The effect of supplementing two levels of rumen buffer on rumen and milk parameters in dairy cows

Peter van Adrichem, MSc

P.A. Abrahamse, G.F. Schroeder

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Background

Why the rumen needs dietary buffering:

- Rumen acidosis affecting biohydrogenation resulting in milk fat depression (Chouinard et al.,1999).
- Fiber digestion
- Rumen pH and inflammation (Li et al., 2012)
  - Depending on origin of acidosis (Khafipour et al., 2009)
- High concentrate rations negatively impact salivation (Beachemin et al., 2008)

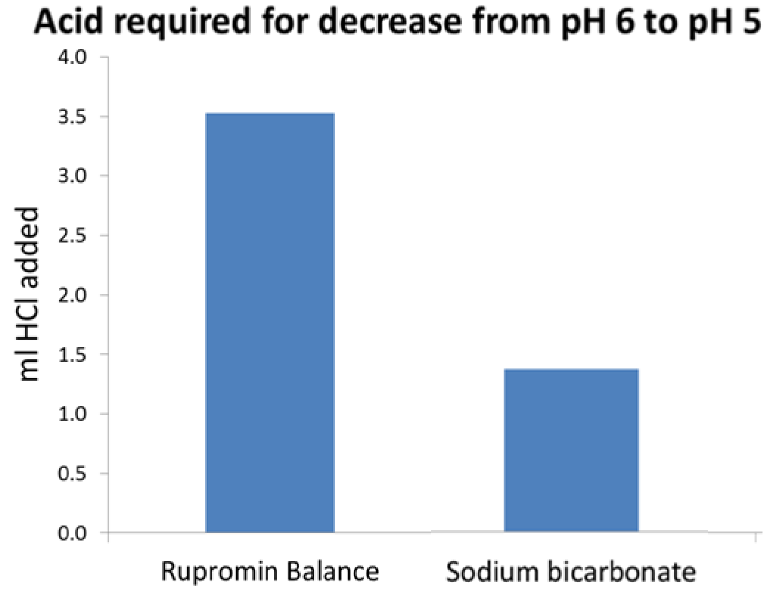
Rumen Buffers

Salt of a weak acid or oxide or hydroxide which neutralises acids present in food stuffs or acids produced during nutrient digestion and metabolism (Chalupa & Schneider, 1985).

‘True buffer’ - Lessens the decrease in pH without causing a pH increase e.g. sodium bicarbonate, calcium carbonate.

‘Alkalising agent’ - Neutralises acid, but also elevates pH e.g. sodium carbonate, magnesium oxide.

In vitro (titration)



Objective and hypothesis

OBJECTIVE

- Evaluate the effect of two levels of rupromin balance on rumen parameters and milk fat content in lactating cows.

HYPOTHESES

Rumen buffer addition will:

1. increase rumen pH
2. Rumen fermentation acids shift
    i. Increase in acetate concentration
    ii. Reduction in propionate concentration
3. Alleviation of milk fat depression indicated by:
    i. Increase milk fat content
    ii. Decrease t10C18:1 concentration in milk

Experiment set-up

3x3 Latin Square

- 6 rumen fistulated lactating HF dairy cows
- 2 weeks pre-experiment shift to high starch diet
- 3 week periods – 2 Weeks adaptation
- Balanced squares, cows blocked based on MY
  - Square 1: 37.0 ± 2.3 L/d; 146 ± 87.2 DIM
  - Square 2: 29.5 ± 2.6 L/d; 217 ± 15.3 DIM

Treatments

- Pelleted in concentrate
- Control: No buffer
- Dose 1: 150 g Rupromin Balance/cow/day
- Dose 2: 300 g Rupromin Balance/cow/day

