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Short communication: Chemical composition, fatty acid composition, and sensory characteristics of Chanco cheese from dairy cows supplemented with soybean and hydrogenated vegetable oils

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ABSTRACT

Lipid supplements can be used to alter fatty acid (FA) profiles of dairy products. For Chanco cheese, however, little information is available concerning effects of lipid supplements on sensorial properties. The objective of this study was to examine effects of supplementation of dairy cow diets with soybean (SO) and hydrogenated vegetable (HVO) oils on chemical and FA composition of milk and cheese and sensory characteristics of cheese. Nine multiparous Holstein cows averaging 169 ± 24 d in milk at the beginning of the study were used in a replicated (n = 3) 3 × 3 Latin square design that included 3 periods of 21 d. All cows received a basal diet formulated with a 56:44 forage:concentrate ratio. Dietary treatments consisted of the basal diet (control; no fat supplement), and the basal diet supplemented with SO (unrefined oil; 500 g/d per cow) and HVO (manufactured from palm oil; 500 g/d per cow). Milk fat yield was lower with HVO compared with control and SO. Cheese chemical composition and sensory profile were not affected by dietary treatment. Vaccenic (C18:1 *trans*-11) and oleic (C18:1 *cis*-9) acids were higher for SO than for control and HVO. Compared with control and HVO, SO decreased saturated FA and increased monounsaturated FA. The thrombogenic index of milk and cheese produced when cows were fed SO was lower than when cows were fed on control and HVO. The outcome of this study showed that, compared with control and HVO, supplementing dairy cow diets with SO improves milk and cheese FA profile without detrimental effects on the chemical composition of milk and cheese and the sensory characteristics of cheese.

Key words: cheese, milk, sensory characteristics, oil supplement

Short Communication

Interest in bovine milk components that may be able to improve human health, such as fat, has been noted (Shingfield et al., 2013), particularly on the prevention of atherosclerosis, hypercholesterolemia, and other factors related to cardiovascular disease (Salter, 2013). Milk contains some FA that could be beneficial to human health, such as the CLA isomer C18:2 *cis*-9,*trans*-11 (**RA**; rumenic acid) and the *trans* fatty acid C18:1 *trans*-11 (**VA**; vaccenic acid; Lock and Bauman, 2004). Modifying the dairy cow diet is a rapid and practical way to increase the milk concentration of beneficial FA from a human health standpoint (Stamey et al., 2012). Dietary soybean oil (**SO**) has been shown to increase VA and total C18:1 *trans* FA concentrations in milk (Lock and Garnsworthy, 2002) and cheese (Allred et al., 2006) of dairy cows. Hydrogenated vegetable oils (**HVO**) are used to increase the energy density of high-producing dairy cow diets (Kargar et al., 2012) and can increase milk and fat yields in grazing systems (Schroeder et al., 2002), leading to a high yield of C16:0 and C18:0 FA.

Sensory characteristics are of great importance for consumer acceptability of dairy products. Previous studies (in the Americas and Europe) on bovine cheeses obtained from milk from cows fed different dietary PUFA sources, such as extruded soybeans (Khanal et al., 2005), extruded linseeds (Sympoura et al., 2009), fish and sunflower oils (Jones et al., 2005), fish and soybean oils (Lynch et al., 2005), rapeseed oil (Ryhänen et al., 2005), and calcium salts of palm and fish oil in combination with soybean products (Allred et al., 2006), have reported minor effects on the sensory properties of cheese.

Chanco cheese, one of the most important bovine cheeses in Chile, is a semihard and greasy cheese (Brito et al., 2003). To our knowledge, no study has been published reporting the effects of dietary supplementation with SO and HVO to dairy cows on the sensorial properties of Chanco cheese. Thus, the objectives of

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the present study were to examine effects of supplementing 2 sources of FA—SO (unsaturated) and HVO (saturated)—in dairy cow diets on the chemical and FA composition of milk and cheese as well as the sensory characteristics of Chanco cheese.

