THE EFFECT OF GRAIN PROCESSING METHOD AND THE ADDITION OF A BUFFER ON THE PERFORMANCE OF LOT-FED SHEEP

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Summary

Four groups of Merino-Cheviot cross wethers were fed diets consisting of 80% whole or ground wheat grain and 20% chaffed millet hay with 1% or no sodium bicarbonate in a simple factorial design.

There was a significant interaction between grain processing method and buffer addition. Sheep fed ground grain and bicarbonate buffer consumed significantly more feed and gained live weight at a significantly faster rate than those fed whole grain and buffer.

I. INTRODUCTION

It has been reported that addition of buffering compounds to cereal grain based sheep diets improved growth and feed conversion efficiency (McManus, Bigham and Edwards 1972; Saville *et al.* 1973). This improvement has been attributed to increases in the pH of the rumen and it seems probable that such an improvement might be enhanced with the use of ground grain.

The present investigations were undertaken to study the nutritional effect of ground grain and bicarbonate on sheep fed a simple grain based diet suitable for feed lot mutton production.

II. MATERIALS AND METHODS

Sixteen, 10 month old Merino-Cheviot cross wethers of similar live weight (28.0±0.88kg) and condition were fed a 1:1 mixture of chaffed lucerne hay and ground wheat grain while they were becoming accustomed to animal house conditions. After the initial settling-in period, they were randomly allocated to one of four treatment groups.

The four experimental diets (Table 1) were offered *ad lib* as a loose mixture. The grain content was increased to 80% over a 14 d period and the final mixture of 80% grain and 20% roughage was fed for a further 60d.

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TABLE 1

Components of the experimental diets[1]

Treatment		Ingredients
A	80% whole wheat[2]	19% chaffed millet hay, 1% urea
B	80% whole wheat	18% chaffed millet hay, 1% urea, 1% $NaHCO_3$
C	80% ground wheat	19% chaffed millet hay, 1% urea
D	80% ground wheat	18% chaffed millet hay, 1% urea, 1% $NaHCO_3$

[1] estimated values for the total ration are: 16.0% DCP, 0.1% Ca (DM basis, National Research Council 1971)

[2] the grain contained 87.4% DM, 16.3% CP and 0.7% ash

Feed refusals for each animal were collected daily for 28 d (commencing 14d after the end of the introductory period) for calculation of feed consumption data. For each animal a 5% sub-sample was taken from each day's collection and bulked for analysis. Feed and feed refusals were analysed for dry matter (DM) and for sodium (Na) by flame photometry. The grain fraction in refusals was determined by placing the bulked sample in a 1% aqueous solution of Tween-80 and separating the roughage by flotation.

The particle size distribution of the ground grain was determined by sieving through a nest of sieves and the geometric mean and standard deviation were estimated graphically (Anon. 1970). The estimated geometric mean and standard deviation of the particle size distribution of the ground grain was 1000um±1.3.

Rates of liveweight gain for each of the four treatments were calculated by the regression of live weight on time so as to remove any bias caused by differing initial mean live weights. The feed consumption data, which were obtained after a period of growth and when the mean live weights of the groups were different, were expressed in terms of metabolic size ($W_{kg}^{0.75}$) and examined by analysis of variance and the calculation of appropriate LSD's.

III. RESULTS

Recovery of Na in the feed refusals indicated that the buffer did not settle out of the feed mixture during eating.

The regression equations for liveweight gain (x = time in days, y = live weight in kg) for the four treatments were:

A: $y = 0.104x + 24.82$ C: $y = 0.138x + 27.68$
B: $y = 0.071x + 28.49$ D: $y = 0.169x + 26.89$

The regression coefficients were all significant ($P<0.01$) and significantly different from each other ($P<0.005$).

The feed intake data is shown in Table 2.

TABLE 2

Growth and feedintake in diets containing whole or ground wheat, with or without a buffer

Attribute	Whole grain 0 buffer	Whole grain 1% buffer	Ground grain 0 buffer	Ground grain 1% buffer
Liveweight gain[1] (g/d)	104	71	138	169
Total DM intake ($g/W_{kg}^{0.75}/d$)	64.46±1.95[2] a,b[3]	50.79±6.03 a	67.82±2.03 b	69.72±1.86 b
Sig.of main effects (P<): processing 0.01, buffer NS,interaction 0.05				
Grain DM intake ($g/W_{kg}^{0.75}/d$)	50.98±1.78 a,b	38.17±6.14 a	54.11±1.80 a,b	57.26±1.72 b
Sig.of main effects (P<): processing 0.01, buffer NS,interaction 0.05				
Roughage DM intake ($g/W_{kg}^{0.75}/d$)	13.48±0.21 a	12.37±0.43 b	13.71±0.32 a	12.47±0.31 b
Sig.of main effects (P<): processing NS, buffer 0.01, interaction NS				
Concentrate/ Roughage ratio	3.780±0.082 a,b	3.115±0.551 a	3.948±0.010 a,b	4.595±0.110 b
Sig.of main effects (P<): processing 0.01, buffer NS,interaction 0.05				

