CANADA · ALBERTA LIVESTOCK RESEARCH TRUST INC.

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

How much fibre is enough?

With milk payment in Alberta soon to be based on multiple component pricing (MCP), it will likely be more profitable for you to produce higher volumes of milk with lower fat and higher protein tests. Milk yield and component levels are strongly influenced by the dietary concentrate to forage ratio. Rations containing large proportions of forage fibre produce lower milk yields with higher fat and lower protein tests. As forage content is decreased in favour of concentrate, milk yield and protein test increase while fat test declines. Since this is exactly what the market demands, it might be tempting to feed very low forage rations.

Fibre requirements

Cows are not pigs. The cow requires enough fibre to maintain an efficient and healthy digestive system. She has requirements for both chemical and physical fibre (see article **1N1**). Chemical fibre, measured in the feed lab as *neutral detergent fibre* (NDF), is required to support the growth of fibre-digesting microbes in the rumen. Physical fibre (structured roughage) stimulates chewing which results in the production of saliva. The buffers contained in saliva help maintain a rumen environment which favours these fibre-digesting microbes and minimizes the risk of acidosis.

What is the minimum amount of fibre required to maintain proper rumen function? Current NRC (National Research Council) feeding recommendations for lactating cows are based on research trials where corn has been the principle concentrate. These recommendations suggest that rations should contain minimum NDF levels of 25-28% with 75% of this provided by forages. Therefore, minimum forage NDF levels should be in the 19-21% range. Are these appropriate for the barley-based rations we feed in Alberta?

Barley versus corn

We recently completed a trial designed to compare the effects of barley versus corn in total mixed rations (TMRs) with varying NDF levels. Barley silage was the only forage offered. Table 1 summarizes our results. Notice that the low NDF barley ration produced higher milk and protein yields but a lower fat yield than the low NDF corn ration. At the same time, cows on barley-based rations consumed more dry matter (DM) and spent more time chewing (eating plus ruminating) than those on corn at all ration NDF levels. These observations suggest that barley can be fed in low NDF rations to increase milk revenue based on multiple component pricing without sacrificing rumen function.

How low can we go?

At 18.9%, the lowest forage NDF levels in the experiment described above were right at the bottom of the range recommended by NRC. But the low NDF barley ration contained a total NDF level of 36.6%, compared with 31.0% for the low NDF corn ration. This is because barley typically contains over twice as much NDF as corn (20% vs 9%). As a result of the large contribution of barley NDF, barley-based rations formulated to contain minimum total NDF levels (25-28%) may contain as little as 12% forage NDF.

	------- BARLEY -------			-------- CORN --------		
NDF LEVEL :	LOW	MED	HIGH	LOW	MED	HIGH
Ration Composition, % of DM						
Grain	58.8	47.8	21.1	58.8	47.8	21.1
Supplement	10.4	12.2	13.9	10.4	12.2	13.9
Barley Silage	30.8	40.0	65.0	30.8	40.0	65.0
NDF	36.6	40.0	49.3	31.0	35.5	47.3
Forage NDF	18.9	24.5	39.9	18.9	24.5	39.9
Production Responses, kg/day						
DM Intake	19.7	19.3	17.0	19.2	19.0	16.7
Weight Change	0.41	0.17	-0.03	0.54	0.32	-0.01
Milk Yield	27.1	26.6	23.1	26.1	25.7	23.2
Fat Yield	0.79	0.87	0.73	0.84	0.80	0.71
Protein Yield	0.91	0.86	0.69	0.82	0.80	0.68
Chewing time, min/day						
Eating	268	311	350	287	314	348
Ruminating	499	510	538	426	458	523

Table 1 : Results of a trial comparing barley and corn in rations varying in NDF level.

What effects would rations with such low forage NDF have on milk yield, milk composition and rumen health? Table 2 shows the results of a TMR feeding trial intended to answer that question. Again, the ration with the lowest forage NDF level (13.2%) produced the most milk and protein with the lowest fat yield. Cows on this ration also gained the most weight during the trial. And, based on measurements of time spent eating and ruminating, the long hay used in this trial provided enough physical fibre to stimulate sufficient chewing. But what would happen if the hay was replaced by silage? And what effect would chop length have on production and digestive function?

Effect of chop length and type of forage

A third trial was designed to answer these questions. This time, TMRs that were either 32% or 62% forage were formulated with different proportions of fine-chopped alfalfa silage, coarse chopped silage and long alfalfa hay. Forage NDF levels were either 12.6 or 25.3%. Table 3 shows some of the results of this experiment. For the 62% forage rations, fine chopping of silage increased DM intake, milk production and protein yield compared with coarse chopping. There was little change in fat yield. But in the low (32%) forage rations, the coarse chopped silage produced the greatest DM intake along with the most milk, protein and fat. The inclusion of 10% hay in low forage rations (replacing silage) had no effect on milk or protein yields but intake and fat test increased slightly. All rations fed in this trial stimulated enough chewing to maintain intake and good digestive function.

	------- NDF LEVEL -------		
	LOW	MED	HIGH
Ration composition, % of DM			
Concentrate	69.8	45.4	19.3
Alfalfa Hay	30.2	54.7	80.7
NDF	33.2	36.9	40.8
Forage NDF	13.2	23.9	35.3
Production Response, kg/day			
DM Intake	22.4	21.8	21.0
Weight Change	1.04	0.16	-0.13
Milk Yield	26.2	23.2	21.9
Fat Yield	0.72	0.80	0.80
Protein Yield	0.92	0.80	0.74
Chewing time, min/day			
Eating	315	355	445
Ruminating	393	415	463

Table 2 : Low NDF rations produced more milk and protein with less fat.

	- COARSE -		---- FINE ----	
FORAGE :	32%	62%	32%	62%
Ration composition, % of DM				
NDF	27.2	31.2	27.2	31.2
Forage NDF	11.9	22.6	11.9	22.6
Production Response, kg/day				
DM Intake	21.9	19.3	21.5	20.9
Milk Yield	26.8	22.3	25.9	23.9
Fat Yield	0.81	0.83	0.77	0.84
Protein Yield	0.93	0.72	0.90	0.80
Chewing time, min/day				
Eating	284	380	300	336
Ruminating	428	458	400	426

Table 3 : The effects of forage chop length on production and chewing in rations containing low or moderate amounts of mixed forages.

Summary

These three trials indicate that :

- cows can be fed barley-based rations containing significantly less forage NDF than is currently recommended by NRC, without jeopardizing intake or chewing activity;
- these low forage NDF rations are likely to produce more milk and protein with less fat, resulting in greater milk revenue from multiple component pricing;
- in low NDF total mixed rations, barley is likely to provoke higher milk and protein yields and reduce fat yield more than corn;
- forages included in low forage rations should be coarse-chopped; fine-chopped forages are more appropriate in higher forage rations;
- long hay is unnecessary in low forage rations based on coarse-chopped silage although it may increase intake and fat test slightly.

Feeding very low forage NDF rations for periods longer than one or two months cannot be recommended without caution, since this has been the maximum duration of these trials. Although our data indicate no negative short-term effects on rumen function, we were unable to evaluate possible long-term effects such as rumenitis, abscessed liver or laminitis. To do so would require experiments lasting at least a full lactation, preferably longer.

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