EFFECT OF FORAGE TYPE AND PARTICLE SIZE ON INTAKE AND RUMINAL DISAPPEARANCE OF DRY MATTER POOLS IN STEERS FED ONCE DAILY

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Introduction

Intake is one of the principle determinants of the nutritive value of forages and is limited by the passage of undigested feed residues from the rumen. Rate of passage measurements using marker techniques reflect the rate at which undigested residues of recently ingested feed are passed from the rumen. These measurements are positively correlated with intake (Warner, 1984). Forages of high nutritional value are rapidly digested in the rumen leaving less amounts of undigested residues to be passed with time after feeding. It is unclear if higher intakes are due to passage of more particulate matter or to more digestion and a reduced requirement for passage. The objective of this experiment was to determine how feeding of forages differing in rate of digestion and particle size affect intake, ruminal disappearance and size of particulate and soluble dry matter pools in steers fed once daily.

Materials and Methods

Seven esophageally and ruminally cannulated Hereford steers were each fed alfalfa (ALF – 19.4 % CP, 50.3 % NDF) or brome grass hay (BRM 6.8 % CP, 66.1 % NDF), chopped short (S) or long (L), according to a 4 x 4 balanced and a 3 x 4 incomplete latin square. Experimental periods consisted of 13 d adaptation and 25 d sampling. Feed was offered once daily for 3 hours beginning at 09:00 h. During adaptation, 3 h *ad libitum* intake was determined. Animals were fed 95 % of 3 h *ad libitum* intake for the first 11 d of sampling during which time masticate was collected for determination of *in sacco* DM disappearance and particle size analysis (wet sieving). Feed intake was reduced to 90 % of 3 h *ad libitum* intake for the last 14 d of sampling during which time rumen contents were emptied and sampled to determine changes in DM content and particle size distribution during and after eating. Rumens were emptied at 09:00, 12:00 and 21:00 h with a minimum of 60 h between each emptying. Intake and changes in rumen content of long particle (LP: retained on a 2.36 mm sieve), short particle (SP: not retained on a 2.36 mm sieve) and soluble (SOL) DM were calculated. Data from the eating period (09:00-12:00 h) and two post eating periods (P1 and P2; 12:00-21:00 and 21:00-09:00 h respectively) were analyzed with intake as a covariable.

Results

The daily intake (90 % of 3 h *ad lib.*) of S-BRM (5.94 kg) was greater than that of L-BRM (5.19 kg; $P < 0.05$) but neither intake was different from the average for ALF (5.56 kg). Intake of ALF was not influenced by particle size. After mastication, LP DM entering the rumen was greater and SP DM entry was less ($P < 0.05$) for ALF than it was for BRM and for L versus S (2.30 and 1.87 kg versus 1.85 and 2.51 kg and 2.37 and 1.80 kg versus 1.85 and 2.51 kg, respectively). The proportion of masticate water SOL DM in S-ALF (0.27) was greater ($P < 0.05$) than that in the other diets which were similar in solubility (L-ALF, 0.23; S-BRM, 0.21; L-BRM, 0.21). The proportion of potentially digestible DM (including SOL DM) and rate of DM disappearance in masticate were higher ($P < 0.05$) for ALF (0.69 and 0 0.086 h^{-1}) than for BRM (0.66 and 0.029 h^{-1}), but were not affected by initial feed particle size. Digestion lag time did not differ between diets (0.73 and 1.2 h for ALF and BRM masticate respectively).

Rumen DM content increased during eating with all diets but increased more in animals fed ALF than it did in those fed BRM ($P < 0.05$). However, total rumen DM pools were larger ($P < 0.05$) at all times in animals fed BRM (5.3, 8.7 and 7.5 kg and 3.7, 7.6 and 5.9 kg at 09:00, 12:00

and 21:00 h for BRM and ALF respectively). The rate of total DM disappearance from the rumen during eating was at least 3 times greater than after feeding and was greater ($P < 0.05$) in animals fed BRM than it was in those fed ALF (table 1) due to a larger net disappearance of particulate DM ($P < 0.10$). Disappearance of particulate DM during eating consisted of greater SP and less LP disappearance with the BRM ($P < 0.05$). These differences were related to the different intake and rumen pool sizes of LP and SP between hays ($P < 0.05$). During the post eating periods, total DM disappeared from the rumen linearly for ALF (over P1 and P2; $P < 0.05$) at a rate not different from that of BRM in P2 (table 1). However, the total DM disappearance rate of BRM was less in P1 ($P < 0.05$). There was a net loss of SOL DM from the rumen for both hays during P1 and P2 indicating that the rate of SOL DM production from particle digestion post eating was less than the rate of SOL DM disappearance from the rumen. The rate of small particle DM disappearance increased between P1 and P2 by an amount greater than the decrease in the rate of

TABLE 1. MEAN RUMEN DM POOL DISAPPEARANCE RATES (G/H) FOR ALF AND BRM DURING POST EATING

DM Pool	EATING			POST EATING P1			POST EATING P2		
	ALF	BRM	SEM	ALF	BRM	SEM	ALF	BRM	SEM
Total DM	568	707	41*	183	137	13*	184	184	7
Soluble DM	114	140	14	62	49	4*	42	27	2*
Particle DM	454	567	42§	121	87	12§	143	157	6
Small particle DM	191	425	44*	35	−5	12*	81	106	4*
Large particle DM	264	143	26*	86	93	7	62	51	4*

* Means were different ($P < 0.05$).
§ Means were different ($P < 0.10$).

LP DM disappearance ($P < 0.05$). This increase in the disappearance rate of SP DM was greater for BRM than it was for ALF ($P < 0.05$). Feed particle size did not affect the rate of total DM disappearance from the rumen.

Discussion

Daily ruminal DM disappearance was equal to DM intake and therefore similar between types of forage. The higher rate of total DM disappearance during eating in animals fed BRM, versus those fed ALF, compensated for the reduced rate of BRM DM disappearance in P1. The rate of total DM disappearance from the rumen post eating was constant for ALF and increased with time after eating for BRM. Since the extent of microbial digestion *in sacco* exponentially decreasses with time of incubation, the rate of disappearance of particulate DM in the rumen due to digestion would be expected to decrease with time after feeding. The increase in the rate of particulate DM disappearance from the rumen for both diets between P1 and P2, therefore represents an increase in the passage of particle DM with time post eating. The increase in the passage of particles with time after feeding was greater in animals fed BRM than it was in those fed ALF. The lower average rumen DM pool size in animals fed ALF indicates a faster DM disappearance rate of recently ingested feed. The pattern of rumen particle and SOL DM pool disappearance during and after eating suggests that this was probably due to a higher rate of microbial digestion and not to increased passage of particles.

(Key words: Particle Size, Rumen Emptying, Rate of Digestion)

Literature Cited

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