PERFORMANCE OF LACTATING DAIRY COWS FED YEAST AND FIBROLYTIC ENZYMES

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Summary

We evaluated the effect of supplementing typical dairy diets with yeast and fibrolytic enzymes on dairy cow performance. Twenty-four Holstein cows were used to evaluate the effects of yeast (Procreatin-7, a live culture of *Saccharomyces cerevisiae*) and various amounts of FP800 (a fibrolytic enzyme mixture) on lactation performance. Treatments were arranged in a 4 × 2 factorial design consisting of 8 treatments: 0, 5, 10, or 15 g of FP800 per day and 0 or 5 g of Procreatin-7 per day. Design and conduct of the experiment allowed at least 10 observations in each of the 8 treatment combinations. Within each 28-day period, the first 2 weeks were used for adaptation to treatment and the next 2 weeks were used for measuring feed intake and milk production. Diets were fed individually to each cow twice daily. The diet contained 22% ground corn, 20% corn silage, 20% wet corn gluten feed, 17% alfalfa, 8% whole cottonseed, and 8% expeller soybean meal. Dietary protein was 19% of dry matter. Treatments were top-dressed to the diets. Cows were milked twice daily. Dry matter intake averaged 64.6 lb/day, milk production averaged 96.8 lb/day, and efficiency of milk production averaged 1.50 lb milk/lb dry matter intake. Dry matter intake, milk production, milk efficiency, and production of all milk components were not changed by addition of either fibrolytic enzymes or yeast. Percentages of fat, protein, and solids-not-fat (SNF) in milk were also not affected by treatment. The results demonstrated no production responses to the addition of fibrolytic enzymes or yeast to the diets of lactating cows under our experimental conditions.

(Key Words: Yeast, Milk Yield, Fibrolytic Enzymes.)

Introduction

A number of experiments have evaluated the effectiveness of live yeast (*Saccharomyces cerevisiae*) cultures on performance of dairy cows. Many of these studies have evaluated performance under conditions of stress to the animal, with the assumption that yeast will reduce some of the digestive disturbances related to variations in feed intake associated with the stressful environment (diet transition or heat stress). Under these conditions, positive responses to yeast cultures have been observed. Applicability of yeast products to a greater segment of the industry, however, has not been as extensively studied.

In a series of experiments at Kansas State University, we have studied in vitro the effects of a number of fibrolytic enzyme mixtures. Among these enzymes, an enzyme mixture containing increased cellulase activity was found to be efficacious in improving in vitro dry matter disappearance of fibrous dairy feeds such as alfalfa, corn silage, corn gluten feed, and soybean hulls. We also observed that responses could be obtained with relatively small amounts of supplementation.

The objective of this study was to evaluate the effects of supplementing typical dairy diets with yeast (live culture of *Saccharomyces* *cerevisiae*) and fibrolytic enzymes on milk yield.

Experimental Procedures

Twenty-four Holstein cows were maintained in tie-stalls and used to evaluate the effects of yeast (Procreatin-7, a live culture of *Saccharomyces cerevisiae* produced by Saf Agri, Milwaukee, WI) and various amounts of FP800 (a fibrolytic enzyme mixture produced by Saf Agri) on lactation performance. The cows studied were typical of cows in the dairy industry. They averaged 106 days in milk at the start of the experiment (range: 59 to 239). All cows were treated with bST (Posilac) on the first day of the experiment and biweekly afterward.

The treatments were arranged in a 4 × 2 factorial consisting of 8 treatments: 0, 5, 10, or 15 g of FP800 per day and 0 or 5 g of Procreatin-7 per day. Each of the 8 treatment combinations was designed to be replicated 12 times over four 28-day periods. Due to issues with animal health, however, data were collected from only 21 of the 24 cows.

Within each 28-day period, the first 2 weeks were used for adaptation to treatment and the next 2 weeks were used for measuring feed intake and milk production. Diets were fed individually twice daily to allow for 5 to 10% orts. The diet contained 22% ground corn, 20% corn silage, 20% wet corn gluten feed, 17% alfalfa, 8% whole cottonseed, and 8% expeller soybean meal. Dietary treatments were weighed individually and top-dressed by hand mixing them at each feeding into the top third of the ration within each cow's feed bunk.

