EFFECT OF DIFFERENT LEVELS OF WHEAT IN CONCENTRATE MIXTURE ON RESPONSES OF LACTATING DAIRY COWS FED SORGHUM SILAGE AS THE ONLY FORAGE

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Story in Brief

A feeding trial was conducted to compare the performance of 21 lactating cows fed concentrate mixtures containing different amounts of wheat included in a complete ration with sorghum silage as the only forage. The concentrate mixtures contained 0, 40, and 60 percent hard red winter wheat with the latter level representing the highest percent that can be used and still maintain protein, fiber and energy content of the total ration at an acceptable level. Cows were assigned near the peak of lactation to treatment sequences of a switchback design with three 4-wk periods. Total dry matter consumption was similar for all treatment groups. No incidence of off-feed or other indication of digestive disorders was noted with wheat intake averaging 13.6 and 20.2 lb per day for cows fed the 40 and 60 percent wheat mixtures. There was a linear decrease in milk yield (63.4, 61.6, and 60.1 lb/day) with a slight increase in fat test as percentage of wheat in the concentrate increased. Milk protein percentage did not differ among treatments. Also, the amount of wheat in the ration had no effect on body weight and condition score changes, rumen pH, rumen ammonia, rumen volatile fatty acids, and blood plasma urea.

High levels of wheat can be utilized in a complete mixed ration wherein sorghum silage is the only forage; however, economic feasibility varies and should be considered.

(Key Words: Wheat, Feed Intake, Milk Yield, Dairy Cows.)

Introduction

In Oklahoma, an abundant supply of wheat is generally available for livestock feeding. At times, the price is competitive with that of other feed grains used as an energy source in dairy rations. When this is the situation, wheat can be used to advantage in formulating high energy rations for lactating dairy cows. However, the extent to which other grains can be replaced by wheat in dairy rations has not been well defined because much of the research on feeding wheat was conducted using cows producing considerably less milk and fed much less concentrates than is common in the industry today.

McPherson and Waldern (1969) found that cows fed alfalfa hay plus concentrate mixtures containing from 20 to 93% Gaines soft white wheat had no problems with "off-feed" and no significant differences in milk production attributable to amount of wheat in the ration. However, their results may not be applicable to herds with higher milk production or where cows are fed hard red winter wheat rather than soft white wheat. Cunningham et al. (1970) fed lactating cows concentrate mixtures containing corn and either 33.3 or 66.7% of two varieties of soft red winter wheat. A combination of alfalfa hay and corn silage (about 1:2.8

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on a dry basis) comprised the forage component of the ration. For cows fed either the low or high protein variety of wheat, milk yield was significantly lower when wheat comprised 66.7% of the concentrate than when half as much wheat was used.

This experiment was conducted to determine the extent to which hard red winter wheat can be utilized in a complete mixed ration for lactating cows where sorghum silage is the only forage. Also, the effect of different levels of wheat in the concentrate mix on ruminal fermentation was evaluated.

Materials and Methods

Twenty-one Holstein cows in their second or greater lactation were used in a feeding trial starting 6 to 10 weeks postpartum to compare concentrate mixtures containing 0, 40, and 60% hard red winter wheat. Wheat replaced corn and some soybean meal. The highest level represented the highest percent that can be used and still maintain protein, fiber and energy content of the total ration at an acceptable level (Table 1). Cows were fed a complete mixed ration consisting of 55% concentrate and 45% sorghum silage on a dry basis. Calculated analysis for the total ration was 15.5% crude protein, 71.4 Mcal net energy for lactation (NE_{ℓ})/100 lb and 16.5% crude fiber. The three mixtures were calculated to be isocaloric and isonitrogenous.

Table 1. Concentrate mixtures fed with sorghum silage[1].

