



Effect of Dietary Yeast Culture on Milk Yield, Composition, and Component Yields at Commercial Dairies

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Abstract

A field trial was conducted to evaluate the effect of dietary yeast culture on milk yield, composition, and component yields at 11 commercial dairies in Wisconsin. Rolling herd averages ranged from 10,000 to 12,800 kg per cow. Yeast culture was added to total mixed rations to allow an average daily intake of 57 g over two 30-d Dairy Herd Improvement (DHI) test periods. Production data from the 30-d DHI test periods immediately before and after the yeast culture feeding period were used as the control. There were 585 cows (245 primiparous and 340 multiparous) that completed the four 30-d period feeding sequence (OFF-ON-ON-OFF). Average days in milk were similar for the yeast and control feeding periods (140.0 vs 140.5, respectively). Dietary yeast culture increased ($P < 0.001$) actual and 150 d adjusted milk yields 0.90 kg/d. Milk fat content was lower ($P < 0.001$) for cows fed yeast culture (3.55 vs 3.65%), but milk fat yield was similar. Dietary yeast culture reduced ($P < 0.05$) milk protein content 0.02 percentage units, but protein yield was higher ($P < 0.01$) for cows fed yeast culture (1.17 vs 1.14 kg/

d). The milk yield response was positive in 8 of 11 herds (herd by treatment interaction; $P < 0.001$). These data indicate that under the conditions of this study the addition of yeast culture to total mixed rations for mid lactation dairy cows in high producing commercial herds increases milk and protein yield.

(Key Words: Dairy Cattle, Milk Production, Milk Composition, Yeast Culture.)

Introduction

Dietary yeast culture is a common feed additive used by commercial dairies. Jordan and Fourdraine (12) reported that 50.8% of dairy managers responding to a survey of high producing dairy herds used a yeast product. This was relative to the use of sodium bicarbonate and niacin in 75.4 and 37.7% of these herds.

Researchers have reported that dietary yeast culture increased percentage ruminal cellulolytic (8, 18) and proteolytic (19) bacteria and apparent total tract hemicellulose digestibility (18), but the digestibility response has not been consistent (8, 13, 19).

Published intake and lactation responses to dietary yeast culture were reviewed (1, 2, 3, 5, 6, 7, 9, 13).

Dietary yeast culture did not improve dry matter intake. Numerical milk production increases to dietary yeast culture were observed in four trials (2, 5, 6, 9), but were not significant ($P > 0.10$). Dietary yeast culture increased milk fat content numerically in five trials (1, 3, 5, 6, 7), but significant increases ($P < 0.05$) were observed in only two trials (5, 6). Dietary yeast culture increased milk protein content numerically in three trials (3, 6, 7) and reduced it numerically in five trials (1, 2, 5, 9, 13), but these responses were significant ($P < 0.05$) in only three trials (5, 6, 13).

It is generally recommended that dietary yeast culture be targeted to early lactation cows (11, 15). However, targeting dietary yeast culture only to early lactation cows is often difficult in high producing herds in which the feeding of one-group total mixed rations (TMR) is common (10). The objective of this study was to determine lactation responses of mid lactation cows to dietary yeast culture on high producing commercial dairies feeding one-group TMR.

Materials and Methods

Eleven high producing commercial Wisconsin dairies feeding one-group TMR were used in the field study. The 11 herds contained 1,500

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Reviewed by G. Hartnell and C. Coppock.

Holstein cows on Dairy Herd Improvement (DHI) test, and rolling herd averages ranged from 10,000 to 12,800 kg per cow.

Herds were located in northeastern ($n = 4$), central ($n = 3$), southeastern ($n = 2$), northern ($n = 1$), and northwestern ($n = 1$) Wisconsin. Herd rations were formulated by feed company nutritionists ($n = 6$), veterinarian ($n = 2$), and private consultants ($n = 3$). Eight different nutritionists were involved in the study; three with 2 herds and five with 1 herd. Yeast products were not being used in any of the herds prior to trial initiation.

Yeast culture (XP[®], Diamond V Mills Inc., Cedar Rapids, IA), a product of yeast (*Saccharomyces cerevisiae*) fermentation and not a source of viable yeast (IFN 7-05-520), was added to TMR to allow an average daily intake of 57 g over two 30-d DHI test periods. Yeast culture was either preweighed and handmixed with mineral ingredients before adding to TMR or added to TMR through a custom mineral-vitamin mix.