Nine multiparous Holstein cows averaging 169 ± 24 DIM (means ± SD) at the beginning of the study were used in a replicated (n = 3) 3 × 3 Latin square design that included 3 periods of 21 d. Average BW of the cows at the onset of the experiment was 583.6 ± 80.4 (means ± SD) with a BCS of 3 ± 0.5 (means ± SD; scored on a 5-point scale). Body weights and BCS were recorded at the beginning of the trial and the end of each experimental period. Cows were individually fed a TMR at a fixed rate (so that cows consumed all their feed and treatment) once daily (at 0930 h). All cows received a basal diet formulated with a 56:44 forage (alfalfa hay and corn silage)-to-concentrate ratio to meet the requirements of a 600-kg dairy cow producing 30 L per day (NRC, 2001). Dietary treatments consisted of a basal diet (control; no fat supplement) and fat-supplemented diets containing SO (unrefined oil; 500 g/d per cow) and HVO (manufactured from palm oil; 500 g/d per cow; Table 1). The SO contained 25 g/100 g of C18:1 *cis*-9 and 51 g/100 g of C18:2 *cis* n-6, whereas HVO contained 47 g/100 g of C16:0 and 43 g/100 g of C18:0. A mixer wagon was used to mix forage and concentrate. Oils were administrated separately and mixed manually into the daily ration for each cow. Animals were housed in individual stalls (2.4 × 6 m) and had continuous access to water. Cows were milked 3 times daily (0700, 1500, and 2200 h). Milk yields were recorded daily and individual samples were taken from the morning milking on d 20 of each period. Milk production during the last 10 d of each period was used for statistical analysis. Milk samples (150 mL/cow) were preserved with potassium dichromate (300 mg) and stored at −20°C for later analysis. Milk samples were analyzed for fat content (Gerber method; British Standards Institution 696; BSI, 1969), CP (16.036; Kjeldahl N × 6.38), ash (16.035), and TS (16.032) according to the AOAC (1984) procedures.

A traditional cheese-making technique was used to make Chanco cheese. Milk collected on d 21 (at 0700 h) was pooled from 3 cows within the same treatment and period and made into cheese without standardizing for fat content. Cheeses were made in a pilot plant as follows: 15 L of milk per treatment per period were heated to 36°C, and commercial rennet was added to curdle the milk at 38°C. No starter culture was added for cheese making, and sodium chloride in cold water (6 g of NaCl/100 mL of H_2O) was added to aid coagulation. After milk had clotted (45 min), the curd was cut to the size of a corn grain and then the vat temperature was gradually increased to 37°C at a rate of 1°C/3 min and maintained for 15 min. The curd was stirred to remove the whey and favor grain aggregation. Curds were placed into 250-g molds and pressed in a horizontal mechanical press. Cheeses were salted in brine at 10°C for 12 h and then transferred to a ripening room where they remained at a temperature of 9 to 10°C and ~90% relative humidity for 14 d. Four cheeses per treatment per period were allowed to mature for 14 d. Two cores of 1 cheese per treatment per period were obtained for chemical composition and FA analyses. Cheeses were analyzed for moisture content by AOAC International (2000) method 934.01 and for ash content by AOAC (1990) method 942.05. The fat content of cheese samples was determined using the Gerber method, and the total protein content was determined by measuring the total nitrogen, according to AOAC (1990) Kjeldahl method 976.06, and converting this value to the protein content by multiplying by 6.38. Three cheeses per treatment per period were vacuum-packaged in airtight plastic bags and sent to the sensory laboratory (Instituto de Nutrición y Tecnología de los Alimentos, Santiago, Chile) at 14 d of aging. All assessments were carried out in individual booths designed according to the international standard, ISO 8589 (ISO, 2007). Judges were not provided information regarding the treatment of each sample in any testing session. The panel was composed of 12 judges who had several years of experience in sensory evaluation and were trained for evaluation of bovine cheeses. Before evaluation, the panel used commercial Chanco cheese in a pretesting session to standardize the panel's definitions for the sensorial attributes. Evaluations considered the following attributes according to the ISO 13299 criteria (ISO, 2003): color homogeneity, holes, overall odor, ripe cheese odor, cow milk odor, saltiness, acidity, bitterness, overall flavor, ripe cheese flavor, sharpness, toughness,

Table 1. Ingredient and chemical composition of control, soybean oil (SO), and partially hydrogenated vegetable oil (HVO) dietary treatments

Ingredient composition (% of DM)	Diet		
	Control	SO	HVO
Alfalfa hay	17.0	16.6	16.6
Corn silage	18.0	17.5	17.5
High-moisture corn	10.0	9.7	9.7
Soybean hulls	34.0	33.1	33.1
Wheat bran	19.0	18.5	18.5
Vitamin and mineral premix[1]	2.0	2.0	2.0
SO	—	2.6	—
HVO	—	—	2.6

[1]Contained per kilogram: 25, 000 mg of P; 80,000 mg of Ca; 25,000 mg of Mg; 1,612 mg of S; 300,000 IU of vitamin A; 50,000 IU of vitamin D_3, and 1,600 IU of vitamin E.