RESPONSES OF DAIRY COWS TO DIFFERENT AMOUNTS OF WHEAT MIDDLINGS IN THE CONCENTRATE MIXTURE

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Story in Brief

A feeding trial was conducted with 18 lactating dairy cows to compare the nutritional value of rations containing different amounts of wheat middlings. Concentrate mixes containing none, 40, or 60 % wheat middlings comprised 60 % of the total ration, with alfalfa hay used as the forage component. Cows were assigned near the peak of lactation to treatment sequences of a switchback design with three 4-wk periods. There was a significant quadratic trend for a reduction in milk yield as the level of middlings in the ration increased, being more pronounced at the highest level. Similar feed consumption for all treatment groups indicated no ration acceptability problems when middlings comprised as much as 60 % of the concentrate mix. Blood urea and ruminal ammonia concentrations at 3 hours after concentrate feeding were similar for all groups.

[Key words: Wheat middlings, dairy cows, intake, ruminal ammonia, blood urea]

Introduction

Although wheat middlings (mids) are a widely used byproduct for livestock feeding, the amount that can be used to advantage in formulating concentrate rations for dairy cows has not been well defined. The amount used is often limited to no more than one-fourth of the concentrate mixture because of concern about an adverse effect on palatability or reduced animal performance. Pelleting has proved beneficial in alleviating the problem of lowered palatability of mixtures containing a high proportion of mids; however, few trials have compared the effect of different levels of mids on milk yield. Van Horn (1982) fed cows rations in which wheat mids comprised up to 45 % of the concentrate (25 % of the total diet) without an adverse effect on milk yields, feed intake or milk fat test. In an experiment designed to determine the effect of pH on ammonia trapping, Kertz et al. (1983) fed dairy cows a concentrate mixture containing 60 % wheat mids and observed no significant effects on feed intake in comparison to mixtures containing 51 % or 36 % mids, respectively. In a previous experiment at this station (Acedo, 1984), inclusion of up to 40 % mids in the concentrate mixture tended to reduce milk yield of cows with no effect on feed intake.

This experiment was conducted to determine the effect of a relatively high proportion of wheat mids in the concentrate mixture on feed intake and milk yield of lactating dairy cows.

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Materials and Methods

Eighteen lactating Holstein cows were used in a feeding trial to compare concentrate mixtures containing (a) None (b) 40 % and (c) 60 % wheat mids. The total ration consisted of 60 % concentrates and 40 % alfalfa hay. The three concentrate mixtures were calculated to be isocaloric and isonitrogenous, with variation in crude fiber content minimized to the extent considered feasible (Table 1). To accomplish this, each added pound of mids substituted for .15 lb corn, .64 lb sorghum grain and .21 lb of cottonseed meal. The wheat mids had 17.4 % protein and 13.1 % acid detergent fiber, on a dry basis. All the concentrate mixes were pelleted (3/8 inch pellets). Cows were fed concentrate and hay separately, with sufficient amounts provided to allow for a small amount of weighback by each cow.

Table 1. Composition and calculated analysis of concentrate mixtures.

Item	Control	40% Mids	60% Mids
Ingredients, % as fed			
Corn, ground	28.5	22.5	19.5
Sorghum grain, ground	43.0	17.5	5.0
Wheat middlings	--	40.0	60.0
Cottonseed meal	13.0	4.5	--
Molasses, liquid	6.0	6.0	6.0
Dicalcium phosphate	1.0	1.0	1.0
Salt	1.0	1.0	1.0
Sodium bicarbonate	1.0	1.0	1.0
Magnesium oxide	.5	.5	.5
Calculated analysis, as fed			
NE , Mcal/lb	.73	.73	.73
Total protein, %	15.2	15.2	15.2
Crude fiber, %	3.2	4.5	5.1
Soluble nitrogen, % of total N[a]	22.4	23.3	40.0

[a]Solubility in .15N NaCl.

A switchback design was used, with three 5-week periods. The cows were assigned to four blocks based on date of calving and then to treatment sequences. Milk yield was recorded at each milking and samples for fat test were taken at four consecutive milkings each week. A sample of hay and each of the concentrate mixes was taken weekly and analyzed for protein and dry matter. At the end of each period, samples were taken for determination of blood urea and ruminal ammonia concentrations at approximately 3 hours after concentrates were fed.

An "in situ" dacron bag nitrogen disappearance study was performed to provide additional information about utilization of protein in wheat mids. One cannulated Hereford cow was used for the experiment which consisted of two feeding periods. In the first, the cow was fed 60%

control concentrate and 40% alfalfa hay for a 10-day adaptation period followed by a 3-day incubation period. In the second feeding period, the cow was fed in the same manner, but the control concentrate was substituted by wheat middlings. The cow was fed three times daily. Dacron bags (5 x 10 cm) with a mesh size of 20 to 40 microns were used for the incubation of control concentrate and wheat middlings samples in both periods. Duplicate samples of each feed were incubated for 4, 8, 12, 24, and 72 hr.

