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Effect of somatic cell count in goat milk on yield, sensory quality, and fatty acid profile of semisoft cheese

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ABSTRACT

This study investigated the effect of somatic cell count (SCC) in goat milk on yield, free fatty acid (FFA) profile, and sensory quality of semisoft cheese. Sixty Alpine goats without evidence of clinical mastitis were assigned to 3 groups with milk SCC level of <500,000 (low), 500,000 to 1,000,000 (medium), and 1,000,000 to 1,500,000 (high) cells/mL. Thirty kilograms of goat milk with mean SCC levels of 410,000 (low), 770,000 (medium), and 1,250,000 (high) cells/mL was obtained for the manufacture of semisoft cheese for 2 consecutive weeks in 3 lactation stages. The composition of milk was analyzed and cheese yield was recorded on d 1. Cheese samples on d 1, 60, and 120 were analyzed for total sensory scores, flavor, and body and texture by a panel of 3 expert judges and were also analyzed for FFA. Results indicated that milk composition did not change when milk SCC varied from 214,000 to 1,450,000 cells/mL. Milk with higher SCC had a lower standard plate count, whereas coliform count and psychrotrophic bacteria count were not affected. However, milk components (fat, protein, lactose, casein, and total solids) among the 3 groups were similar. As a result, no significant differences in the yield of semisoft goat cheeses were detected. However, total sensory scores and body and texture scores for cheeses made from the high SCC milk were lower than those for cheeses made from the low and medium SCC milks. The difference in milk SCC levels also resulted in diverse changes in cheese texture (hardness, springiness, and so on) and FFA profiles. Individual and total FFA increased significantly during ripening, regardless the SCC levels. It is concluded that SCC in goat milk did not affect the yield of semisoft cheese but did result in inferior sensory quality of aged cheeses.

Key words: somatic cell count, goat cheese, sensory quality, free fatty acid

INTRODUCTION

The worldwide dairy goat population reached 160 million in 2006 and goat milk production surpassed 13.8 million tonnes, representing significant increases of 12 and 15%, respectively, as compared with a decade ago (FAOSTAT, 2007). Since goat milk was specifically defined in the Grade A Pasteurized Milk Ordinance in 1989, it has become more and more popular in the United States. The number of dairy goats in the United States approached 2 million in 2007 (USDA, 2007). Goat milk cheese has gradually gained popularity among certain ethnic groups, health food lovers, and goat milk producers in the United States. The dairy goat industry is now playing an active role in the agricultural economy of many states and becoming an economically viable income source for many small-scale farmers (Park, 1991; Dubeuf et al., 2004).

Subclinical mastitis in goats has been reported to reduce milk and cheese yields because of deterioration of milk quality in the infected glands, reflected by high SCC (Leitner et al., 2004). Somatic cell count in cow milk is commonly used as an effective index of udder health in dairy cows. Many studies have been carried out to determine the effect of SCC on the yield and quality of milk and dairy products, especially cheeses. The increase of cow milk SCC above 100,000 cells/mL was reported to have a negative effect on cheese yield (Barbano et al., 1991). High SCC in milk results in a longer coagulation time and a weaker coagulum during cheesemaking, which in turn leads to increased moisture content in the cheese and an overall lower cheese yield (Rogers and Mitchell, 1994; Auldist and Hubble, 1998; Klei et al., 1998).

It is generally agreed that goat milk has a higher SCC than cow milk and sheep milk (Park, 1991; Zeng and Escobar, 1996) because of the apocrine secretory system of dairy goats (Dulin et al., 1982). Goat milk SCC has been the target of different legal limits or payment-by-

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quality schemes proposed by different countries (Zeng et al., 2010). The current Pasteurized Milk Ordinance regulation (PMO, 2007) allows 1,000,000 somatic cells/mL in grade A goat milk, whereas the limit of cow milk SCC has been 750,000 cells/mL. However, the interrelationship between intramammary infection, inflammatory response, caseinolysis, and consequently, cheese yield and quality are complicated (Le Roux et al., 1995). To interpret the effects of subclinical mastitis in goats on quality and production of milk and cheese, and to determine whether SCC can be used as a single, reliable measure to correlate between SCC in goat milk and cheese yield and quality, it is necessary to understand the effects of SCC levels in goat milk on the yield and quality of cheese. Information is also greatly needed to assist payment-by-quality schemes to make goat dairying profitable for both goat milk producers and cheese manufacturers and to promote the dairy goat industry as an economically sustainable agricultural segment. Therefore, this study was carried out to investigate the effect of SCC in goat milk on yield, quality, and fatty acid profile of semisoft cheese.