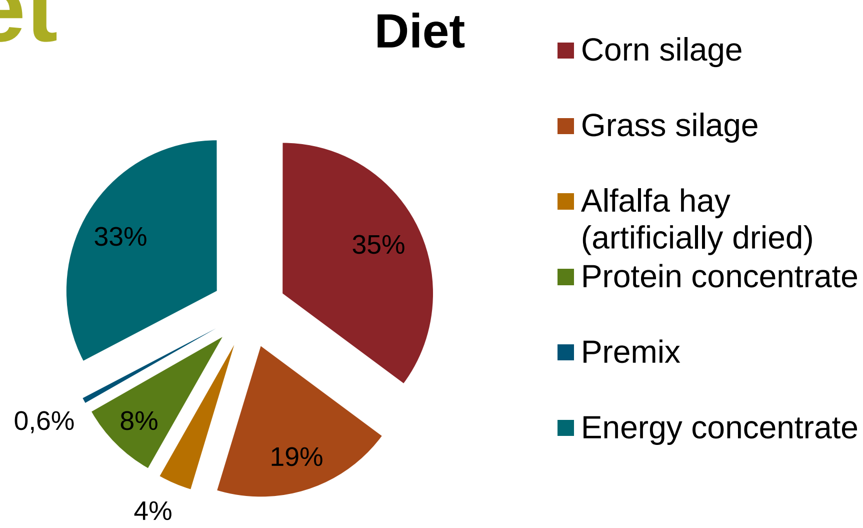
Energy concentrate supply

	SQ 1: 8 kg	**SQ 2: 6 kg**
Morning (9.00h)	3,5	3,5
Afternoon (12.00h)	3	2,5
Evening (18.00h)	1,5	
Total	**8 kg**	**6 kg**

Measurements

- MY, DMI
- Rumen fluid samples – VFA, lactate: 3 and 6h after feeding
- Milk samples, afternoon and morning separate
  - Fat, protein, lactose, SCC, urea
  - Complete OBCFA profile
  - FPCM calculated according to CVB
- Rumen pH, 5 min interval, 96h

Diet



Energy concentrate

	With buffer	without buffer
Ingredient composition (% DM)		
Soybean meal HP	19	13,4
Wheat	60	60
Corngluten feed	-	15,1
Molasses	5,0	5,0
SBM Mervobest Marsh	5,0	5,0
Limestone	1,0	1,0
Salt	0,5	0,5
Hyprofat	2,0	-
Rupromin Balance	7,5	-

