QUANTITATIVE STUDIES OF THE DIGESTION OF RHODES GRASS HAY BY ZEBU-CROSS STEERS

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SUMMARY

Six Zebu-cross steers were fed Rhodes grass (Chloris gayana) hay plus urea and min r s ad libitum each 12 hours. Organic matter intakes were equivalent to if% .d and digestibility was 557 g/kg, with 65% of the digestibility occurring in the rumen. Nitrogen leaving the stomach in forms other than ammonia was only about 63% of that predicted from other studies, possibly associated with rumen ammonia levels being less than 50 mg N/L for at least one third of each 12 hour period. A wet sieving technique applied to rumen and abomasal digesta indicated that the fraction forming approximately 89% of the particles in the abomasum also represented **almost** 60% of particles within the rumen.

Keywords : intake, digestibility, Rhodes grass, steers.

INTRODUCTION

The many studies linking digestive physiology and energy metabolism in temperate regions of the world have permitted the development of predictive models of the nutritive value of feeds of defined chemical composition. By contrast few similar data are available to describe the interaction of tropically adapted **cattle** deriving nutrients from forages also adapted to harsh environmental conditions. There is clearly need to remedy this situation if the nutritional problems of more' than one third of the national herd are to' be addressed. As part of this, a study has been made of various aspects of digestion by Zebu-cross steers offered Rhodes grass (Chloris gayana) hay.

MATERIALS AND METHODS

Six Zebu-cross steers two years old and of mean **(±SE) live weight 219 (±16) kg,** fitted with permanent **rumen** and abomasal fistulae, were kept **in metabolism** cages indoors. They were offered ad libitum in two equal lots, at 0800 h and 2000 h, Rhodes grass hay supplemented with minerals (Siebert and Kennedy 1972) plus 12 g urea/kg DM. Preliminary experiments had shown a 6% increase ($P>0.05$) in feed **intake in response to this level of urea supplement. After three weeks' adaptation period,** infusion of 'two reference markers chromium-EDTA (Cr-EDTA) and **ruthenium phenanthroline were commenced and continued for eight days during which faeces were collected. On the last three days samples of rumen and abomasal digesta were collected and after the infusions** had ceased samples of **rumen** fluid **were collected during 31 hours. On the next three days the rumen was emptied once daily to provide data'on the amount and composition of digesta 4, 8 and 12 hours after. feeding.**

Organic matter (OM) was estimated as loss in weight of dry matter (DM) after 2 hr at 600°C, total nitrogen (N) and ammonia by the auto-analyser method of Clare and Stevenson (1964), acid detergent fibre by the method of Goering and Van Soest (1970), chromium by atomic absorption and ruthenium by a modified Megarrity and Siebert (1977) technique. Volatile fatty acids (VFA) **were determined by gas liquid chromatography with iso butyrate as an internal standard. Particles from rumen and reconstituted abomasal digesta were separated' by wet sieving (Poppi et al. 1980) with collection, of fines, but excluding**

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soluble DM, passing the smallest sieve. Data are presented as the means with the standard error of the mean given in brackets.

RESULTS

The hay contained 927 g/kg DM, which contained (g/kg) 79 ash, 6.5 N, and 456 acid detergent fibre. The intake of OM was equivalent to 57 g/$W^{0.75}$.d and digestibility was 557 g/kg (Table 1) of which approximately 65% of this occurred in the stomach. The N intake was 42.9 g/d to which the roughage component contributed approximately 54%. A net loss of nitrogen occurred in the stomach, the amount leaving the stomach in forms other than ammonia being equivalent to about 85% of intake. Approximately 55% of this fraction was digested in the intestines. Rumen ammonia levels pre-feeding were approximately 40 mg N/L and rose to about 100 mg N/L within four hours of feeding but then declined rapidly so that for five hours of the twelve they were below 50 mg N/L (Fig. 1). VFA levels were relatively steady at 108 (2) mmole/L with the molar proportions of acetic 74.3 (cv 1.9) propionic 19.2 (cv 8.4) and butyric acids 6.5 (cv 6.9) percent also showing little variation. The DM (kg) in the rumen increased from the pre-feeding level (= 12 h post-feeding) of 4.59 (0.24) to 5.72 (0.36) at 4 hours after feeding and then declined to 5.49 (0.34) by 8 hours. The mean volume (L) of liquid in the rumen, estimated by dilution of Cr-EDTA at 41.6 (2.5), agreed well with that measured by rumen emptying 41.4 (1.7), but at 4, 8 and 12 hours after feeding, the volumes were 46.1 (2.1), 43.1 (1.9) and 36.1 (1.8).

Table 1. Variables relating to the intake and digestion of organic matter and nitrogen (g/d) in cattle fed on Rhodes grass plus urea and minerals

	Organic matter	Nitrogen
Intake	3225 + 222	42.9 + 4.22
Leaving stomach	2097 304	40.6 4.61 (36.4 4.61)*
Faecal output	1430 112	16.0 0.99

* Values in brackets are N in forms other than ammonia.

