EFFECT OF YEAST CULTURE ON INTAKE AND PRODUCTION OF DAIRY COWS FED CORN OR WHEAT BASED CONCENTRATE MIXTURES

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Story in Brief

The effect of supplementing corn or wheat based concentrate mixtures with yeast culture (*Saccharomyces cerevisiae*, YEA-SACC[4]) on feed intake and milk yield was evaluated using 24 Holstein cows. Treatments included feeding either corn or 60% wheat based concentrate mixtures, with or without added yeast culture. Yeast culture was added at the rate of 3.0 lb/ton of concentrate mixture to the two yeast containing treatments. Concentrate mixtures were calculated to be isonitrogenous and approximately equal in energy content. Alfalfa hay (50:50) and the concentrate mixture were each fed separately in individual stanchions twice each day at about 12 hour intervals. Dry matter intake by cows fed corn was higher (corn, 52.6; corn-yeast, 51.9 lb/day) than for cows fed wheat (wheat, 48.0; wheat-yeast 47.3 lb/day). Additionally, average milk yield was higher for cows fed corn than for cows fed wheat based concentrate mixtures (69.5 vs 67.0 lb/day) as was butterfat test (3.42 vs 3.19%) and fat corrected milk yield (63.6 vs 59.2 lb/day). Dry matter intake and milk yield were unaffected by the addition of yeast. Ruminal pH was higher (6.20 vs 5.94) in cows fed corn than in those fed wheat.

(Key Words: Corn, Wheat, Yeast, Milk Production, Dairy Cows.)

Introduction

In many areas of the United States, periodically wheat is competitively priced with other feed grains as a potential energy source for use in concentrate mixtures for dairy cows. In recent Oklahoma studies (Faldet et al., 1986), feed intake and milk yield were reduced, however, when cows were fed isonitrogenous concentrate mixtures in which hard red winter wheat

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replaced 0, 40, 60 or 80% of the corn and some protein supplement. Little research on supplementing ruminant rations with yeast cultures has been reported during the last two decades, although some nutritionists recommend the inclusion of yeast in rations for high producing dairy cows (McCullough, 1986). Therefore, this study was conducted to explore the effects of adding yeast culture to corn or wheat based concentrate mixtures on feed intake, milk production, ruminal fluid pH and volatile fatty acid (VFA) production in lactating dairy cows.

Materials and Methods

Twenty-four Holstein cows were allotted to four treatments: a) Control, consisting of a corn based concentrate mixture (C), b) C plus yeast (CY), c) 60% wheat-based concentrate mixture (W), and d) W plus yeast (WY). Yeast (YEA-SACC) was added at the rate of 3.0 lb/ton of grain mixture. Yeast levels were those suggested by the manufacturer. The concentrate mixtures and alfalfa hay were fed individually in a 50:50 ratio (Table 1). Cows were fed the experimental rations in a switchback design

Table 1. Composition of concentrate mixtures.

	Corn	Corn & yeast	Wheat	Wheat & yeast
Ingredients, % as fed				
Corn	65	65	18	18
Wheat[a]	--	--	60	60
Sorghum grain	6	6	--	--
Cottonseed meal, solv, ext.-	9.5	9.5	2.5	2.5
Fixed portion[b]	19.5	19.5	19.5	19.5
Yeast culture (YEA-SACC)[c]	-	+	-	+
Calculated analysis:				
Net energy, Mcal NE_L/100 lb	75.5	75.5	76.8	76.8
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

[a]Hard red winter wheat, No. 2 grade.
[b]Fixed portion of concentrate mix: soybean hulls 15, dicalcium phosphate 2.0, salt .75, sodium bicarbonate 1.25, and magnesium oxide 0.5%
[c]Product produced by ALLTECH, Nicholasville, KY; included in concentrate mix at a level of 3.0 lb/ton.

with three 4-week periods (Lucas, 1956). The first two weeks of each period were allowed for adjustment to rations with data from the final two weeks being used for treatment comparisons. Cows were assigned by calving date to treatment sequences. The concentrate and forage were fed in individual stanchions in two equal portions twice daily at approximately 12 hour intervals. The hay was fed separately from the concentrate mixture approximately 4 hours after feeding of the concentrate mixture. Feed intake was recorded daily. Feed orts or weighbacks for each cow were composited on a weekly basis and analyzed for dry matter (DM) and crude protein (CP). Milk yield was recorded twice daily, and samples were taken at four consecutive milkings each week to determine fat and protein content. Each cow was weighed on two consecutive days prior to the trial and on the first and last day of each period. Cows were weighed just prior to milking, with milk weight being deducted from the respective body weights.

During the last week of each period, a rumen fluid sample was taken from each cow by stomach tube 3 to 4 hours after feeding concentrate. A minimum of 300 ml of rumen fluid was strained through a double layer of cheese cloth, and pH was measured immediately. Two hundred ml of rumen fluid was then acidified with 8 ml of 50% hydrochloric acid and frozen for later ruminal fluid ammonia-nitrogen (NH_3-N) analyses, and 100 ml of strained rumen fluid was mixed with 1 ml of saturated mercuric chloride and frozen for volatile fatty acid analyses. At the same time rumen fluid samples were taken, blood samples were taken from the media caudal vein for subsequent plasma urea nitrogen determination. However, data for NH_3-N and plasma urea-N are not included herein.

Statistical analysis was conducted by summarizing response variables on a per period basis. Analysis of variance (Lucas, 1956) was performed with block, period, cow and treatment included in the model. The adjusted treatment means were compared using pre-planned orthogonal contrasts as follows: corn-wheat; yeast-no yeast; and grain x yeast.

