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Proceedings

INCREASING DIGESTA VISCOSITY MAY INCREASE PARASITE ESTABLISHMENT IN THE SMALL INTESTINE OF SHEEP

C.L. Bath-Jacobson, J.R. Pluske, K. Bell, R.B. Besier, D.W. Pethick

School of Veterinary and Biomedical Sciences, Murdoch University, South St., Murdoch, Western Australia, WA 6150, Australia. e-mail: cbath@murdoch.edu.au

INTRODUCTION

Strongyle infections and diarrhoea are major problems for the sheep industry, but the nutritional factors determining faecal consistency and susceptibility to enteric diseases are not well understood. Soluble non-starch polysaccharides (sNSP) have been shown to affect the physico-chemical environment of the gut lumen, by increasing viscosity of digesta and affecting microbial fermentation in the large intestine; however, the role of sNSP in sheep has not been studied. sNSP have been shown to increase parasite establishment in the small intestine of mice (3) and decrease parasite establishment in the large intestine of pigs (2). Carboxymethylcellulose (CMC) is a non-fermentable viscous-forming agent that is used to study the effect of soluble NSP in increasing digesta viscosity independent of potential effects on fermentation (1). The aims of this study were to investigate whether increasing viscosity of digesta using CMC may affect establishment of *Trichostrongylus colubriformis* and *Teladorsagia (Ostertagia) circumcincta* in sheep and whether the type of roughage and CMC may affect faecal consistency in sheep with strongyle infections.

MATERIALS AND METHODS

24 sheep (6 per treatment) were drenched with avermectin-albendazole-levamisole-closantel (Q-Drench®), individually housed and given a 3-day introductory period before treatments commenced. The experimental treatments were roughage type ("fresh" lucerne versus lucerne chaff) and CMC supplementation (high viscosity CMC added at 8% diet dry matter content versus no CMC). Sheep were dosed orally with 10,000 larvae of both *T. colubriformis* and *Tel. circumcincta*. Diets were provided ad libitum and dry matter intake was assessed daily. After D21, the "fresh" lucerne was unavailable and hence, all sheep were fed lucerne chaff from D22. Faeces were collected on 14 occasions for measurement of faecal dry matter (DM) and consistency score (F-score) on a scale of 1 (hard faecal pellet) to 5 (watery diarrhoea). All sheep were slaughtered on D50 or D51 and total worm counts were performed. Statistical analysis was carried out with SPSS 11.0, using univariate analysis of variance (ANOVA). All data was normally distributed and had equal variances (Levene's test of equality or error variance), thus did not require log transformation.

RESULTS

The results of the total worm counts and faecal assessments are Table 1. There was a significant effect of CMC supplementation on the establishment of *T. colubriformis* infestation. Sheep supplemented with CMC had higher numbers of *T. colubriformis* than sheep with no CMC supplementation ($P=0.045$). There was evidence of a trend for sheep fed chaff diets with CMC to have greater *T. colubriformis* establishment than sheep fed chaff diets without CMC ($P=0.055$). There was no significant effect of any of the treatments on the establishment of *Tel. circumcincta*, immature stages, L4 larvae, total strongyle count or L3 larvae. There was a significant effect of CMC on both mean faecal score and mean faecal dry matter measured from day 27 to 50 (slaughter), with CMC inclusion associated with increased faecal score and moisture (i.e. softer, wetter faeces).

Table 1. Effect of roughage type and CMC supplementation on strongyle establishment measured at slaughter and mean faecal parameters (day 27 to 50).

