CANOLA MEAL AND FORMALDEHYDE TREATED CANOLA MEAL IN RATIONS FOR LACTATING COWS

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Canola meal has been examined as a protein source for dairy cows in a number of experiments in barley type rations (Ingalls, 1978). These studies suggested that rations containing 25% canola meal could be used as a protein supplement in diets for relatively high producing cows. These levels of canola meal do not provide enough supplementary protein for corn grain, corn silage type diets. Also some studies suggest that at high levels of production in early lactation the level of protein as a percent of the diet suggested by the National Research Council (1978) may not result in maximum milk production (Cressman, 1980).

Several systems proposed during the past few years for assessing the protein requirements of ruminant livestock (e.g. Agricultural Research Council 1980) incorporate the concept of rumen escape protein (REP), careful manipulation of which may allow more efficient utilization of dietary crude protein. An effective method of increasing the level of REP is to protect the protein source with formaldehyde (FA) (Fergusen et al., 1967).

In Western Canada, rations containing canola (rapeseed) meal, barley and corn silage are fed to ruminant livestock but all three ingredients have low levels of REP. Thus, there is a possibility that rations based on these ingredients contain insufficient amounts of REP to support a high level of milk production and, therefore, they may benefit from a protein supplement treated with FA.

Experiments were conducted with the objective of: 1) Comparing canola meal and soybean meal as protein sources in diets requiring high levels of supplemental protein. 2) Determining if lowering the rumen degradability of canola meal protein by formaldehyde treatment would improve protein utilization and milk production during early lactation.

Experiment I*

Sixteen holstein cows were randomly assigned to canola meal (Tower) or soybean meal supplemented diets (Table 1) for 12 weeks. Chemical analysis of the diets indicate that the canola diet was somewhat lower in protein than the soybean meal diet. All cows were housed in individual tie stall with rubber mats and individual water bowls. Complete mixed rations were prepared daily in a horizontal mixer. The diets were formulated to be isocaloric and isonitrogenus. All cows were fed ad libitum once daily. Milk production was recorded daily and samples taken weekly for analysis of milk constitutents. At 8 to 9 weeks post calving, nitrogen balance studies were carried out on six cows per treatment.

No differences (P>0.05) in actual, solids corrected milk or fat corrected milk yields were detected. Using milk production during the first four weeks as a covariate also indicated no differences (P>0.05) in the adjusted means for persistency of milk production or milk yield. Dry matter intake was not different (P>0.05) between treatments (Table 2) although consumption of the canola diet tended to be higher. No differences (P>0.05) were found in digestibilility of the diets or nitrogen utilization. Diet protein solubility and degradation rates were quite similar as measured by a buffer system and a bacterial protease system.

This study suggested similar animal performance when canola and soybean meal made up 20 and 18.7% respectively of the experimental diets.

Experiment II

Forty Holstein cows were assigned to one of four isocaloric diets (Table 1) approximately two weeks post-partum in a 2x2 factorial arrangement with two levels of protein (14.6% and 17.4%) and control canola meal or canola meal treated with 1.2 g formaldehyde (FA) per 100 g crude protein. Concentrate, corn silage and brome hay were fed ad libitum for 12 weeks in the ration 50:43:7 (DM basis). Blood and rumen fluid samples were taken monthly just before feeding. Additional rumen fluid samples were taken 3 hrs after feeding from 6 cows per treatment. Total urine and fecal collections were made on six cows per treatment.

There was no indication that the high level of supplementary canola meal in the diets had any detrimental effects on milk production. If first calf heifers are removed from the analysis,

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*Part of a larger experiment

multiparous cows on the high protein diets produced an average of 34.3 kg milk/day while consuming 5 kg canola meal/day. Low milk iodide levels have been associated with feeding rapeseed or canola meal and may indicate impaired iodine utilization by the cow. In the present study, milk iodide levels were within the normal range for raw milk produced on commercial dairy farms. In addition, dietary treatment had no effect on milk iodide concentration even though the high protein diets contained twice as much canola meal as the low protein diets.

Dietary treatment had no effect on milk composition. Milk yield and 4% FCM were increased by the high level of dietary CP but not by FA treatment (Table 2). Treatment with FA reduced the ruminal NH_3-N concentration but did not reduce the apparent digestibilities of DM, N or ADF. Plasma concentrations of several essential amino acids (histidine, valine, leucine and isoleucine) were increased by FA treatment. This response was similar to the effect of the high dietary CP level on plasma essential amino acids (with the exceptions of tyrosine and threonine). The results suggest that treatment of canola meal with FA reduced ruminal protein degradability without significantly reducing intestinal protein digestion or ruminal fibre digestion. The increased plasma concentration of some essential amino acids suggests that amino acid uptake from the gut was increased by FA treatment. Possibly, FA treatment did not increase milk production because (a) amino acid supply to the mammary gland did not limit milk synthesis, or (b) FA treatment did not increase the absorption of those specific amino acids whose availability limited milk production. Treatment with FA destroyed 57% of the canola meal tyrosine and 29% of the lysine and this may be partially responsible for the lack of response in milk production.