	Percent Wheat in Mix		
Composition	0	40	60
Ingredients (%, as fed)			
Corn, ground	53	18	--
Wheat, ground[2]	--	40	60
Soybean meal	30	25	23
Fixed portion[3]	17	17	17
Calculated analysis (as fed)			
Net energy, Mcal/100 lb	73.0	73.3	73.4
Total protein, %	20.2	20.0	20.1
Crude fiber, %	5.5	5.7	5.7

[1]Conc:forage, 55:45 (dry basis); total ration (dry): NE_{ℓ} 71.4 Mcal/100 lb; protein 15.5%; fiber 16.4%.

[2]Hard red winter wheat, no. 2 grade, test wt. 60 lb/bu.

[3]Fixed portion of concentrate mix: cottonseed meal 4, cottonseed hulls 4, oats 4, limestone 1.5, dicalcium phosphate 1.25, sodium bicarbonate 1.0, salt .75, and magnesium oxide .50%.

A switchback design with three 4-wk periods was used. The first two weeks for adaptation and the last two weeks of each period were used for comparisons among treatments. The cows were assigned to three blocks based on date of calving and then randomly to treatment sequences. Rations were fed to individual cows in three portions at 8-hour intervals. Milk weights were recorded daily and samples were taken at four consecutive milkings each week to determine fat and protein percentage. Feed weighbacks for each cow were taken daily and composited on a weekly basis for determination of dry matter and crude protein content. A sample of silage and each concentrate mixture also were analyzed for these components each week so that intake could be calculated. Each cow was weighed prior to the trial and on two consecutive days during the last week of each period. Body condition of each cow was evaluated initially and on the last day of each period using the scoring system described by Aalseth et al. (1983).

During the last week of each period, 3 to 4 hours after the 11:00 AM feeding, a sample of rumen fluid was taken by stomach tube to determine pH, ammonia and volatile fatty acid (VFA) concentration. A sample of blood from the median caudal vein was also taken to determine plasma urea concentration.

Results and Discussion

Feed intake was not affected by the amount of hard red winter wheat in a complete ration with sorghum silage as the only forage (Table 2). Intake of wheat averaged approximately 13.6 and 20.2 lb per day for cows fed the 40 and 60% wheat mixtures, on an as-fed basis. No problems were encountered with feed intake or clinical acidosis, even though concentrate intake averaged more than 30 lb/cow/day for the entire trial. Similarly, McPherson and Waldern (1969) observed that cows had no problems with "off-feed" or acidosis even when fed a concentrate mixture with 93% wheat so that consumption of wheat was over 25 lb/cow/day. In their experiments, Gaines soft white wheat was used and alfalfa hay was the only forage in the ration. It seems apparent that high levels of wheat can be utilized in a complete mixed ration wherein sorghum silage is the only forage if good management practices are followed in regard to adaptation of cows to such rations. In our trial, the cows were adjusted to new rations over a period of 5 days. Also, mineral buffers, sodium bicarbonate and magnesium oxide, were included in the concentrate mixtures for the purpose of stabilizing conditions in the rumen to reduce the likelihood of digestive disorders.

There was a linear decrease ($P<.0002$) in milk yield as the amount of wheat in the ration increased (Table 2), although milk yield of cows fed the highest level of wheat was sustained at a high level, i.e., 60 lb/day. Similarly, Cunningham et al. (1970) observed that milk yield was significantly lower ($P<.05$) when soft red winter wheat comprised 66.7 compared to 33.3% of a concentrate mixture (59.4 vs. 62.0 and 56.5 vs. 60.1 lb/day). In contrast, in a trial wherein concentrate rations contained 20 to 93% Gaines soft white wheat, McPherson and Waldern (1969) observed no significant difference among groups with an overall average milk production of 51.4 lb/day. However, milk yield was moderately low in their experiment compared to others previously mentioned and wheat replaced barley rather than corn in the concentrate mixtures. In our trial, wherein wheat replaced corn and some soybean meal (Table 1), the amount of lysine in the ration which was calculated to reach the small intestine was reduced. Whether or not this is a factor affecting

Table 2. Responses of cows fed different levels of wheat.

