INFLUENCE OF DIFFERENT LEVELS OF WHEAT IN THE CONCENTRATE MIXTURE ON PRODUCTION RESPONSES OF LACTATING DAIRY COWS FED ALFALFA HAY AS THE ONLY FORAGE

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Story in Brief

A feeding trial was conducted to compare the performance of 24 lactating dairy cows fed concentrate mixtures containing 0, 40, 60 and 80% of hard red winter wheat with alfalfa hay comprising the only forage in the ration. Intake of both concentrate and hay was lower when cows were fed the rations containing wheat; however, there was very little difference among rations containing different amounts of wheat. No problems were noted with feed refusals or clinical acidosis. Milk yield declined as the amount of wheat in the concentrate increased (66.9, 65.5, 65.1, 63.7 lb/cow/day). Milk fat test percent decreased linearly as the percentage of wheat in the concentrate increased, whereas milk protein percentage was not affected by treatment. Also, the amount of wheat in the ration had no effect on body weight and condition score change.

Considering the decrease in feed intake as well as the decrease in milk yield and fat test of cows fed the different levels of wheat, the highest return over feed costs was obtained with the ration containing 40% wheat in the concentrate mixture. With current ingredient prices, wheat would need to be valued at about $4.75/cwt to give a return over feed cost equal to that obtained with the ration without wheat when cows are fed concentrate mixtures containing 60 or 80% wheat. However, if one assumes that with adequate fiber in the ration no depression in fat test would occur, and milk yield would be the same as observed, it can be calculated that feeding wheat would be profitable at all the different levels.

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

Introduction

Wheat is often competitive in price with other feed grains used as an energy source in dairy rations. Therefore, there is a need to more clearly define the limits to which wheat can be included safely in rations for high producing dairy cows and to identify management factors that are important in successful use of large amounts of wheat. This information would be valuable in designing feeding programs for dairymen in Oklahoma and other areas where substantial quantities of wheat are produced.

Tommervik and Waldern (1969) compared the nutritive value of Gaines soft white wheat to corn, oats, barley, milo and a mixed concentrate ration for dairy cows. Each of the five single grain mixtures contained 95.7% of the respective grains and was pelleted. The complete ration consisted of 45% concentrate and 55% alfalfa hay with consumption of

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grain dry matter averaging 17.4 lb/day for the cows fed wheat. They noted negligible differences among the concentrates as to palatability or effect on milk production and composition. McPherson and Waldern (1969) noted no problems with "off-feed" and no significant differences over all treatments in daily milk production when they fed alfalfa hay plus concentrate mixtures containing from 20 to 93% Gaines soft white wheat.

Results from these earlier experiments may not be applicable today since they were conducted using cows producing considerably less milk and fed much less concentrates than is common in the industry today. Also, results may differ when cows are fed hard red winter wheat rather than soft white wheat. Our experiment was conducted to help define the extent to which hard red winter wheat can replace other grains in rations for lactating dairy cows while utilizing alfalfa hay as the only forage.

Materials and Methods

Twenty-four Holstein cows (12 in first lactation and 12 in second or later lactation) were used in a feeding trial starting 6 to 10 weeks postpartum to compare concentrate mixtures containing 0, 40, 60 and 80% hard red winter wheat. The 80% level of wheat represents the maximum that can be used if protein, net energy and fiber levels are maintained at an acceptable level. The rations were adjusted as necessary to maintain consumption of the desired ratio of 55% concentrate to 45% alfalfa hay on a dry basis. The four concentrate mixtures were calculated to be isocaloric and isonitrogenous (Table 1) with total ration calculated to have 72.5 Mcal net energy for lactation (NE_{ℓ})/lb, 16.5% protein, and 17.0% crude fiber on a dry basis.

