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The effect of different processing methods of barley in Holstein dairy cows

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ABSTRACT

Eight lactating Holstein cows in a duplicated 4×4 Latin-square experiment were used to compare the effect of differently processed barley. Treatments were: 1. ground barley, 2. steam-rolled barley, 3. dry-rolled barley (PI=72%), 4. dry-rolled barley (PI=81%). Treatment 2 and 3 compared to 4 showed higher milk (28.25, 28.82 vs 26.59 kg/d), and protein (0.84, 0.86 vs 0.80 kg/d) and treatment 1 and 3 showed higher 4% FCM (27.42, 27.44 vs 25.57 kg/d), compared with treatment 4. These results indicate diets consisting of 25% ground barley can be used effectively, without any negative effects on performance.

KEY WORDS: barley, steam rolling, dry rolling

INTRODUCTION

Morgan et al. (1991) observed improved growth performance for cattle fed steam-rolled barley compared with whole barley. Yang et al. (2000) concluded, barley that was steam-rolled to a medium-flat thickness produced the most milk, because of highest DMI and highest digestibility in the rumen and in the intestine.

Fine grinding of barley is the main processing method in Iran, so the objective of this study were to determine the effects of differently processed barley on milk yield, and composition, apparent digestibility of OM and DM, ruminal pH, and proportions of VFA.

MATERIAL AND METHODS

Eight multiparous lactating Holstein cows averaging 85±15 d in milk were arranged in a replicated 4×4 Latin-square experiment, with 21-d periods. A total mixed ration (TMR) containing a forage: concentrate ratio of 43:57 was used (Table 1). For diet 1, barley grain was finely ground, with a mean particle size of about 1 mm.

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For diet 2, barley grain was steam-rolled with PI=68%. Barley was steamed by high pressure for about 5 min before passing through a roller mill. For diets 3 and 4, barley grain was dry-rolled with a roller mill with PI=72 and 81%, respectively. Treatment periods lasted 21 d, including 14 d of adaptation and 7 d for measurement of animal response. AIA was used as an internal indigestible marker for determining apparent digestibility.

Feed consumption was recorded daily. Composite feed samples were dried at 55°C for 72 h and ground with a cyclone mill to a maximum particle size of 2 mm.

Table 1. Ingredients and chemical composition of the diets (DM basis)

Item	
Ingredients	
lucerne hay	21.27
maize silage	21.27
barley grain	25.59
cottonseed meal	9.23
cottonseed, whole with lint	9.98
soyabean meal	12.12
minerals and vitamins	0.99
salt	0.30
sodium bicarbonate	0.25
Chemical composition	
NEL, Mcal/kg	1.56
CP, % DM	16.1
CP- ruminal degradable protein, % DM	11.5
CP- ruminal undegradable protein, % DM	4.6
acid detergent fibre, % DM	24.1
neutral detergent fibre, % DM	38.5
none fibre carbohydrate, % DM	35.8
Ca, % DM	0.6
P, % DM	0.5
ether extract, % DM	3.5
dietary cation-anion balance, meq/kg	276

The cows were milked three times daily and milk samples were collected during the last 7 d of each treatment period.

Samples of ruminal fluid, urine and faeces were collected *via* an esophageal tube, manual stimulation of the vulva, and directly from the rectum, respectively. Ruminal fluid was collected on the last d of each period at 4 h post-feeding and pH was determined immediately after collection. Samples of faecal material and urine were obtained 4 h after feeding for pH determination. Ruminal VFA was determined on samples taken 4 h post feeding.

The data were analysed by using GLM procedures of SAS, and the difference between means was determined by Duncan's test.

RESULTS AND DISCUSSION

Dry matter intake

The DM intake was not affected by any of the treatments (Table 2). In current study the amount of barley in experimental diets was low (25.6% on a DM basis) which may be the reason for having no effect on feed intake. Feed efficiency was not different among treatments (Table 2).

