ENZYME ADDITIVES FOR SILAGE. DUODENAL NITROGENOUS CONSTITUENT FLOWS AND WEIGHT GAINS IN GROWING STEERS

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Introduction

The addition of enzymes (hemicellulases and cellulases) to grass prior to ensiling has been shown to *increase* cellulose breakdown within the silo (Leatherhead et al., 1963) thus possibly leading to an increase in fermentable sugars available as energy sources for the microflora therin. Additionally, if such enzymes did affect the structural carbohydrates of the plant during ensilage this might also influence the digestibility of the silage within the rumen leading to greater production responses. However, results from production trials with enzyme treated silages have been equivocal (Olson and Voelker, 1961; Woodford and Satter, 1986) which may reflect differences in the types and extents of the supplements used. A fuller understanding of the nutritive value of such silages and their utilisation by rumen microbes could lead to more effective use of enzymes in silage making.

Materials and Methods

Two silages were prepared from minimum wilt, first cut perennial ryegrass (cv. Melle) of about 19% dry matter. One was treated with formic acid at a rate of 3.0 l/tonne (Formic silage; FS) and one with a mixture of cellulases, hemicellulases and glucose oxidase (Forum Chemicals Limited, England) at a rate of 0.3 l/tonne (Enzyme silage; ES). Each silage was supplemented with rapeseed meal (RSM) at levels of 0, 6 and 12% DM intake. The silages were offered to Friesian steers in a 6x6 Latin square arrangement at 95% *ad lib* intake in two equal portions/d. The steers were fistulated in the rumen and duodenum and had mean liveweights of 154 ± 4 and 260 ± 5 kg at the beginning and end of the experiment respectively. Each experimental period lasted for 28d and consisted of 14d adaptation to the diet, 9d digestibility trial and 5d digestion study. Daily flows of constituents at the duodenum were measured using a dual phase marker technique (Yb and CrEDTA). Microbial nitrogen was measured using ^{15}N.

Results

Nitrogen intakes and duodenal flows of nitrogenous constituents are presented in table 1. RSM supplementation of FS diet had no significant effect on total nitrogen (TN) non-ammonia nitrogen (NAN) or microbial nitrogen (MN) at any level but ammonia nitrogen (AN) flows were significantly higher on FS12 compared with FS0. On the other hand RSM supplementation of ES diets significantly increased ($p < 0.01$) the flows of all

TABLE 1. NITROGEN INTAKES AND DUODENAL FLOWS OF NITROGENOUS CONSTITUENT

Supplement level	FS			ES		
	0	6	12	0	6	12
Nitrogen intake (g/d)	101	114	127	98	110	123
Duodenal flows (g/d):						
Total nitrogen	99	96^{a}	106^{b}	90^{c}	109^{acd}	121^{bcd}
Ammonia nitrogen	7^{a}	8	10^{a}	6	7	8
Non Ammonia nitrogen	92	88^{a}	96^{b}	84^{c}	102^{ac}	113^{bc}
Microbial nitrogen	64	68	67^{a}	59^{bc}	75^{b}	81^{ac}

Horizontal values with the same superscript are significantly different ($p < 0.01$).

TABLE 2. ORGANIC MATTER INTAKE, FERMENTATION PARAMETERS AND LIVEWEIGHT GAINS

Supplement level	FS			ES		
	0	6	12	0	6	12
OM intake (kg/d)	3.81	3.99	4.20	3.81	3.99	4.28
ADOM (g/g intake)	0.519^{ab}	0.587^{a}	0.577^{b}	0.574^{cd}	0.517^{c}	0.512^{d}
MN (g/kg ADOM)	33.7	31.2	28.8^{a}	27.9^{bc}	37.7^{c}	38.6^{ab}
Liveweight gain (kg/d)	0.48	0.55	0.65	0.49^{a}	0.81	0.91^{a}

Horizontal values with the same superscript are significantly different ($p < 0.01$)

constituents measured except AN and there were also significant differences in duodenal flows of TN and NAN between ES6 and ES12 diets. Comparisons between FS and ES diets supplemented with the same level of RSM showed significantly greater flows of TN, NAN and MN on the ES diets. RSM supplementation resulted in increased OM apparent digestion (ADOM) in the rumen with FS diets but decreased ADOM with ES diets (table 2). Efficiencies of microbial protein synthesis were not significantly different within FS diets or between FS diets and the unsupplemented ES diet but were significantly higher with RSM supplemented ES diets.

Liveweight gains increased with increasing level of supplementation but increases were greater over all diets with ES ($p < 0.05$). A significantly greater ($p < 0.01$) liveweight gain was observed with ES12 compared with ES0 diets.

Discussion

Whole tract OM digestibilities of both ES and FS silage were about 0.77 and the similarity of the digestion data production from both unsupplemented silages would indicate little or no difference between them in nutritional quality. However the significant response to RSM supplementation of the ES diets showed a greater efficiency of capture of nitrogen by the rumen microbes resulting in higher protein flows at the duodenum which were reflected in liveweight gains. RSM is rapidly and extensively degraded in the rumen but the response observed with ES diets was obviously not simply a question of RDP supply as there was no similar response with FS diets. The extent of OM digestion in the rumen was not consistantly affected by enzyme treatment. Thus it seems reasonable to assume that the major difference between silages was either in the rate of availability of existing energy sources or in a better matching of nitrogen and energy availability. In the latter case the form of available nitrogen sources (peptides/polypeptides) may also have been important in stimulating microbial growth (Vestergaard-Thomsen, 1985). Nevertheless it can be concluded that enzyme treatment of the grass during ensiling has had a marked effect on the availability or utilisability of the structural carbohydrates. It is also apparent that different silages respond in different ways to supplementation and a greater understanding of interactions in the rumen is required to enable maximum utilisation of different silages.

(Key Words: Grass Silage, Enzyme Additives, Digestion Responses)

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