Production data from the 30-d DHI test periods immediately before and after the yeast culture feeding period was used as the control. There were 585 cows (245 primiparous and 340 multiparous) that completed the four 30-d period feeding sequence (OFF-ON-ON-OFF). The trial was initiated in December, 1992 and ended with the March, 1993 DHI test. This time period was selected because it allowed sufficient time for silage preservation and silo feedout in the fall, because forage type and quality are usually more consistent than other times of the year, and because this time period allowed for trial completion before summer heat stress. Feed ingredients used in TMR and the formulated nutrient densities of TMR were not changed over the 4-mo trial. The proportions of specific ingredients in TMR changed to accommodate changes in forage quality over the 4-mo trial.

Milk production was recorded by the DHI technician during each

monthly test. Milk samples from each monthly test were analyzed for fat, protein, and somatic cell count by infrared analysis (Wisconsin DHI Laboratory, Appleton, WI). Data for cows that were more than 200 d in milk (DIM) at the first OFF period test were not included in the analyses to eliminate partial records from cows that dried off during the trial. Data for cows that were less than 60 DIM at the first OFF period test were not included in the analyses to remove potential bias of cows in the ascending portion of their lactation curve on the production response. Data were analyzed using the General Linear Models procedure of SAS[®] (17). The economics of using or not using yeast culture was evaluated using our production data and the Type I/Type II error method described by Galligan et al. (4).

Forages were sampled monthly, and analyzed by wet chemistry at commercial testing laboratories for DM, CP, ADF, and NDF. Forage TDN was estimated from the equation $88.9 - 0.779 \times \text{ADF}$ (16), and NE_1 was calculated from TDN according to NRC (14). Nutrient densities of TMR were calculated monthly from forage analyses and using NRC (14) feedstuff composition tables for concentrates. Undegraded intake protein (UIP) concentrations of TMR were calculated using NRC (14) UIP values for feedstuffs. Feedstuff nonfiber carbohydrate concentrations were calculated as $100 - (\text{NDF} + \text{CP} + \text{Fat} + \text{Ash})$.

Results and Discussion

Nutrient densities of control and yeast culture diets are presented in Table 1. Average nutrient concentrations of diets exceeded NRC (14) recommendations, but are typical of high producing commercial dairies in Wisconsin (10). Calculated TMR nutrient densities were similar for control and yeast culture feeding periods. There was no apparent relationship between TMR nutrient densities in a specific herd and the lactation response to yeast culture in that herd.

A summary of feed ingredients used in control and yeast culture diets is presented in Table 2. Alfalfa silage was fed in all herds, and comprised about two-thirds of the forage dry matter on average. In the five herds that consumed dry hay, only 2.0 to 2.5 kg/d was fed per cow. High-moisture corn was provided to all herds. Whole oilseeds and animal proteins were common ingredients. Sodium bicarbonate, magnesium oxide, and zinc methionine were common feed additives. There was no apparent relationship between feed ingredients used in a specific herd and the lactation response to yeast culture in that herd.

Milk yield, composition, and component yield responses to dietary yeast culture are presented in Table 3. Days in milk were similar for the control and yeast feeding periods, averaging 140.0 and 140.5 DIM, respectively (data not presented in table). Dietary yeast culture increased ($P < 0.001$) actual and 150-d adjusted milk yields 0.90 kg/d. Positive milk production responses to dietary yeast culture have been reported (2, 5, 6, 9). Milk fat content was lower ($P < 0.001$) for cows fed yeast culture (3.55 vs 3.65%). Kim et al. (13) reported a 0.15% unit reduction ($P < 0.05$) in milk fat content for cows fed yeast culture. The reason for reduced milk fat content for cows fed yeast culture is not clear, as dietary yeast culture was not shown to increase ruminal volatile fatty acid concentration or molar percentage propionate or decrease ruminal pH (19). Fat and 4% fat-corrected milk yields were similar for control cows and cows fed yeast culture. Dietary yeast culture reduced ($P < 0.05$) milk protein content 0.02 percentage units, but protein yield was higher ($P < 0.01$) for cows fed yeast culture (1.17 vs 1.14 kg/d). Reduced milk protein percentage was apparent for mature cows (3.11 vs 3.08% for control and yeast culture, respectively; data not presented), but not first lactation heifers (parity \times treatment interaction; $P < 0.05$). The explanation for the slight reduction

TABLE 1. Calculated nutrient densities of control and yeast culture diets.

Nutrient	Control	Yeast culture
		(% DM)
DM	60.0 (50 to 69)	61.0 (49 to 67)
CP	18.8 (17.5 to 19.5)	18.8 (17.5 to 19.5)
UIP ^a	7.0 (6.1 to 7.7)	7.0 (6.1 to 7.6)
Fat	5.9 (5.0 to 6.9)	5.8 (4.5 to 7.0)
TDN ^b	78 (76 to 79)	78 (75 to 79)
ADF	18.7 (17.0 to 20.2)	18.4 (16.8 to 20.0)
NDF	28.5 (25.1 to 34.0)	27.8 (24.3 to 30.0)
NFC ^c	38.0 (32.5 to 43.0)	38.9 (35.0 to 43.6)

^aUndegraded intake protein calculated from NRC (1989).

