EFFECT OF YEAST CULTURE ON INTAKE AND PRODUCTION OF DAIRY COWS FED HIGH WHEAT RATIONS

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Story in Brief

The effect of supplementing rations with yeast culture on milk yield and feed intake was evaluated using 24 Holstein cows. Treatments were: (a) control corn mixture, (b) control plus 3 lb yeast culture/ton, (c) wheat mixture (60% wheat), and (d) wheat mixture plus yeast culture. Concentrate mixtures were calculated to be isonitrogenous and approximately equal in energy content. Concentrates and alfalfa hay (50:50) were each fed separately in individual stanchions twice each day at about 12-hour intervals. Dry matter intake by cows fed the corn mixtures was higher than that of cows fed the wheat mixtures (52.6 and 52.0 vs. 48.0 and 47.2 lb). Milk yield was higher for cows fed the corn rations than for those fed wheat (70.5 and 68.6 vs. 67.1 and 66.9 lb). Dry matter intake and milk yield were unaffected by the addition of yeast culture under the condition of this trial. Ruminal pH was higher and digestibility of dry matter and protein was lower in cows fed corn than in those fed wheat. Milk protein, ruminal NH_3-N and blood urea-N were not affected by treatment.

Introduction

In many areas of the U.S., wheat is competitive in price with other feed grains used as an energy source in dairy rations. However, the extent to which wheat can replace other feed grains in concentrate mixtures for dairy cows appears to be limited because of reduced feed intake and milk yield when large amounts of wheat are used.

In work by McPherson and Waldern (1969), feed intake and milk yield were similar for cows fed rations wherein Gaines soft white wheat replaced barley in concentrate mixtures up to 93% of the mixture. In contrast, Cunningham et al. (1970) observed that milk yield was significantly lower when soft red winter wheat replaced corn to the extent of 66.7% than when it comprised only 33.3% of a concentrate mixture.

In recent work at the Oklahoma station (Faldet et al., 1986), cows were fed concentrate mixtures containing 0, 40, 60 and 80% hard red winter wheat replacing corn and some protein supplement so that protein content was held constant.

Intake of both concentrate and hay was lower when cows were fed the rations containing wheat. Milk yield declined as the amount of wheat in the concentrate increased (66.9, 65.5, 65.1 and 63.7 lb/cow/day for cows fed mixes with 0, 40, 60 and 80% wheat).

Very little research on supplementing rations of ruminants with yeast cultures has been reported during the last two decades, although many nutritionists recommend their inclusion in rations for high producing dairy cows (McCullough, 1986). Rumen studies suggest that the inclusion of yeast cultures in diets for cattle enhance the number

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of cellulolytic bacteria and increase the digestibility of cellulose and the synthesis of microbial protein (Huber, 1987). In one recent report (Gomez-Alarcon et al., 1987) adding yeast to diets for dairy cows at a rate of 3g/d increased milk production and feed intake was noted. Arambel and Tung (1987), after having supplemented Holstein Heifer diets with yeast, found that cellulolytic bacteria numbers in the rumen and digestibilities of DM, protein and hemicellulose were increased.

Sniffen (1986) suggested that yeast products could provide the necessary amino acids to provide adequate isoacids for bacterial growth and action; however, no evidence for this was presented. Phillips and Von Tungeln (1985) found that the addition of yeast culture to the poststress diet of feeder calves did not increase either dry matter intake nor poststress performance. On the other hand, Fallon and Harte (1987) observed that DM intake and live weight of calves were increased when a barley/soya diet including yeast culture was given to calves.

Lassiter et al. (1958) reported that addition of live yeast culture at the rate of 1% of a grain ration had no significant effect on production of 4% fat-corrected milk, fat test or feed intake by dairy cows. Digestibility of crude protein and ether extract were significantly reduced upon inclusion of yeast in the ration and cows fed yeast gained less weight than those receiving a control ration. Similarly, Jordan and Ward (1959) found that a live yeast culture added at 2% of the grain mixture had no significant effect on milk production or fat test of Holstein cows.

Harris and Lobo (1987) in a study conducted with 2 groups of mid-lactation Holstein cows supplemented with 40 g of yeast culture/cow, found no significant differences on milk yield, fat, protein and FCM for cows starting and completing the 90 day study. Since groups were maintained at about 150 cows/group, some cows were removed each month and results showed a significant increase in milk fat, FCM and decrease in milk protein for cows entering the groups during the experiment.

