Evaluation of acid detergent fibre, sulphuric acid lignin and n-alkanes as markers for estimating ruminal digestibility in cattle

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Introduction

Most of the published studies on 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. Although there is not an ideal or standard marker, compared to external markers, internal markers have the advantage of occurring naturally in the diet and, consequently, they flow intimately associated with digesta (Titgemeyer 1997). In digestibility studies where total faeces output is measured, duodenal digesta flow may be estimated based on both faeces output and the ratio of a marker concentration in faeces and in duodenal digesta. Sulphuric acid lignin (ADL) has been commonly used as an internal marker in this approach. However, its low concentrations in duodenal digesta usually compromises estimate precision. The objective of this study was to evaluate acid detergent fibre (ADF) in comparison with ADL, as well as with n-alkanes, as a marker for estimating OMRD in cattle.

Material and methods

Four Holstein steers (156±33 kg live weight (LW) fitted with duodenal t-type cannula, housed in metabolism cages, fed *Avena strigosa* (60%), concentrate (40%) and varying levels of *Acacia mearnsii* tannin extract (0, 8, 16 or 24 g/kg dry matter (DM)), were used in a Latin Square experiment through four 15 day periods. Feed was offered twice daily at a rate of 20 g DM/kg LW/day. From day 5 to 15 of each experimental period the animals were orally dosed with 125 mg/day of C_{32} n-alkane. From day 10 to 15 total faeces output was weighed and sampled. Samples of duodenal digesta were taken at 2-h intervals during a 24 h period. Feed offered, feed refusals, faeces and duodenal digesta samples were dried in a forced-air oven at 55°C, ground (1 mm screen) and pooled by animal-period for analysis. Samples were analysed for concentration of DM, OM, ADL, ADF and n-alkanes (C_{31}, C_{32} and C_{33}).

Duodenal flux (g/day) of OM was calculated from external C_{32} n-alkane as: dosed C_{32} (mg/day)/C_{32} in duodenal digesta (mg/g OM); and from duodenal and faecal concentration of either marker (*i.e.* ADL, ADF or either of n-alkanes C_{31}, C_{32} and C_{33}) as: [faeces OM (g/day) × marker in faeces (mg/g OM)]/marker in duodenal digesta (mg/g OM).

Table 1. Organic matter (OM) digestibility in steers fed *Avena strigosa* (60%), concentrate (40%) and levels of *Acacia mearnsii* tannin extract (0, 8, 16 or 24 g/kg DM), estimated through different markers of duodenal digesta flow. Values are least square means (LSMEANS) of all tannin treatments (n=16).

Marker	LSMEANS	Standard deviation
Internal:[†]		
Sulphuric acid lignin	0.34 c	0.110
Acid detergent fibre	0.49 bc	0.051
n-alkane C_{31}	0.73 a	0.116
n-alkane C_{33}	0.63 ab	0.145
External n-alkane C_{32}		
Dosed-based[ψ]	-0.04 d	0.267
Fecal/duodenal ratio-based[†]	0.52 bc	0.129

a,b,c,d: means followed by differet letter differ by Student t test (P<0.05).
[†]Duodenal OM flow calculated as: [feces OM (g/day) × marker in feces (mg/g OM)]/ marker in duodenal digesta (mg/g OM)
[ψ] Duodenal OM flow calculated as: dosed C_{32} (mg/day)/C_{32} in duodenal digesta (mg/g OM)

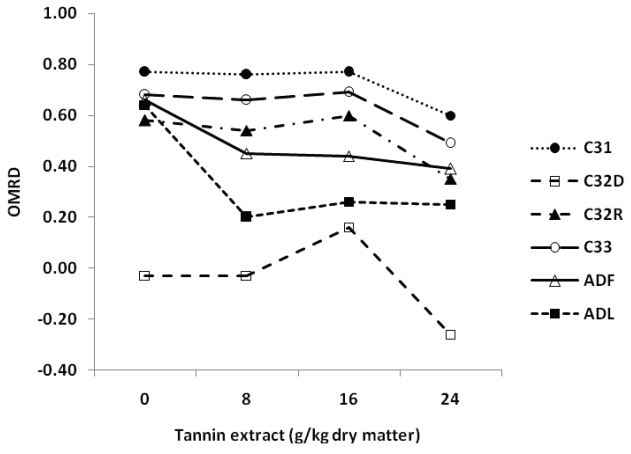

Figure 1. Organic matter rumen digestibility (OMRD) in steers fed *Avena strigosa* (0.60), concentrate (0.40) and levels of *Acacia mearnsii* tannin extract (0, 8, 16 or 24 g/kg DM), estimated through different markers of duodenal digesta flow. ADF, acid detergent fibre (*P*<0.001); ADL, sulphuric acid lignin (*P*=0.005); C31 and C33, internal n-alkanes C_{31} (*P*=0.202) and C_{33} (*P*=0.268); C32D; estimate based on external n-alkane C_{32} dosed (*P*=0.083); C32R, estimate based on external n-alkane C_{32} fecal/duodenal ratio (P=0.253).

The OMRD was calculated as: [OM intake (g/day) – duodenal OM (g/day)]/OM intake (g/day).

Data of OMRD were analysed using the MIXED procedure of SAS. The statistical model included the fixed effects of level of tannin extract, marker type and their interaction, and the random effects of animals and periods. The effect of level of tannin extract on OMRD was also evaluated within each marker.

Results

There was no significant tannin extract × marker interaction. The OMRD was significantly affected ($P<0.05$) by marker type (Table 1). The highest mean values were obtained by using the internal C_{31} and C_{33} n-alkanes. The use of dosed C_{32} n-alkane resulted in negative OMRD mean value indicating that there was considerable disappearance of this alkane in the forestomach. The lowest residual error was obtained for ADF as the internal marker.

Significant ($P<0.05$) effect of tannin treatments on OMRD was observed only when ADF or ADL were used as the marker (Fig. 1). However, reliable and expected OMRD estimates were obtained only for ADF.

Conclusion

In digestibility experiments where faeces output is measured and spot samples of duodenal digesta are taken, the OMRD may be accurately estimated from the relationship between ADF concentration in faeces and in duodenal digesta of ruminants.

References

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