Introduction

As society becomes increasingly health conscious, there is a demand for healthier foods with disease-prevention properties. Conjugated linoleic acid (CLA) has been shown to protect against induction and proliferation of chemically induced skin, forestomach, colon, prostate, and mammary tumors in mice (Hughes and Dhiman, 2002). Similar effects in humans are currently being explored. The CLA, c9, t11-18:2, is also known as n-7 conjugated linoleic acid (n-7 CLA). Along with the n-7 CLA, isomers of n-9 CLA, an essential fatty acid. The CLA can be formed in tissue when vaccenic acid (VA), c9, t11-18:1, is saturated by delta-9 desaturase in ruminal tissues. The VA and some CLA is formed in the rumen during biohydrogenation by microorganisms. Because the biohydrogenation of fatty acids occurs in ruminants and certain tissues contain the desaturase enzyme, dairy products are the main source of natural CLA in humans. It has been shown that the desaturation of VA is the primary source of CLA in milk (Grinari et al., 2000).

Previous work has shown that adding soybean oil or fish oil to diets results in increased CLA in milk (Allred et al., 2000; Baer et al., 2001). These increases in fatty acid production were reflected in the cheese produced from the milk (Allred et al., 2000). The response has been greater with fish oil, but a combination of the two oils may be important for the greater response because of the differing fatty acid composition of the two oils sources. Sugar alcohols are thought to alter the formation of products from ruminal fermentation and vitamin E has proven to increase alpha-tocopherol in milk, which increases the resistance of milk fat to oxidation (Focant et al., 1998).

Objectives

1. Determine the effects of feeding fish and soybean oils, vitamin E, and sorbitol on the fatty acid and total fat concentrations in milk and cheese and animal performance from lactating dairy cows.

Materials and Methods

Eight lactating dairy cows (four Holstein and four Jersey) were used in a 4 x 4 Latin square design; therefore, four periods occurred during the experiment. Each period consisted of three weeks, with week three being used for sample collection. The cows were fed four diets: 1) control diet (CNTL; 500 IU vitamin E), 2) 2% fish oil, 0.5% soybean oil, and 500 IU of vitamin E (FSO), 3) 2% fish oil, 0.5% soybean oil, and 2000 IU of vitamin E (FSOE), and 4) 1% sorbitol (SORB, dry form; 500 IU vitamin E). Each cow was rotated onto a different diet for each period so that by the end of the experiment, each cow had been fed each of the treatments. The cows were fed a total mixed ration (TMR) twice daily (0700 and 1600) and had free access to water. The TMR was mixed once daily and contained 41% neutral detergent fiber (NDF) and 21% crude protein (CP).

Intake and milk yield were recorded daily, and body weight was recorded weekly. Feed samples were collected weekly for analysis of dry matter, NDF, CP, and fatty acids. Rumens samples for analysis of volatile fatty acids (VFA) were collected at 4 h postfeeding during 2 consecutive days of week from the Holstein cows (one with rumen cannula and via stomach tube for the other 3 cows). Milk samples (200 mL) were taken during the last three days of the period (2 AM milkings and 2 PM milkings) from each cow. These samples were analyzed for total fat, protein, and milk urea nitrogen by DHI Cooperative, Inc. (Columbus, Ohio). Additional milk samples from all eight cows were taken during week 3 for determination of individual fatty acids using gas chromatography. Milk (4 L) from the Holstein cows during each period was used to make cheddar cheese in the pilot plant in the Department of Food Science and Technology. The cheese was analyzed for texture, protein, and individual fatty acids.

Results

Diet with oil reduced dry matter intake (DMI) (18.8 versus 22.7 kg/d), but DMI was similar between CNTL and SORB. Milk yield (31.7 kg/d) and MUN (17.0 mg/dL) were similar among diets (Table 1). Diets with oil reduced milk fat and protein percentages (3.87, 2.50, 2.58, and 3.96%; and 3.38, 3.09, 3.16, and 3.32%) for CNTL, FSO, FSOE, and SORB, respectively). Body weight and rumen VFA were similar among diets. Additional milk samples from all eight cows were taken during week 3 for determination of individual fatty acids using gas chromatography. Milk (4 L) from the Holstein cows during each period was used to make cheddar cheese in the pilot plant in the Department of Food Science and Technology. The cheese was analyzed for texture, protein, and individual fatty acids.

Conclusions

Addition of soybean and fish oils decreased total fat in milk, but increased the proportion of LCFAs in milk. Feeding supplemental vitamin E with the oils resulted in the highest CLA concentration in milk. This elevation of CLA in milk was associated with the elevated CLA in cheese.

Literature Cited