[1] from the regression equation for each treatment group [2]group mean ± S.E.
[3] in each row, means with the same letter are not different (P<0.05)

Significant interactions between grain processing method and buffer addition were found for grain intake, concentrate/roughage ratio of the diets as eaten, and DM intake, When the data for each buffer treatment were pooled, a significant difference between the whole and ground grain treatments was observed for the above parameters. No significant differences between the buffer treatments were detected when the whole and ground grain data were pooled except for a significant depression of roughage intake which was independent of grain processing method.

No differences between the treatments were noted for metabolic feed conversion efficiency (MFCE,g DM/$W_{kg}^{0.75}$/g liveweight gain) or gross feed conversion efficiency (FCE,g DM/g liveweight gain). Values for these (grand mean±SE) are 0.464±0.040 and 6.255±0.547 respectively.

IV. DISCUSSION

The significant interaction obtained between grain processing method and buffer addition throws new light on the use of buffers in the feeding of grain. It appears that the reported favourable responses to buffer addition in sheep (McManus, Bigham and Edwards 1972; Saville _et al._ 1973) may be modified by the physical form of the grain. In this experiment the only response to buffer addition which was not so modified was a reduction in roughage intake when buffer was fed.

The type of interaction found suggests that addition of a buffer to whole grain may reduce feed intake and growth rates,

Buffer addition to ground grain resulted in a beneficial effect which may be explained by the fact that the grain particle size and degree of exposure of starch granules to ruminal fermentation is independent of chewing. Microbial attack, in this case, could begin immediately after ingestion, possibly resulting in a rapid and extensive fall in pH which could be counteracted by the buffer. Bigham, McManus and Edwards (1973) have shown that addition of buffer maintains rumen pH, and increases the proportion of propionic acid and decreases that of lactic acid in the rumen liquor. It is possible that these effects may contribute to the observed improvement in DM and grainintake as Keenan, McManus and Freer (1970) have suggested that a low rumen pH and associated increase in VFA concentration may reduce intake.

Improvements in sheep growth rate when Na was added to their diet have been reported by a number of workers (McClymont et al. 1957; Saville et al. 1973), but it is unlikely that the present response to buffer was due to added Na since buffer was associated with lower performance when added to whole grain diets.

The lack of difference in FCE and MFCE in view of the different concentrate / roughage ratios may imply that the yield of net energy per unit DM intake was similar for both roughage and grain, that the roughage contributed little net energy under those conditions or that increased roughage intakes were associated with increased efficiency of digestion due to a stimulation of rumination and rumen movements. Similar results for FCE have also been reported for sheep fed hay ad lib and 500 or 750 g oats per day (McLaughlin, Gillespie and McIntyre 1974).

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VI. REFERENCES

ANON. (1970). Journal of Dairy Science 53:689.

BIGHAM, M.L., McMANUS, W.R. and EDWARDS, G.B. (1973). Australian Journal of agricultural Research 24:425.

KEENAN, D.M., McMANUS, W.R. and FREER, M. (1970). Journal of agricultural Sciences, Cambridge 74:477.

McCLYMONT, G.L. WYNNE, K.N., BRIGGS, P.K. and FRANKLIN, M.C. (1957). Australian Journal of agricultural Research 8:83.

McLAUGHLIN, J.W., GILLESPIE, D.S. and McINTYRE, J.S. (1974). Proceedings of the Australian Society of Animal Production 10:392.

McMANUS, W.R., BIGHAM, M.L. and EDWARDS, G.B. (1972). Australian Journal of agricultural Research 23:331.

NATIONAL RESEARCH COUNCIL (1971). "Atlas of Nutritional Data on United States and Canadian Feeds" (National Academy on Sciences: Washington D.C.).

SAVILLE, D.G., DAVIS, C.H., WILLATS, H.G. and McINNES, P. (1973). Australian Journal of experimental Agriculture and Animal Husbandry 13:22.