The effect of Acid Buf in diets for lactating Dairy Cows

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The potential impact of excess rumen acidity on fibre digestibility has been clearly shown by Wales et al 2004 (*) and illustrated in table 1. Buffering rumen pH to vary about a mean of 6.1 resulted in significant improvements in fibre digestibility compared with that possible if the mean pH was 5.6.

Acid Buf is the skeletal remains of the seaweed *Lithothamnium calcareum*, harvested off the Irish Coast. It has been used extensively as a buffer in ruminant nutrition but the extent of its effects on rumen metabolism and production response in dairy cows has only recently been rigorously evaluated. The aim of a study, carried out at the University of Stellenbosch under the supervision of Dr. Christian Cruywagen, was to determine the effect of different dietary inclusion levels of Acid Buf on milk production, milk composition and rumen parameters of dairy cows receiving a high concentrate diet.

Experimental Design

Two experiments were conducted:

1. A production trial using early lactation cows selected from a commercial herd. Cows remained on the selected treatment for the full period of 70 days. Milk production was monitored daily and milk samples were taken weekly and analyzed for protein, fat and lactose. Cows were weighed and condition scored at 0, 28, 56 and 70 DIM. Feed intake was monitored using Callan gates for 3 out of 5 treatments but the cows on the extreme treatments were group fed. Milk yield was adjusted by covariate analysis against initial performance.
2. A metabolism trial using continuous monitoring of rumen pH and periodic sampling for VFA and nitrogen parameters. The dietary treatments were fed individually to five ruminally cannulated lactating Holstein cows (110-130 DIM) in a Latin square arrangement. Every cow received each diet for a period of 22 days prior to a data collection period of 8 days. Rumen pH was monitored continuously every 10 minutes for 4 days using a portable data logging system and in-dwelling electrodes. Samples of rumen liquor for VFA analysis were collected 2 hours before the morning feeding and again at 2, 6 and 10 hours after this feed allocation

Diets

A high concentrate TMR, formulated to be potentially acidotic (Table 2), was used to construct five dietary treatments in which Acid Buf was included at increasing levels of 0.125, 0.3, 0.6, 0.9 and 1.2% of dietary DM in place of limestone. The basal diet contained 26% NDF, 46.8% NFC and 17% CP.

Results

Production Trial

Milk yield was significantly increased by the increase in Acid Buf from 0.125% to 0.3% of the diet. Milk yield and 4% FCM yield was the highest for the 0.3% Acid Buf level. Milk fat levels continued to increase for each increase in level of Acid Buf while protein percentage increased up to 0.6% inclusion.

All cows were in positive energy balance by 70 days in milk. There was a tendency for those cows on diets containing 0.125% to 0.6% Acid Buf to mobilize more body tissue to 56 DIM compared with those on other treatments, both in terms of condition score and body weight.

Metabolism trial

Continuous monitoring of rumen pH demonstrated the increase in acidity that occurs with feeding. Minimum pH levels were noted after the second feed at about 7pm. There was a dose response to increasing Acid Buf levels on rumen pH, with an average increase of 0.4 pH units between the extremes of Acid Buf addition to the diet.

The effect of diet on VFA output (figure 2&3) indicated that rumen VFA concentration was maximized at 0.6% Acid Buf and only when used at levels in excess of this was there a movement in the acetate:propionate ratio. Up to 0.6% Acid Buf, the diets were favouring a propionate fermentation, which would have promoted milk protein and milk yield. Only above 0.6% Acid Buf did the fermentation switch to

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* J. Dairy Sci.2004; 87:1864-1871.
Diurnal Variation in Ruminal pH on the Digestibility of Highly Digestible Perennial Ryegrass During Continuous Culture Fermentation
W. J. Wales[1], E. S. Kolver[2], P. L. Thorne[2] and A. R. Egan[3]

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Table 1: Effect of Rumen pH on Fibre Digestibility in vitro - Wales et al, 2004.			
	Variable about Ph 5.6	Variable about pH 6.1	Difference, %
OM - true digestibility (%)	59.0b	69.1a	15
NDF - fibre digestibility (%)	46.2b	65.6a	30
ADF - fibre digestibility (%)	47.7b	74.7a	36

Table 2: Diet composition.	
Oat hay	17.2
Lucerne hay	17.6
Wheat bran	3.6
Soybean meal	7.2
Cottonseed meal	3.7
Fish meal	2.5
Ground corn	40.6
Urea	0.48
Molasses	3
Megalac	2.56
MinVit	0.15
Limestone	1.04
Salt	0.2

