AMINO ACID SUPPLEMENTATION OF HIGH-WHEAT CONCENTRATE MIXTURES FOR DAIRY COWS

T. Nalsen[1], L.J. Bush[2] and G.D. Adams[3]

Story in Brief

The effect on milk yield of protected amino acids (lysine and methionine) or high rumen escape protein was determined using 24 Holstein cows in their second or later lactation. Treatments were: a) Positive control (typical concentrate mixture for high producing dairy cows with corn as the principal grain) b) Negative control (high wheat mixture having low rumen escape protein) c) High wheat mixture with supplemental protected amino acids and) d) High wheat mixture with supplemental protected amino acids plus rumen escape protein equal to the positive control. These concentrate mixtures were fed in complete rations with sorghum silage as the only forage. Total dry matter consumption was similar for all treatment groups. Cows fed high-wheat rations, with or without supplementation with protected amino acids, produced less milk (63.9 vs. 67.8 lb/day) than cows fed the control ration. Increasing the rumen escape protein content of the high-wheat ration by substituting corn gluten meal and blood meal for soybean meal restored milk yield to that of cows fed the control ration. Fat test was greatest for the groups fed wheat, and milk protein was greatest for the cows fed the wheat rations supplemented with protected amino acids.

(Key Words: Wheat, Lysine, Protein, Milk Yield.)

Introduction

The cost of surplus wheat limits its use in livestock rations. To what extent wheat can be subtituted for other grains and yet maintain productivity remains to be defined. Faldet et al., (1986a) substituted wheat for corn in concentrate mixtures containing sorghum silage as the only forage. Milk yield decreased as the amount of wheat substitution increased, being 63.4, 61.5, and 60.0 lb/day for cows fed mixtures with 0, 40 and 60% wheat. The rumen escape protein (RUP) was calculated (NRC, 1985) to be 8.4% for the concentate mix containing corn and 5.8% for the mixture with 60% wheat. In particular, the amount of lysine in the concentrate mixture that would be expected to escape ruminal degradation was reduced from .41% for the corn mixture to .26% for the mixture containing 60% wheat. In a second trial wherein wheat was 0, 40, 60 or 80% of the concentrate mixture and alfalfa hay was the only forage, milk production tended to decrease also (Faldet et al., 1986b). The amounts of RUP and lysine escape were reduced in the rations in which wheat was substituted for corn plus soybean meal. Whether or not altered protein or amino acid supplies is responsible for a decline in milk yield when cows are fed rations containing a large amount of wheat remains to be determined.

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[1]Graduate Student [2]Professor [3]Instructor

This experiment was conducted to determine the effects of increasing rumen escape lysine and methionine or these plus total escape protein in high-wheat concentrate rations on the performance of dairy cows.

Materials and Methods

Twenty-four Holstein cows in their second or later lactation were used in a feeding trial starting 6 to 8 weeks postpartum. A switchback design with three 4-wk periods was used. The first two weeks of each period were used for adjustment to the rations whereas the last two weeks were used for comparisons among treatments. The cows were assigned to three blocks based on date of calving and randomly assigned within block to a treatment sequence. The experimental rations were: a) Positive control (with corn at 45 and barley at 10% of the concentrate mix), b) Negative control (wheat at 60% of the concencrate,) c) Diet "b" plus supplemental protected lysine and methionine, and d) Diet "c" plus RUP from corn gluten meal and blood meal at 9 and 2% of concentrate mix replacing most of the soybean meal. The mixtures were by calculation nearly equal in net energy and total protein content (Table 1). These concentrate mixes were included in complete rations with sorghum silage as the only forage at a rate of 55% concentrate to 45% forage on a dry matter basis.

Cows were fed in individual stanchions three times daily at 8-hour intervals. Milk weights were recorded twice daily and samples were obtained at four consecutive milkings each week for fat and protein analysis. Feed intake was recorded daily with feed weighbacks for each cow composited on a weekly basis for determination of dry matter and crude protein content. Weekly samples of silage and each concentrate mixture also were analyzed for these components to calculate intake. 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). On the last day of each period, at 2 and 4 hours after the 11:00 am feeding, a sample of rumen fluid was taken by stomach tube to measure pH and concentration of ammonia and volatile fatty acids (VFA). Digestibilities of selected nutrients and concentration of blood urea nitrogen also were measured and will be reported elsewhere.

Results and Discussion

Dry matter intakes were similar for all treatment groups (Table 2). Intake of concentrate mixes containing wheat averaged 32.6 lb/day so that intake of wheat averaged approximately 22 lb/day (air-dry). No problems with off-feed or digestive disturbances occurred as a result of this amount of wheat. Intake of total protein exceeded NRC requirements (Table 2).

