

# SUBSTITUTING WHEAT FOR CORN IN A CONCENTRATE MIXTURE FOR DAIRY COWS ON A WEIGHT BASIS

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## Story in Brief

The effect of substituting wheat for corn on a weight rather than a protein basis was determined using 18 Holstein cows in their second or greater lactation. Treatments consisted of concentrate mixtures as follows: a) Control (75% corn adjusted to 12.1% protein) b) Wheat (75% wheat, 15.1% protein) and c) Wheat (75% wheat, 12.1% protein). All three rations were isocaloric. Alfalfa hay was the only forage, fed in a 50:50 ration. Intake of dry matter was lower for cows fed the wheat rations. Milk yield by cows fed the wheat rations was decreased, with the yield of cows fed the ration where wheat was substituted for corn on a weight basis being intermediate to those of cows fed the other rations (74.1 vs 76.0 and 72.6 lb/day). Milk fat test and milk protein were similar for all treatments.

(Key Words: Wheat, Protein, Alfalfa Hay, Milk Yield)

## Introduction

A major justification for the use of wheat in livestock rations is the low cost and abundant supply of wheat in the U.S. As the cost of wheat declines or remains lower than that of other grains it becomes economically feasible to use more wheat.

When Faldet et al. (1986) fed concentrate mixtures containing 0, 40, 60 and 80% wheat with alfalfa hay as the only forage, milk yield declined as the amount of wheat increased (66.9, 65.5, 65.1 and 63.7 lb/day, respectively). In that trial the protein percentages of the concentrate mixtures were similar, averaging 12.2%. 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 (high protein, 18% and normal protein, 14%). A combination of alfalfa hay and corn silage (about 1:2.8 on dry matter basis) comprised the forage component of the ration. For cows fed either the low or high variety of wheat, milk yield and milk fat content was lower ( $P < .05$ ) when wheat comprised 66.7 compared to 33.3% of the concentrate mix. However, average yield and composition of milk by cows fed the two wheat rations were similar to that of cows fed a control corn-based concentrate mixture. In that study the protein percentages of the concentrate mixtures were similar across treatments, i.e., 15.3%. The manner in which the amount of protein of wheat affects the production of milk remains to be defined.

The objective of this experiment was to determine the effect on the performance of dairy cows of substituting wheat for corn on a weight basis, without adjusting for protein, using alfalfa hay as the only forage.

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## Materials and Methods

Eighteen Holstein cows in their second or greater lactation were used in a feeding trial starting 6 to 10 weeks postpartum. A switchback design with three 4-wk periods was used. The first two weeks were for adaptation to rations and the last two weeks of each period were used for comparisons among treatments. The cows were assigned to two blocks based on date of calving and then randomly to treatment sequences. The experimental rations were: a) Control (75% corn base mixture, 12.1% protein), b) Wheat (75% wheat base, 15.1% protein) and c) Wheat (75% wheat base, 12.1% protein). All the rations were calculated to be isocaloric (Table 1). Alfalfa hay was 50% of the total ration. The concentrate mixtures and hay were fed separately twice daily at 12-hour intervals. The alfalfa hay was fed 3 hours after the concentrate was fed each time.

Milk weights were recorded twice daily and samples were taken at four consecutive milkings each week for fat and protein analysis. Feed intake was recorded daily and alfalfa hay weighbacks were composited on a weekly basis for analysis of dry matter (DM) and crude protein (CP). A sample of alfalfa hay and each concentrate mixture also were analyzed for DM and CP each week for intake calculations. Each cow was weighed on two consecutive days prior to the trial and 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 day of each period, 3 to 4 hours after feeding, a sample of rumen fluid was taken by stomach tube to determine pH and concentration of ammonia nitrogen and volatile fatty acids (VFA). Also, a sample of blood from the median caudal vein was

Table 1. Composition of concentrate mixtures.