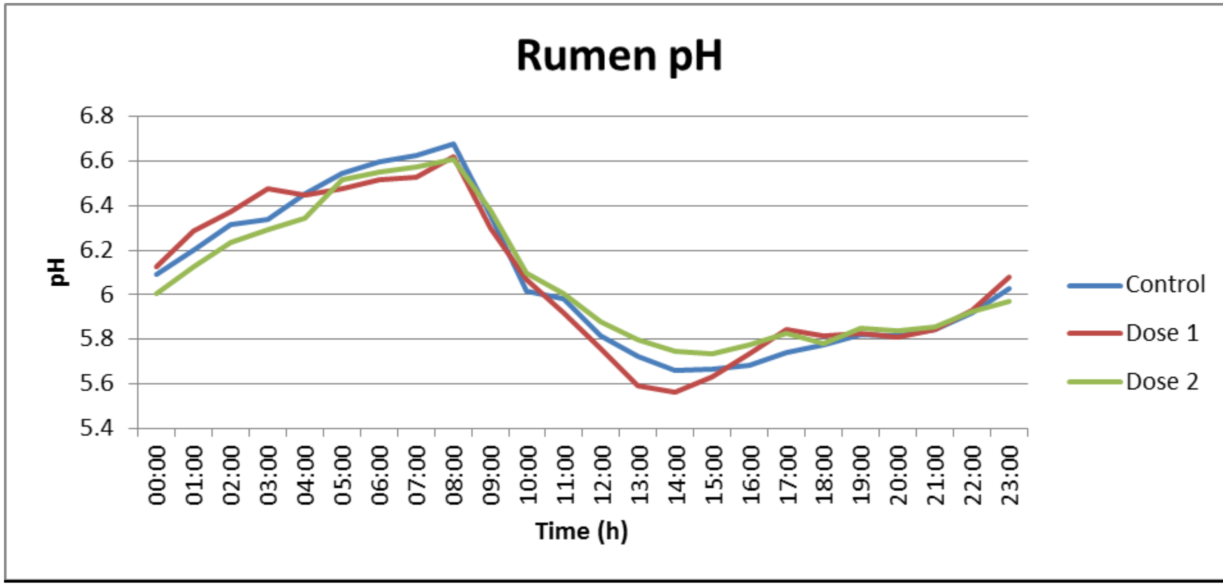
0,2 or 4 kg

g/kg DM	With buffer	Without buffer
Crude protein	18.0	18.5
Crude fat	3.23	1.51
Crude fibre	2.44	3.37
Crude ash	11.6	5.1
Starch	35.4	37.5
Dry matter	87.5	86.9
NDF	9.61	14.44
ADF	0.35	0.46
ADL	0.05	0.06
VEM	961	974
DVE	114	115
OEB	24.0	24.0

Ration – nutrients

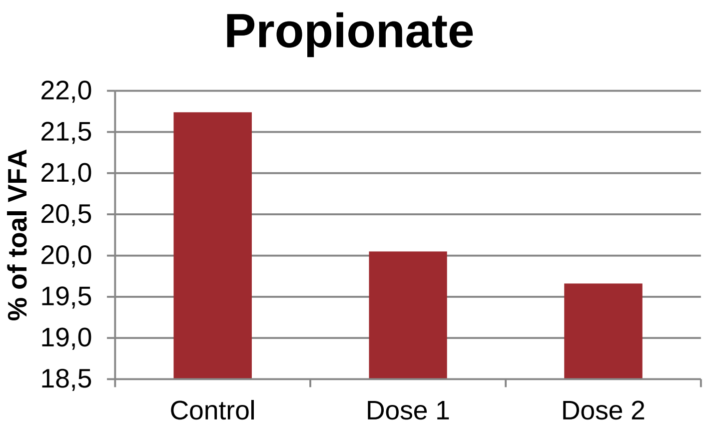
g/kg DM	Control	Dose 1	Dose 2
Crude protein	161	160	160
Crude fat	28.5	29.9	31.2
Crude fibre	166	165	164
Crude ash	70.3	75.3	80.8
Starch	244	243	241
Sugar	49.9	50.0	50.2
Dry matter	471	471	471
NDF	371	367.1	363
ADF	181	180	179
ADL	22.5	22.5	22.5
VEM	960	958	957
DVE	90.3	90.1	89.9
OEB	11.1	11.1	11.0

