A comparison of fresh, *pasta filata*, and aged Hispanic cheeses using sensory, chemical, functional, and microbiological assessments

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ABSTRACT

Anecdotal information suggests that some Hispanic consumers may consider US-made Hispanic cheeses as having a general lack of authenticity compared with those made in their countries of origin. To characterize the potential differences, samples of fresh, *pasta filata*, and aged Hispanic cheeses were acquired from both the United States (total n = 39) and countries of origin (total n = 30) purchased from Mexico, Central America (Costa Rica and El Salvador), and the Caribbean (Puerto Rico). The proximate composition, microbial counts, melt profile, and sensory characteristics were evaluated and compared in country-of-origin cheeses and the US-made counterparts. The presence of *Listeria* spp. was confirmed for 1 Mexican aged cheese sample and 6 cheese samples from Central America (3 fresh, 2 *pasta filata*, and 1 aged). The chemical composition, melt profile, and sensory characteristics of fresh and *pasta filata* US Hispanic cheeses were not significantly different from their Mexican counterparts. Likewise, the chemical composition and melt profile of US aged Hispanic cheeses was not significantly different from the aged Mexican cheeses, but sensory characteristics varied among all aged cheeses. These results demonstrate the similarities and differences among US fresh, *pasta filata*, and aged Hispanic cheeses relative to their counterparts made in the countries of origin.
Key words: Hispanic cheese, sensory, canonical discriminant analysis

INTRODUCTION

In general, the term "Hispanic cheese" refers to cheeses that originate in the Spanish-speaking countries of North and South America. Hispanic cheeses can be loosely grouped into traditional classifications of fresh, semi-hard, and hard cheeses based on moisture content, culinary application, and age of the cheese. Fresh cheeses, such as Queso Fresco and Queso Panela, are high in moisture, have a pH of 5.3 to 6.5 (Hnosko et al., 2009), undergo little to no ripening, and consequently have a shelf life of 2 to 3 wk with high susceptibility to microbial contamination and outgrowth. *Pasta filata* cheeses such as Queso Oaxaca, Queso Asadero, and Quesillo, are soft to semi-hard cheeses with lower moisture content than fresh cheeses, have a pH of 5.0 to 5.6, and are generally recognized as melting cheeses. Aged cheeses, such as Queso Cotija, Queso Duro, and Queso Añejo, are characterized by their hard texture, low moisture, and high sodium content (Tunick, 2007) with strong flavors and aromas reminiscent of those in Parmesan or Romano cheeses, and are commonly grated or crumbled in culinary applications.

The production of Hispanic cheese varieties in the United States has increased from 96 million pounds in 2001 to over 250 million pounds in 2014 (USDA, 2015). This significant growth is driven by the increased popularity of Hispanic foods in the United States (Packaged Facts, 2012) and by the fact that, with a population of over 52 million, the Hispanic ethnicity is the fastest-growing consumer segment in the United States (US Census Bureau, 2012). However, despite the increased domestic supply of Hispanic cheese, anecdotal information suggests that Hispanic consumers may consider US-made Hispanic cheeses inauthentic. Consequently, some Hispanic consumers select cheeses imported from their countries of origin, as evidenced by the 34 million pounds of Hispanic cheese imported annually, on average, between 2009 and 2014 (Wisconsin Milk Marketing Board, 2015), or even cheeses manufactured in small, unlicensed facilities that might not fully comply with regulatory standards, thus presenting a potential health risk. This study explored whether specific differences exist in the composition, functionality, flavor, and texture properties of Hispanic cheeses made in the United States compared with those made in their countries of origin with the intention to aid US cheese manufacturers in producing Hispanic cheeses with more authentic character.