Table 3: Results of the production trial.						
Item	Treatment					P
	0.125% AB	0.3% AB	0.6% AB	0.9% AB	1.2% AB	
Ave daily milk yield (kg)	39.0b	44.6a	41.4ab	39.3b	41.6ab	<0.05
4% FCM (kg)	35.0b	41.7a	38.8a	37.8a	40.2a	<0.01
Ave milk fat (%)	3.33b	3.58ab	3.60ab	3.77a	3.82a	<0.02
Milk fat wk 3-6	3.01b	3.28ab	3.49a	3.54a	3.61a	<0.0002
Ave milk protein (%)	2.80b	2.93ab	3.07a	2.95ab	3.08a	<0.001
Ave milk lactose (%)	4.79	4.77	4.79	4.76	4.76	NS
Milk fat yield (kg/d)	1.29b	1.59a	1.48a	1.47a	1.57a	<0.01
Milk protein yield (kg/d)	1.09b	1.31a	1.27a	1.16a	1.28a	<0.03

Table 4: Feed intake and body change data from the production trial.						
Item	Treatment					
	0.125% AB	0.3% AB	0.6% AB	0.9% AB	1.2% AB	P
DMI (kg/d)	-	26.4	25.2	24.5	-	NS
Efficiency(kg milk/kg DMI)	-	1.69	1.64	1.6	-	NS
Body weight:						
At calving	641	654	654	664	667	NS
28 DIM	600	604	629	664	632	NS
56 DIM	604	603	608	631	640	NS
70 DIM	614	611	610	640	643	NS
Body condition score:						
At calving	3.3	3.2	3.4	3.6	3.6	NS
28 DIM	2.6	2.6	2.6	3	3.1	NS
56 DIM	2.4	2.3	2.1	2.6	2.7	NS
70 DIM	2.6	2.3	2.1	2.8	2.9	NS
Values with P showing as "ns" do not differ significantly at a significance level of 0.05 and higher".						

Figure 1: Effect of dietary Acid Buf level on 24hour ruminal pH in lactating dairy cows.

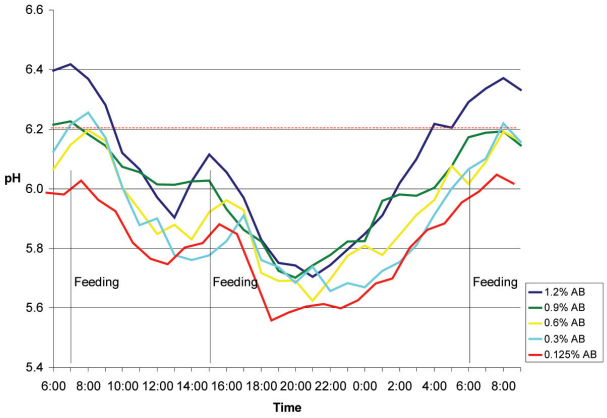


Figure 2: Effect of Acid Buf on molar ratios of acetic acid:propionic acid.

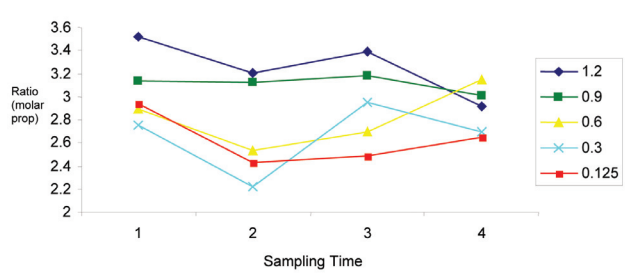
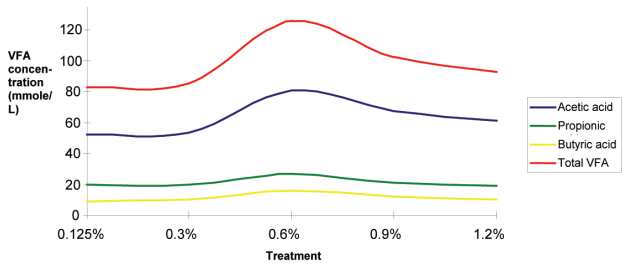


Figure 3: Effect of Acid Buf on mean ruminal VFA levels (mmole/L).



acetate and this coincided with ever increasing levels of milk fat percentage in the production trial.

Conclusion

The experiment indicates that an increase in average rumen pH does not only improve fibre digestibility as shown by Wales et al 2004, but can also impact on milk yield and quality. For normal milk production from a high concentrate TMR, Acid Buf inclusion levels of at least 0.3% of DM (80g/d) appears to support maximum milk production. Higher inclusion levels resulted in increased milk fat and protein contents. The positive effect of Acid Buf appears to be related to its buffering capacity in the rumen and a drive towards increased volatile fatty acid production, which appears to be optimal at the 0.6% inclusion level. Also the VFA profile continues to maintain a high propionate concentration up to 0.6% Acid Buf in the diet, maintaining the focus on milk output and milk protein production.

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