as having a sufficient number of test products to establish statistical models.

In this context, the objective of the present study was (1) to determine the drivers of liking of yogurts using external preference mapping with a quadratic model, and (2) to quantify the intensities of each sensory descriptor of ideal products in clusters of consumers. To achieve this, 8 products were studied. They were chosen to be as broadly representative as possible of the French market for plain yogurts. In parallel with a sensory profile performed by a trained panel, 180 consumers were asked to score their overall liking of the yogurts. Clusters of consumers were identified as a function of their hedonic scores of the products. Preference mapping with a quadratic regression model was performed on each cluster, and an optimum product was thus identified for each one. Finally, the different

groups were characterized using a cognitive restraint questionnaire.

MATERIALS AND METHODS

Products

Eight commercial yogurts were studied. They were chosen to create a broad range that included set and stirred yogurts, with or without a health component (Bifidus content), and with differing fat contents (low-fat and semi-skim milk), according to a full factorial design with three 2-level factors.

The samples were coded using a 3-letter code (e.g., Y-B-S; Table 1). The first letter corresponded to the starter culture (**Y** for standard yogurt or **B** for Bifidus); the second letter corresponded to the texture—**B** for "brassé" (stirred) or **F** for "ferme" (set). The last letter corresponded to the lipid content, with **S** for standard (>0 g per 100 g of product) and **A** for 0% (0 g per 100 g of product). All yogurts were tested midway through their shelf lives and were served just before tasting.

Sensory Characterization

A group of 12 panelists (25–60 yr old; 9 women and 3 men) were selected for their motivation and their ability to describe fresh dairy products. The evaluation was carried out in a standardized room containing separate booths. Ten sessions were completed, including training and evaluation. First, the 12 panelists generated a vocabulary of sensory attributes that covered the appearance, odor, texture, taste, aroma, and aftertaste of the yogurt samples. This was completed by a consensus phase, which enabled compilation of a list of 27 attributes with their definitions and protocols for evaluation (Table 2). Three sessions were then carried out to train the panel on the appearance and texture, odor, taste, aroma, and aftertaste attributes. Finally, panelists were trained in use of a 10-cm unstructured linear scale.