FEEDING VALUE OF BARLEY FOR SHEEP

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SUMMARY

The feeding value of barley when fed at different levels and ratios with pasture, and the effect of different methods of grain processing on the feed value of barley were investigated using wether hoggets. Results showed that the replacement of pasture with barley failed to increase the rate of liveweight gain. The data suggested that growth rates decreased as the proportion of barley in the diet increased. The intakes of digestible crude protein may have been inadequate for optimum animal performance. There was no benefit from using processed rather than whole barley grain for feeding to sheep.

FEW DATA are available on the feeding value of concentrates for ruminants under New Zealand conditions. In recent years barley has increased in importance as a supplement for winter- and drought-feeding of stock. It is generally fed to sheep as grain in addition to either hay or pasture. The experiment described in this paper investigated:

(1) The feeding value of barley when fed at different levels and ratios with pasture.

(2) The effect of different methods of grain processing on feed value of barley.

MATERIALS AND METHODS

Twenty-eight Border Leicester × Romney wether hoggets were used in a changeover-type design trial (Table 1) with each group of animals being fed only one type of diet but at both maintenance and 1.5 × maintenance levels. The rations were pasture-barley mixtures in which the proportion of barley in the diet ranged from 0 to 50% on a metabolizable energy basis. All animals were pre-fed each diet for a two-week period followed by a four-week experimental period and subsequently another pre-feeding and experimental period. Three types of barley were fed: Whole grain, medium rolled, and ground through a 3 to 4 mm mesh screen.

TABLE 1: TRIAL DESIGN

Diet		g DM/day fed at maintenance or (1.5 maintenance) levels	
Pasture:Barley	Type of Barley	Pasture	Barley
100:0	—	377 (566)	0 (0)
75:25	Whole Rolled Ground	283 (424)	87 (131)
50:50	Whole Rolled Ground	189 (283)	174 (261)

Measurements were made of liveweight changes, organic matter, gross energy and crude protein digestibilities and nitrogen retention.

At the same time a series of trials were also carried out using six rumen fistulated wethers fed diets of pasture and a 50:50 pasture-barley combination but where all three types of processed barley grain were used. Measurements were made of volatile fatty acid (VFA) concentrations and individual acid ratios and ammonia and lactic acid levels in the rumen fluid.

RESULTS AND DISCUSSION

Chemical analysis of the feeds used (Table 2) showed that pasture contained approximately twice the amount of crude protein present in barley, a slightly higher calorific value and almost four times the ash content. Processing of the barley resulted in slight reductions in crude protein and ash contents but these were probably of little or no importance.

TABLE 2: CHEMICAL COMPOSITION OF FEEDS
(DM basis)

Feed	% Crude Protein	kcal/g	% Ash
Pasture	25.5	4.615	10.75
Whole barley	13.1	4.353	2.92
Rolled barley	13.0	4.482	2.86
Ground barley	12.8	4.463	2.63

TABLE 3: FEED INTAKE AND DIGESTIBILITY AND ANIMAL LIVEWEIGHT GAIN AND URINARY LOSSES

Diet		Daily Intake			Liveweight Change	% Digestibility			Urine Energy		Urine N	
Pasture:Barley	Type of Barley	DOM (g)	DE (Mcal)	DN (g)	(g)	OM	GE	N	kcal/ day	As % Energy Intake	g/day	As % Nitrogen Intake
100: 0	—	333	1.64	15.4	46.4	75.6	71.9	75.8	178.6	7.9	13.2	65.7
75:25	Whole	343	1.65	13.5	43.6	79.0	75.8	77.4	157.9	7.4	11.4	66.1
	Rolled	347	1.68	13.8	35.7	78.1	74.9	75.9	159.3	7.3	11.8	65.9
	Ground	348	1.68	13.5	43.6	78.0	74.6	74.7	200.7	7.4	11.5	64.6
50:50	Whole	337	1.58	11.1	23.6	82.0	79.1	78.3	126.4	6.4	8.8	62.7
	Rolled	338	1.60	11.4	28.6	81.9	79.0	78.9	137,1	6.8	9.4	66.6
	Ground	349	1.63	11.0	34.3	80.6	76.9	74.7	135.7	6.5	8.9	60.2
1.0	Maintenance	280	1.34	10.5	— 16.4	79.7	76.5	77.1	132.1	7.6	9.2	68.1
1.5	Maintenance	404	1.93	15.1	89.3	78.9	75.6	76.0	169.3	6.6	12.2	61.0
Significance of differences:												
Pasture v. mixed diet		NS	NS	***	NS	***	***	—	***	**	***	NS
Barley level		NS	NS	***	**	***	***	—	***	**	***	NS
Barley type		NS	NS	NS	NS	*	*	**	NS	NS	NS	NS