Composition	Ration		
	Corn-base	Wheat-base (Weight basis)	Wheat-base (Protein basis)
Ingredients, % as fed			
Wheat	--	75	75
Corn	75	--	--
Oats	4	4	14
Cottonseed meal	12	12	2
Cottonseed hulls	5	5	5
Dicalcium phosphate	1.75	1.75	1.75
Salt	.75	.75	.75
Sodium bicarbonate	1.00	1.00	1.00
Magnesium oxide	.50	.50	.50
Calculated analysis, as fed			
Net energy, Mcal/100 lb	74.7	74.7	74.4
Total protein, %	12.2	15.1	12.1
Rumen undeg. protein, %	6.2	3.8	2.6
Crude fiber, %	5.5	6.2	6.0

taken to determine plasma urea nitrogen. The data on concentration of ammonia nitrogen and VFA in ruminal fluid and plasma urea nitrogen will be available in a future publication.

### Results and Discussion

Intake of dry matter from both concentrate and hay were affected with intake of concentrate being significantly lower ( $P < .05$ ) for cows fed either of the wheat rations (Table 2). Data for feed intake and milk yield of one cow were omitted in the analysis because the cow had severe mastitis during part of the experimental period. The decrease in feed intake was consistent with the results of Faldet et al. (1986), in that they observed a decrease in intake as the amount of wheat in the concentrate mixture increased. Total protein intake was significantly higher ( $P < .001$ ) for the wheat ration with 15.1% protein, as expected. Also, the intake of protein by cows in the control group was higher than that of cows fed the wheat ration containing 12.1% protein. However, intake of protein by all groups exceeded NRC requirements for total protein.

Milk yield for the cows fed the wheat mixture containing the 12.1% protein was lower than that of cows fed the control ration, i.e., 72.6 and 76.0 lb/day, respectively. This was greater decline in yield than observed in a previous trial where wheat comprised 60% of a concentrate mixture Faldet et al. (1986), possibly because the cows in the present

Table 2. Responses of cows to experimental rations.

Item	Ration / Percent Protein		
	Corn 12.1%	Wheat 15.1%	Wheat 12.1%
DM Intake, lb/day			
Concentrate mix	27.5 <sup>a</sup>	26.4 <sup>b</sup>	26.1 <sup>b</sup>
Hay	26.0 <sup>a</sup>	25.4 <sup>ab</sup>	24.7 <sup>b</sup>
Total	53.5 <sup>a</sup>	51.8 <sup>b</sup>	50.8 <sup>b</sup>
Protein Intake			
Total protein lb/day	9.08 <sup>a</sup>	9.78 <sup>b</sup>	8.70 <sup>c</sup>
TP, % of NRC requirement	128	141	126
Milk Yield			
Milk, lb/day	76.0 <sup>d</sup>	74.1 <sup>df</sup>	72.6 <sup>ef</sup>
Fat test, %	3.18	3.14	3.22
Protein, %	2.87	2.82	2.86
Weight change, lb/4 wk	18.5	20.2	21.9
Condition score change/4 wk	.40 <sup>a</sup>	.03 <sup>b</sup>	-.03 <sup>b</sup>
Ruminal fluid pH	6.3	6.2	6.2

<sup>abc</sup> Means in rows with different superscripts differ ( $P < .05$ ).

<sup>def</sup> Means with different superscripts differ ( $P < .06$ ).

trial produced more milk and were more responsive to differences in ration content.

Milk fat test and milk protein were similar across treatments, although lower than expected, since alfalfa hay having acid-detergent fiber content of 34.1% (dry basis) constituted 48.7% of the total dry matter intake by the cows. In addition, all the grain mixtures contained mineral buffers, sodium bicarbonate and magnesium oxide, for the purpose of stabilizing conditions within the rumen and to prevent milk fat depression. Production of cows fed the concentrate mixture wherein wheat was substituted for corn on a weight basis without other changes in formulation was intermediate between that of the other two groups. It appeared that the impact of substituting wheat for corn on milk yield was less severe when the amount of protein derived from other components of the ration was not reduced. This was consistent with the observation in another trial (Nalsen et al., 1987) that milk yield of cows fed a high-wheat ration was maintained by substituting corn gluten meal and blood meal for part of the soybean meal in the mixture. The amount of protein in the wheat mixtures had no significant effect on body weight changes. However, the condition score change for cows fed the corn mixture was significantly greater ( $P < .05$ ) than that of cows fed the wheat mixtures, i.e., .4 vs .03 and -.03. The amount of protein in the wheat mixtures had no effect on rumen pH.

More research is needed in this area to find ways that a large amount of wheat can be used in dairy rations without decreasing production.

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