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Sensory properties and drivers of liking for Greek yogurts

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ABSTRACT

Greek yogurt is currently the largest growing sector in the dairy industry. Because no standard of identity exists for Greek yogurts in the United States, and they can be made by a variety of methods, variability in sensory properties is expected. Knowledge of consumer perception and specific drivers of liking will be useful information for product developers. The objective of this study was to document the sensory properties of commercial Greek yogurts and to determine drivers of liking through descriptive profiling and consumer testing. Flavor and texture attributes of commercial Greek yogurts (n = 24) were evaluated in triplicate by a trained descriptive sensory panel. An online survey (n = 520) was used to collect consumer usage and attitude information for Greek yogurts before consumer acceptance testing. Consumer acceptance testing (n = 155) was then conducted on commercial Greek yogurts (n = 10). Univariate and multivariate statistical analyses were used for data analysis. Sensory properties of yogurt differed with fat content and manufacture (Greek vs. fortified Greek). Full-fat yogurts were characterized by firmness and denseness, whereas low- and non-fat yogurts lacked firmness, denseness, cohesiveness, and, after stirring, viscosity. Fortified Greek yogurts generally had more surface shine and jiggle and lower denseness compared with traditional Greek yogurts. Fewer flavor differences were observed among yogurts compared with texture differences. Fortified Greek yogurts displayed a burnt/beefy flavor not documented in traditional Greek yogurts, but this flavor was not evident in all fortified Greek yogurts. Consumer preferred Greek yogurts with firm, dense texture, moderate sweet aromatic, milkfat and dairy sour flavors, and moderate sour taste. Consumers were aware of the increased protein content of Greek yogurts but generally unaware of differences between strained and fortified Greek yogurts; both strained Greek and fortified Greek yogurts received the highest overall liking scores in blinded acceptance testing. Successful Greek yogurts can be manufactured using addition of dried dairy ingredients or by traditional straining and centrifugation.
Key words: yogurt, Greek, flavor, sensory property

INTRODUCTION

Yogurt is a popular food and is believed to be one of the oldest fermented foods, originating in the Middle East and Asia (Tamime and Robinson, 1999). Yogurt production in 1980 was close to 260 million kilograms in the United States and increased to 2 billion kilograms in 2009. Yogurt dollar sales rose 7% to $5.2 billion at the end of May 2011 (Ag MRC, 2013). The US Census Bureau 2012 survey revealed that per capita yogurt consumption has increased more than 400% during the past 30 yr (Dairy Foods Magazine, 2012). Increased yogurt consumption and production are attributed to the perceived health benefits of yogurt and its consumer appeal. The US Food and Drug Administration defines yogurt as, "the food produced by culturing one or more of the optional dairy ingredients cream, milk, partially skimmed milk or skimmed milk, used alone or in combination with a characterizing bacterial culture that contains the lactic acid producing bacteria, *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (US Food and Drug Administration, 2008). Different types of yogurt are defined based on fat content. All yogurts, regardless of the fat content, must have a titratable acidity of at least 0.9% and 8.25% milk solids-not-fat.

Concentrated yogurt or Greek yogurt, known as strained yogurt in Europe, is a fermented semi-solid product derived from yogurt by draining away part of its water and water-soluble components. Strained yogurt is traditionally produced by straining yogurt in cloth bags until the desired level of total solids is achieved; however, modern manufacturing methods include the use of centrifugation and ultrafiltration (Nsabimana et al., 2005). Greek yogurt may also be manufactured using the addition of dried ingredients, including dairy protein ingredients or other hydrocolloids, to provide a thick texture; it is referred to as fortified or Greek-style yogurt when manufactured by using this approach. According to the Codex Standard for Fermented Milk (–Codex Alimentarius, 2003), strained yogurt has to have increased protein content before or after fermentation

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to a minimum of 5.6% compared with regular yogurt, which has a protein content of minimum 2.7%. No legal standard or definition exists in the United States for Greek or fortified Greek yogurt. The increased health awareness associated with the consumption of diets rich in protein has fueled the consumption of Greek yogurt (Jaoude et al., 2010). Greek yogurt accounted for about 25% of all segment sales, more than doubling the figures from the previous year (Anonymous, 2012a).