Cows were milked twice daily, and milk weights were recorded at each milking. Milk samples were collected weekly (a.m./p.m. composite) and analyzed for lactose, fat, protein, milk urea nitrogen (MUN), and somatic cell count (SCC) by the Heart of America DHI Laboratory, Manhattan, Kansas. Component yields were calculated by multiplying average daily milk weights by the weekly values for milk composition. Cows were weighed and scored for body condition (1 = thin and 5 = fat) at the beginning of the experiment and at the end of each 28-day period.

Samples of feed ingredients were combined by period for analysis. Wet feed stuffs were monitored at least weekly to determine moisture content, and the diet was altered to account for changes in water content. Orts were weighed once daily for calculation of feed intakes. Feed ingredients were analyzed for dry matter, ash, crude protein, neutral detergent fiber (NDF), and acid detergent fiber (ADF).

Results and Discussion

The nutrient composition of the diet (Table 1) was determined by laboratory analysis of individual ingredients. The diet is typical of dairy diets fed in the Midwest. Composition of ingredients was typical of expectations for these feedstuffs. Dietary protein was 19% of dry matter, so protein supplied in the diet should not have limited production by the cows.

Dry matter intake averaged 64.6 lb/day, which is typical for cows maintained under our experimental conditions. Average milk production (96.8 lb/day) and efficiency of milk production (1.50 lb milk/lb dry matter intake) in this experiment were also typical of production levels observed in our herd.

Dry matter intake, milk production, milk efficiency, and production of all milk components were not impacted by the addition of either fibrolytic enzymes or yeast (Table 2). Percentages of fat, protein, and solids-not-fat (SNF) in milk were also not affected by treatment. We were surprised to find that an interaction between yeast and quadratic effect of enzyme amount altered percentages of milk lactose and SCC. The effect on milk lactose is unusual because lactose secretion drives milk secretion such that its concentration is typically very constant. The effect on SCC can be attributed to a few large SCC values that skewed the results in several treatments.

Table 1. Diet Composition

Ingredient	% of Dry matter
Corn, ground	21.8
Corn silage	20.2
Wet corn gluten feed (Sweet Bran 60)	20.2
Alfalfa	16.8
Whole cottonseed	8.4
Expeller soybean meal (Soybest)	7.6
Limestone	1.34
Fishmeal	1.25
Molasses	0.94
Sodium bicarbonate	0.79
Trace mineral salt[1]	0.33
Magnesium oxide	0.20
Vitamin ADE premix[2]	0.10
Trace mineral premix (Zinpro 4-plex)[3]	0.05
Vitamin E premix[4]	0.02
Sodium selenite premix[5]	0.01
Nutrient	
Organic matter	92.2
Crude protein	19.0
Neutral detergent fiber	29.3
Acid detergent fiber	16.1
Ether extract	4.9

[1]Provided in diet dry matter: 0.32% NaCl, 7.9 ppm Mn, 7.9 ppm Fe, 1.6 ppm Mg, 1.1 ppm Cu, 1.1 ppm Zn, 0.23 ppm I, and 0.13 ppm Co.
[2]Provided per lb diet dry matter: 2,000 IU vitamin A, 1,000 IU vitamin D, and 6 IU vitamin E.
[3]Provided in diet dry matter: 13 ppm Zn from zinc methionine, 7 ppm Mn from manganese methionine, 4.4 ppm Cu from copper lysine, and 0.9 ppm Co from cobalt glucoheptonate.
[4]Provided 3 IU vitamin E per lb diet dry matter.
[5]Provided 0.06 ppm Se in diet dry matter.

Amounts of FP800 fed produced a quadratic change in body weight during each 28-day period. Weight gain was less for cows receiving the intermediate amounts of enzyme (5 and 10 g/day) than for those fed either no enzyme or the largest amount of enzyme (Table 3). Although the effect on efficiency of milk production was not significant, changes in body weight mirrored changes in milk efficiency, suggesting that the slight differences in body weight might be due to repartitioning of energy between milk and body reserves for cows receiving different amounts of enzymes. This relationship demonstrates that the body-weight response to treatment was probably not due to depressions in energy release from the diet for the intermediate enzyme amounts. Changes in body condition did not differ among treatments.

