THE EFFECTS OF MILLING HAY AND STRAW ON INTAKE AND GROWTH OF CATTLE

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SUMMARY

Yearling steers were fed ad lib. on diets containing 62% hay or 71% straw in which the roughage was either coarsely milled and mixed with grain, or fed long and separate from the grain, in both cases comprising the same proportion of the diet. Milling the hay had large effects upon intake and growth, but very little upon feed conversion ratio, while milling the straw had negligible effects upon intake, growth and feed conversion.

Keywords: Cattle, milling, hay, straw, performance.

INTRODUCTION

Estimates of profit-maximising diets for finishing cattle using the model of Barker et al (1986) commonly indicate that it is desirable to provide up to 80% hay in the diet. However, milling this amount of roughage is laborious and time-consuming without costly equipment, such as a tub grinder. The reported effects of feeding roughages in the long or the hammer milled form are not consistent. Mira et al (1983) reported better intake and performance of steers fed long than shredded straw in a 50% straw/barley and soya bean meal diet in a short cross-over experiment, but no difference when subsequently fed continuously for a longer period. Pirie and Greenhalgh (1978)also reported no significant differences in intake and daily gain between steers fed chopped or milled barley straw as 60% of the diet. However, Beardsley (1964) ascribed most of the improvement in intake and efficiency of ground and pelleted roughage to grinding it. Minson (1963) concluded that digestibility was commonly, butnotalways, slightly depressed by grinding roughages, but rate of passage, intake and performance were increased. The net result of milling long roughages is the sum of its effects upon intake and digestibility and their interaction. The aim of the experiment was to comparelongand coarsely milled hay and straw as major components of diets fed ad lib. to yearling cattle.

MATERIALS AND METHODS

Eighty five yearling steers of 250 ± 26kg fasted weight were allocated at random from five liveweight strata to 13 treatment groups, 11 of five animals and two of 15 animals. The 11 treatments were ad lib. milled roughage and grain mixtures, two of which formed part of the experiment reported here. One of these contained 71% wheat straw, 27% milled lupins, 0.9% urea, and 0.6% minerals and trace elements, and the other contained 62% subterranean clover/annual ryegrass hay, 29% barley, 8% lupins, 0.9% urea and 0.6% minerals and trace elements. Thirty three ppm monensin was added to the milled and mixed diets and pro rata amounts to the milled grain component of the long roughage treatments. The roughage was coarsely milled by using a hammer-mill fitted with a 40 mm screen. The two groups of 15 cattle were fed long roughage plus milled grain. The long roughage was offered ad libitum and the grain component was fed daily in a

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separate identical feeder. The amount of grain supplied to these cattle was that which together with their mean roughage intake for the previous three days, provided the same proportions of the components as were provided for those on the milled and mixed diets.

The cattle were treated with 1.125 g oxfendazole intraruminally, 5 ml Clostridium perfringens type D, Cl. oedematiens, Cl. chauvoei, Cl. septicum and Cl. tetani mixed toxoids subcutaneously, 30 mg sodium selenite by mouth and 36 mg zeranolby implantation. They were kept in individual pens and introduced progressively to their prescribed diets over 14 days prior to commencement of the experiment.

The original intention was to slaughter the cattle as each attained 5 mm estimated carcass fat cover at the 12th rib. However, those on the straw treatments only gained weight slowly and lost condition, and were consequently only kept on the treatments for 100 days. Those on the hay treatments were finished and slaughtered as planned.

Intakes of the mixed diets and of milled grain and long roughage were measured daily, liveweight weekly and hot carcass weight and fat cover at slaughter. The rumens and livers were examined for macroscopic pathological changes at slaughter. Weekly samples of the grains and roughages and mixed diets. were collected and bulked up for analysis. Subsamples were analysed for dry matter digestibility (DMD) and crude protein content (CP). In vitro DMD s of subsamples of the roughages and grains were estimated using the method of McLeod and Minson (1978), with a predigestion using amylase (A.C. Dunlop pers. comm.) for the grains. Calibration of the methods was made by regression of the in vitro DMD of 18 standard feeds on their in vivo DMD, as determined by feeding them to wethers at maintenance. The in vivo DMD of the mixed diets was measured by feeding subsamples of each at maintenance level to 6 wethers for 5 day faeces collection following 14 days introduction. The method of Isaac and Johnson (1976) was used to estimate the CP content of subsamples of the roughages, grains and mixed diets. The milled roughages were fractionated into 3 particle size classes by measuring the proportions by weight, of 100 g subsamples that passed through sieves of 40, 14 and 6 mm meshes, used sequentially. Initialcarcass weights were estimated from initial live weights (McIntyre and Ryan 1982). The data were analysed by analysis of variance, and covariance was used to adjust the carcass variables to the same (6 mm) fat cover basis.