Factors likely contributing to the variability in responses obtained to feeding live-cell yeast to ruminant animals include level of feed intake, number and kind of organisms in the yeast culture, viability of the cultures, and specific ingredient combinations comprising the rations. There is a need for information concerning responses that can be obtained from feeding yeast cultures currently available in the feed trade using ration combinations typical of those used in the livestock industry.

This research was conducted to explore the possibility that the addition of yeast culture to the concentrate mixture might impact the microbial action in the rumen of cows in a favorable manner that would be reflected in improved performance by cows when large amounts of wheat are fed.

Materials and Methods

The responses of lactating dairy cows to rations with and without yeast culture were measured in a well-controlled feeding trial. The experimental rations were: (1) typical corn-base concentrate mixture, (2) corn-base mixture plus yeast culture (YEA-SACC[4]), (3) high-wheat concentrate mixture, and (4) high-wheat mixture plus YEA-SACC. These

[4]Product of Alltech Biotechnology Center, Nicholasville, KY.

concentrate mixtures constituted 50% of the total ration and alfalfa hay was the only forage (Table 1).

Twenty-four Holstein cows received the experimental rations in sequences of a switchback design with three 4-week periods. The first two weeks of each period were allowed for adjustment to rations with data from the final two weeks used for comparisons among treatments. The concentrate mixes were fed in individual stanchions in two equal portions twice daily at approximately 12-hour intervals. Alfalfa hay was fed in individual stalls once each day with an opportunity provided for the cows to consume hay during a second period approximately 12 hours later. The hay was fed approximately 4 hours after feeding of the concentrate mixtures. Samples of both concentrate mixes and hay were taken weekly for analysis.

Milk yield was recorded twice daily and samples were taken at four consecutive milkings each week for determination of fat and protein content. During the last week of each period, a rumen fluid sample (approximately 250 ml) was taken from each cow by stomach tube at 3 to 4 hours after concentrate feeding. The pH of the sample was determined immediately and an appropriate amount of sample was processed for later analysis for ruminal VFA and NH^3-N. Also, a sample of blood was obtained from the median caudal vein for determination of blood plasma urea-nitrogen concentration.

During the second period of the trial, chromium sesquioxide (Cr_2O_3) was mixed with the concentrate mixes for 20 cows at a concentration of .27% for use as an indigestible marker to permit calculation of apparent

Table 1. Composition of concentrate mixtures.

Item	Control (Corn-Base)	Yeast (Corn-Base)	Control (Wheat-Base)	Yeast (Wheat-Base)
Ingredients (%, as fed)				
Corn[1]	65	65	18	18
Wheat[1]	--	--	60	60
Sorghum grain	6	6	--	--
Cottonseed meal, solv. ext.	9.5	9.5	2.5	2.5
Fixed portion[2]	19.5	19.5	19.5	19.5
Yeast culture(YEA-SACC)[3]	-	+	-	+
Calculated analysis (as fed)				
Net energy, Mcal NE /100 lb	75.6	75.6	76.7	76.7
Total protein, %	12.0	12.0	12.0	12.0
Rumen undegradable protein, %	5.8	5.8	3.3	3.3
Crude fiber, %	7.9	7.9	7.7	7.7

[1]Hard red winter wheat, No.2 grade.
[2]Fixed portion of concentrate mix: soybean hulls 15, dicalcium phosphate 2.0, salt .75, sodium bicarbonate 1.25, and magnesium oxide .5%.
[3]Product produced by ALLTECH, Nicholasville, KY; included in mix at level of 3 lb/ton.

digestibility of different nutrient components. Following a preliminary period of 10 days, fecal "grab" samples were collected at 4-hour intervals for a period of four days. Concentrate mixes, orts and feces were analyzed for chromium and these plus the hay were analyzed for dry matter, total protein and neutral detergent fiber.

Results and Discussion

The coefficient of variability for most variables measured was quite low (e.g., 3.4% for milk yield and 5.8% for total dry matter intake), indicating a high level of consistency in the responses of cows in the trial. Intake of dry matter by cows fed the concentrate mixtures containing wheat was lower ($P<.001$) than that of cows fed mixtures containing corn as the principal energy source. Intake of both concentrate and alfalfa hay were affected by grain type, indicating that factors other than palatability of the concentrate mixtures were involved (Table 2). Total protein content of all the rations was calculated to be the same; therefore, the larger amount of protein intake by cows fed rations containing corn simply reflected greater feed intake by those cows, especially with regard to protein derived from the forage component.

