Sensory profile and Beijing youth preference of seven cheese varieties

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ABSTRACT

The sensory characteristics that determined consumer preference of seven imported cheeses were investigated. Descriptive sensory analysis was performed by seven trained panelists who used 24 descriptors to quantitatively describe the sensory characteristics of these cheeses. Principal component analysis of descriptive data found significant differences between the cheeses ($P < 0.05$) on the first three principal components which accounted for 44%, 29% and 11% of the experimental variance, respectively. In parallel, the preference of 217 Beijing youth on these cheeses was expressed on a nine-point hedonic scale. Cluster analysis of the preference data identified five consumer clusters with different preferences and demonstrated that there existed a potential market for each of these cheeses. External preference mapping indicated a relative homogenous preference of Beijing youth for cheese flavor. "Soured milk", "sour" and "milky" flavors and "rate of breakdown", "slimy" and "moist" textures appeared to be drivers of liking for most Chinese youth, whereas "bitter", "salty", "umami" and "free fatty acid" flavors and "firmness" texture were drivers of disliking. In addition, "nutty" as a typical aged flavor in cheese was desirable to some consumer cluster and could be cultivated among Chinese.

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1. Introduction

Over the last two decades, the demand for dairy products in China has increased drastically (Yang, 2007). With the improvement of people's living standards, the structure of dairy products has also changed. Chinese have mainly consumed fresh milk and yogurt. Nowadays, more attention has been paid to non-traditional dairy products such as probiotic beverage and cheese.

Cheese is a relatively new type of food in the traditional Chinese diet. In 2006 the cheese consumption in China was 20,000 tons, of which 90% were imported (Gee & Townson, 2007). Although the cheese import has increased markedly in recent years (1320 tons annually 2000–2006) (Dairy Association of China, 2007), the Chinese cheese market is still at its initial stage. The current Chinese cheese consumption is 200 g per capita annually according to Dairy Association of China (2007). In comparison, the annual per capita consumption is 16 kg in the United States and 24 kg in France (International Dairy Federation, 2007).

Diet cultures and preference of ethnic Chinese are significantly different from those of Western people. To date, there is no data available regarding the preference of Chinese consumers on

cheese. Due to the great variability of cheese varieties and flavors, an extensive and systematic study would be important to the development of a cheese industry in China. Sensory attributes (flavor and texture) are critical to the identity of cheese and consumer acceptance (Van Hekken et al., 2006). Therefore, the first step would be to identify the favorable flavor and texture characteristics that drive Chinese consumer preference for cheese.

Sensory evaluation is one means of measuring and quantifying the relationship between the sensory characteristics of food and its consumer preferences. Techniques such as descriptive sensory analysis, cluster analysis and external preference mapping have been applied to cheese study. Descriptive sensory analysis is a research tool to characterize the aromas and flavors in cheese (Drake, McIngvale, Gerard, Cadwallader, & Civile, 2001). This procedure requires a trained panel to evaluate cheeses and a sensory lexicon to describe their sensory attributes. Cluster analysis techniques can be applied to the analysis of consumer preference data to identify clusters of consumers with similar preference patterns within the sampled population (Pagliarini, Monteleone, & Wakeling, 1997). External preference mapping relates the descriptive sensory data with the consumer preference data and the resulting model helps identify the sensory characteristics required for consumer acceptance or preference (McEwan, 1996; McEwan, Earthy, & Ducher, 1998; Schlich, 1995). External preference mapping has been widely applied to determine consumer preference for cheese sensory characteristics (Caspia, Coggins, Schilling, Yoon, & White,

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2006; Murray & Delahunty, 2000; Young, Drake, Lopetcharat, & McDaniel, 2004).

In this study, Beijing youth's preference for seven imported cheeses was assessed using the preference mapping technique. We chose the youth as the target group since they are most open to new ideas including food. The objectives of this study were: (1) to evaluate the sensory profiles of seven imported cheeses; (2) to define Beijing youth preferences for these cheeses; (3) to characterize the clusters according to socioeconomic data; and (4) to establish the relationships between sensory attributes and Chinese consumer preferences.

2. Materials and methods

2.1. Cheese samples

Seven cheese varieties (six natural and one processed, appropriate 10 kg of each) were purchased from local wholesale or retail shops in Beijing, China. These cheeses were selected to represent the majority of cheese types currently available on the Beijing market. The cheese origin and the main characteristics are summarized in Table 1. All samples were stored under refrigeration conditions and placed at room temperature for 1 h before evaluation. Both sensory analysis by the trained panelists and consumer evaluation by the youth were conducted within 1 month after the cheeses were purchased.

