

THE PRODUCTION AND COMPOSITION OF MILK FROM DAIRY COWS FED HAY SUPPLEMENTED
WITH WHOLE, ROLLED OR ALKALI-TREATED HARLEY GRAIN

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SUMMARY

Friesian cows were offered either 25% or 50% of their calculated metabolisable energy (ME) requirements as either whole barley grain, rolled barley or alkali-treated barley. The remainder of the ME requirement was offered as pasture hay.

The mean dry matter intakes of grain, expressed as a percentage of the grain offered to the cows at 25% and 50% of ME requirements respectively were for whole barley 79.5% and 64.5%, rolled barley 100% and 100%, and alkali-treated barley 81.4% and 84.9%.

The yields of milk, fat, protein and solids-not-fat from cows offered rolled barley and alkali-treated barley at 25% of ME requirements were not significantly different. Cows offered rolled barley at 50% of ME requirements produced similar amounts of milk, protein and solids-not-fat, but significantly more fat compared to cows offered alkali-treated barley at 50% of ME requirements. The yield of milk fat was significantly less for cows offered whole barley than for cows offered rolled barley and alkali-treated barley at both 25% and 50% of ME requirements.

Dairy cows fed small quantities of alkali-treated barley grain will maintain a similar level of milk production to that of cows fed rolled grain, but problems in handling the treated grain must be overcome before the technique can be recommended to dairy farmers.

INTRODUCTION

The dry matter digestibility of barley grain by cattle can be increased by rolling (Toland 1976; Ørskov *et al.* 1978). Ørskov and Greenhalgh (1977) and Ørskov *et al.* (1978) have found that treatment of barley grain with sodium hydroxide will disrupt the fibrous seed coat, allowing the ingress of rumen bacteria, resulting in a digestibility of barley by steers similar to that of rolled barley and significantly greater than that of whole barley.

It has been estimated that in South Australia, alkali-treatment of barley is cheaper than rolling when less than 20 tonnes of grain is processed annually. Most dairy farmers in South Australia feed less than 20 tonnes of concentrates annually to dairy cows.

Little information is available on the comparative milk production by dairy cows fed roughage diets supplemented with cereal grains processed mechanically or chemically. This experiment compared the milk production and milk composition of dairy cows fed hay supplemented with either whole barley, rolled barley or sodium hydroxide-treated barley.

MATERIALS AND METHODS

Barley grain (*Hordeum vulgare* L. var. Clipper) was either rolled through a roller mill or sprayed with a 300 g/litre solution of sodium hydroxide, to give

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a concentration of sodium hydroxide in the grain of 35 g/kg. The grain was treated with sodium hydroxide while being augered from a storage silo. After treatment, the mass of barley grain tended to solidify and consequently the grain was spread out to a depth of ten cm under cover for 24 hours and then stored in 200 l steel drums until fed.

Forty-eight Friesian cows, with a mean live weight of 509±8 kg and in the first, second or third month of lactation, were each fed 4.5 kg-daily of rolled barley together with pasture hay for a fourteen-day adaptation period followed by a seven-day covariance period. The cows were then allocated by restricted randomisation on the basis of milk fat yield and stage of lactation to one of six treatments which consisted of either 25% or 50% of metabolisable energy (ME) requirements (calculated from the *in vitro* digestible dry matter content of whole barley (Tilley and Terry 1963) according to Anon. (1975)) fed as either whole barley, rolled barley or alkali-treated barley. The remainder of the ME requirement was provided as pasture hay.

Hay was fed twice daily after milking to each treatment group of cows held in 0.1 ha paddocks. Supplements were fed with the hay to balance the calcium and phosphorus requirements of the cows (National Research Council 1971). Grain was fed twice daily to each individual cow in a feed shed before milking.

The experimental diets were fed for a 14-day pre-experimental period and 35-day experimental period. Cows were milked daily at 0600 and 1500 hours and individual milk yields recorded. Milk sampling, recording and analyses and California Mastitis Test (CMT) procedures were as described by Valentine and Wickes (1979). Cows were weighed three times each week.

Milk data were analysed by analysis of covariance, live weight and grain intake data by analysis of variance and CMT data by Chi-square heterogeneity tests.

RESULTS

The heat generated from the grain after treatment with sodium hydroxide resulted in scorching of some of the barley grains to a light brown colour. No moulding was apparent in the treated grain stored in 200 l steel drums.

The cows were offered 2.7 kg and 5.4 kg of grain (DM basis) daily as 25% and 50% of ME requirements respectively. The mean dry matter intakes of grain expressed as a percentage of the grain offered to the cows at 25% and 50% of ME requirements respectively were, for whole barley 79.5% and 64.5%, rolled barley 100% and 100%, and alkali-treated barley 81.4% and 84.9%. Although cows consumed all of the alkali-treated grain offered for periods of up to eight consecutive days, they refused approximately 55% of the grain on the first day of offering a new batch of alkali-treated barley, taking several days before all of the grain offered daily was consumed. In excess of 97% of the hay offered was consumed by the cows.