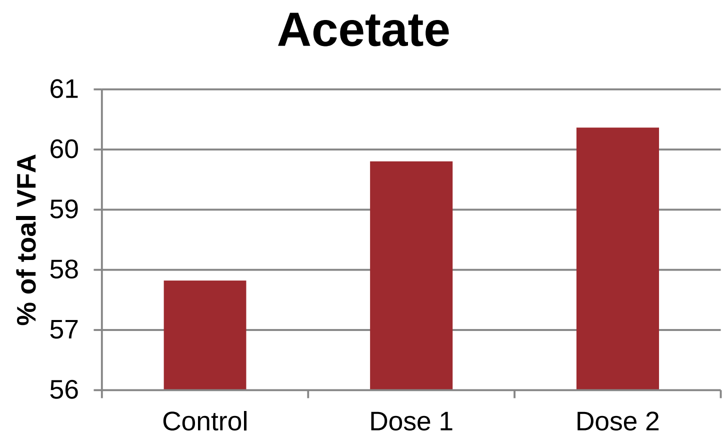
Results: Rumen pH

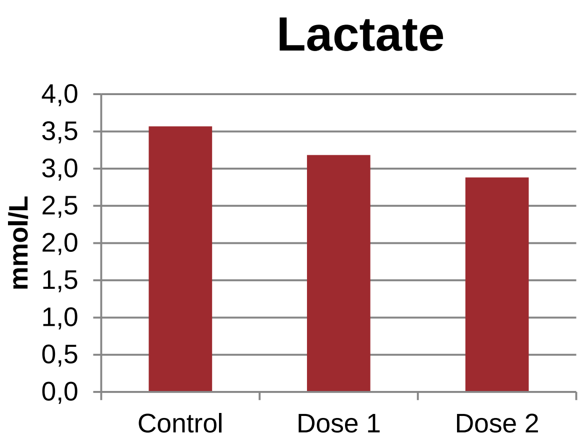


	Treatment				p-values	
	Control	Dose 1	Dose 2	SEM	T	T*lin*
Rumen pH						
Average pH	6.07	6.06	6.07	0.1	0.99	0.99
Minimum pH, hourly	5.60	5.66	5.62	0.09	0.45	0.76
Maximum pH,hourly	6.41	6.36	6.43	0.08	0.59	0.77
Time pH below 5.6, min/d	156	156	178	53.2	0.63	0.41
Area pH below 5.6, min*pH	20.6	22.1	20.7	7.78	0.95	0.99
’ 0 (Colman, 2012)	4.71	4.11	4.58	0.39	0.23	0.72
² 1	6.13	6.12	6.08	0.08	0.44	0.21

Results: rumen VFA profile







	Treatment				p-values	
	Control	Dose 1	Dose 2	SEM	T	T*lin*
Lactate, mmol/L	3.57	3.18	2.88	0.35	0.11	**0.05**
Rumen VFA, % of total						
Acetate	57.8	59.8	60.4	1.63	0.11	**0.05**
Propionate	21.7	20.1	19.7	1.58	0.09	**0.04**

Results: Milk fatty acids profile

Negative correlation with Ac/Prop (Maxin et al., 2011)

g/100g FA	Treatment			SEM	p-values	
	Control	Dose 1	Dose 2		T	T*lin*
C5:0	0.037[a]	0.030[ab]	0.025[b]	0.003	**0.05**	**0.02**
C7:0	0.039	0.030	0.027	0.004	0.12	**0.05**
C17:0	0.539[a]	0.491[b]	0.474[b]	0.019	**0.01**	**0.01**
t10C16:1	0.012	0.010	0.009	0.001	0.13	**0.06**
t11+t12C16:1	0.021	0.020	0.032	0.004	0.06	**0.04**
c9C17:1	0.203[a]	0.179[b]	0.173[b]	0.011	**0.03**	**0.02**
c9C20:1	0.106	0.116	0.126	0.007	0.10	**0.04**
t10C18:1	0.473	0.307	0.354	0.069	0.09	0.11
isoC15:0	0.220[a]	0.244[b]	0.256[b]	0.008	**0.01**	**0.00**
isoC17:0	0.332	0.331	0.377	0.015	0.07	**0.05**

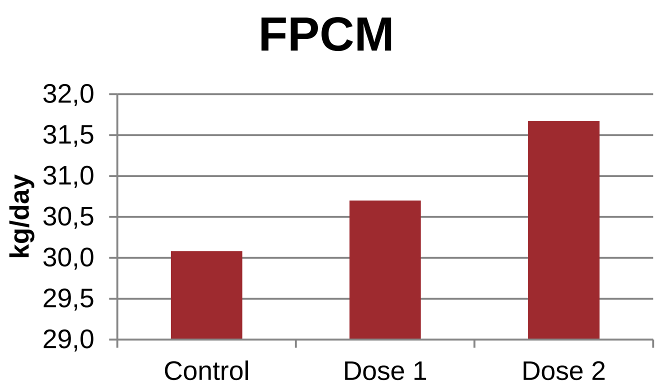
Positive correlation with propionate (Vlaeminck et al, 2006)