MATERIALS AND METHODS

Cheese Samples

Commercial samples (∼1.5 kg) corresponding to different US-made Hispanic fresh (Queso Blanco, n = 21), *pasta filata* (Queso Oaxaca, n = 6), and aged (Queso Cotija, n = 12) cheeses were purchased from stores in different cities of the United States, including Madison and Milwaukee, Wisconsin; Chicago, Illinois; and Los Angeles and San Diego, California. Samples of fresh (Queso Panela, n = 6), *pasta filata* (Queso Oaxaca, n = 6), and aged (Queso Cotija, n = 3) cheeses made in Mexico were purchased in Hermosillo, Sonora, and Cuernavaca, Morelos. Samples of fresh (Queso Turrialba, n = 3), *pasta filata* (Queso Palmito, n = 3), and aged (Queso Bagaces, n = 2, and Queso Duro Viejo, n = 2) Central American cheeses were purchased in San Jose, Costa Rica, and San Salvador, El Salvador. Samples of fresh (Queso Blanco Fresco, n = 4) and *pasta filata* (Queso Oaxaca, n = 1) Caribbean cheeses were purchased in San Juan, Puerto Rico, but no aged samples were found. All samples were transported in refrigerated containers within 24 h of purchase and, upon arrival, assigned a random 3-digit reference number and stored at refrigeration temperatures for no longer than 2 wk before analysis. Samples were acquired over a period of 12 mo. It was our intention to secure more imported samples for study but import costs and customs restrictions prevented this endeavor.

Proximate Composition

All samples were analyzed, in triplicate, for protein and fat contents using AOAC International (2000) methods (methods 991.20 and 933.05, respectively), moisture and pH as described in Wehr and Frank (2004; methods 15.111 and 15.022, respectively), and sodium content using a chloride analyzer (M926 Chloride Analyzer, Nelson-Jameson, Marshfield, WI) as described in Johnson and Olson (1985).

Microbiological Analyses

Cheese samples were analyzed for aerobic plate count, coliform, and yeasts and molds using AOAC International (2000) methods (990.12, 991.14, and 997.02, respectively), heterofermentative lactobacilli following Downes and Ito (2001; method 19.526), and lactic acid bacteria as described in CCFRA (1995; method 14.1). Additionally, cheeses were assessed for the presence of *Listeria* spp. (Hitchins, 1998), *Salmonella* spp. (Andrews and Hammack, 1998), and coagulase-positive staphylococci (Bennett and Lancette, 2001), and any samples found positive for any of the 3 type of bacteria were excluded from sensory studies.

Melt Profile

Melting properties were characterized using a UW Meltmeter (Muthukumarappan, 2001) at the time the samples were evaluated by the descriptive panel. Samples were cut into cylinders 7 mm in height and 30 mm in diameter and allowed to stabilize to a temperature of 6°C over 3 h; then, the height of the sample was recorded every 3 s over a period of 15 m. The softening point, flow rate, and degree of flow of each sample were calculated from the melt profile obtained. Each sample was measured in quadruplicate.

Descriptive Sensory Analysis

Individuals from university staff and the student body (n = 13) were selected based on availability, interest, and sensory acuity. The panel received 30 h of training and 10 h of practice on the Spectrum method (Meilgaard et al., 2007) for appearance, hand texture, mouth texture, and basic taste attributes, and on quantitative descriptive analysis for flavor attributes. Appearance (Table 1) and texture (Table 2 and Table 3) attributes were evaluated using visual, hand, mouth, and residual techniques (Drake et al., 1999; Brown et al., 2003; Meilgaard et al., 2007). Hand firmness anchors were created using commercial putty (Thera-Flex Therapy Putty, Isokinetics Inc., De Queen, AR) with different degrees of resistance. Flavor descriptors (Table 4) were adopted from previous research on Cheddar cheese (Drake et al., 2001) and the Chihuahua cheese lexicon (Van Hekken et al., 2007), and were then expanded during training sessions as panelists identified and defined other attributes.

Cheese samples were prepared 2 h before evaluation. Cheese was cut into 2-cm^3 cubes using a cheese slicer (Easy Cheeser N55300A-2, Nemco Inc., Hicksville, OH). Four cubes from each sample were placed in covered plastic containers labeled with random 3-digit codes and stored at 4°C until analysis. All evaluations were done at room temperature (21°C) and the appearance, texture, and flavor references were available to the panelists at all times.

Statistical Analysis

Statistical differences in proximate and melt profile data were determined by ANOVA using Fisher's least significant difference at $\alpha < 0.05$. Sensory data were evaluated using canonical discriminant analysis on the means of each product by region of origin. Flavor