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Effect of 3 months frozen-storage on organic acid contents and sensory properties, and their correlations in soft goat milk cheese

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Abstract

Organic acid concentrations and sensory properties, and correlations between the two parameters for soft goat milk cheeses were evaluated throughout 3 months of frozen-storage. Three different lots of commercial soft goat cheeses were purchased, and subdivided into three equal portions. One portion was stored at 4 °C as the non-frozen control and the other two were immediately frozen (−20 °C) for 0 and 3 months, then subsequently thawed the next day at 4 °C and stored at 4 °C for 0, 14 and 28 days. Organic acids were analyzed using a HPLC (Hewlett Packard; LC-1100 Series). Descriptive sensory properties were evaluated by a trained panel, and flavors and tastes were scored on a 10-point Spectrum™ intensity scale. Results showed that tartaric, citric, uric and propionic acids in the soft goat cheese tended to increase after 3 months frozen-storage, while formic and malic acids decreased, and pyruvic acid was absent. Initial sensory properties of goat cheeses through 3 months frozen-storage were not changed in comparison of non-frozen fresh cheeses. However, cooked/milky, whey, milkfat, diacetyl and sweet, sour, and salty tastes diminished with prolonged refrigerated aging time for all frozen-storage regimes, while brothy, yeasty, and oxidized flavors increased. Some correlations (r) between organic acids and sensory properties were observed, including r-values between tartaric acid and goaty/waxy flavor, formic acid and sour taste, malic acid and cooked milky flavor, acetic acid and saltiness, citric acid and whey flavor, propionic and brothy or oxidized flavor, and some unknown acids with milk fat lactone flavor.

Keywords: Goat cheese; Organic acids; Sensory score; Correlations

1. Introduction

Extended storage of caprine milk cheeses is not only greatly desired for year-round marketing, but important for the enhancement of the sustainability and profitability of the dairy goat industry due to the sea-

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sonality of goat milk production (Park et al., 2002). Therefore, exploring the feasibility of extended storage of goat milk cheeses in frozen-storage, and evaluation of effects of such storage on chemical and sensory qualities would be of great importance.

The flavor profile of a cheese is dependent on the cheese variety and type. Organic acids are important compounds affecting flavors of most aged cheeses. They are formed as a result of hydrolysis of milk fat during lipolysis, bacterial growth, normal ruminant metabolic processes, or addition of acidulants during cheesemaking (Adda et al., 1982; Park, 2001; Akalin et al., 2002; Izco et al., 2002). Organic acid are an indicator of microbial metabolism and classifying index of varieties of cheese types for their ripening stages (Califano and Bevilacqua, 1999; Akalin et al., 2002). Quantitative analysis of organic acids is an important tool for studying flavor and nutritional quality as well as a determining factor of bacterial activity of aging cheeses, since organic acid concentrations were well correlated with the total aroma intensity in grating cheeses (Akalin et al., 2002).

Sensory properties of goat milk cheeses are an important factor for consumer acceptability and marketability of the products. Most sensory and textural attributes of cheeses increase during ripening. Researchers reported that Cheddar cheese increased in sharpness, sourness, dirtiness, fruity flavor, fermented flavor, unpleasant aftertaste, bitterness intensity as the cheese ripened (Schroeder et al., 1988; Barlow et al., 1989; Grazier et al., 1991). Research to improve the ability to predict the quality of aged cheeses beyond that achieved by cheese graders has been based on flavor volatiles, composition, chemical indices and sensory attributes (Roberts and Vickers., 1994).

In a study with the freezing of sheep milk curd, Sendra et al. (2002) found that there was no difference in moisture loss in the cheeses made from frozen curds. No significant changes in the main components of cheese or in the lipolytic activity were observed. In another study, they noted that temperature fluctuations during frozen-storage of sheep milk curds did not affect curd composition, proteolysis, lipid stability and pH. Ripening partially overcame changes in the microstructure observed in the frozen curds (Sendra et al., 1999). Freezing fully ripened sheep milk cheeses at −20 °C for up to 6 months was a suitable method of storing cheeses to control inventory throughout the year (Tejada et al., 2002).

Although numerous varieties of goat milk cheeses are produced worldwide, and goat milk cheese has recently gained popularity among many consumer groups and farmers in the United States (Park and Jin., 1998), few studies have been conducted on storage stability of goat milk cheeses in relation to organic acid contents, rheology, and sensory scores of the products. The objectives of this study were to: (1) determine the profiles of organic acids and sensory properties of soft goat cheeses, and (2) evaluate the correlations between the two indices in the goat cheeses stored under different storage and aging treatments.

2. Material and methods

2.1. Preparation of soft goat milk cheese samples

Three batches of commercial soft goat milk cheeses were purchased from the Blue Moon cheese company, Harlem, Georgia, and the cheeses were manufactured using a modification of the method of Le Jaouen (1987). Goat milk was pasteurized at 62.8 °C for 120 min and followed by slow coagulation and natural draining, then hanging the cheese in cheesecloth for 3 days in a cool room (22 °C) before packaging. The cheeses were packaged in 0.454 kg rod shapes with polyolefin shrink wrap, then shipped to the analytical laboratories in an ice pack box via overnight delivery.

2.2. Experimental design and treatment

Each batch of the cheese was assigned to three different storage treatments in three equal portions in a 3×3 factorial experiment. One subgroup (fresh) of each variety was stored at 4 °C for 0, 14 and 28 days as a non-frozen control. The other two subgroups were immediately frozen at −20 °C and stored for 0 month (24 h frozen) and 3 months, subsequently thawed the next day at 4 °C, and then aged at 4 °C in the same way as the non-frozen control samples. All samples taken at each treatment period ($3 \times 3 \times 3 = 27$ samples) were subjected to organic acid and sensory analyses.