Sensory properties of yogurts have been documented. Muir and Hunter (1992) examined unflavored fermented milks, including yogurts, and concluded that 8 odor, 12 flavor, 4 aftertaste, and 8 texture attributes were important for the sensory description of these products. Barnes et al. (1991) and Harper et al. (1991) applied 14 attributes that differentiated and described these products. Martin et al. (1999) applied to a trained panel to document the effects of bacterial strain, temperature, pH, and storage time on plain stirred yogurts. Brennan et al. (2002) used children to determine acceptance of yogurt thickness and its influence on perceived flavor intensity. More recently, Coggins et al. (2008) evaluated storage time and temperature effects on yogurt flavor and texture using descriptive analysis.

Preference mapping is used to establish relationships between descriptive panel results and consumer acceptance data (Meilgaard et al., 2007). Drivers of liking for many dairy products including drinkable strawberry yogurt (Thompson et al., 2007), Cheddar cheese (Drake and Yates, 2006; Drake et al., 2008, 2009a), and cottage cheese (Drake et al., 2009b) have been examined using preference mapping. Strawberry remains the most popular yogurt flavor, followed by other fruit flavors (Thompson et al., 2007). Allgeyer et al. (2010) concluded that for flavored yogurt drinks, a medium level of sweetness and a high viscosity drove consumer liking. Thompson et al. (2007) concluded that strawberry flavor, aroma, and sweetness were the 3 main drivers of liking for drinkable strawberry-flavored yogurts.

Sensory properties and drivers of liking for Greek or fortified Greek yogurt have not been reported. Because no standard of identity exists for Greek yogurts and they can be made by a variety of methods, variability in sensory properties is expected. The list of permissible ingredients is vast and the choice of ingredients used can affect sensory properties. Knowledge of consumer perception and specific drivers of liking will be useful information for product developers. The objective of this study was to document the sensory properties of commercial Greek yogurts and to determine drivers of liking through descriptive profiling and consumer testing. A category survey of commercial Greek yogurts was conducted followed by a consumer survey, acceptance testing, and preference mapping.

MATERIALS AND METHODS

Yogurt

Plain commercial Greek yogurts (n = 24, 15 strained, 9 fortified) were collected from across the United States. Yogurts were selected based on market share as well as fat content (full fat = 5, reduced or low fat = 5, and fat free = 14). National, regional, and store brands were included. Samples were purchased from the store at least 30 d before their expiration date and stored in the dark at 4°C. Each product was evaluated no later than 21 d before the expiration date. Triplicate lots of each brand were obtained approximately 20 d apart.

Composition Analysis

Proximate analysis was conducted on all the yogurts (n = 24). They were analyzed for total solids by vacuum drying oven (AOAC International, 2012; method 990.20; 33.2.44). Measurement of pH was conducted using a Mettler-Toledo (Schewezenbach, Switzerland) probe (Combination Electrode, BNC, Corning, NY) at 4°C. Protein content was determined using the Sprint Rapid Protein Analyzer (CEM, Matthews, NC), and fat content was determined by Mojonnier analysis. All measurements were taken in duplicate.

Descriptive Analysis

Sensory testing was conducted in compliance with the North Carolina State University (**NCSU**) Institutional Review Board for Human Subjects approval. Yogurts (30 g) were scooped into lidded 60-mL soufflé cups with random 3-digit codes. Yogurts were tempered to 12°C for tasting. Each sample was served monadically with deionized water and unsalted crackers.

A trained descriptive sensory panel (n = 8, females, ages 24 to 50 yr) evaluated the samples using a 0–15 intensity scale consistent with the Spectrum method (Drake and Civille, 2003; Meilgaard et al., 2007). Each panelist had more than 200 h of prior experience with the descriptive analysis of flavor and texture of foods, and approximately 100 h of experience with descriptive analysis of dairy products, including cheese, sour cream, and milk powders. Yogurt attributes were generated in consensus across three 2-h sessions during which panelists tasted an array of yogurts along with other cultured dairy products (sour creams and buttermilks). The lexicon generated for yogurts included 10 flavor, 4 taste, 2 appearance, and 8 texture attributes (Tables 1 and 2). Ten 3-h sessions were subsequently conducted to allow the panel to consistently identify and score the attributes. Analysis of variance of the data collected