DAIRY RESEARCH HIGHLIGHTS

# Manipulating Milk Composition

## 3. Feeding rumen-protected whole canola seed

Milk has traditionally been considered one of nature's most perfect and natural foods as it provides a balance of protein, fat, carbohydrates, vitamins and minerals. However, the possibility of a link between cardiovascular disease and saturated fatty acid intake has eroded the positive attitude consumers have had toward milk.

Cow's milk typically contains about 70% saturated fatty acids (SFA), 25% monounsaturated fatty acids (MUFA) and 5% polyunsaturated fatty acids (PUFA). The objective of several recent trials at the University of Alberta has been to evaluate diets for lactating cows which might increase the proportions of MUFA and PUFA at the expense of 14- and 16-carbon SFA. A previous article in this series (**1F4**) reported positive results when full-fat canola or flax seeds were fed. One of the most significant responses was provoked by feeding a form of canola oil protected from rumen microbes. This article reports the results of further trials where we tested the feeding of protected full-fat canola seed.

### Effect of protection on digestibility

Without the addition of supplementary lipids (fats or oils - see article **1F1**), diets for lactating cows typically contain less than 3% fat. It is generally accepted that an additional 3-5% can be included in the diet to increase its energy density. But beyond this, supplemental lipids may have a negative effect on rumen fermentation and nutrient digestibility. Unsaturated fatty acids are considered particularly detrimental because they are subject to *biohydrogenation* in the rumen, a process that converts them to more saturated forms while reducing microbial efficiency. And, since biohydrogenation reduces the delivery of MUFA and PUFA to the small intestine, we would expect it to reduce the impact of feeding unsaturated fatty acids on milk composition. We were therefore interested in determining whether protecting full-fat canola seed from interaction with rumen microbes might reduce its potential detrimental effects on fermentation and improve its effect on milk fatty acid profiles.

To test effects on rumen fermentation and nutrient digestibility, we compared a canola meal/barley supplemented diet with 3 diets containing 5% rolled canola seed (2.1% lipid) on a dry matter (DM) basis. The canola seed was either untreated or 'protected' through treatment with heat or formaldehyde. Results are summarized in table 1.

None of the 3 forms of full-fat canola had significant effects on DM intake or the parameters of rumen fermentation which we measured. However, in cows fed the formaldehyde-treated canola, rumen NDF digestibility was significantly lower and, compared with the control diet, whole tract NDF digestibility was significantly lower in all diets containing full-fat canola seed. Similar reductions in whole tract Crude Protein (CP), DM and ADF digestibilities were also seen, although these changes were slight and not consistently significant. We concluded that the level of supplemental dietary fat (2.1%) carried by the 3 full-fat canola ingredients had negligible effects on rumen and whole tract nutrient digestibility.

| | | CANOLA TREATMENT | | |
|---|---|---|---|---|
| | CTRL | NONE | FORM | HEAT |
| DM Intake, kg/d | 20.3 | 22.8 | 20.7 | 20.3 |
| Rumen fermentation | | | | |
| Rumen pH | 6.28 | 6.18 | 6.27 | 6.24 |
| Lactate, mM | 18.8 | 25.4 | 20.8 | 19.0 |
| $NH_3$ N, mg/dl | 18.6 | 19.0 | 16.7 | 17.8 |
| VFA, mM | 127.8 | 128.5 | 128.6 | 121.4 |
| Acet:Prop | 2.58 | 2.30 | 2.51 | 2.46 |
| Rumen digestibility, % | | | | |
| NDF | 54.3$^{a}$ | 47.3$^{ab}$ | 40.5$^{b}$ | 56.3$^{a}$ |
| ADF | 41.1$^{ab}$ | 41.1$^{ab}$ | 30.0$^{b}$ | 49.7$^{a}$ |
| Whole tract digestibility, % | | | | |
| Crude Protein | 79.6 | 77.8 | 76.2 | 77.2 |
| Dry Matter | 73.4$^{a}$ | 71.9$^{b}$ | 72.9$^{ab}$ | 71.8$^{b}$ |
| NDF | 60.5$^{a}$ | 53.4$^{b}$ | 56.0$^{b}$ | 56.2$^{b}$ |
| ADF | 53.4$^{a}$ | 50.9$^{ab}$ | 49.2$^{b}$ | 48.5$^{b}$ |

*Table 1 : Effects of feeding rolled canola meal, either untreated (NONE), formaldehyde-treated (FORM) or heat-treated (HEAT), compared with a canola meal/barley control diet (CTRL). Values in the same row with different subscripts are significantly different from one another.*

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In contrast to the minor effects on total diet digestibility summarized above, formaldehyde- and heat-treatment produced large and highly significant effects on the rumen degradation rates of the seed components themselves (see figure 1).

