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DAIRY RESEARCH HIGHLIGHTS

University of Alberta

Manipulating Milk Composition

2. Feeding oilseeds alters fat composition

Although the scientific evidence is open to debate, consumers have come to believe that a direct link exists between the consumption of saturated fatty acids (see article **1F1**) and the risk of heart disease. Among the saturated fatty acids, myristic (14:0) and palmitic (16:0) acids are considered to be most harmful. The results of recent population studies suggest that consumption of 18-carbon (C18) fatty acids, including stearic (18:0), oleic (18:1), linoleic (18:2) and linolenic (18:3) may actually be beneficial to human health.

As shown in figure 1, animal fats contain higher levels of saturated fatty acids than vegetable oils. Milk fat is higher in 14:0 and 16:0 but lower in 18:0 than other animal fats. Both canola and flaxseed oils are rich in unsaturated 18-carbon fatty acids, with the 18:1 level in canola oil and the 18:3 in flaxseed oil being particularly high.

An increase in the C18 fatty acid content of milk fat should improve its negative image among consumers. To this end, we have conducted several experiments at the University of Alberta to test the effect of feeding whole canola or flaxseed on milk fatty acid profiles. Here are the results of those experiments:

Feeding full-fat canola seed

Canola seed contains about 40% oil, of which about 90% is in the form of unsaturated fatty acids (figure 1). In an experiment completed in 1982, we fed ground canola seed (GCS) to late lactation cows to achieve canola oil intakes of 310, 520 or 820 grams/day. A fourth experimental group was fed 560 grams/day of free canola oil. Compared with controls, milk from cows fed GCS or free oil contained significantly lower concentrations of short (C4-C12) and medium (C14-C17) chain fatty acids, while long chain (C18-C20) and unsaturated fatty acids increased.

In a second experiment, late lactation cows were fed either whole, unprocessed canola seed (WCS), ground canola seed (GCS) or a form of canola oil protected from rumen microbes (PCS), each at 60 g/kg of concentrate which delivered approximately 310 g/day of oil. Results are shown in figure 2.

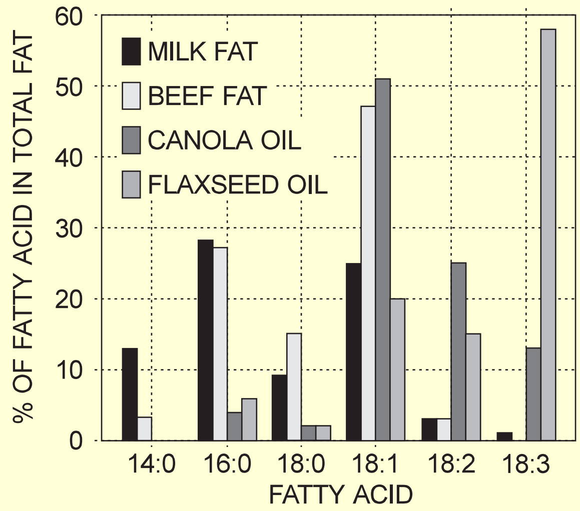

Figure 1 : Fatty acid profiles of milk fat, beef fat, canola oil and flaxseed oil.

Changes in fatty acid profile produced by feeding ground canola seed were over twofold greater than those provoked by whole seed. The difference was probably due to poor ruminal and intestinal digestion of the fat in the intact seed.

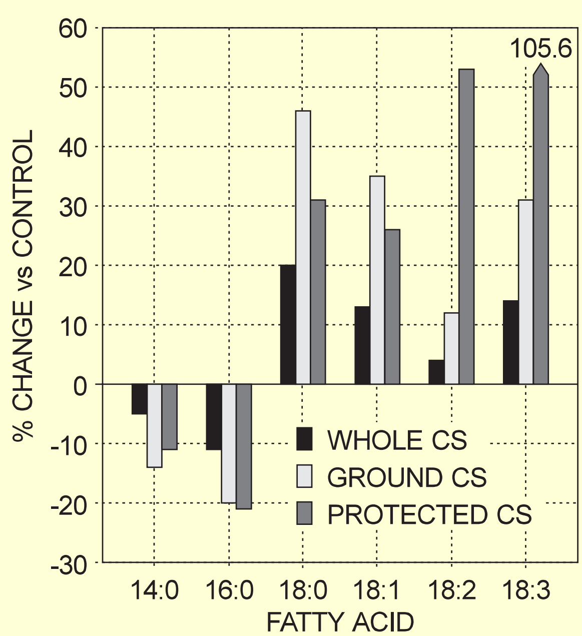

Figure 2 : Changes in fatty acid profiles compared with controls for late lactation cows fed whole, ground or protected canola seed.