	<i>Telad.</i>	<i>Trich.</i>	Total-L3	F score	DM (%)
Fresh lucerne	2692	20775	31200	1.7 ^a	33.2 ^a
Fresh Lucerne + CMC	2367	24950 ^a	32683	2.2 ^b	31.0 ^{ab}
Lucerne chaff	3300	14350 ^b	23967	1.9 ^a	32.6 ^{ab}
Lucerne chaff + CMC	3233	22650	33592	2.1 ^b	29.5 ^b
sed	823	2038	2810	0.06	0.78
ANOVA: P values					
CMC	NS	0.045	NS	<0.001	0.040
Roughage type	NS	NS	NS	NS	NS
CMC x roughage	NS	NS	NS	NS	NS
Intake (covar.)	-	-	-	NS	NS
TWC - L3 (covar.)	-	-	-	NS	NS

Telad. / *Trich.*: number of adult *Telad. circumcincta* / *T. colubriformis* at slaughter, Total - L3: total strongyle worm count excluding L3 larvae, F. Score: Faecal consistency score, DM: Faecal dry matter, sed: standard error of the difference, NS: not significant ($P>0.05$)

DISCUSSION

The results suggest that increasing digesta viscosity using CMC, produces softer and more wet faeces in sheep with strongyle infections and may increase parasite establishment of *T. colubriformis* in the small intestine, but not of *Tel. circumcincta* in the abomasum, particularly in sheep fed chaff-based diets. The repeatability of this result and the mechanism, by which this may have occurred is not known and needs further investigation. Possible causes include modifications in intestinal architecture, increased intestinal motility/decreased transit time and antinutritive effects associated with increased digesta viscosity. These results are consistent with findings in monogastric species, whereby increasing digesta viscosity with CMC increased susceptibility to b-haemolytic *Escherichia coli* infections in the small intestine of pigs (1) or increased dietary sNSP in increased establishment of the nematode *Heligmosomoides polygyrus* in mice (3). In contrast, diets high in sNSP have been shown to reduce establishment of *Oesophagostomum dentatum* in the large intestine of pigs, possibly through changes in the colonic environment attributable to alterations in bacterial fermentation (2). Interactions between sNSP and parasite biology and the mechanisms by which these interactions occur are likely to be complex and dependent on the location of the parasite in the gastrointestinal tract.

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INCREASING VISCOSITY OF DIGESTA HAS DETRIMENTAL EFFECTS ON FAECAL CONSISTENCY IN SHEEP

C.L. Bath-Jacobson, J. Pluske, K. Bell, D.W. Pethick

School of Veterinary and Biomedical Sciences, Murdoch University, South St., Murdoch, Western Australia, WA 6150, Australia.
e-mail: cbath@murdoch.edu.au

INTRODUCTION

Although diarrhoea and faecal soiling of fleece are major problems for the sheep meat and wool industries, there is little information on the nutritional factors that determine faecal consistency in sheep. Research in monogastric species has shown that the soluble non-starch polysaccharide (sNSP) content of the diet is a major determinant of faecal consistency and susceptibility of animals to enteric diseases (2, 3), but there have been no studies on the role of sNSP in sheep. sNSP have profound effects on the physio-chemical conditions of the gut lumen by increasing viscosity of digesta and affecting microbial fermentation in the large intestine (2). Carboxymethylcellulose (CMC) is a non-fermentable viscous-forming agent that has been used in pig diets to study the effect of sNSP of increasing digesta viscosity, independently of potential effects on fermentation (2).

This study aimed to investigate if CMC could be used as a model for studying the effect of increasing digesta viscosity in sheep and whether dietary CMC supplementation would have any detrimental effects on faecal consistency.

MATERIALS AND METHODS

Forty sheep (8 per treatment) were individually housed and fed pasture silage for an introductory period of 5 days then fed diets consisting of 2 grades of CMC (high or low viscosity CMC) added to the silage at a rate of 0%, 2% or 8% dry matter content for 7 days. Dry matter intake was measured daily. Faeces were collected daily for assessment of faecal moisture, consistency and viscosity. Faecal moisture was assessed by measuring faecal dry matter content. Faecal consistency score was assessed using a scale of 1 (hard faecal pellet) to 5 (watery diarrhoea). Faecal viscosity was measured using a cone-plate rotational viscometer. Statistical analysis involved univariate analysis of variance (ANOVA) using SPSS 11.0. All data were normally distributed.