RESULTS

The DMD s of the lupins, barley, hay and straw were 0.93, 0.83, 0.51 and 0.30 and their CP contents (g/kg) were 360, 143, 73 and 24 respectively. The in vivo DMD s of the milled and mixed straw and hay. diets were 0.55 and 0.70, their CP contents (g/kg) were 105 and 128% respectively. The particle sizes of the milled roughages were:

	< 6 mm	6 – 14 mm	14 – 40 mm
Hay (%)	28	29	43
Straw (%)	35	25	40

The effects of milling the two diets are shown in Table 1.

Table 1 Effects of milling straw- and hay-based diets upon dry matter (DM) intake, growth and feed conversion of yearling cattle

	Straw		Hay		LSD
	Milled	Long	Milled	Long	$p < 0.05$
DM intake (kg/d)	4.45	4.47	8.81	6.91	0.62
Days on feed	100	100	108	173	20
Liveweight gain (kg/d)	0.25	0.27	1.35	0.90	0.17
Carcass fat cover (mm)	-	-	6.7	4.8	1.1
Carcass gain* (kg/d)	-	-	0.83	0.60	0.1
Intake/gain (live) (kg)	18.6	18.0	6.5	7.7	1.66
Intake/gain (carcass)* (kg)	-	-	11.0	11.4	2.56

*Adjusted by covariance to the same carcass fat cover.

Milling the straw-based diet had little effect upon intake or performance of the cattle, but milling the hay-based diet improved daily intake by 27.5%, liveweight gain by 50% and carcass weight gain by 38.3%. The 15.6 and 3.5% lower feed conversion ratios to liveweight and carcass weight gain respectively on milled hay were not significant.

No cases of bloat or laminitis occurred and no macroscopic lesions of parakeratosis or rumenitis or liver abscesses were found in any of the cattle at slaughter.

DISCUSSION

The major finding in this experiment was the very large interaction between the type of roughage and the effect of coarse milling. Intake, growth and performance on the long straw diet were low, and were not improved by milling it; on the long hay diet intake and performance were high, and were further improved by milling.

The lack of response to coarse milling of straw may have been a consequence of an overriding effect of its low digestibility upon its rate of passage. On the other hand if the rate of passage of long hay of moderate digestibility was limited by its rate of comminution then the improvements we recorded in intake and performance on milled hay may have been consequences of a reduction in the time required for comminution to a particle size which permits passage out of the reticulorumen. The particle sizes of our milled straw and hay were similar and mostly well in excess of the critical size reported by Poppi et al (1980), indicating that in both cases a large degree of comminution would have been required before they could leave the reticulorumen.

Our results on the straw diet are similar to those of Drennan(1980) who fed young cattle long or chopped straw and recorded no effects on intake, performance or feed conversion ratio. Mira et al (1983) reported similar straw intakes and daily gains of steers fed shredded or long straw as 70% of the diet. Low et al (1984) reported 29% greater total daily feed intake of calves fed 20% milled compared to long straw together with 80% wheat, but no improvement in growth rate. All four reports agree that there is no effect of these processes upon feed conversion of straw.

The intake response of the cattle to coarsely milling hay was similar to those reported by Cullison (1961) who fed ground and pelleted hay, Yates and Moir (1983) who fed finely milled hay and Low et al (1984) who fed hay milled through a 25mm screen. Our' cattle also grew much faster on the diet containing 62% hay which had been milled, as did those reported by Cullison (1961) and Yates and Moir (1983), but Low et al (1984) obtained no growth response to milling hay when it only comprised 20% of the diet. In a review of research at North Dakota Experiment Station, Bishop (1973) reported no response to chopping mouldy lucerne hay and variable growth and feed conversion responses to chopping very high quality lucerne hay and brome grass hay.

We conclude that coarse milling of pasture hay of moderate quality, in comparison with feeding it long, will result in considerably improved intake and growth of young cattle, and consequently shorter feeding periods to slaughter, but improvement in efficiency of feed conversion to carcass weight is likely to be small at best. Coarse milling of wheat straw is unlikely to improve intake, performance or feed conversion over that obtainable by feeding it in the long form to young cattle.

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