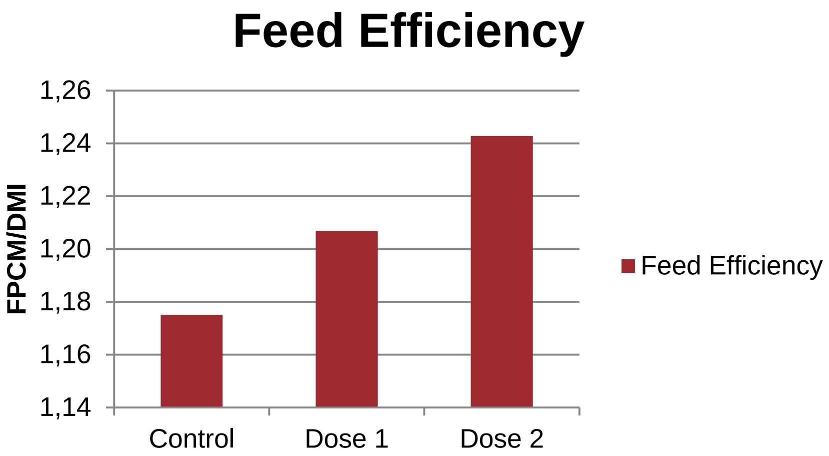
Indicator for acidosis – no effect shown in rumen pH however

Positive correlation with acetate in the rumen (Vlaeminck et al, 2006)

Colman et al., 2012. Linked to β1

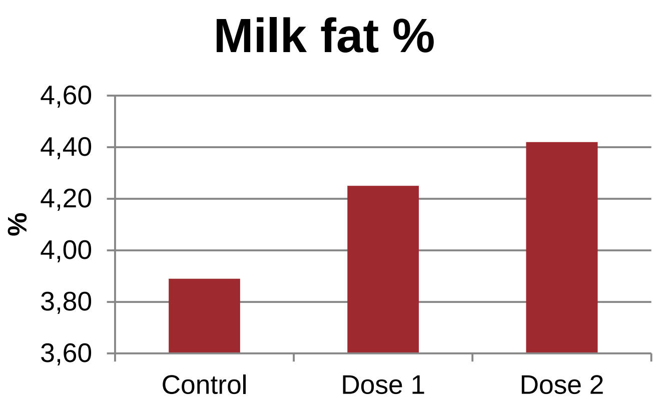
Results: Production and intake





	Control	Dose 1	Dose 2	SEM	T	T*lin*
FPCM, kg/d	30.1	30.7	31.7	0.87	0.11	**0.04**
Milk yield, kg/d	29.8	29.3	29.6	0.87	0.67	0.67

	Control	Dose 1	Dose 2	SEM	T	T*lin*
DMI, kg/day	25.6	25.5	25.7	0.43	0.81	0.77
FE (FPCM/DMI)	1.18	1.21	1.24	0.03	0.1	**0.04**



	Control	Dose 1	Dose 2	SEM	T	T*lin*
Milk fat, %	3.89[a]	4.25[b]	4.42[b]	0.12	**0.02**	**0.01**
Milk fat, kg/d	1.16[a]	1.25[b]	1.31[b]	0.07	**0.03**	**0.01**
Milk protein, %	3.67	3.64	3.67	0.06	0.61	0.95
Milk protein, kg/d	1.09	1.06	1.08	0.02	0.39	0.65
Milk lactose, %	4.50	4.49	4.47	0.03	0.15	0.06
MUN, mg/dl	23.3	22.8	22.3	1.41	0.70	0.42
SCC *10^3/mL	137	346	126	138	0.36	0.95

Discussion

- No effect of buffer treatment on rumen pH.
  - Khafipour *et al*., 2009; Li *et al*., 2012 show that decreasing pH via either grain or alfalfa pellets lead to completely different animal reaction.
  - Variation in rumen pH, cow dependent

- Increase milk fat yield due to:
  - propionate's lipogenic properties
  - more milk fat precursor (acetate)

- Milk fatty acid profiles indicate a shift away from biohydrogenation induced milk fat depression

Conclusion

- Linear increase of milk fat % and yield by treatment
- No change in rumen pH observed
- Rumen fermentation changed in favor of milk fat production
- Milk fatty acid profiles indicate a shift away from the milk fat depression *t*-10 C18:1 pathway

Thank you!

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