2.2. Descriptive sensory analysis

A portion of all cheese purchased were repacked and shipped to the US. Descriptive sensory assessment was carried out in Kraft Foods Limit (Glenview, IL, USA). Cheese flavors were evaluated using a 0- to 15-point Spectrum™ universal intensity scale while cheese texture attributes were scaled using a 0- to 15-point product specific intensity scale (Meilgaard, Civile, & Carr, 2007). A trained panel (n = 7) (6 females/1 male) with over 150 h of experience each with descriptive analysis of cheese sensory participated in the assessment. During a preliminary session the objectives of the experiment were explained in details. Then the panelists attended six 1.5 h training sessions during a one-week period prior to sample evaluation sessions. During this phase, panelists reviewed all samples, developed 24 descriptors for flavor and texture, and defined the intense of the descriptors (Table 2). Many descriptors in the vocabulary are found in literatures (Drake et al., 2001; Heisserer & Chambers, 1993; Meilgaard et al., 2007; Yates & Drake, 2007). However, some new descriptors specific to these seven cheeses were defined. Each descriptor was extensively described and explained to avoid any uncertainty about the relevant meaning. For each attribute, panelists also chose and identified references, i.e., "any chemical, spice or product which characterizes an attribute or attribute intensity". Once the panel agreed on descriptors and the intensity, evaluation sessions were conducted individually on paper ballots in separate booths dedicated to sensory analysis and free from external aromas, noise and distractions. On the day of assessment the outer layer (5 mm) of each cheese was discarded. A portion (5 g) of Cream and Cottage cheese was placed into 58 ml soufflé cups with lids, while the other five varieties of cheese were cut into 5 g cubes and placed into 58 ml soufflé cups. Each sample was coded with a randomly selected 3 digit number and the order of presentation was balanced to account for first order and carry-over effects (MacFie, Bratchell, Greenhoff, & Vallis, 1989). Flavor and texture evaluations were in separate sessions. Basic taste solutions and previously defined flavor and texture references were available during all flavor and texture evaluations. Panelists evaluated duplicates of each sample in eight evaluation sessions (three or four samples per session). They were instructed to expectorate samples after evaluation. Water (Evian, Danone, France), unsalted crackers (Unsalted Tops Premium Saltine Crackers, Nabisco, Parsippany, NJ, USA) and expectorant cups were provided for rinsing their palates between samples.

2.3. Consumer assessment

Consumer test was performed by 217 youth who attended middle school, high school, or university) in Beijing, aged from 12 to 25. They received a consent form which included a clear description of this study. Only those who returned a consent form participated in the study.

This consumer test was carried out at the sensory laboratory of China Agricultural University, Beijing. The consumers arrived in groups of 20. The seven cheeses were evaluated across 2 days for each group. A constant control cheese was presented with other three cheeses each day, to reduce the testing bias. The control cheese was selected from the descriptive analysis results based on its moderate sensory intensities. The outer layer of each cheese was removed. Samples were cut into 5 g cubes, numbered with 3-digit codes, and served at room temperature. Consumers were allowed to swallow or expectorate the samples as they desired. Retasting was also allowed and each consumer proceeded at his or her own pace. Cheeses were presented individually in a randomized balanced order following presentation of the constant control cheese. The consumers were given two sets of questionnaires. The first questionnaire asked the consumer to score the cheese samples for the overall liking on a nine-point hedonic scale, where 1 = dislike extremely, and 9 = like extremely (Peryam & Pilgrim, 1957). The other questionnaire was designed to collect demographic information.

2.4. Statistical analysis

Descriptive and consumer data were analyzed separately and then compositively. Descriptive data were analyzed with SPSS 16.0 for Windows (SPSS Inc, Chicago, IL, USA) using One-Way ANOVA and the post hoc tests were performed using Duncan's Multiple Range test. Descriptive data were standardized and then analyzed by Principal Component Analysis (PCA) using Unscrambler (v9.7 CAMO, AS, Norway).

A hierarchical clustering using Ward's method was performed with inspection of the dissimilarity plot and dendrogram, which showed that a five-cluster solution would be optimal. After having identified the groups, the consumers were segmented by the k-means clustering method. This method divides consumers into K clusters so that the within-cluster sum of squares is minimized. Chi-squared tests and Fisher's exact tests were conducted to compare consumer demographic data from each segment. These analyses were carried out using SPSS (SPSS 16.0, Chicago, IL, USA). One-Way ANOVA using Duncan's Multiple Range test was also applied to the consumer segments' preference scores to

Table 1
Cheese samples under investigations.

Code	Cheese[a]	Cheese type	Origin
A	Brick	Semi-hard, brick-shaped cheese	USA
B	Cottage	Low fat soft cheese	USA
C	Cream	Soft cheese	USA
D	Havarti	Creamy semi-hard cheese with eyes	Denmark
E	Cheddar	Hard cheese labeled by mild flavor	USA
F	Mozzarella	Semi-hard cheese	USA
G	Processed Cheddar	Processed cheese	Australia

[a] Processed Cheddar cheese was a processed cheese, while all other six cheeses were natural cheeses.