Feeding Barley To Dairy Cattle

C.S. Park

Most dairymen have traditionally purchased corn as the main energy source in grain mixtures. Recently, dairymen in North Dakota and surrounding states have become interested in barley because of its availability and its potential merit as a relatively high protein, high fiber source for use in diets of growing heifers and lactating dairy cattle in particular. In the past, the nutritive and feeding values of barley have usually been evaluated by comparing them to those of corn, which has its own unique dietary characteristics. Few studies to date have touched upon the interaction of barley with other feed ingredients in cattle diets and its influence on the palatability, feed intake, metabolic changes in rumen and vital organs, and subsequent production expression -growth rate and milk production. We know little about the nutritive value of barley grown in North Dakota and neighboring states for growing and milking dairy cattle as a source of protein, energy, and fiber.

Objectives of this study were to ascertain the feasibility of using a high level of barley in diets of lactating cattle. Specifically, we determined the influence of barley in diets on milk yield and related production responses. The nutritive value of barley was evaluated by analyzing certain metabolites in blood and rumen and correlating them with production parameters.

EXPERIMENTAL PROCEDURES

Forty cows at the NDSU Dairy Research Center were paired according to age, stage of lactation, and previous production records. Cows within the pairs were randomly assigned to either a control (20 percent barley) or treatment (60 percent barley) diet. The total 32-week experimental period was divided into two 16-week stages in which dietary protein was set at 17 and 16 percent for stage 1 and 2, respectively. Net energy of lactation varied from 1.70 to 1.62 Mcal/kg. Table 1 shows nutrient specifications broken down for lactation stage 1 (early) and 2 (mid to late). Complete blended diets consisting of corn silage, alfalfa hay and grain mixtures were fed twice daily in amounts to ensure a 5 to 10 percent weighback, with intakes determined and recorded.

Ingredients and composition of experimental diets are shown in Table 2. Barley consisted of 20 percent and 60 percent of grain mixtures for the control and treatment group, respectively. Milk yields were recorded daily and summarized monthly. Body weights were measured monthly. Health and reproduction data were noted from daily management records and from DHIA summaries. Blood was taken monthly for subsequent analysis of protein, cholesterol, urea, and blood glucose. Rumen samples were analyzed for ammonia and volatile fatty acid production. Milk samples taken biweekly were assayed for butter fat, protein, total solids, cholesterol and fatty acids.

Park is professor, Department of Animal and Range Sciences.

Table 1. Nutrient specifications for lactation stages.

	Stage 1 (Early)	Stage 2 (Mid-late)
Milk production (pound)	over 60	40-60
Dry matter intake (pound)	48.	40.
Net energy lactation (Mcal/kg)	1.70	1.62
Protein (% dry matter)	17.	16.
Calcium (% dry matter)	.7	.6
Phosphorus (% dry matter)	.5	.4

Table 2. Ingredients and chemical composition of diets.

	Control (20% Barley)		Treatment (60% Barley)	
Variable	**Stage 1**	**Stage 2**	**Stage 1**	**Stage 2**
Ingredient	(% Dry matter)			
Corn silage	10.0	33.3	9.8	12.0
Alfalfa hay	20.7	4.0	28.7	15.6
Concentrate	69.3	62.7	61.5	72.4
	(% Concentrate)			
Barley	19.2	20.8	59.4	58.5
Corn	51.1	38.3	3.7	17.4
Soybean Meal	24.7	35.4	17.1	18.0
Sunflower seed	0	0	14.3	0
Dicalcium phosphate	.5	.9	.5	.7
Limestone	.7	.6	.4	.9
Sodium bicarbonate	.7	.9	1.5	1.4
Constant ingredients[a]	3.1	3.1	3.1	3.1
Chemical analysis of diet				
Crude protein	17.4	16.6	18.0	16.3
Acid detergent fiber	23.2	26.0	23.5	24.5

[a]The 3.1% constant ingredient corresponds to 0.7% molasses and 2.4% trace mineralized salt (NaCl 95.0%) with vitamin A and D added to provide 3,400 and 760 IU/kg of diet, respectively.

RESULTS AND DISCUSSION

A summary of milk yield and feed intake data is presented in Table 3. Average daily milk production was affected by diets in that the treatment (60 percent barley in grain mix) cows produced signficantly more milk as compared to control (20 percent barley) groups. Mean percentage increase in milk by the treatment cows was about 8 percent over that of the control animals. Jorgenson et al. (1) reported that average daily production of both actual milk and 4 percent FCM was not different by dairy cows when fed concentrates containing corn or barley grains. Similar results were reported by other workers (1, 2, 3). Increased milk production observed from cows fed 60 percent barley in the present study is likely due to the sunflower seed in the diets during the early stage of lactation. Our previous study (5) found that cows fed diets containing sunflower seed (10 percent of diet) produced more milk and were more energy efficient. The high barley diet depressed the fat content in milk (Table 3). This decrease in milk fat production may be related to feeding sunflower seed which contain approximately 40 percent oil. Linoleate acid comprises 70 percent of the fatty acid in sunflower oil. We have previously discussed (5) relationships and effects of oil seed feeding on milk yield and composition.