MATERIALS AND METHODS

Milk Sample Collection

Milk was obtained from lactating Alpine does in the E (Kika) de la Garza American Institute for Goat Research of Langston University (Langston, OK) at 3 stages of lactation (May, July, and early October). Average DIM were approximately 35, 110, and 181 d for early, middle, and late lactations, respectively. Prior to milk collection, milk samples from individual lactating goats were screened 3 times for SCC at the certified Langston University DHI laboratory. Sixty Alpine goats without evidence of clinical mastitis were assigned to 3 groups with milk SCC levels of <500,000 (low), 500,000 to 1,000,000 (medium), and 1,000,000 to 1,500,000 (high) cells/mL. Does in each group were milked separately using 10 units of a side-by-side pipeline milking system (Alfa Laval Agri Inc., Kansas City, MO) on the Langston University dairy goat farm. Thirty kilograms of milk per batch was collected from each group in 2 to 3 milkings for cheese manufacture. Duplicate experiments were conducted in 2 consecutive weeks at all 3 stages of lactation.

Chemical Composition, SCC Analysis, and Microbiological Tests

Prior to cheesemaking, 1 representative milk sample (40 mL) from each group was collected and analyzed in duplicate for chemical composition (fat, total protein, lactose, and TS) and SCC using a CombiFoss 5000 unit (Foss North America, Eden Prairie, MN) that was calibrated monthly. Antibiotic residue was also tested using SNAP test kits and a Snapshot Reader (Idexx Laboratories Inc., Westbrook, ME) before cheese manufacture. Another representative milk sample (100 mL) was aseptically collected from the storage milk can of each group and analyzed for SPC, coliform count (**CC**), and psychrotrophic bacteria count (**PBC**; Wehr and Frank, 2004) on the same day. After microbiological tests, pH of goat milk was measured (Wehr and Frank, 2004).

Cheese Manufacture and Sampling

Three batches of semisoft (Colby-like) cheese were made simultaneously in the Langston University dairy processing pilot plant from milk with 3 SCC levels following procedures of Kosikowski and Mistry (1999). Briefly, 30 kg of milk was pasteurized at 63°C for 30 min and cooled to the ripening temperature (31 ± 1°C). Three grams of direct vat set (DVS) culture (MAO11, Texel Group Rhone-Poulenc, Saint-Romain, France) was inoculated to the milk. After 60 min of ripening, 5 mL of double-strength chymosin (Rhodia Inc., Madison, WI) was diluted with deionized water (1:40) and added to the milk. After 45 min of coagulation at 31 ± 1°C, the coagulum was cut with 8-mm curd knives. The curd temperature was raised to the cooking temperature of 39°C over a period of 30 min, and the curd was cooked for another 30 min at this temperature. One-third of the whey was drained and the curd was washed twice using cold water. After draining, 130 g of salt was sprayed onto and mixed with the curd. The curd was packed into hoops and initially pressed at 276 kPa for 2 h, and then at 483 kPa for 14 h (overnight) at room temperature (21 ± 1°C). Cheeses were taken out of the hoops and cut into 3 blocks after weighing. One of the blocks was used for subsequent sampling and analysis of pH, sensory quality, and texture profile analysis (**TPA**). Two more samples of the same block were collected and stored at −20°C for later analyses of moisture and FFA. The other 2 cheese blocks were aged at 8 to 10°C for 60 and 120 d after vacuum package. Cheese samples were then collected and the same analyses were conducted on d 60 and 120 of aging. The above study was repeated the following week at all 3 stages of lactation.

Cheese Composition

Moisture content of cheese samples was determined by freeze-drying (FTS Systems, Stone Ridge, NY). Then, moisture-adjusted cheese yields (Y_{MA}) were arithmetically calculated from actual yields (Y_A) as described by