ESTIMATION OF ORGANIC MATTER DIGESTIBILITY AND INTAKE FROM FAECAL ORGANIC MATTER AND DAILY N EXCRETION AND CONCENTRATION

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Abstract

This study was performed with grazing sheep, to establish: a) if the amount of total faecal N (C; in g $100g^{-1}$ of organic matter intake (OMI)) remains constant at three feeding levels, in four utilisation periods of deferred *Panicum coloratum* cv. Verde; b) the relationship between C and faecal N fractions, and c) the relationship between faecal daily excretion of OM and N, and OMI. Intake increased ($P<0.01$) with utilisation period, and was related ($r = -0.82$; $P<0.01$) to the protein content of food, the insoluble N fraction ($r = -0.49$; $P<0.01$) and the soluble:insoluble N ratio ($r = 0.41$; $P<0.01$) in faeces. No relation with total N concentration ($r = -0.22$; $P>0.05$) or soluble N fraction ($r = -0.02$; $P>0.05$) in faeces could be found. Daily excretion of OM and N were positively related ($R^2 = 0.93$ and 0.96, respectively; $P<0.01$) to OMI. The slopes of regression lines, but not the intercepts, were different ($P<0.01$) between evaluation periods. The digestibility can be estimated from OMI and faecal N whenever time of the year is taken into consideration.

Keywords: Faecal N, digestibility, intake, prediction.

Introduction

It has been proposed that the amount of excreted N, within a range of crude protein (CP) in diet, as a proportion of organic matter intake (OMI), is constant (Gallup and Briggs, 1948), and that faecal N (FN) is positively related to organic matter digestibility (OMD). OMD can be estimated from the constant and FN (Lancaster, 1949). However, one given value of FN might produce different OMD, as the OMD:FN ratio can be affected by animal and forage related factors (Corbett, 1978; Minson, 1990). The present study was carried out to establish: a) if the amount of total faecal N (C; in g $100g^{-1}$ of OMI remains constant at three feeding levels, in four utilisation periods of deferred *Panicum coloratum* cv. Verde; b) the relationship between C and faecal N fractions, and c) the relationship between faecal daily excretion of OM and N, and OMI.

Material and Methods

The study was performed at the Facultad de Agronomía, (UNLPam) (36° 46’ S; 64° 16’ W), on a *Panicum coloratum* cv. Verde pasture. Forage OMD and OMI were measured in four periods of 16 days each, whose beginning dates were: March 21 (Period I), May 2 (II), June 13 (III) and July 25 (IV), 1995. Seventeen Pampinta rams (liveweight: 57.4 ± 9.7 kg) were randomly distributed into three different feeding levels: a) 0.5 maintenance level (five rams); b) 1.0 maintenance level (five rams); c) *ad libitum* (1.5 of actual intake; 7 rams).

The forage produced during the whole growing season was manually clipped at 5 cm above ground before each of the two daily feeding times (8:00 and 17:30 h). Each experimental period was composed of 8 days for adaptation to the diet and 8 days of data collection. Offered and refused forage, and total faeces production were weighed, dried (55°C, 72 h) and milled (1mm screen), to estimate OMI, OMD, N and NDF concentration. Ash concentration in forage and faeces was estimated by oven ignition (550°, 12 h). OMD was measured by the total collection of faeces method, and OMI by difference between offered and refused OM.

The amount of N voided in faeces by 100 g of OMI (Y_{ijk}) was analysed through the following model: $Y_{ij} = \mu+\alpha_i+\beta_j+\alpha\beta_{ij}+\in_{ij}$, where α feeding level (i = 1...3), β: evaluation period (j = 1...4), and $\in_{ij}$ residual error. The relationship between daily faecal excretion of OM or N (X) and OMI (Y) was analysed by linear regression. Pseudovariables (Z) were used to discriminate between evaluation periods, according to the following model: $Y_i = \alpha_0+\beta_1X+\delta_2Z+\in$ where α_0 intercept, β_1 and δ_2 constants, and e_i: random error.