Milk protein was not affected by treatment. The 60 percent barley diet decreased total milk solids. We found no significant treatment difference in dry matter intake and body weight change during the total 32-week trial period.

There were no significant treatment effects on various rumen chemical constituents measured with the exception of lowered ammonia-N in the high barley group. Selected blood metabolites presented in Table 4 revealed that the treatment did not alter blood protein, sugar, and LCAT activity. Total cholesterol and high density lipoprotein were elevated in cows fed the high barley diet. This increase in cholesterol is largely associated with the sunflower seeds fed during early lactation diets. Our previous studies (4, 5) have shown increased fat and cholesterol in the blood as a result of added dietary fat (sunflower seeds).

Table 3. Mean yield and composition of milk and feed intake for cows fed varying amounts of barley.

Response	Control	Treatment	SE[a]	Level of probability
Milk yield (pounds/day)				
Actual	56.9	61.8	.7	.012
Fat-corrected	53.2	53.0	.4	.348
Milk composition (%)				
Butterfat	3.76	3.36	.07	.027
Protein	2.88	2.85	.04	.455
Total solids	11.98	11.74	.12	.242
Dry matter intake (pounds/day)	34.7	35.6	.4	.062
Initial body weight (pounds)	1305	1287	15	.417
Body weight change (pounds/day)	.66	.68	.08	.354

[a]Standard error of the mean, where n = 10.

Table 4. Rumen composition and serum urea of cows fed different amounts of barley.

	Control	Treatment
Rumen VFA (molar %)		
Acetate	55.5	56.5
Propionate	21.4	20.9
Butyrate	16.2	16.4
Rumen pH	6.65	6.78
Rumen NH_3-N (mg/dl)	12.15	9.40
Serum Urea-N (mg/dl)	19.5	19.8

Table 5. Effects of feeding different levels of barley on selected blood metabolites

Parameter	Control	Treatment	SE[a]	Level of Probability
	---------- (x) ----------			
Protein (g/dl)	8.75	8.64	.40	.132
Glucose (mg/dl)	58.3	55.2	3.1	.415
Blood cholesterol (mg/dl)				
Total	171.8	288.6	14.3	.001
High density lipoprotein	142.4	235.0	6.5	.001
LCAT[b] activity (nmol ml^{-1} h^{-1})	80.2	85.7	4.3	.244

[a]Standard error of the mean, where n = 10.
[b]Lecithin cholesterol acyltransferase.

SUMMARY

The study evaluated the effects of feeding a high level of barley (20 percent vs. 60 percent of grain mixtures) in diets on lactation and metabolism of dairy cows. Cows receiving a 60 percent barley diet supplemented by sunflower seed produced significantly more milk than those on the 20 percent barley diet 61.8 vs. 56.9 pounds of milk per day). The level of barley in diets did not affect most metabolic responses.

SIGNIFICANCE

Motivation for this study was based on an increased interest by dairy producers in need for information on the use of barley in dairy rations. Dairymen as well as beef producers in North Dakota and surrounding states presently have the option of including barley in lactating and growing cattle diets with the opportunity to reduce total feed costs in many cases. Experimental results indicate that substantial amounts of barley can be substituted for corn in cattle rations, particularly in lactating dairy cow rations. It is estimated that a reduction of approximately 13 percent of feed cost per hundred-weight milk production may be achieved when barley is utilized in lactation rations. This would represent about $185 additional return per cow-lactation. A similar magnitude of saving can be expected for growing heifers and finishing beef cattle.

LITERATURE CITED

1. Jorgenson, N.A., G.H. Tenpas, R.E. Roffler, H.J. Larsen and R.P. Niedermier. 1967. Barley in grain mixtures for dairy cows. Research Report, Wis. Agri. Exp. Sta., Madison.
2. Marx, G.D. 1984. Feeding barley to dairy cattle. Minn. Dairy Rep., Univ. of Minn.
3. Moss, B.R., C.R. Miller and C.W. Newman. 1976. Utilization of barley varieties by dairy cattle. J. Dairy Sci. 59:208.
4. Park, C.S. 1985. Influence of dietary protein on blood cholesterol and related metabolites of growing calves. J. Anim. Sci. 61:924.
5. Rafalowski, W. and C.S. Park. 1982. Whole sunflower seed as a fat supplement for lactating cows. J. Dairy Sci. 65:1484.