A switchback design was used, with three 4-week periods. The first two weeks of each period were allowed for adjustment to rations and recovery from possible carry-over effects. Data collected the final two weeks of each period were used for comparisons among treatments. The cows were assigned to two blocks based on lactation number and then assigned randomly to treatment sequences. Alfalfa hay was fed twice daily separate from the concentrate mixtures. Weighbacks of both concentrate and alfalfa hay were composited on a weekly basis for analysis of dry matter (DM) and crude protein (CP). Milk weights were recorded at each milking and samples were taken at four consecutive milkings each week for determination of protein and fat content. Body weights were recorded on two consecutive days before the trial and during the last week of each period. Body condition also was evaluated prior to the beginning of the trial and during the last week of each period using the system described by Aalseth et al. (1983).

At the end of each period, rumen samples were taken 3 to 4 hours after the 3:30 AM concentrate feeding to determine rumen pH, rumen ammonia, individual rumen volatile fatty acids (VFA), and rumen lactic acid concentration. Also, at this time a blood sample was taken from the median caudal vein to determine plasma urea concentration.

Results and Discussion

Intake of both concentrate and hay was affected by the amount of hard red winter wheat in the concentrate mix, being lower for the cows fed the rations containing wheat (Table 2). However, there was very

Table 1. Concentrate mixtures fed with alfalfa hay[1].

Composition	Percent Wheat in Mix			
	0	40	60	80
Ingredient (%, as fed)				
Wheat, ground	--	40	60	80
Corn, ground	75	38	19	--
Cottonseed meal	12	6.5	3.5	2
Oats, ground	4	6.5	8.5	9
Fixed portion[2]	9	9	9	9
Calculated analysis, as fed				
Net energy, Mcal/100 lb	74.7	74.9	74.9	75.0
Crude fiber, %	5.5	5.5	5.5	5.6
Total protein, %	12.4	12.2	12.0	12.4
Soluble nitrogen, % of total N[3]	17.0	19.1	20.7	18.0
Acid detergent fiber, % dry basis	6.9	6.5	6.4	7.9

[1]Conc:hay, 55:45; total ration (dry): NE_{ℓ} 72.5 Mcal/100 lb; protein, 16.5%; crude fiber, 17.0%.
[2]Fixed portion: cottonseed hulls 5, dicalcium phosphate 1.75, sodium bicarbonate 1.0, salt .75 and magnesium oxide .50%.
[3]Solubility in borate-phosphate buffer.

little difference among rations containing different levels of wheat. No problems were noted with clinical acidosis or digestive disorders in cows on any of the treatments. Intake of wheat averaged 10.4, 15.2, and 19.7 lb/day on as-fed basis for cows fed the 40, 60 and 80% wheat mixtures, respectively. Similarly, no problems with "off-feed" or acidosis were observed by McPherson and Waldern (1969) with cows fed levels from 20 to 93% of Gaines soft white wheat in the concentrate mix and fed alfalfa hay at a rate of 1 lb to 100 lb of body weight. At the highest level, wheat intake was over 25 lb/cow/day. It seems reasonable to conclude that wheat can be incorporated in a nutrition scheme for dairy cows; however, some management factors are important in successful use of large amounts of wheat in dairy rations. In our protocol a 5-day adaptation period was used to bring cows up to 100% of each respective ration when ration changes were made. Also, sodium bicarbonate and magnesium oxide were added to the concentrate mixtures (Table 1) to prevent digestive disorders.

Milk yield declined as the amount of wheat in the concentrate increased (Table 2). However, milk yield of cows in their second or greater lactation was still sustained at a high production level, i.e., 78.3 lb/day, even when fed the concentrate mixture with 80% wheat. Milk yield of the control group was 82.1 lb/day. Cows in their first lactation averaged 49.0 lb/day when fed the high-wheat ration, compared to 51.6 lb/day for controls. Similarly, Cunningham et al. (1970) reported

Table 2. Feed intake and milk yield by cows.