Taken as a whole, the results indicate that no production responses occurred in response to addition of fibrolytic enzymes or yeast to the diets of lactating cows under our experimental conditions. The experiment was conducted from December 3, 2003, through March 24, 2004, so cows were not exposed to any environmental temperature stress during the experiment. Cows were maintained in tie-stalls, and conditions were likely not stressful for the cows. In addition, all cows were at least 59 days in milk, suggesting that stress related to the transition into lactation was limited. Yeast supplementation has been demonstrated to be beneficial to cows maintained under stressful conditions, and our lack of response to yeast supplementation should not be extrapolated to cows maintained under stressful environments.

Responses to enzyme supplementation should be most clearly demonstrated under the minimally stressful conditions of our experiment in which cows could easily respond to changes in energy availability from the diet. It is possible that smaller amounts of the enzyme mixture may have been beneficial. In some previous experiments, responses to enzymes have been reported at smaller enzyme amounts, with greater amounts of enzymes being unable to yield the same benefits. In our in vitro studies with FP800, we observed that in vitro digestibility was dependent upon the enzyme amounts. In one in vitro study, amounts of FP800 calculated to mimic 1 or 5 g/day fed to a lactating dairy cow yielded a response that was greater than could be achieved with amounts of 15 or 30 g/day. In another in vitro study, responses to FP800 were positive and essentially the same for amounts ranging from 0.3 to 5 g/day. It is unknown if smaller amounts of FP800 would lead to production responses, but this possibility cannot be excluded from our data because amounts of enzyme less than 5 g/day were not tested.

Table 2. Performance of Lactating Dairy Cows Fed Combinations of Yeast and Fibrolytic Enzymes

	No yeast				5 g/day yeast				
	Enzyme, g/day								
Item	0	5	10	15	0	5	10	15	SEM
Cows, no.	10	10	10	12	10	10	10	12	
	lb/day								
DMI	65.7	64.5	63.6	65.2	64.9	63.4	63.9	64.8	0.80
Milk	97.0	97.6	95.6	97.1	97.4	96.9	96.0	96.2	1.6
Milk fat	3.41	3.52	3.32	3.32	3.40	3.40	3.41	3.42	0.093
Milk protein	3.04	3.05	2.95	3.04	3.01	3.03	2.98	3.03	0.059
Milk lactose	4.64	4.81	4.68	4.74	4.78	4.67	4.67	4.67	0.084
Milk SNF	8.57	8.79	8.53	8.69	8.71	8.60	8.55	8.60	0.15
Milk/DMI	1.48	1.52	1.50	1.49	1.50	1.53	1.50	1.49	0.018
	%								
Milk fat	3.54	3.62	3.48	3.43	3.51	3.52	3.57	3.57	0.094
Milk protein	3.14	3.14	3.10	3.14	3.10	3.14	3.13	3.16	0.032
Milk lactose*	4.79	4.92	4.89	4.88	4.91	4.81	4.86	4.85	0.034
Milk SNF	8.85	9.02	8.94	8.96	8.94	8.88	8.92	8.95	0.054
MUN, mg/dL	16.4	16.7	16.7	16.6	17.0	16.7	16.9	16.9	0.37
SCC*, × 1000	687	48	269	292	78	127	719	293	246

*Interaction (*P*<0.05) between yeast and quadratic effect of enzyme amount.

Table 3. Body Weights (BW) and Body Condition Scores (BCS) and Their Changes in Lactating Dairy Cows Fed Combinations of Yeast and Fibrolytic Enzymes

	No yeast				5 g/day yeast				
	Enzyme, g/day								
Item	0	5	10	15	0	5	10	15	SEM
	lb								
Initial BW	1342	1364	1371	1355	1349	1354	1367	1342	9.9
BW change*	25	3	-7	10	15	7	2	23	9.5
	units								
Initial BCS	2.37	2.62	2.62	2.61	2.50	2.64	2.73	2.59	0.097
BCS change	0.23	-0.04	0.26	0.21	0.05	-0.12	0.05	0.17	0.14

*Quadratic ($P < 0.05$) effect of enzyme amount.