As previously observed in other trials, milk yield of cows fed concentrate mixtures containing corn was higher than that of cows fed mixtures containing 60% wheat (69.5 vs 67.0 lb/day). Milk fat test of cows fed the corn mixtures was also increased ($P<.01$), resulting in an advantage in 4% fat-corrected milk yield of 4.5 lb/day in comparison to that of cows fed the wheat mixtures. Neither yield nor fat content was

Table 2. Feed intake and milk yield of cows.

Item	Control (Corn-Base)	Yeast (Corn-Base)	Control (Wheat-Base)	Yeast (Wheat-Base)
Dry matter intake, lb/day				
Concentrate mix	26.6	26.2	24.6	23.9
Alfalfa hay	26.0	23.4	23.3	
Total	52.6	52.0	48.0	47.2
Protein intake, lb/day				
Concentrate mix	3.40	3.32	3.45	3.45
Alfalfa hay	5.43	5.40	4.94	4.89
Total	8.83	8.72	8.39	8.34
Milk yield				
Milk, lb/day	70.5	68.6	67.1	66.9
Fat test, %	3.36	3.48	3.17	3.22
FCM, lb/day	63.9	63.3	59.1	59.1
Protein, %	2.99	3.01	3.00	3.02
Gross feed efficiency (Milk/total DM intake)	1.35	1.33	1.41	1.43

affected by inclusion of yeast culture in the concentrate mixtures. Neither grain type nor addition of yeast culture affected milk protein content.

The molar percentage of acetic acid in the ruminal fluid at 3 to 4 hours after concentrate feeding was higher for cows fed the mixtures containing corn than for those fed mixtures with wheat (65.4 vs 60.9, Table 3). This was accompanied by a lower molar percentage of propionic acid in the rumen fluid of cows fed the corn mixtures compared to those fed wheat (21.9 vs 26.6) which was consistent with the observed differnce in milk fat content. No significant differences in VFA proportions were attributable to inclusion of yeast culture in the concentrate mixtures.

The pH of the ruminal fluid was higher in cows fed the corn mixtures than in those fed wheat (6.2 vs 5.9), which was consistent with the changes in VFA proportions noted above. These differences were consistent with other observations that both the protein and carbohydrate fractions of wheat are degraded very rapidly in the rumen of cows. Addition of yeast culture did not affect ruminal pH and neither grain type nor yeast culture had any effect on concentration of ruminal NH_3-N or blood plasma urea-N (Table 4).

Table 3. Effect of diets on molar proportion of ruminal VFA.

Acid	Control (Corn-Base)	Yeast (Corn-Base)	Control (Wheat-Base)	Yeast (Wheat-Base)
Acetic	65.61	65.10	60.94	60.88
Propionic	21.98	21.82	26.59	26.59
Isobutyric	.35	.45	.35	.33
Butyric	10.03	10.23	9.46	9.61
Isovaleric	1.02	1.22	.86	.86
Valeric	1.01	1.18	1.79	1.73

Table 4. Effect of diet on ruminal pH and NH_3-N concentration blood urea-N and total apparent digestibility of ration components

Item	Control (Corn-Base	Yeast (Corn-Base	Control (Wheat-Base	Yeast (Wheat-Base
Ruminal pH	6.18	6.27	5.86	6.01
Ruminal NH_3-N, mg/dl	4.6	5.2	4.5	5.0
Blood urea-N, mg/dl	12.4	12.3	12.0	12.9
Ration digestibility,%				
Dry matter	68.9	68.2	72.6	70.3
Total protein	65.4	64.5	71.2	69.8
Neutral-detergent fiber	58.4	58.4	63.6	58.3

Apparent digestibility of total dry matter and protein was lower for cows fed mixtures containing corn than for cows fed the wheat mixtures (Table 4). Thus, it appeared likely that both the site of digestion and the extent of total digestion was different for the two types of grain.

Since the carbohydrate of grains is mainly starch, the lack of a difference in apparent digestibility of NDF due to type of grain was not unexpected. Addition of yeast culture to the concentrate mixtures did not result in an increase in apparent digestibility of any of the ration components measured under the conditions of this trial. The possibility exists that different results might be obtained under conditions where all components of the ration are fed together in a complete ration.

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