Evaluation of internal markers for estimating duodenal digesta flow in ruminants: acid detergent fibre and lignin disappearance at the lower gastrointestinal tract

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Introduction

Most of published studies carried out for estimating organic matter (OM) rumen digestibility (OMRD) use research animals fitted with simple t-type cannulas and an external or internal marker for estimating the duodenal digesta flow. Compared to external, the internal markers have the advantage of occurring naturally in diet and, consequently, they flow intimately associated with digesta (Titgemeyer 1997). Porter and Singleton (1971a) reported from a study with sheep fitted with re-entrant duodenal cannula that lignin degradation takes place entirely in the stomach. Thus, in digestibility studies where total faeces output is measured, duodenal digesta flow may be estimated based on both faeces output and the ratio of lignin concentration in faeces and in duodenal digesta. However, sulphuric acid lignin (ADL) is present in low concentrations in duodenal digesta and the precision of duodenal flow estimates is usually compromised. This study evaluated the disappearance at the lower gastrointestinal tract and, consequently, the potential use of acid detergent fibre (ADF), in comparison with ADL, as an internal marker for estimating duodenal digesta flow in cattle.

Material and methods

The intestinal disapearance of ADF and ADL from forage (*Avena strigosa*, *Pennisetum purpureum*, *Cynodon dactylon* and *Medicago sativa*) and concentrate (corn grain, soybean meal and sunflower meal) samples was evaluated through the mobile-bag technique in four Holstein steers (156 ± 33 kg live weight (LW) fitted with duodenal t-type cannula, and used in a Latin Square experiment through four 15 day periods. The steers were housed in metabolism cages, fed *Avena strigosa* (60%), concentrate (40%) and either level of *Acacia mearnsii* tannin extract (0, 8, 16 or 24 g/kg dry matter (DM)). Feed was offered twice daily at a rate of 20 g DM/kg LW/day. From day 10 to 15 of each experimental period, approximately 1.5 g of dried and ground (2 mm screen) samples of each forage and concentrate were weighed in polyester filter bags (7 × 5 cm; 25µm porosity) and incubated in the rumen (12, 24, 36 or 48 h) of an additional, fistulated Devon steer. For each sample type, incubation time, Latin Square period and Holstein steer, four bags were incubated. Following rumen incubation, contents of two of the four bags were analysed for ADF and ADL concentrations. The other two bags were introduced in the duodenum of steers and recovered in faeces. All ADL and ADF concentrations were expressed as g/kg of incubated DM. The respective ADF or ADL concentrations of the contents of the two bags recovered post rumen incubation were randomly paired against the corresponding concentrations (ADF or ADL) of the contents of the two bags recovered in faeces. All paired concentration values obtained respectively before and after the lower gastrointestinal passage were compared through linear regression. Deviation of the intercept from 0 or of the slope from 1 was assessed using a two tailed *t* test.

Results

The ADF and ADL concentrations in the bags recovered in faeces were strongly related, respectively, to ADF and ADL concentrations in the paired bags recovered post rumen incubation (and not inserted in the duodenum) (Fig. 1). For both chemical components (*i.e.* ADF and ADL), neither was the intercept different from 0 nor was the slope different from 1. However, the determination coefficient (R^2) of the linear regression, and consequently the precision, was higher for ADF than for ADL.

Conclusion

Acid detergent fibre may be used as a replacement of sulphuric acid lignin as an internal marker for estimating duodenal digesta flow in digestibility experiments with ruminants where faeces output is measured and spot samples of duodenal digesta are taken, with the advantage of improving the precision estimates.

References

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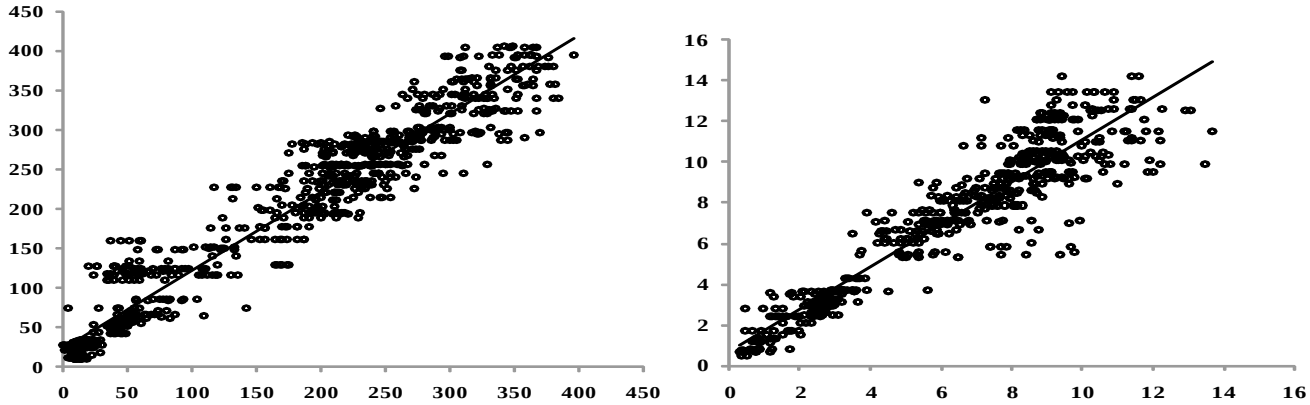

Figure 1. Relationship between the concentrations (g/kg of incubated dry matter) of acid detergent fibre (Panel A, n=901, *P*<0.05) or sulphuric acid lignin (Panel B, n=590, *P*<0.05) in bags before (X) and after (Y) passage throughout the lower gastrointestinal tract of steers.