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Nutritional and sensory characteristics of Minas fresh cheese made with goat milk, cow milk, or a mixture of both

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ABSTRACT

This study aimed to assess and compare the nutritional, technological, and sensory characteristics of Minas fresh cheese made with goat milk, cow milk, or a mixture of the two stored in cold conditions for 21 d. The yield and centesimal composition of the cheeses were not affected by the type of milk used in their preparation. Reductions were observed in the moisture content, pH, proteolysis index, and instrumental hardness; moreover, increases were observed in the syneresis, acidity index, and depth of proteolysis index in all cheeses. The percentages of caprylic, capric, oleic, and linoleic fatty acids were higher in goat milk cheese and cheese made with a mixture of goat and cow milk compared with cow milk cheese, and a sensory evaluation revealed differences in color, flavor, and aroma between the cheeses. The preparation of Minas fresh cheese with a mixture of goat and cow milk can be a viable alternative for dairy products in the market that can be characterized as high-quality products that meet consumer demands.
Key words: goat raising, dairy product, quality, cheese

INTRODUCTION

Minas fresh cheese is one of the most traditional dairy products produced in Brazil, which outstandingly accepts it in the domestic market (Souza and Saad, 2009). The ubiquity of this cheese is defined by its high yield, simple manufacturing process, low cost, and acceptance by most consumers, all of which garner the interest of the cheese industry. Minas fresh cheese that is produced from the enzymatic coagulation of milk with rennet, with or without starter cultures, exhibits a soft texture, a slightly acidic flavor, and a high moisture content and should be consumed shortly after production (within 20 d; Andreatta et al., 2009; Souza and Saad, 2009).

Cheeses made with goat milk are consumed worldwide and have been associated in recent years with increased goat milk production and demand in numerous countries (dos Santos et al., 2012; Queiroga et al., 2013). However, a lack of technology and research characterizing dairy products made with goat milk limit its expansion in the market. In addition, the sensory aspects of goat products, such as a more intense flavor and aroma, also contribute to the low acceptance of these products by some consumers (Dubeuf, 2005).

In this context, partial substitution of goat milk for cow milk in dairy products, such as cheeses, offers an alternative for consumers who wish to consume more goat dairy products (Sheehan et al., 2009). This partial substitution of goat milk with cow milk may represent an opportunity to diversify the dairy market because it may add value and unique characteristics in comparison to products made only with cow milk (Vargas et al., 2008). These features are largely related to the chemical composition of goat milk, which consists of proteins with high biological value and a lower allergenic potential. These characteristics are related to the quantity and structural differences of whey proteins (α-LA and β-LG) and to small-diameter fat globules, which allow for higher digestibility compared with cow milk. In addition, goat milk harbors a higher mineral content (calcium, iron, zinc, and magnesium), a higher vitamin content (A and B complexes) and has less atherogenic FA, which characterize it as a highly nutritious food for consumers (Haenlein, 2004; Park et al., 2007; Slačanac et al., 2010).

Considering these aspects, studies that evaluate the characteristics of cheeses made with goat milk and that discuss innovative technologies for developing these products are vital for disseminating the technological and nutritional advantages of goat milk, with the goal of enhancing goat milk production. We aimed to develop and assess some of the nutritional, technological, and sensory parameters of Minas fresh cheese produced

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with a mixture of goat and cow milk, which were compared with the characteristics observed for Minas fresh cheese made with goat or cow milk alone.