Milk production and composition

Milk yield was affected ($P<0.05$) by steam-rolling and dry-rolling (with PI=72%) and 4%FCM was affected by steam-rolling and grinding ($P<0.05$) compared to cows fed coarsely dry-rolled barley (with PI=81%) (Table 2). Milk yield was increased by 5.9 and 7.7% for cows fed steam-rolled and finely dry-rolled barley (diet 3) as compared with diet 4, respectively. The yield of 4% FCM of cows fed ration 1 and 3 was higher by 6.1 and 6.8% compared to cows fed ration 4.

No differences ($P>0.05$) were noted in the percentage and yield of milk fat between all the treatments. Christen et al. (1996) and Yang et al. (2000) that have evaluated the effects of processing of barley grain on the performance of dairy cattle reported no effect on milk fat. Yield of milk protein was increased significantly ($P<0.01$) by 4.8 and 7% for cows fed steam-rolled and dry-rolled barley (with PI=72%), compared to treatment 4, respectively.

Table 2. Feed intake and milk production of cows with differently processed barley

Item	Diets[1]				
	1	2	3	4	SEM
DMI, kg/day	23.44	23.80	23.33	23.98	0.381
Actual milk production, kg	27.61^{ab}	28.25^{a}	28.82^{a}	26.59^{b}	0.471
4 % FCM, kg	27.24^{a}	27.02^{ab}	27.44^{a}	25.57^{b}	0.426
Fat, kg	1.08	1.05	1.06	0.99	0.019
Protein, kg	0.83^{ab}	0.84^{a}	0.86^{a}	0.80^{b}	0.012
Feed efficiency[2]	1.17	1.19	1.22	1.12	0.023
Milk composition, %					
fat	4.01	3.79	3.77	3.83	0.061
protein	3.03	3.02	3.01	3.01	0.018
lactose	5.10	5.14	5.17	5.16	0.022
TS	12.27	12.11	12.11	12.15	0.694

1. ground barley (with a mean particle size of about 1 mm), 2. steam-rolled barley (with PI=68%), 3. dry-rolled barley (with PI=72%), 4. dry-rolled barley (with PI=81%)

[2] efficiency was calculated by dividing 4 % FCM (kg/d) by DMI (kg/d)

[a,b] means within a row with a common superscript do not differ ($P>0.05$)

Dry matter digestibility, faecal, ruminal and urinary pH

No difference for apparent digestibility of DM and OM were observed among the rations (Table 3). Urinary pH and ruminal pH were not affected by the treatments (Table 3). Significant difference (PI=0.05) existed between diet 2 and 3 for faecal pH (Table 3).

Rumen VFA

The proportion of VFA, and acetate-to-propionate ratio were not affected by treatments (P>0.05) (Table 3).

Table 3. Digestibility, proportion of VFA and ruminal, urinary and faecal pH of different diets

Item	Diets[1]				
	1	2	3	4	SEM
VFA, molar proportion%					
acetate (A)	65.02	64.94	66.83	67.14	0.736
propionate (P)	20.25	20.70	19.37	17.87	0.580
butyrate (B)	11.11	11.07	9.90	10.64	0.328
A : P	3.29	3.25	3.56	3.82	0.129
Ruminal pH	6.73	6.59	6.76	6.83	0.062
Faecal pH	6.64[ab]	6.68[a]	6.58[b]	6.65[ab]	0.014
Urine pH	7.92	7.91	7.90	7.91	0.009
Digestibility of DM, %	67.86	68.56	66.17	68.06	0.561
Digestibility of OM, %	68.61	69.32	66.91	68.82	0.567

1. ground barley (with a mean particle size of about 1 mm, 2. steam-rolled barley (with PI=68%), 3) dry-rolled barley (with PI=72%), 4. dry-rolled barley (with PI=81%)

[a,b] means within a row with a common superscript do not differ (P>0.05)

CONCLUSIONS

These results indicate that dairy cows fed TMR diets consisting of 25% ground barley grain (dry matter basis), and with adequate fibre, can be used effectively, without any negative effects on dairy cow performance.

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