Item	Percent Wheat in Mix			
	0	40	60	80
DM Intake, lb/day				
Concentrate mix	25.0	23.1	22.6	21.9
Hay	19.4	17.7	17.0	17.2
Total	44.0	40.8	39.6	39.1
Protein Intake				
Total protein, lb/day	7.26	6.60	6.47	6.40
TP, % of NRC req.	117	110	110	111
Milk Yield				
Milk, lb/day[a]	66.9	65.5	65.1	63.7
Fat test, %[b]	2.82	2.74	2.53	2.56
Protein, %	2.74	2.78	2.82	2.83

[a]Linear trend approaching statistical significance ($P < .08$).
[b]Significant linear trend ($P < .006$).

that cows produced less milk when soft red winter wheat comprised 66.7% of a concentrate mix than when it was 33.3% of the mixture. In contrast, McPherson and Waldern (1969) reported that milk production was similar for cows fed concentrate mixtures containing 20 to 93% Gaines soft white wheat. In our trial, milk fat test declined linearly as the percentage of wheat in the concentrate mixture increased (Table 2). The reason for the decline is not known; however, fat test was low for all the groups. This presumably was due to the total ration being lower in fiber than is needed to maintain normal milk fat content. The rations were calculated to contain 17% crude fiber on a dry basis, but the alfalfa hay used in the experiment was higher in quality than assumed in the calculations making total fiber content of the ration lower than expected. The percentage of concentrate in the ration consumed, i.e., about 56% on a dry basis, was within acceptable limits for dairy cow rations. Milk protein did not differ among treatments.

An economic analysis was performed to determine whether or not wheat can be used to an advantage in formulating rations for dairy cows under the conditions existing in our trial. Less feed was consumed when wheat was included in the concentrate mixtures; therefore, reduced intake of both alfalfa hay and concentrate was considered. The daily ration ingredient cost per animal declined from $2.70 for cows consuming the control ration without wheat to $2.26 for cows fed the concentrate with 80% wheat. In our trial the highest return over feed ingredient costs was for the group fed the concentrate mixture containing 40% wheat (Table 3). The decline in milk yield and fat test of cows fed concentrate mixes containing 60 and 80% wheat was such that with current prices for other ingredients (Jan '86), wheat would need to be valued at about $4.75/cwt to produce equal returns over feed cost. However, with

Table 3. Economics of feeding wheat with alfalfa hay as the only forage.

Item	Wheat in Conc. Mix			
	0	40	60	80
Amount of milk, lb/day	66.9	65.5	65.1	63.7
Value of milk produced per day, $[a]	7.54	7.30	7.04	6.92
Feed ingredient costs[b]				
Conc. mix, $/100 lb	6.44	6.21	6.08	6.00
Alfalfa hay, $/100 lb	4.00	4.00	4.00	4.00
Daily ration consumed, $	2.70	2.43	2.32	2.26
Return per day over feed costs, $[a,b]	4.84	4.87	4.72	4.66
Price needed for same return as with control ration				
Conc. mix, $/100 lb			5.60	5.26
Wheat, $/100 lb			4.82	4.70

[a]Milk priced at $12.36/cwt for 3.5%, with 16¢ differential.
[b]With wheat @ $5.62, corn @ $5.74, cottonseed meal @ $9.25, and oats @ $5.90/cwt (Jan. 22, 1986).

Table 4. Responses of cows fed experimental rations.

Item	Percent Wheat in Mix			
	0	40	60	80
Weight change, lb/4-wk period	7.8	-5.5	24.1	30.6
Condition score change	0.07	0.15	-0.28	-0.10
Ruminal fluid pH[a]	6.65	6.42	6.41	6.09

[a]Significant linear trend ($P<.05$).

corn priced at $6.40/cwt and cottonseed meal at $8.44/cwt as they were in March '85, it would be economically feasible to use wheat priced around $5.30/cwt. Also, if one assumes that with adequate fiber in the ration no depression in fat test would occur and milk yield would be the same as observed in our experiment, it can be calculated that feeding wheat would be profitable at all the different levels with current feed ingredient prices.

The amount of wheat in the ration had no effect on body weight and condition score changes (Table 4). However, ruminal pH was lower in cows fed the different levels of wheat than in those fed the control ration. Nevertheless, the pH values were well above the level generally observed to be associated with problems of digestive disorders or "off-feed" in cows fed large amounts of grain.

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