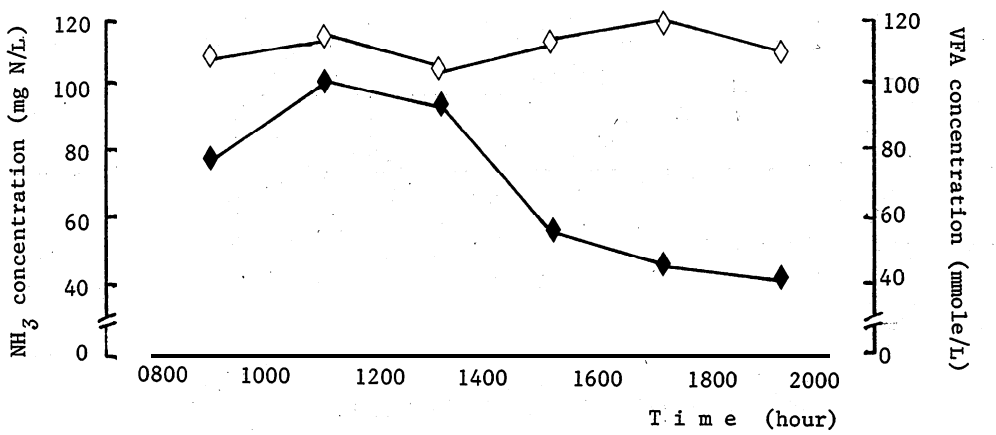

Fig. 1. Concentration of NH_3-N (◆) and VFA (◇) in the rumen liquor of cattle fed Rhodes grass plus urea and minerals

The distribution of size of particles in rumen digesta and in abomasal digesta is given in Fig. 2. Approximately 89% of abomasal digesta DM was able to pass through a 0.60 mm sieve and this fraction represented on average 57% of the rumen digesta DM, the values at 4, 8 and 12 hr after feeding being 56, 53 and 63% respectively. The apparent fractional passage rates (Table 2) suggest that the larger fractions pass from the rumen at considerably slower rates than the smaller fractions.

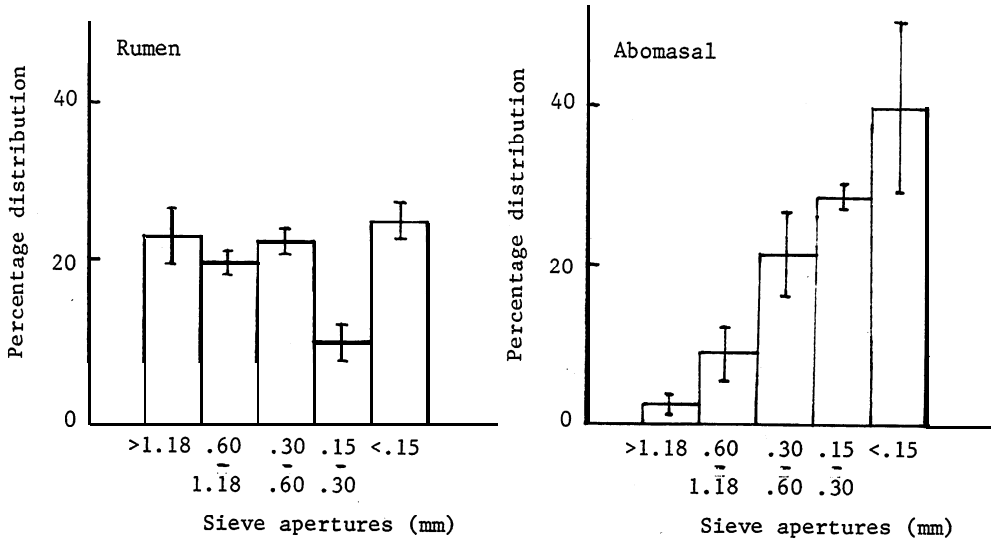

Fig. 2. **The percentage distribution of dry matter retained on and between sieves of various apertures for rumen and abomasal digesta of cattle fed on Rhodes grass plus urea and minerals**

Table 2. Weights of particulate fractions in the rumen (kg), leaving the abomasum (kg/d) and apparent fractional passage rates (/d) of particulate fractions *

	Sieve apertures (mm)					
	>1.18	0.60–1.18	0.30–0.60	0.15–0.30	<0.15	Total
In the rumen	1.24	1.04	1.17	0.52	1.31	5.27
Leaving stomach	0.04	0.17	0.41	0.55	0.77	1.94
Apparent fractional passage rate **	0.03	0.16	0.35	1.06	0.59	0.37

* Means of three emptying times
** Ratio of DM leaving stomach to that in the rumen

DISCUSSION

Digestion of organic matter and the concentrations and proportions of rumen VFA conformed to the pattern expected from temperate forages. However, crude protein flow was only 63% of that predicted from relationships that appear with sheep fed tropical forages (Hogan and Weston 1981). Similar observations have been reported by Kennedy (1982) and Hunter and Siebert (1986), although those authors presented other results more in accord with the predictions. All these results have involved digesta flow rates measured with non-radioactive ruthenium the analysis of which presents difficulties; adverse comments on the use of ruthenium phenanthroline to measure digesta flow with mature forages have also been made (Egan and Doyle 1984). However in the present experiment, OM transactions showed no indication that digesta flow rate are too low. Possibly microbial protein synthesis was lower than anticipated. Certainly rumen ammonia levels for at least one third of the day were below those needed for maximum fibre fermentation (Boniface et al 1986) and probably for maximum protein synthesis (Elliott and Armstrong 1982; McAllan and Smith 1984). The true situation regarding the amounts of protein derived by cattle from mature tropical forages need to be established urgently as at present it is not possible to predict the protein status of such cattle with any confidence. The distribution of feed particles in abomasal and ruminal digesta suggests that at any time approximately 60% of particles are small enough to pass from the rumen, but the fractional passage rate of these particles was low in comparison with values for sheep given oaten hay (Egan and Doyle 1984). The low fractional passage rates of large particles indicate that particle size reduction and digestion are the major avenues of removal of large particles from the rumen.

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