Results and Discussion

Milk yields of cows fed rations containing wheat middlings were lower than those of cows fed the control concentrate (Table 2). Although the yield of cows fed the concentrate containing 40 % mids did not differ greatly from the control, there was a significant ($P<.05$) quadratic trend for reduction in milk production as the percentage of mids was increased in the concentrate. The reduction in milk yield was particularly pronounced for cows fed the mixture containing 60 % mids. Similarly, Waldern and Cedeno (1970) observed that cows fed a concentrate mix containing a high proportion of wheat mixed feed produced significantly less milk than cows fed a control concentrate. Considering both the present trial and others in which cows were fed concentrate mixtures containing up to 40 or 45 % mids (Acedo, 1984; Van Horn, 1982), it was concluded that no appreciable decline in milk yield should be expected from use of wheat mids in the ration unless the percentage exceeds around 40 % of the concentrate. Use of as much as 60 % mids to replace high energy feed grains and an oilmeal supplement to some extent may indeed result in lower milk yield than could otherwise be expected. On the other hand, use of mids to replace lower energy ingredients would not be expected to have the same effect.

Table 2. Responses of cows fed experimental rations.

Item	Control	40% Mids	60% Mids
Feed intake, lb/day			
Concentrate DM	26.8	27.7	27.1
Hay DM	17.6	18.0	17.2
Total DM	44.4	45.7	44.3
Total protein	8.1	8.3	7.9
Milk Yield			
Milk Yield, lb/day[a]	57.6	56.9	54.6
Fat test, %	3.6	3.7	3.7
FCM, lb/day	54.3	54.2	52.3
Rumen ammonia, mg/dl	8.2	8.3	8.5
Blood urea, mg/dl	22.7	21.0	21.8

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

Dry matter intake was similar for all treatment groups (Table 2), which indicated no problem with acceptability of a pelleted concentrate mixture containing as much as 60 % mids. This was in agreement with results of other studies in which mixtures with a similar percentage of mids were fed to dairy cows. Thus, it appears that intake of pelleted mixtures with a high percentage of mids is not a factor that need limit the use of this ingredient in dairy rations.

Blood urea and ruminal ammonia concentrations at 3 hours after feeding concentrates were similar for all treatment groups (Table 2). Thus, the trend for higher concentrations of these with increasing levels of mids observed in a previous trial (Acedo, 1984) was not evident in this trial. The difference in results in the two trials can be attributed partly to the fact that cows in the present trial received dietary protein more in excess of requirements than did those in the previous trial (i.e., 136 to 139% vs. 123 to 126% of requirements). In this trial, efficiency of protein utilization did not appear to be a factor limiting the value of the rations for milk production.

Solubility of nitrogen in wheat middlings has been observed to be greater than that of some other feedstuffs. However, the values for solubility of nitrogen in an NaCl solution did not differ greatly for the control and the 40% mids concentrate mix, whereas that for the 60% wheat mids concentrate was considerably higher (Table 1). In the dacron bag trials, the incubation time of 72 hr was considered too long to be meaningful in regard to degradation of wheat middlings by rumen bacteria in dairy cows. Therefore, the rate of degradation was calculated for the 4 to 24 hr period. Nitrogen disappearance rate for protein in wheat middlings was higher than that in concentrate when the cow was fed wheat middlings; however, when the cow was fed control concentrate, disappearance of nitrogen from the concentrate was more rapid (Table 3).

Table 3. Dry matter and nitrogen disappearance rates.

	Dry matter disappearance				Nitrogen disappearance			
	Conc. fed		Mids fed		Conc. fed		Mids fed	
Time[a]	CC	Mids	CC	Mids	CC	Mids	CC	Mids
72	92.4	89.2	97.2	89.9	--	95.8	--	96.0
24	91.7	70.8	81.5	70.3	83.7	91.8	63.8	74.4
12	63.2	70.5	57.9	58.1	53.8	88.5	40.7	51.1
8	61.2	67.7	53.4	52.0	48.9	87.4	40.8	43.6
4	51.2	64.8	37.6	36.1	43.3	79.0	27.7	26.0
Rate[b]	9.07	.85	6.09	3.59	6.49	4.13	3.35	5.20

[a] Incubation time in hours
[b] Rate of disappearance, % N or DM/hr, 4 to 24 hr of incubation.

The time needed for the disappearance of one-half of the original amount of nitrogen in the substrate was less for wheat middlings than that for the control concentrate. Thus, there was some evidence that rate of degradation of protein in wheat mids was more rapid than that in a control concentrate containing typical ingredients; however, inconsistency of the results provides little basis to account for the difference in performance of cows fed rations containing different amounts of mids.

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