MATERIALS AND METHODS

Experimental Design and Raw Materials

Three different cheese types were made in triplicate at 3 different times, from the same milk batch. The following 3 treatments were adopted, using a randomized experimental design: cheese made with cow milk (**CCM**; 100%); cheese made with goat milk (**CGM**; 100%); and cheese (**CCGM**) made with a mixture of cow milk (50%) and goat milk (50%). Cow (Girolando breed) and goat milk (Alpine breed) samples were obtained from the Department of Production, Federal University of Paraíba (Bananeiras, Paraíba, Brazil). The average physicochemical values for 100 g of goat milk (in g; means ± SD) were protein, 3.75 (±0.32); fat, 3.35 (±0.13); ash, 0.73 (±0.09); lactose, 4.31 (±0.01); and TS, 11.40 (±0.26), with a pH of 6.48 (±0.03), whereas the values for 100 g of cow milk were (in g) protein, 4.33 (±0.39); fat, 3.23 (±0.21); ash, 0.70 (±0.07); lactose, 5.79 (±0.02); and TS, 12.60 (±0.56), with a pH of 6.87 (±0.01).

Manufacture of Minas Fresh Cheese

The cheeses were manufactured following the procedure described by Buriti et al. (2005). Goat and cow milk were heat treated (65°C/30 min), cooled to 37°C, and 0.01 g/L of lyophilized mesophilic starter culture DVS (R-704 *Lactococcus lactis* ssp. *lactis* and *Lactococcus lactis* ssp. *cremoris*; Chr. Hansen Indústria e Comércio Ltda, Valinhos, Brazil) was added by direct inoculation. Fifty percent calcium chloride (0.5 mL/L) and 0.8 mL/L of commercial rennet (Ha-La; Chr. Hansen Indústria e Comércio Ltda) were added. The cultures remained at rest (37°C) until a firm curd was observed (approximately 40 min), which was smoothly cut into cubes, slowly stirred for 20 min, and salted in brine (15 g of NaCl/kg) while the cheese whey was partially removed. The curd was placed in a perforated circular container (10-cm diameter) and stored at 4°C for 24 h. The cheese obtained after storage at 4°C for 24 h was regarded as the final product. The cheeses were vacuum packaged in sterile polyethylene bags and stored for 21 d at 4°C.

Analyses

The final product (stored at 4°C for 24 h) and cheeses stored for 7, 14, and 21 d (at 4°C) were submitted to physical, chemical, proteolytic, and instrumental texture analyses after 25-g portions were aseptically collected. The FA profile determinations and sensory analyses were conducted after 7 and 14 d of storage.

Yield and Syneresis

The yield of each formulation was expressed as the ratio between the mass of fresh cheese produced and the milk volume used (kg of cheese/L of milk; Fritzen-Freire et al., 2010). Syneresis was calculated as the whey mass (in grams) released from each cheese sample in its own package after different storage periods divided by the cheese mass (in grams) in the same packaging multiplied by 100 (Souza and Saad, 2009).

Microbiological Analyses

To evaluate the microbiological quality of the raw materials and cheeses, we quantified the total and thermotolerant coliforms (most probable number/g), the coagulase-positive staphylococci (cfu/g) and verified the presence of *Salmonella* spp. and *Listeria monocytogenes*, according to the methodology recommended by the American Public Health Association (APHA, 2001).

Physicochemical Analyses

The moisture (method 925.09), fat (method 2000.18), lactose (method 923.09), ash (method 930.30), and acidity (g/100 g of lactic acid; method 920.124) were analyzed according to the AOAC International (2005) guidelines. The total protein was estimated by the Kjeldahl method (method 939.02) using a conversion factor of 6.38. The cheese pH was determined using a digital pH meter (model Q400AS; Quimis, Diadema, São Paulo, Brazil).

Instrumental Color Analysis

The CR-300 colorimeter (Minolta Co., Osaka, Japan) was used for instrumental color evaluation. The CIE Lab color scale (where **L*** represents the lightness of the color, **a*** represents its position between red/magenta and green, and **b*** represents its position between yellow and blue) was used with a D65 illuminate (standard daylight) at a 10° angle. The L*, a*, and b* parameters were determined according to the International Commission on Illumination (CIE, 1996). Using reference plates, the apparatus was calibrated in the reflectance mode, and the specular reflection was excluded. A 10-mm quartz cuvette was used for analyz-