^bCalculated from commercial forage analyses and NRC (1989).

^cNonfiber carbohydrate calculated as 100 – (NDF + CP + Fat + Ash).

in milk protein content for cows fed yeast culture is not clear, but could be related to the dilution effect of higher milk production. Somatic cell count averaged 226,000 and 215,000 for control cows and cows fed yeast culture, respectively (data not presented).

Data for milk production and milk fat and protein content by farm are presented in Table 4. The 150-d milk yield response was positive in 8 of 11 herds (herd × treatment interaction; $P < 0.001$) averaging 1.4 kg/d per cow. Responses in milk fat and protein content to dietary yeast culture were negative in 8 of 11 herds (herd × treatment interaction; $P < 0.001$ and 0.05, respectively).

Using the 0.90 kg/d increase in milk yield and 0.10% unit reduction in milk fat content, \$0.05/d per cow additive cost, and a milk price of

\$0.26/kg (butterfat differential of \$0.132 per tenth), the net return from feeding dietary yeast culture was \$0.13/d per cow. This assumes that the extra milk produced comes from improved ration digestibility rather than higher feed intake. Dietary yeast culture has been shown to improve apparent total tract fiber (13, 18) and OM (19) digestibilities.

The economics of using or not using yeast culture was evaluated using our production data, the above additive cost and milk price, and the Type I/Type II error method of Galligan et al. (4). The milk production response needed to break-even was 0.23 kg/d per cow. The response was above the break-even point 73% of the time. The cost of using yeast culture when the response is below the break-even point is \$0.05/d per cow. The cost of not using yeast culture when the response is above the break-even point is \$0.17/d per cow. This analysis suggests that the least costly business decision error would be to use dietary yeast culture. In conclusion, under the conditions of this study, the addition of yeast culture to TMR for mid lactation dairy cows in high producing commercial herds increased milk and protein yield and its use was profitable.

TABLE 2. Summary of feed ingredients used in control and yeast culture diets.

Feed ingredients	No. of farms
Alfalfa silage	11
Corn silage	8
Hay	5
Concentrates	
High-moisture corn	11
Whole cottonseed	10
Roasted soybeans	8
Soybean meal	10
Animal proteins	10
Tallow	6
Additives	
Sodium bicarbonate	9
Magnesium oxide	10
Zinc methionine	6
Niacin	2
Sodium bentonite	1
Chlortetracycline	1

TABLE 3. Milk yield, composition and component yield responses to dietary yeast culture.

Item	Control	Yeast culture	SE	$P < ^a$
Milk, kg/d	36.7	37.6	0.2	F, P, T, FxT (0.001)
150-d milk, kg/d ^b	35.8	36.7	0.1	F, P, T, FxT (0.001)
4% FCM, kg/d	34.5	34.8	0.1	F, P (0.001)
Milk fat, %	3.65	3.55	0.02	F, P, T, FxT (0.001)
kg/d	1.32	1.31	0.01	F, P (0.001)
Milk protein, %	3.15	3.13	0.01	F, P (0.001), T, FxT, PxT (0.05)
kg/d	1.14	1.17	0.01	F, P, FxT (0.001), T (0.01)

^aF = farm; P = parity; T = treatment.

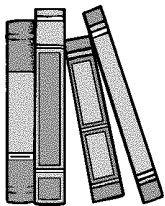
^bLactation = 1: 150-d milk = milk + milk [(DIM – 150) × 0.0019]. Lactation > 2: 150-d milk = milk + milk [(DIM – 150) × 0.0029].

TABLE 4. Milk yield and composition responses to dietary yeast culture by farm.

Farm	150-d Milk ^a		Milk fat ^b		Milk protein ^c	
	Control	Yeast culture	Control	Yeast culture	Control	Yeast culture
	(kg/d)				(%)	
1	34.6	36.0	3.67	3.55	3.20	3.15
2	38.7	37.8	3.59	3.65	3.30	3.26
3	33.0	32.1	3.85	3.74	3.18	3.21
4	36.3	37.7	3.68	3.70	3.26	3.16
5	39.1	40.9	3.86	3.83	2.99	3.05
6	38.6	40.9	3.66	3.66	3.18	3.20
7	30.9	32.2	3.51	3.29	3.11	3.09
8	34.6	35.6	3.63	3.67	3.06	3.03
9	33.0	33.3	3.63	3.38	3.20	3.19
10	37.9	39.3	3.69	3.54	3.11	3.10
11	34.2	33.4	3.60	3.41	3.14	3.07

^{a,b}Farm x treatment interaction ($P < 0.001$).

^cFarm x treatment interaction ($P < 0.05$).



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