NS = Not Significant; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Data on intake and utilization of the rations are given in Table 3. Although there were no significant differences between diets in either digestible organic matter or digestible energy intakes, there were significant differences ($P < 0.01$) in liveweight gains. Rations containing higher proportions of pasture promoted higher liveweight gains, with sheep on a sole pasture diet gaining at a 60% faster rate than those on a 50:50 pasture-barley ration. Differences in liveweight gain were not related to the type of barley fed.

Digestible nitrogen intakes decreased markedly as the proportion of barley in the ration increased. This was due to the low protein content of the barley grain. It is possible that, where barley contributes a significant part of the complete ration, the digestible nitrogen intake may be a limiting factor in growth rate. This may have occurred in this experiment since, as the digestible nitrogen intake fell in a ratio of 100:88:73 as the proportion of barley in the diet was progressively increased, liveweight gains similarly decreased in a ratio of 100:88:63. The American National Research Council (N.R.C., 1968) recommendation for digestible nitrogen intake for animals of this weight and rate of gain is 14.0 to 14.5 g digestible nitrogen per day. Whereas the digestible nitrogen level in the sole pasture diet met these standards, the 50:50 diet supplied only 78% of theoretical requirements.

As the proportion of barley in the diet increased, the digestibility of organic matter and gross energy also significantly increased. No significant difference in nitrogen digestibility between pasture and barley diets was found but nitrogen digestibility fell significantly as the degree of barley processing was increased ($P < 0.01$).

Despite similar levels of digestible energy intakes between diets, more energy appeared as urinary energy the higher the proportion of pasture in the diet. This may be a consequence of the higher water and nitrogen content of the pasture herbage. Urinary nitrogen losses were higher also for animals on predominantly pasture diets but this represented a constant proportion of the total nitrogen intake.

Analysis of rumen fluid samples (Table 4) showed no differences in total VFA, lactic acid or ammonia levels. However, animals fed diets containing barley had higher proportions of butyrate in the rumen fluid. This effect was most marked on animals fed diets in which the barley had undergone the greatest degree of processing.

TABLE 4: VFA COMPOSITION OF RUMEN SAMPLES
(Data for 50:50 pasture:barley diets)

Diet	*Total VFA*	*% of Total VFAs*		
		Acetic	*Propionic*	*Butyric*
Pasture	10.03	71.5	19.2	9.3
Pasture and whole barley	10.24	69.4	20.4	10.2
Pasture and rolled barley	9.61	68.6	19.0	12.4
Pasture and ground barley	10.57	68.6	17.6	13.8
1.0 Maintenance	9.59	67.7	20.2	12.1
1.5 Maintenance	10.63	71.2	17.9	10.9

CONCLUSIONS

The following conclusions arise from this experiment:

(1) Provided that sufficient pasture of a high digestibility is available, it is doubtful whether the inclusion of barley in the diet would increase the rate of live-weight gain in sheep. Indeed the results of this experiment suggest that growth rates would decrease as the proportion of barley in the diet increased.

(2) Under certain conditions diets containing a high proportion of barley may not supply adequate available protein to meet requirements for optimum animal performance.

(3) There appears to be no benefit from processing barley grain as carried out in this experiment when it is used for feeding sheep.

REFERENCE

N.R.C., 1968: Nutrient requirements of domestic animals. Nutrient requirements of sheep. *Nat. Acad. Sci. Nat. Res. Counc. Publ. 1693.*