Item	Percent Wheat in Mix		
	0	40	60
Dry matter intake, lb/day			
Concentrate mix	30.5	30.4	30.0
Silage	25.0	24.7	24.2
Total	55.5	55.1	54.2
Protein intake			
lb/day	8.07	8.03	8.08
% of NRC requirement	124	127	128
Wheat intake (as-fed), lb/day	0	13.6	20.2
Milk Yield			
Milk, lb/day[a]	63.4	61.5	60.0
Fat test, %	3.68	3.71	3.81
Protein, %	3.15	3.12	3.15
Weight change, lb/4-wk period	1.7	21.3	-4.2
Condition score change	.3	.2	.1

[a]Significant linear trend (P<.0001).

[b]Significant linear trend (P<.05).

the performance of cows fed large amounts of wheat remains to be determined by further research.

Milk fat test increased slightly as wheat in the ration increased, but may have been simply a reflection of the decrease in milk production (Table 2). The amount of wheat in the ration had no effect on milk protein. No significant difference was observed among levels of wheat in regard to body weight and condition score changes of the cows. Also, rumen pH, ammonia, VFA concentration, and blood plasma urea were similar for cows fed different amounts of wheat. The ratio of molar percentages of acetic to propionic acids was 3.1:1 across treatments and was adequate for maintenance of normal milk fat test.

The economics of feeding wheat where sorghum silage constitutes the only forage merits consideration. Small differences among treatments were observed in feed intake; therefore, the same amount of intake was assumed for each ration in the economic analysis. Thus, the economic feasibility of feeding wheat was estimated on the basis of observed responses in milk yield and current milk and feed prices. A concentrate mixture containing 40% wheat, replacing 35 lb corn and 5 lb soybean meal, must cost 62 ¢/cwt less than a typical corn-soybean meal mixture to give the same return over feed cost (Table 3). Similarly, a concentrate mixture containing 60% wheat must cost about 92 ¢/cwt less to obtain equal return over feed cost. With current prices (Jan. '86) for corn and soybean meal, wheat would need to be priced around $4.65/cwt to make the substitution profitable. On the other hand, if corn were priced at $6.40/cwt and soybean meal at $9.25/cwt as it was March '85, it would be feasible to use wheat priced around $5.25/cwt. At times the

Table 3. Economics of feeding wheat with sorghum silage as the only forage.

Item	Wheat in Conc. Mix, %		
	0	40	60
Amount of milk, lb/cow/day	63.4	61.5	60.0
Value of milk produced per day, $[a]	8.02	7.81	7.71
Feed Costs			
Conc. mix, $/100 lb[b]	7.22	6.98	6.89
Silage, $/100 lb	1.25	1.25	1.25
Daily ration consumed, $	3.25	3.17	3.14
Return over feed costs/cow, $[ab]	4.77	4.64	4.57
Price needed for same return as with control ration			
Conc. mix, $/100 lb		6.60	6.30
Wheat price[c]		4.67	4.65

[a]Milk priced at $12.36/cwt for 3.5% test, with 16 ¢ differential.

[b]Ingredient prices (January 1986) per 100 lb: wheat $5.12, corn $5.74, soybean meal $9.50, oats $5.90, cottonseed meal $9.25, cottonseed hulls $2.70, limestone $4.00, dicalcium phosphate $20.50, sodium bicarbonate $18.00, salt $4.40, and magnesium oxide $17.00.

[c]Assuming all other ingredient prices are those indicated above.

price of wheat is competitive with that of other feed grains used as an energy source in dairy rations and can be used to an advantage. Although it is possible to use high levels of wheat in formulating high energy rations for lactating dairy cows where sorghum silage is the only forage, the economic feasibility of doing so should be considered. In future research it should be possible to identify the factor(s) responsible for reduced milk yield when cows are fed complete rations containing a large amount of wheat and sorghum silage as the only forage. If so, it is likely that cost effective measures for overcoming this problem can be developed.

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