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# Proceedings

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## 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 *Oesophagostomun 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 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

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## 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.

## RESULTS

There was no significant difference in the mean daily dry matter intake of any of the 5 diets and there was no significant effect of CMC type or inclusion on intake.

Sheep fed high viscosity CMC and 8% low viscosity CMC had significantly higher faecal scores and faecal moisture (i.e. softer wetter faeces) than sheep fed the control diet or 2% low viscosity CMC (Table 1). All sheep fed CMC had higher faecal viscosity than sheep fed the control diet (Table 1). Table 2 shows the ANOVA results for factors affecting faecal parameters. Rate of CMC inclusion and mean daily dry matter intake (DMI) had a significant effect on both faecal score and faecal dry matter with higher DMI and inclusion associated with increased faecal score and faecal moisture. CMC type had a significant effect on faecal dry matter with higher viscosity CMC associated with increased faecal moisture. There were no significant interactions between CMC type and inclusion rate on any of the faecal parameters measured.

**Table 1. Effect of dietary CMC on faecal parameters (mean value days 3-7).**

| | CMC type and inclusion | | | | | | |
|---|---|---|---|---|---|---|---|
| | Control | Low viscosity | | High viscosity | | | |
| | 0% | 2% | 8% | 2% | 8% | Mean | SED |
| Faecal score | 2.14[a] | 2.21[a] | 2.50[b] | 2.56[b] | 2.56[b] | 2.40 | 0.05 |
| Faecal dry matter (%) | 29.2[a] | 28.3[a] | 26.2[b] | 26.0[b] | 25.3[b] | 27.0 | 0.30 |
| Faecal viscosity (mPAS) | 2.55[a] | 3.4[b] | 3.26[b] | 3.43[b] | 3.77[b] | 3.35 | 0.13 |

Mean values within rows with different superscripts are significantly different ($P<0.05$), SED: standard error of the difference.

**Table 2. P values for ANOVA analysis of factors affecting faecal parametres.**

| | Faecal score | Faecal dry matter | Faecal viscosity |
|---|---|---|---|
| Intake (covariate) | 0.011 | 0.008 | ns |
| CMC type (CMC) | ns | 0.004 | ns |
| CMC Inclusion (rate) | 0.015 | 0.008 | ns |
| CMC x rate | NS | NS | NS |

NS: no significant effect ($P>0.05$).

## DISCUSSION

The results suggest that CMC can be used as a model for investigating the effects of increasing viscosity of digesta in sheep. Dietary CMC inclusion had no detrimental effects on dry matter intake of sheep. Dietary CMC affected faecal parameters and increased faecal viscosity relative to the control group suggesting that CMC must escape rumen fermentation to some extent. Increased rate of CMC inclusion was associated with softer and more wet faeces. The type of CMC also affected faecal moisture with high viscosity CMC associated with more wet faeces than low viscosity CMC.

Soluble and insoluble NSP are not assessed in routine fibre measurement of animal diets. sNSP are present in the hemicellulose and pectin fraction of diets. The hemicellulose fraction decreases as pasture plants reach maturity and the cellulose (insoluble NSP) increases. In general, the pectin content of legumes is much higher than that of grasses and it has been suggested that portions of pectin may be resistant to degradation the rumen (1). Therefore analysis of soluble and insoluble NSP contents of different pasture species and at different levels of maturity warrants investigation. Further work is required to understand the role of sNSP on the physical and chemical properties of the gut environment in sheep and the role of sNSP in pasture diets, including the fermentability of sNSP in the rumen and large intestine and possible interactions between sNSP and enteric diseases.

## ACKNOWLEDGEMENTS

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