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DAIRY RESEARCH RESULTS
from the Agriculture and Agri-Food Canada Research Centre, Lethbridge

Adding Enzymes to Dairy Diets
2. Experimental Results

The first article of this series (**1E1**) discussed the background required to understand how enzymes can affect feed digestibility. And we presented preliminary observations from a lactation trial in which enzyme was included in the concentrate portion of a total mixed ration (TMR).

Trial 1

Dry matter intake (DMI) and milk production responses observed in our first dairy trial are shown in figure 3 of article **1E1**. Over the course of the 12 week study, average milk production for the cows on the enzyme treated diet was 39.5 kg/day compared with 35.9 kg/day for the control cows, a 10% increase (table 1). However, fat, protein and lactose levels in the milk from the treated cows were all lower. These decreases were probably due to the fact that the marked increase in milk yield was not accompanied by a significant increase in DMI. Although enzyme treatment increased both DM and NDF digestibility (and, therefore, ration energy availability), inadequate intakes of other nutrients likely limited the synthesis of milk components.

As shown in figure 1, at the beginning of the trial, solids-corrected milk (SCM) output from the enzyme-treated cows was almost 25% higher that that from the controls. But, by week 5 of the trial, there was no difference in SCM output from the 2 groups - further evidence that nutrients for milk component synthesis became increasingly limited.

Trial 2

Our second dairy trial was a sequel to a study where we had applied enzyme to backgrounding rations fed to steer calves. When enzyme was applied to diets consisting of 96.7% cubed alfalfa and 3.3% supplement, we recorded average daily gains which were up to 30% greater than those of the controls. Surprisingly, the highest rates of gain were produced with intermediate, rather than the highest, levels of enzyme.

	Control	Enzyme	Percent Change
DM intake, kg	18.7	19.0	+1.6
Milk yield, kg	35.9	39.5	+10.0
Milk composition, %			
Fat	3.87	3.37	-12.9[a]
Protein	3.24	3.03	-6.5
Lactose	4.73	4.62	-2.3
Diet digestibility, %			
Dry matter	60.9	68.9	+13.1[a]
NDF	61.5	70.9	+15.3[a]

Table 1 : Summary of results from trial 1. [a]denotes statistically significant changes.

In our second dairy trial, 3 groups of fistulated, mid-lactation cows were fed diets consisting of 45% alfalfa cubes, 10% barley silage and 45% concentrate on a dry matter (DM) basis. The alfalfa cubes fed to control cows were untreated, while those fed to the other 2 groups were treated with either a low, or a medium level of enzyme. The low rate was equal to that which gave us the maximum response in our steer growth trial. The medium rate was equivalent to twice the low rate. Although the medium rate produced a lower response in the steer trial, diets in that trial contained over twice the amount of alfalfa cubes which would be practical in a ration for lactating cows. Therefore, the medium rate of application in the dairy study supplied an amount of enzyme which was slighly lower than the maximum-response level in the steer trial.

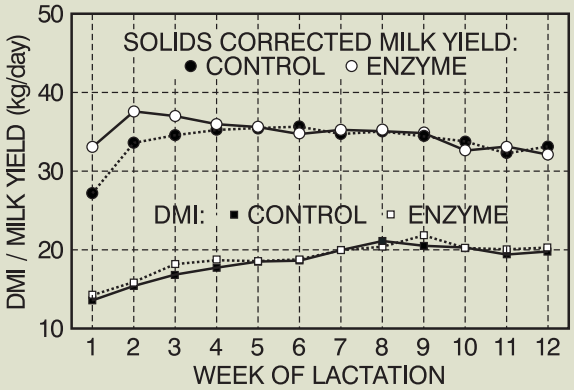

Figure 1 : Time course of solids-corrected milk production and dry matter intake in trial 1.

The results of our second dairy trial are summarized in table 2. Low and medium levels of enzyme resulted in 0.9 and 1.9 kg increases in daily milk yield, respectively, without significantly affecting milk component levels. These are substantial increases for surgically prepared, mid-lactation cows; effects are expected to be even greater for commercial dairy cows in early lactation. As shown in our earlier trial, the increased energy availability resulting from enzyme treatment can lead to a direct increase in milk output because early lactation cows are normally in negative energy balance. Rebalancing the levels of other nutrients in the diet would prevent the reduction in milk component levels we observed in that trial.

As in trial 1, the improvement in milk yield due to adding enzymes in trial 2 was the direct result of increased feed digestibility rather than a change in feed intake. NDF increased both in the rumen and in the total digestive tract (table 2). Because enzymes increased digestion of feed in the rumen, protein degradability within the rumen also increased. Thus, the rumen undegradable protein (bypass protein) content was lower for the medium enzyme diet compared with the control. However, this effect was not entirely negative as the amount of microbial protein synthesized in the rumen increased as a result of more feed digested in the rumen. Thus, the total amount of nitrogen available for absorption from the small intestine was only slightly lower due to the use of enzymes.

	Diet		
	Control	Low Enzyme	Medium Enzyme
Dry matter intake, kg	20.4	20.7	20.7
NDF digestibility, %			
Rumen	30.7	34.9	36.9
Total digestive tract	38.8[b]	41.2[ab]	43.6[a]
CP degradability, %	50.0[a]	58.8[ab]	60.3[b]
Microbial CP, kg	1.81	1.71	2.10
Milk yield, kg	23.7[b]	24.6[ab]	25.6[a]
Milk yield / DM intake	1.16	1.19	1.24
Milk composition, %			
Fat	3.79	3.70	3.78
Protein	3.40	3.40	3.40

Table 2 : Summary of results from trial 2. Values in the same row with different subscripts are statistically different from one another.

	Diet		
	Control	Low Enzyme	Medium Enzyme
Net revenue, $/cow/day	12.35	12.65	13.22
increase over control	-	0.30	0.87
Enzyme cost, $/cow/day	-	0.20	0.40
Margin over enzyme cost:			
$/cow/day	-	0.10	0.47
$/100 cows/month	-	300	1410

Table 3 : Economics of enzyme use. Net revenue is gross milk revenue minus producer deductions, based on: 1000 litres of fluid quota plus MSQ to cover excess milk and class 1 skimoff; October 1997 milk prices and marketing statistics from Alberta Dairy Control Board.

Because the enzymes improved feed digestibility without affecting feed intake, feed efficiency (measured as kilograms of milk yield per kilogram of dry matter consumed) was also higher for cows fed enzyme-treated cubes.

Economics of enzyme use

Table 3 shows the effect of enzyme treatment on projected net milk revenue, based on the assumptions given. The enzyme preparation used in this trial is about to become commercially available and we anticipate the cost of applying the medium level used in this trial will be 30-40¢ per cow per day. At the higher amount, the results of applying the medium level of enzyme would improve net milk revenue for a 100-cow herd by $1410 per month. As suggested earlier, this result might be significantly greater for higher yielding commercial cows in early lactation.

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