The yields of milk, fat, protein and solids-not-fat (SNF) were significantly ($P<0.05$) greater for the cows offered 25% of their ME requirements as rolled barley than for the cows offered 25% of their ME requirements as whole barley (Table 1). The yields of milk, fat, protein and SNF from cows offered rolled barley and alkali-treated barley at 25% of ME requirements were not significantly different.

Milk, fat, protein and SNF yields were significantly ($P<0.01$) greater for cows offered rolled barley and alkali-treated barley than for cows offered whole barley at 50% of ME requirements. Also, the yield of fat from cows offered

rolled barley was significantly ($P < 0.01$) greater than from cows offered alkali-treated barley at 50% of ME requirements. The concentration of protein in the milk was significantly ($P < 0.05$) greater for cows offered rolled barley and alkali-treated barley than for cows offered whole barley at both 25% and 50% of ME requirements.

Cows offered whole barley at 25% of ME requirements had significantly ($P < 0.01$) higher yields of milk and milk components than cows offered whole barley at 50% of ME requirements.

TABLE 1 Covariance-corrected mean daily yields of milk and milk components, and the milk composition and liveweight changes of cows fed whole, rolled or alkali-treated barley grain

Treatment	Milk yield (l)	Fat yield (kg)	Protein yield (kg)	SNF yield (kg)	Fat (g/l)	Protein (g/l)	SNF (g/l)	Liveweight change (kg/day)
25% of ME								
Whole barley	11.1	0.46	0.36	0.96	42.4	33.2	86.9	+ 0.14
Rolled barley	12.5	0.55	0.43	1.11	44.6	35.4	89.7	+ 0.32
Alkali-treated barley	11.6	0.51	0.40	1.02	43.6	34.3	89.1	+ 0.07
50% of ME								
Whole barley	8.8	0.40	0.27	0.74	44.9	31.5	85.9	- 0.11
Rolled barley	12.2	0.56	0.43	1.09	46.6	35.8	89.7	+ 0.52
Alkali-treated barley	11.4	0.47	0.39	1.01	42.7	34.3	89.5	- 0.19
LSD: 1% level	1.5	0.06	0.07	0.13		1.5	3.3	0.42
5% level	1.1	0.05	0.05	0.10	N.S. ⁺	1.1	2.5	0.31

⁺N.S. = not significant

No significant differences were recorded between treatments in CMT score changes from the covariance period to each week of the experimental period.

DISCUSSION

The lower intake of whole barley and alkali-treated barley compared to rolled barley by dairy cows has not been reported in the literature, although calculations from the data of Ørskov *et al.* (1978) indicate that Friesian steers fed approximately 2.7 kg daily of either whole barley or alkali-treated barley consumed only 91% and 87% respectively of the barley offered. In the present experiment, the lower mean daily intake of alkali-treated barley compared to rolled barley was the result of an immediate reduction in intake following the feeding of grain from a new batch of alkali-treated barley. It was found that even though the alkali-treated grain was stored for four days before feeding, the cows were able to detect differences between the batches of treated barley. Consistency in handling of the alkali-treated grain after treatment is important if grain intakes are to be maintained at a constant level.

The lower milk production and protein content of milk from cows offered whole barley compared to those offered rolled barley is probably due to a lower ME intake of the cows fed whole barley, resulting from a combination of lower intake and digestibility of the whole barley (Toland 1976; Ørskov *et al.* 1978). The similar milk production of cows offered alkali-treated grain to those offered rolled grain at 25% of their calculated ME requirements, indicated that the

digestibilities of the rolled and alkali-treated grain were similar, as reported by Ørskov et al. (1978). When the alkali-treated grain was offered at 50% of calculated ME requirements, lower intakes resulted in a significantly lower production of milk fat when compared to cows fed rolled barley.

The lower production of milk and milk components by cows offered whole barley at 50% of ME requirements compared to those offered whole barley at 25% of ME requirements is probably due to a lower total intake of ME resulting from the greater refusal of grain when offered at the higher rate.

Some practical problems were experienced with the handling of the grain after treatment with alkali. Immediately after treatment, the mass of barley grain tended to solidify and consequently the grain could not be augered directly after treatment into a storage silo, but had to be agitated during cooling to prevent solidification. Toland (pers. comm.) has reported similar problems.

It may be concluded that dairy cows fed small quantities of alkali-treated barley grain will maintain a similar level of milk production to those fed rolled grain. However, some research into causes for low intakes by cows when changing from one batch of treated grain to the next, and problems associated with handling of the grain immediately after alkali treatment is required before it can be recommended as an alternative to rolling grain on the farm.

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