## Production responses

Since treatment of canola seed reduced its fat degradation rate in the rumen, it can be assumed that biohydrogenation was reduced and that a larger proportion of the fat became available for absorption from the small intestine. What effect would this have on the production of milk and milk components?

There were no significant differences in milk yields from cows on the 4 diets. Milk fat content was significantly reduced in cows fed the untreated seed but milk protein content was unaffected.

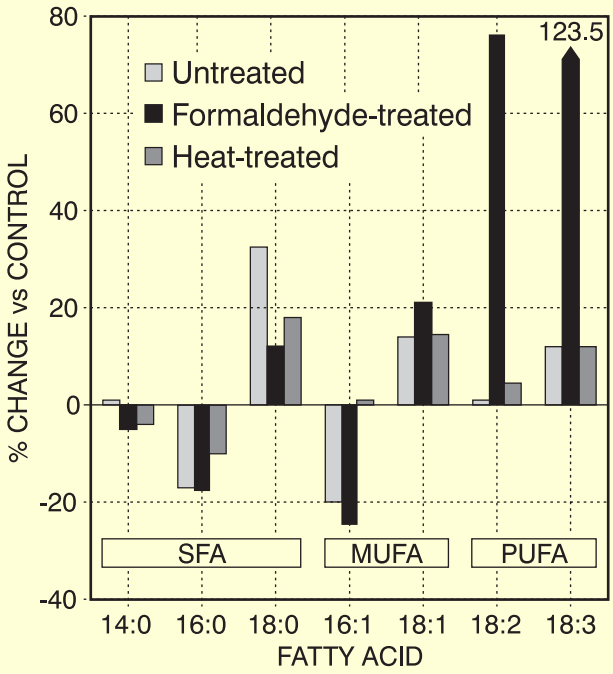


*Figure 2 : Milk fatty acid profiles compared with controls for cows fed untreated, formaldehyde-treated or heat-treated full-fat canola seed.*

Changes in the relative proportions of milk fatty acids (figure 2) were similar to those seen when whole canola seed or protected canola oil were fed (see article **1F4**). Among the SFA, 14:0 and 16:0 decreased and 18:0 increased when any form of seed was fed. The net effect was a significant reduction in total SFA — most profound with the formaldehyde-treated seed. Formaldehyde-treatment also provoked the greatest reduction in 16:1 and the largest increases in 18:1, 18:2 and 18:3 fatty acids.

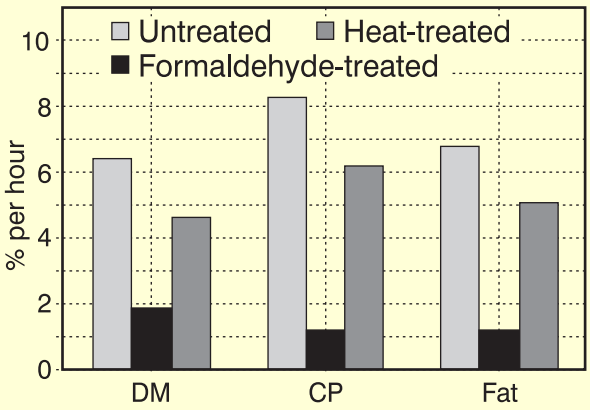


*Figure 1 : Formaldehyde- or heat-treatment markedly reduced rumen degradation rates of canola seed DM, CP and fat. All treatment comparisons are significant.*

## Summary

We tested the possibility that the oil in rolled seed might have negative effects on rumen fermentation and nutrient digestibility. In anticipation of such negative effects, rolled seed was protected from rumen degradation through formaldehyde- or heat-treatment. The only significant responses seen to untreated seed were slight decreases in whole tract DM and NDF digestibility. Treated seed provoked similar responses.

Formalhehyde treatment of rolled canola seed profoundly decreased rumen degradation rates of its DM, CP and fat, effectively increasing the 'bypass' values of these components. Degradability rates were less affected by heat treatment.

All 3 forms of canola seed altered milk fatty acid profiles in a direction which would be considered favourable for human health. Formaldehyde treatment produced the most favourable effects: an 8% drop in total SFA combined with a 21% increase in total unsaturated (MUFA+PUFA) fatty acids.

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