LOW GLUCOSINOLATE RAPESEED MEALS IN RATIONS FOR LACTATING DAIRY COWS

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Western Canadian plant breeders have greatly reduced the level of glucosinolates in rapeseed meal (RSM) with the introduction of the Tower and Candle varieties. Research carried out with low glucosinolate Bronowski RSM (Ingalls and Sharma, 1975) suggested that the limitation of 10% Canadian RSM in rations for lactating cows (Ingalls and Waldern, 1972) did not apply with low glucosinolate RSM. Five experiments were conducted to examine the use of Tower and Candle RSM in dairy rations and will be summarized in this paper.

Experimental Methods

Experiment 1 - Twelve dairy cows in early lactation were used in a changeover design with three periods of 4 wk each separated by a changeover period of 7 days. Cows were fed four diets containing either 25% commercial rapeseed meal (CRSM), double zero rapeseed meals (1788 or Tower) or 22.5% SBM. Chopped hay, corn silage (33.1% DM) and grain mixtures were mixed (1:1:2 DM basis) at the time of feeding and fed to appetite. At the end of the 5th wk, rumen fluid samples were collected 3 1/2 hours after feeding by a stomach tube for VFA and ammonia-N analyses. Jugular blood samples were also collected at the same time and analyzed for serum thyroxine (T_4) and urea N levels.

Experiment 2 - Eight cows in early lactation were used in a double 4 x 4 latin Square design. The grain mixtures contained either 18.5% SBM, 25% Tower RSM, 15% Tower RSM + 1% urea (TU) or 15% Tower RSM + 1% urea mixture that was extruded using a Brady Crop cooker. Grass silage (31.6% DM), hay and grain were mixed (40:10:50, DM basis) for each cow and fed to appetite. Rumen fluid and jugular blood samples were collected 3 hours post feeding in the 4th wk of each period. In the 5th wk, total collections of feces and urine with urinary catheters were made for 5 days to determine the apparent digestibility of nutrients and nitrogen (N) retention.

Experiment 3 - Twelve Holstein cows at the declining stage of lactation were used in a Lucas switch-back design with 5 week experimental periods. All cows received an allowance of alfalfa-brome hay (crude protein:9.1% DM; Acid detergent fiber (ADF):49.1% DM) and treatment grain mixture to meet NRC (1971) recommended energy requirements for maintenance and growth. The grain mixtures containing soybean meal, 20% 1821 RSM, 30% 1821 RSM or 26% Tower RSM were fed at the rate of 0.4 kg per kg milk produced. Milk samples were analyzed biweekly for protein, fat and SNF; and twice in each period for iodine and SCN^- content and once for other aglucones and intact glucosinolates. Thyroxine (T_4 and T_3) levels were determined with plasma obtained from blood samples obtained from the coccidial wein during the last week of each period.

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Experiment 4 - Twelve Holstein cows at the declining stage of lactation were used in a Lucas switch-back design with 6 week periods. Treatments were the four grain mixtures which included supplemental protein as soybean meal (SBM) or Tower RSM containing 0, 4 or 8% Tower RSM gums. The gums were added to the RSM as follows: The viscosity of gums was first reduced by adding ethyl alcohol (10 parts per 100 parts of gums). After thorough mixing, the slurry was added to RSM, mixed well, and stored in paper bags for several months prior to use in this experiment. All cows received 2 kg of alfalfa-brome hay (crude protein: 10.5% DM; Acid detergent fiber (ADF): 39.3% DM) and an allowance of urea supplemented corn silage DM 40.0%; N x 6.25:12.6% DM; ADF 31.1% DM) on the basis of energy required for maintenance. Grain mixtures were fed at the rate of 0.4 kg per kg milk produced. Blood samples were drawn biweekly from the coccidial vein and analyzed for packed cell volume (PCV), erythocyte count (RBC), hemoglobin (Hb) and leucocyte count (WBC).

