Effects of pectin on production and urinary nitrogen excretion in lactating Saanen dairy goats

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Introduction Urinary nitrogen (N) is rapidly converted to ammonia (NH_3) during manure collection and storage, whereas faecal N is converted to NH_3 at a much slower rate. Developing nutritional strategies to shift N excretion from urine to faeces may reduce NH_3 from dairy manure which is implicated in reduced air quality. Previous work suggests that increasing post-ruminal fermentation may reduce urinary N and consequently manure NH_3 losses (Gressley and Armentano, 2005). Pectin is a class of neutral detergent-soluble fibre (NDSF) and studies in monogastrics have shown that it is completely degraded by resident intestinal bacteria (Buchanan *et al*., 1994). Gut bacteria are capable of converting blood urea-N into NH_3 and subsequently microbial protein. Therefore, growth of intestinal microorganisms using energy supplied by pectin can result in a net conversion of blood urea N into faecal microbial N, thereby reducing urinary N. The aim was to determine the effect of increasing carbohydrate fermentation in the large intestine on urinary N in lactating dairy goats.

Material and methods Four primiparous lactating Saanen dairy goats (average body weight (BW) 41±1.5 kg, days in milk 48±2.1 and milk production 1.93±0.35 kg) were used in a 4*4 Latin squares design with 14-d periods. Goats were abomasal cannulated and housed in metabolism crates with free access to water. Goats were fed with a basal diet (40% lucerne hay and 60% concentrates on dry matter (DM) basis) and offered at 95% of its estimated ad libitum intake throughout the experiment. Treatments were abomasal infusion of saline only (0 Pectin), saline containing 40, 80 or 120 g/day pectin. High-methoxyl slow-set citrus pectin was infused at 2.4 l/d from day 6 to 14 of each period. Total faecal and urine output was collected during the last 4 days of each period in order to calculate N balance. Faecal and urine samples were collected twice daily during the last 4 days of each period and prior to N analysis the samples were bulked within goat and period, with an equal portion taken from each sampling time. Duplicate milk samples from both a.m. and p.m. milking were taken during the final 4 days of each period and analysed for milk constituents. Data were analysed using a general linear model (GLM) in SAS (1999) and the significance of any infusion effects were detected using the Duncan's multiple range tests.

Results Dry matter intake decreased from 2250 g/day for 0 g/d to 1985 g/day for 120 g/d pectin infusion. Infusion of 120 g/d also decreased milk yield and 4% fat corrected milk (FCM) yield. Other treatments did not affect milk production. Treatments had no effect on milk composition. Increasing abomasal pectin infusion decrease urinary N and increase faecal N. Urinary N decreased from 3.92 and 4.32% with 80 and 120 g/d pectin infusion respectively.

Table 1 Effect of abomasal pectin infusion on intake, milk production and composition

	Pectin (g/day)				
	0	40	80	120	S.E.M.
Basal DM eaten[1]	2250^{a}	2215^{a}	2190^{ab}	1985^{b}	79.4
Total DM input[2]	2250^{a}	2245^{a}	2270^{a}	2105^{b}	89.42
Milk yeild (Kg/day)	1.95^{a}	1.90^{a}	1.90^{a}	1.75^{b}	0.09
4% FCM yeild (Kg/day)	1.77^{a}	1.76^{a}	1.77^{a}	1.60^{a}	0.08
Protein (%)	3.01	3.10	3.05	3.01	0.06
Fat (%)	3.40	3.55	3.50	3.43	0.10
Lactose (%)	4.63	4.65	4.60	4.62	0.03
total solid (%)	11.65	11.90	11.76	11.67	0.70
solid not fat (%)	8.25	8.34	8.26	8.24	0.58

[1] Intake of the basal ration only, not including pectin infused; [2] Intake of the basal ration plus pectin infused; S.E.M, standard error of the mean

Table 2 Effect of abomasal pectin infusion on intake and excretion of nitrogen

	Pectin (g/day)				
	0	40	80	120	S.E.M.
Milk, % of intake	15.60	15.85	15.76	15.56	0.65
Faeces, % of intake	25.2^{a}	26.5^{a}	28.8^{b}	29.4^{b}	0.41
Urine, % of intake	36.31^{a}	34.79^{a}	32.39^{b}	31.97^{b}	0.52
Urine N/(faecal N + urine N)	59.20^{a}	57.25^{a}	53.69^{b}	52.42^{b}	0.63
Retained N, (% of intake)	23.05	23.21	23.80	23.34	0.91

Nitrogen retained = intake N - milk N - urine N - faecal N.

Conclusions Although similar studies had not been performed in lactating dairy goats, these data support the hypothesis that increasing post-ruminal fermentation in dairy goats might shift some N excretion from urine to faeces. Infusion of 120 g/d pectin negatively affects production but 80 g/d abomasal fibre shifted approximately 3.9% from urine to faeces without adversely affect production.

References

Buchanan, C.J., Fry, S.C., and Eastwood, M.A. 1994. Journal of the Science of Food and Agriculture. 66, 163-173.
Gressley, T.F. and Armentano, L.E. 2005. Journal of Dairy Science. 88,4028-4044.