Results and Discussion

Means, standard deviations and ranges of parameters under study are shown in Table 1. The faecal N excretion (by 100 g of OMI) showed, in the lower feeding level and periods I and II, a trend to be significant (interaction feeding level x evaluation period; P = 0.069). Moreover, it increased (P<0.0001) with evaluation period (Table 2) and correlated (r = -0.82; P<0.001) inversely with the protein level of feed. On the other hand, N excretion presented no relation neither with the concentration of total N (r = -0.22; P>0.05) nor with the N soluble in neutral detergent (NDS-N) (r = 0.02; P>0.05). However, it presented significant correlations with the NDF-N (r = -0.49; P<0.001) and with the NDS-N : NDF-N ratio (r = 0.41; P<0.001).

The concentration of faecal total N was the most closely related fraction to NDS-N in faeces (r = 0.81; P<0.001), whilst the total N and NDF-N relationship was also significant (r = 0.57; P<0.01). The soluble faecal N is mostly microbial and endogenous, while insoluble N is by-passed forage N (Orskov, 1982). The total N in faeces decreased (P<0.01) with evaluation period, and correlated (r = 0.77; P<0.01) with feed CP content. Coincidentally, Stallcup *et al.* (1975) and Karn and Hofmann (1990) found increasing amounts of total N in faeces when increased dietary CP content. The amount of excreted N depends, partially, on the amount of microbial N, the compartment where it is produced (rumen or colon), and the extent of its digestion (Arman *et al.*, 1975). It seems likely that the increase found in the NDS-N : NDF-N ratio with evaluation period and its direct relation with faecal N excretion by 100^{-1} OMI are digestion site associated factors.

The OMI (g Kg LW^{-1}) was closely related to daily faecal excretion of OM (1.23+2.85 OM–0.70 OMZ_{II}–1.060 MZ_{III}–1.00 OMZ_{IV}; R^2 = 0.93; P<0.0001; Sy.x = 1.2) and N (-0.11+204.3 N–36.1 NZ_{II}–69.0 NZ_{III}–55.9 NZ_{IV}; R^2 = 0.96; P<0.0001; Sy.x = 0.9). However, the latter association was more precise, as predictor of OMI, than the former. The four regression lines (one by evaluation period), for faecal excretion of OM and N, had the same intercept, but different slopes (P<0.0001). This finding clearly shows that the relation OMI and daily excretion of OM or N is affected by evaluation period, as also found by other authors (Minson and Kemp, 1961; Bartiaux-Thill and Oger, 1986).

The variations found with the feeding level are similar for the different periods of evaluation (time of the year), as shown by the absence of difference between intercepts. When only N is considered, the absolute value of intercept is not different from zero (P>0.05), indicating that feeding level had no effect upon the relationship.

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Table 1 - Means, standard deviations and ranges of values of OMI, OMD, production of faeces and daily faecal excretion of N and its fractions.

	Mean	s.d.	Range
OMI (g OM kg LW)	11.6	4.1	6.1-24.0
OMD (g 100 g^{-1} OM)	56.9	8.9	36.5-78.0
Faecal-N			
Total N (g 100 g^{-1} OM)	1.498	0.150	1.240-2.127
SND-N[†] (g 100 g^{-1} OM)	0.944	0.117	0.580-1.320
NDF-N (g 100 g^{-1} OM)	0.555	0.089	0.396-0.809
SND-N : NDF-N	1.744	0.336	0.756-2.591
Faecal OM			
(g kg^{-1} LW d^{-1})	4.86	1.59	1.85-8.29
Total faecal N			
(g kg LW^{-1} d^{-1})	0.072	0.022	0.031-0.118

[†] SND-N = Total N – NDF-N

Table 2 - Faecal excretion of N of rams (g 100 g^{-1} OMI), at three feeding levels in four evaluation periods.

	Evaluation period				
Feeding level	I	II	III	IV	Mean(± s.d.)
0.5 maintenance	0.529	0.667	0.724	0.687	0.652±0.095
1.0 maintenance	0.508	0.564	0.731	0.688	0.623±0.101
Ad libitum[†]	0.482	0.601	0.766	0.654	0.626±0.114
Mean(± s.d.)	0.503±0.030[d]	0.610±0.066[c]	0.743±0.061[a]	0.674±0.058[b]	0.633±0.022

[†] 1.5 of actual intake.

Means with different superscripts are significantly different (P<0.05)