Results and Discussion

Dry matter feed intake on wheat diets (avg 47.6 lb/day) was lower ($P<.001$) than on corn diets (52.1 lb) (Table 2). Since hay and the concentrate mix were fed in a fixed ratio, intake of both hay and grain were reduced on wheat diets. Wheat starch is more readily fermented in the rumen than corn starch (Axe et al., 1987). Decreased feed intake by cows fed wheat based diets may have been due to altered ruminal fermentation. Ruminal pH was lower ($P<.01$) in cows fed wheat (5.93) than in cows fed corn (6.22) diets. Feeding concentrates more frequently than twice daily may have reduced the differences in ruminal pH and may have increased feed

Table 2. Feed intake, milk yield and ruminal pH.

	Corn	Corn & yeast	Wheat	Wheat & yeast	Statistical significance: Grain type	Yeast	Interaction	SE
Dry matter intake, lb/day								
Concentrate mix	26.6	26.2	24.6	24.0	P<.001	NS	NS	1.08
Alfalfa hay	26.0	25.7	23.3	23.3	P<.001	NS	NS	1.03
Total	52.3	51.9	47.9	47.3	P<.001	NS	NS	1.91
Protein intake,, lb/day								
Concentrate mix	3.41	3.32	3.45	3.45	NS	NS	NS	.132
Alfalfa hay	5.39	5.39	4.93	4.88	P<.001	NS	NS	.198
Total	8.80	8.71	8.38	3.34	P<.02	NS	NS	.286
Milk yield								
Milk, lb/day	70.4	68.6	67.1	66.9	P<.003	NS	NS	1.50
Fat test, %	3.36	3.48	3.17	3.22	P<.009	NS	NS	.07
FCM, lb/day	63.8	63.4	59.2	59.2	P<.001	NS	NS	2.27
Protein, %	2.99	3.01	3.00	3.02	NS	NS	NS	.02
Gross feed efficiency (Milk/total DM intake)	1.35	1.33	1.41	1.43	P<.01	NS	NS	.02
Ruminal pH	6.18	6.27	5.86	6.01	P<.01	NS	NS	.09

NS = Not significant (P>.05).

intake on the wheat based diets. The inclusion of yeast, however, had no effect on pH. Faldet et al. (1986) also noticed a decrease in both concentrate and hay intake when cows were fed rations containing increasing levels of wheat. However, McPherson and Waldern (1969) reported similar DM intakes when soft white wheat replaced barley at up to 93% of the concentrate mixture.

Intake of DM tended to be lower ($P>.3$) for cows fed rations containing yeast culture than for those fed rations without yeast; however, the differences were relatively small (.5 lb/day). Several authors (Fallon and Harte, 1987; Hughes, 1987; Lyons, 1986; Gomez-Alarcon et al., 1987) have suggested increased DM intakes by ruminants fed yeast cultures which were attributed to buffering effects of the additive. Lassiter et al. (1958), however, observed no effect of yeast culture on feed intake by dairy cows.

Milk yield of cows fed corn-based concentrate mixtures was higher ($P<.03$) than for cows fed grain mixtures containing 60% wheat (69.5 vs 67.0 lb/day) which could be attributed to a higher DM intake of cows fed the corn based grain mixture. Since wheat is higher in protein than corn and the diets were formulated to be isonitrogenous, the wheat based grain mixes contained 7.0% less cottonseed meal than did the corn based diets and also were lower in rumen undegradable protein. In what ways these items may have contributed to reduced intake and milk yield on wheat based diets are not known but need further study. Milk fat test of cows fed the corn based mixture (3.42%) was higher ($P<.01$) than for those fed wheat (3.19%), resulting in an advantage in 4% fat corrected milk (FCM) of 4.5 lb/day for cows fed corn instead of wheat (Table 2). Milk yield and fat content, however, were not affected by the inclusion of yeast culture ($P>.05$). Neither grain type nor the addition of yeast culture affected milk protein content.

The total concentration of VFA was greater ($P<.03$) when cows were fed wheat compared to being fed corn based diets. The molar percentage of acetic acid in the ruminal fluid was higher (65.4 vs 60.9%, $P<.007$) and propionic acid was lower (21.9 vs 26.6%, $P<.004$) for cows fed corn based grain mixtures (Table 3), which was consistent with the observed difference in milk fat content. No significant differences in either total VFA concentration or in proportions of VFA were observed by the inclusion of yeast culture.

In summary, the addition of yeast culture to concentrate mixtures for dairy cows fed either corn or wheat as the principal energy source in the grain mixture did not affect performance under the conditions of this trial. Yeast had no effect on feed intake, milk yield and composition, pH of the ruminal fluid or VFA.

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

					Statistical significance			
	Corn	Corn & yeast	Wheat	Wheat & yeast	Grain type	Yeast	Inter-action	SE
Total conc., mm/l	450.2	335.8	470.4	472.1	P<.03	NS	NS	32.05
Molar %								
Acetic	65.60	65.10	60.94	60.90	P<.007	NS	NS	1.37
Propionic	22.00	21.82	26.60	26.60	P<.004	NS	NS	1.32
Isobutyric	.35	.45	.35	.33	NS	NS	NS	.08
Butyric	10.03	10.23	9.46	9.61	NS	NS	NS	.67
Isovaleric	1.02	1.22	.86	.86	P<.03	NS	NS	.09
Valeric	1.0	11.18	1.79	1.73	P<.001	NS	NS	.11

NS = Not significant (P>.05).

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