Milk yield of cows fed the mixtures containing wheat, calculated to be low in RUP with or without protected amino acids, was lower ($P<.01$) than that of cows fed the corn-based mixture and of cows fed the wheat mixture supplemented with RUP. Milk production responses may reflect the amount of feed protein that escaped ruminal degradation and was available for digestion in the small intestine. Supplementation of the wheat mixture having low RUP with protected amino acids (lysine and methionine) alone had no effect on milk yield suggesting that protein components other than lysine and methionine limited production.

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

Composition	Control	Wheat (Low RUP)	Wheat (Low RUP+AA)	Wheat (High RUP+AA)
Ingredients, (% as fed)				
Wheat[2]	--	60	60	60
Corn	45	--	--	6.6
Barley	10	--	--	--
Oats	5	5.5	5.5	5
Corn gluten meal	--	--	--	9
Blood meal	--	--	--	2
Soybean meal	25	20	20	3
Cottonseed meal	5	4.5	4.1	4
Fixed portion[3]	10	10	10	10
Protected lysine amino acids[4]	--	--	.4	.4
Calculated analysis (as fed)				
Net energy, Mcal/100 lb	72.1	73.0	72.7	73.4
Crude fiber, %	6.3	6.2	6.2	5.5
Total protein, %	19.0	19.0	19.1	19.0
Rumen undeg. protein, %	7.56	5.41	5.55	7.63
Rumen undeg. lysine, %	.36	.24	.38	.38

[1]Concentrate: forage, 55:45 (dry basis); Total ration (dry): NE_{ℓ} 71.6 Mcal/100 lb, total protein 14.5%, crude fiber 16.8%.

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

[3]Fixed portion of concentrate mix: Cottonseed hulls 5, limestone 1.5, dicalcium phosphate 1.25, sodium bicarbonate 1.0, salt .75, and magnesium oxide .5%.

[4]Product of Eastman Chemicals Division, Eastman Kodak Co., Rochester, NY; 37% lysine and 11.8% methionine content.

Table 2. Responses of cows fed concentrate mixtures containing 60 percent wheat.

Item	Control	Wheat (Low RUP)	Wheat (Low RUP+AA)	Wheat (High RUP+AA)
Dry matter intake, lb/day				
Concentrate mix	32.6	32.7	32.3	32.7
Sorghum silage	26.5	26.4	26.0	26.2
Total	59.1	59.1	58.3	58.9
Protein intake				
Amount, lb/day	8.59	8.62	8.65	8.52
% of NRC requirement	127	131	132	125
Milk yield				
Milk, lb/day	67.8[a]	63.8[b]	64.0[b]	66.5[a]
Fat test, %	3.61	3.79	3.76	3.78
FCM, lb/day	63.5[cd]	61.6[c]	61.6[c]	64.2[d]
Protein, %	3.25	3.24	3.31	3.34
Protein, lb/day	2.20	2.07	2.12	2.22
Condition score change	.2	.1	.2	-.1

[ab]Means with different superscripts differ (P<.005).

[cd]Means with different superscripts differ (P<.04).

Milk fat test was slightly greater for the cows fed the wheat rations than for cows fed the corn-based ration (Table 2). The milk fat test (3.79%) for the cows fed the wheat-based concentrate mixture tended to be greater ($P<.06$) than that (3.61%) of cows fed the corn-based mixture. However, this increase in milk fat percentage may simply reflect the decrease in milk production. Concentrations of ruminal VFA which were observed should have produced normal milk fat test, although the molar percentage of acetic acid and the ratio of acetic to propionic acid tended to be lower for the wheat diets. At 2 hours after feeding, the pH of the ruminal fluid of cows fed wheat rations was lower (avg. 6.2 vs 6.5) than that of cows fed the corn-based diet. Protein content of the milk of cows fed the protected amino acids was slightly higher (3.33 vs. 3.25) than that of cows not fed this supplement.

Some research has suggested that lysine or methionine, or both, limit milk protein synthesis. In this experiment, supplementation of rations with protected lysine and methionine did not alter milk production, fat percentage, or dry matter intake. This suggests that these specific amino acids did not limit milk production in this trial. On the other hand, the amount of rumen escape protein appeared to be critical for maximum milk yields by cows fed a wheat-based diet. The site of digestion of feed protein must be considered in formulation of rations for maximum milk yield. Providing an adequate total protein level to meet or exceed NRC requirements will not suffice with diets having low ruminal escape of protein.

Literature Cited

Aalseth, E.P. et al. 1983. A system for evaluating the body condition of dairy cows. Ok. Agr. Exp. Sta. MP-114:261.

Faldet, M.A. et al. 1986a. Effect of different levels of wheat in concentrate mixture on responses of lactating dairy cows fed sorghum silage as the only forage. Ok. Agr. Exp. Sta. MP-118:66.

Faldet, M.A. et al. 1986b. Influence of different levels of wheat in the concentrate mixture on production responses of lactating dairy cows fed alfalfa hay as the only forage. Ok. Agr. Exp. Sta. MP-118:71

National Research Council 1985. Ruminant nitrogen usage. National Academy Press.