Feeding protected seed produced increases in linoleic (18:2) and linolenic (18:3) acids which were much larger than those for GCS, although increases in stearic (18:0) and oleic (18:1) were smaller. This is because unsaturated fatty acids which are accessible to rumen microbes are converted to more saturated forms through the process of *biohydrogenation*. It is likely that some of the 18:2 and 18:3 in the GCS was converted to 18:1 and 18:0, while that in the PCS was effectively protected from biohydrogenation.

Feeding full-fat flaxseed

In a study completed in 1992, unprocessed flaxseed was included in the diets of mid lactation cows at 0, 5, 10 or 15% of dietary dry matter (DM). With the whole seed containing about 40% oil, the experimental diets delivered approximately 350, 730 and 1100 grams of oil, respectively. Results are shown in figure 3. Feeding intact flaxseed produced reductions in 14:0 and 16:0 accompanied by increases in all C18 fatty acids. Although changes in fatty acid concentrations were small, they were all roughly proportional to the amount of flaxseed fed.

We speculated that the modest responses measured in the first flaxseed trial were due to poor digestibility of the intact seed. Therefore, in a second experiment we compared the effects of intact and rolled flaxseed fed to early lactation cows at 10% of dietary DM.

Figure 4 summarizes the results of this trial. With the exception of 18:0, milk fatty acid responses to rolled flaxseed were significantly greater than those to the intact seed.

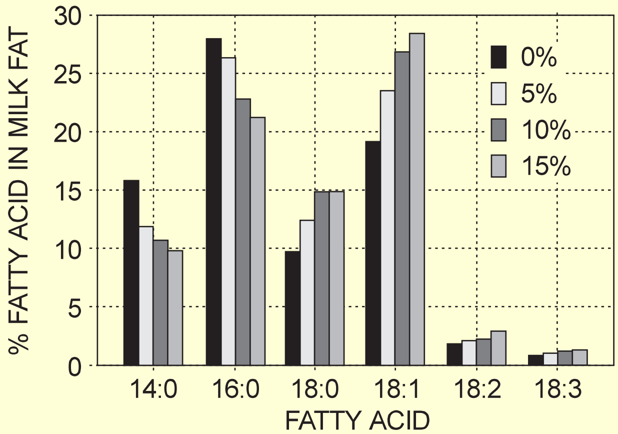

Figure 3 : Milk fatty acid profiles produced by feeding increasing amounts of unprocessed flaxseed (% of dietary DM).

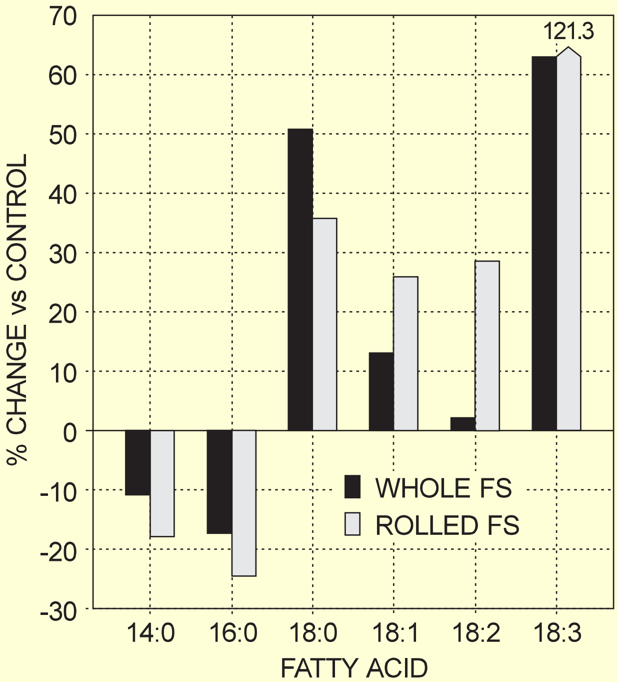

Figure 4 : Changes in fatty acid profiles compared with controls for early lactation cows fed whole or rolled flaxseed.

In practice ...

Our experiments, and those of others, have demonstrated that it is possible to significantly alter the fatty acid profile of milk fat in a direction which should increase its appeal to the consumer. However, there are several other factors to be considered before the marketing of ‘designer’ dairy products can become a practical reality:

- unsaturated fatty acids are more susceptible to spontaneous oxidation (see article **4O1**) which may reduce the shelf-life of these products;
- the melting point of milk fat containing more unsaturated fatty acids will be lower. This will improve the spreadability of butter but would also require modification of procedures for the manufacture of butter and cheese;
- separate collection, processing and packaging would be required.

We are currently working with potential industry partners to resolve these issues with a view to making a ‘designer’ milk available for test marketing in Alberta in the near future.

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