Animals assigned to the high protein diets excreted a high proportion of dietary N in the urine. Therefore, although milk production was increased by feeding the high protein diets (i.e. high canola meal), utilization of the additional N was less efficient.

Increasing dietary protein level from 14.6% to 17.4% using canola meal as the protein source resulted in increased milk yield during early lactation. Reducing the ruminal protein degradability of canola meal by treatment with FA did not enhance the efficiency of protein utilization even though the basal diet contained a low proportion of REP. Alternative procedures for reducing canola-protein degradability may be more beneficial.

Experiment III and IV

Tyrosine was added to the diets of lactating cows to determine if the lack of response to FA treated canola meal could be due to a failure to increase the uptake of tyrosine.

Tyrosine (50 g/day/cow) was fed to six lactating Holstein Friesians in a Lucas switch back design. Concentrate and alfalfa hay were fed ad libitum in a ratio of 59:41. Feed intake and milk yield were recorded during the final seven days of each ten day period. Milk yield was increased by the supplementary tyrosine (Table III) with no apparent change in plasma tyrosine concentration.

Twelve multiparous cows in early lactation were assigned to four treatments in a Lucas switch back design. Cows received rations containing canola meal or canola meal treated with 1.2 g FA/100 g crude protein and zero or 50 g tyrosine per day. Treatment periods lasted 14 days and during this time, concentrate (32% canola meal), corn silage and brome-alfalfa hay were fed in a ratio of 52:43:5. Milk yield was increased (Table III) when cows received the tyrosine supplemented diet containing FA treated canola meal with no apparent change in plasma tyrosine level.

In conclusion, oral administration of tyrosine resulted in increased milk production. Animals fed diets containin FA treated canola meal showed a greater response than animals fed untreated canola meal.

References

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Table I. Ingredient Composition of Experimental Diets

Ingredient %	Experiment I		Experiment II			
	Control	Canola	FA High	FA Low	High	Low
Brome Hay	-	-	7	7	7	7
Corn Silage	61.3	49.7	43	43	43	43
Barley	-	-	21.2	32	21.2	32
Cracked Corn	17.6	26.0	-	-	-	-
Soybean M (48 %)	18.7	2.5	-	-	-	-
Canola Meal	-	20	23.5	13	23.5	13
Minerals & Vitamins	2.4	1.8	2.2	2.5	2.2	2.5
Tallow	-	-	2.7	2	2.7	2
Urea	-	-	.5	.5	.5	.5
Composition						
C. Protein (%)	17.2	14.8	17.4	14.6	17.3	14.7
Soluble Protein (%)	33	34				

Table II Animal Response to Experimental Diets

Item	Experiment I		Experiment II			
	Control	Canola	Protein Level		Treatment	
			High	Low	FA	Control
DM Intake (kg)	19.8	21.1	19.5	18.3	19.0	18.7
Milk Yield (kg)	28.8	29.8	33.2	30.4*	31.2	32.4
FCM Yield (kg)	26.2	25.9	33.3	30.0*	31.4	31.9
Milk Protein (%)	3.2	3.2	2.9	3.0	2.9	3.0
Milk Iodine (µg/100 g)	-	-	33.1	32.8	33.0	32.8
DM Dig. (%)	64.0	62.8	62.4	62.9	62.9	62.5
Starch Digestion (%)	91	88				
Nitrogen Utilization (Milk & Retention)	51%	60%				
Intake - Fecal						

*Sig difference ($P<0.05$) between protein levels

Table III Effect of Supplemental Tyrosine on Performance of Dairy Cows

Item	Experiment III		Experiment IV			
	Control	Tyrosine	Control Meal		FA Meal	
			Tyr.	Cont.	Tyr.	Cont.
Plasma Tyrosine μMole/l	82	91	59	52	68	51
DM Intake (kg)	22.4	22.9	20.9	20.5	21.0	20.5
CP (%)	18.7	18.7				
Milk (kg)	29.3	30.3*	32.9	32.4	33.1**	31.5
% Fat	3.0	3.1	3.3	3.4	3.2	3.6
% Protein	3.16	3.15	2.95	3.00	3.02	3.03

* Significant ($P<0.05$) difference between control and tyrosine.

** Significant ($P<0.05$) difference between cows on diets with and without tyrosine for the FA treated diets.