Experiment 5 - Fifteen Holstein-Friesian cows at the declining stage of lactating were stratified according to milk yield and the cows in each strata were randomly assigned to grain mixtures containing 25% Tower RSM, 25% Turret RSM or soybean meals as supplemental protein. All cows received 2.0 kg of alfalfa-brome hay (as Fed: N x 6.25: 12.0%; ADF: 39.3%) and an allowance of urea supplemented corn silage (DM: 40.0%; on DM basis: N x 6.25 = 11.2%; ADF: 31.1%) to meet the calculated maintenance requirement for energy. The grain mixtures were fed at the rate of 0.4 kg per kg of milk yield. The trial was divided in three periods (I, II, III) which lasted two, eight and two weeks respectively. In periods I and III, all cows received the soybean meal treatment while in period II they received the assigned treatment. Milk samples were collected weekly and analyzed for protein, butterfat, solids non fat (SNF), iodine, SCN^- and glucosinolate content. Blood samples were collected weekly for determination of packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC) abd hemoglobin concentration (HB). Plasma from these samples was stored in -10°C and was used for thyroxine (T_4 and T_3) analysis. Total urine collection, using urinary catheters was carried out during week 5 of period II for iodine and SCN^- analysis with two cows on each of the Control and Tower treatments.

Results

Feed intake was not different among treatments when Tower RSM made up 25% of the grain mixture in complete feed systems (exp.1, 2) or when the more common practice of feeding grain according to production and separate from the roughage (exp. 3,4,5) was followed. Adding 20 or 30% 1821 (Candle) RSM to the grain mixture had no apparent effect on intake. The differences in grain consumption with 4 and 8% added gums were not shown to be significant ($P > 0.05$).

Supplementing rations with 1821 or Tower RSM in place of soybean meal had no apparent effect on milk yield or composition with the exception that milk yield was higher ($P > 0.05$) in exp. 3 when 30% 1821 RSM was added to the grain mixture. The reason for this difference is not known but could be related to under estimation of the energy value of RSM and/or differences in protein solubility. Rumen ammonia data was not collected for exp. 3. In exp.1 and 2, there were no significant ($P > 0.05$) differences in blood urea or rumen ammonia levels when sampled about 3

hours after feeding.

The effect of low glucosinolate RSM on blood thyroxine level varied. In exp. 1 and 5, blood thyroxine levels were lower ($P>0.05$) when RSM was fed. In exp. 3, there was no indication of reduced T_4 levels. A recent study at Manitoba with young calves fed RSM for 9 weeks indicated an increase in thyroid size with diets containing 25% Tower or Target RSM. Target RSM reduced plasma T_4, packed cell volume, hemoglobin and erythrocyte count for the calves but Tower RSM did not. Calves receiving Target RSM had more pronounced histological changes in the thyroid than those receiveing Tower RSM. There appeared to be little change in blood parameters measured for cows receiving Tower RSM in exp. 4.

Feeding RSM reduced the level of iodine in milk (exp. 3,4,5) and resulted in higher levels of SCN^- in the milk. Limited data suggested about 5% of the ingested SCN^- was excreted in the milk (exp. 5) but no measurable amounts of intact glucosinolates, isothiocyanates of OZT were found in milk. Our data suggest that a small amount (3%) of the ingested unsaturated nitrile or a compound with a similar GLC regention time was found in milk. However, a smaller quantity of a compound with a similar retention time was also found in milk from cows receiving a soybean meal treatment. It is not clear what becomes of intact glucosinolate as it passes through the GI tract. The ingested intact glucosinolates could not be accounted for i milk, urine or feces. Milk fed to growing rats from cows receiving RSM in exp. 5 resulted in some increase in thyroid size. However, when iodine was added to the rat diets, the difference in thyroid size was removed.

Summary

The animal performance data suggest that the limitation of 10% RSM in dairy rations, at least for the short term, is not applicable for RSM from Tower or Candle rapeseed. Dairy Cows consuming dairy concentrate containing up to 25% Tower or Candle RSM in short-term studies produced equal quantities of milk with similar composition to those receiving dairy concentrates containing soybean meal. Adding RSM gums back to the meal at several times the normal amount was not shown to have any significant ($P>0.05$) effect on intake, milk yield or milk composition. The amount of SCN^- in Candle and Tower RSM is not all that different from the higher glucosinolate type RSM's and thus have a somewhat similar effect on increasing SCN^- and decreasing iodine level in milk.

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References

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