Feeding Lactating Holstein Dairy Cows Reduced-Fat Dried Distillers Grains with Solubles: Milk Composition and Feed Efficiency

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Summary and Implications

In this experiment, feeding reduced-fat distillers grains with solubles (RF-DDGS) as 20% DM of a TMR supplemented with lysine did not negatively influence production parameters related to milk composition or nutritional physiology of the cow. Milk urea nitrogen (MUN) was, however, decreased, and milk protein percentage was increased. Total milk solids were not influenced by inclusion of RF-DDGS. Additionally, RF-DDGS did cause a decrease in fat-corrected milk (FCM) efficiency as a result of an increase in DMI. When energy-corrected milk (ECM) efficiency was calculated (accounting for fat, protein, and lactose concentration in milk), no difference in feed efficiency resulted ($p > 0.05$).

These data indicate that RF-DDGS can effectively be included in rations of multiparous lactating dairy cows, at least when supplemented with lysine. Additionally, decreased milk urea nitrogen (MUN) and increased milk protein percentage indicate that dietary protein utilization may be improved by including RF-DDGS as a protein source in the ration, presumably because DDGS are generally considered to be a good source of rumen undegradable protein. Taken together, these results indicate that RF-DDGS may be an attractive feed ingredient for inclusion in lactating ruminant diets.

Introduction

Because the value of corn oil is greater than the value of DDGS, it seems unlikely that a "full-fat" (>10% fat) DDGS will be available in the future. Limited prior research has investigated the effect of feeding reduced-fat (<7.5% fat) dried distillers grain with solubles (RF-DDGS) to lactating dairy cows. One study found that feeding RF-DDGS had no effect on milk fat or yield but increased dry matter intake (DMI) and had inconsistent results on milk protein concentration. A second study found that feeding RF-DDGS increased milk fat concentration and efficiency of milk production as well as increased milk protein concentration. Neither study examined the effects of feeding RF-DDGS on fatty acid composition of milk (potentially important for prevention of milk fat depression), and only one study examined feed efficiency (but without using a cross-over design). In addition, both studies utilized a low-fat (3.5-5%) DDGS, whereas most commercially available RF-DDGS are approximately 6% fat on a DM basis.

Recently, researchers fed cows one of four treatments (30% conventional DDGS, 30% RF-DDGS, 30% RF-DDGS plus rumen inert fat, or control) and saw increased milk protein concentration when cows were fed any diet containing DDGS. Additionally, they found that cows fed RF-DDGS had increases in milk yield, no change in milk fat percentage, and increased DMI. The experiment was done as a 4 × 4 Latin square design, but used a diet dissimilar to most conventional dairy rations (i.e., < 22% forage and > 18% protein). Because of the relatively recent appearance of RF-DDGS in conventional dairy rations and because of the inconsistent results of previous research, further investigation of the influence of feeding RF-DDGS to lactating dairy cows on milk components is warranted.

The objective of this study was to test the hypothesis that feeding 20% RF-DDGS (DM basis) would not influence milk components (e.g., milk fat and protein) or feed efficiency negatively when compared with a standard corn/corn silage/hay ration.

Materials and Methods

Thirty-five multiparous lactating Holstein dairy cows were assigned to one of two dietary treatment groups. Rations were formulated to be isonitrogenous and isoenergetic and to contain similar available amino acid concentrations. Ration one (control) was a standard corn/corn silage/hay based ration supplemented with SoyPlus (Dairy Nutrition Plus, Des Moines, IA) as a protein source. Ration two was formulated using the same base ration as control but with 20% of the dry matter being a RF-DDGS (Poet Biorefining, Jewell, IA) containing approximately 6.5% fat in place of SoyPlus (Table 1). Ration two (RF-DDGS) was supplemented with lysine to make diets similar in available limiting amino acids. Cows were fed each diet in a two-period, two-treatment crossover design. Each experimental period lasted 35 days, and cows were fed individually using Calan gates (American Calan, Northwood, NH), allowing for measurement of individual feed intake. Additionally, individual milk production was recorded daily by using a Boumatic milking system (Boumatic LLC, Madison, WI). Weekly, after a 14-day acclimation period, individual milk samples were collected at the three milkings for proximate analyses and other components (i.e., MUN, somatic cell count) (Performed by using official NIR methods at Dairy Lab Services, Dubuque, IA). During the final week of each experimental period rumen fluid was collected for volatile fatty acid (VFA) concentration analyses approximately four hours post-feeding following milking and at the time of maximal VFA production. In addition to rumen fluid, during the final week of each experimental period, blood was collected for metabolic profiling.

Results and Discussion

In contrast with our previous research utilizing full-fat DDGS (~13% fat), milk components were not negatively affected by incorporation of RF-DDGS at a 20% by dry matter (DM) inclusion rate. Total milk fat production per day did not change (control 1.30 kg/day and DDGS 1.26 kg/day) nor did milk fat percentage (control 3.70% and DDGS 3.63%) (Table 2). Milk protein percentage (control 3.05% and DDGS 3.15%) increased significantly but total milk protein (control 1.08 kg/day and DDGS 1.07 kg/day) was unaffected. Both total lactose production (control 1.67 kg/day and DDGS 1.65 kg/day) and percentage of milk lactose (control 4.78% and DDGS 4.78%) did not change as a result of the treatment diet (Table 2). In addition, total percentage milk solids (control 12.32% and DDGS 12.37%) were not altered (Table 2). When cows were fed RF-DDGS, MUN (12.78 mg/dl) was lower in concentration than control (14.14 mg/dl) (Table 2) indicating that, when taken with milk protein %, RF-DDGS may support better protein utilization. Additionally, blood glucose concentration (control 53.51 mg/dl and DDGS 55.27 mg/dl) did not differ between treatments.

Feeding TMR containing RF-DDGS at a 20% inclusion rate increased feed intake of cows fed DDGS compared with the control TMR (46.5 vs 45.6 ± 0.5 kg/d as fed, respectively) (Table 3). Milk production was not altered by feeding DDGS compared with control TMR (36.0 vs 35.9 ± 0.5 kg/d, respectively) (Table 3). Nor did feeding DDGS affect milk production when milk was normalized for energy (energy corrected milk; ECM) or fat (fat-corrected milk; FCM). Consequently, efficiency of milk production, measured as kilograms of milk produced per kilogram of feed consumed daily, was not altered when using raw milk or using the ECM value. Only expressing milk production on a FCM basis resulted in a decrease in FCM production efficiency in cows fed the DDGS TMR compared with cows fed the control TMR (0.81 vs 0.83 ± 0.01 kg FCM/kg feed intake, respectively). Finally, rumen fluid pH was not altered when cows were fed DDGS (6.55 ± 0.06) compared with control TMR (6.50 ± 0.06).

Overall Summary

These findings demonstrate that feeding RF-DDGS did cause a decrease in FCM efficiency as a result of an increase in DMI; however, when ECM efficiency was calculated (accounting for fat, protein, and lactose concentration in milk), no difference in feed efficiency resulted. These results indicate that RF-DDGS can be effectively fed at a 20% (DM) inclusion rate without having negative effects on milk components, blood glucose, or ECM milk efficiency and that protein utilization may be improved when cows are fed RF-DDGS.

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Table 1. Diet composition.

Ingredient, % dry matter	Control	DDGS
Corn silage	35.13	31.57
Alfalfa hay	23.09	20.74
Whole cotton seed	8.03	7.21
Ground corn	14.41	15.13
RF-DDGS	0.00	19.45
Soy Plus[1]	13.51	0.54
Quality Liquid Feeds[2]	3.81	3.42
USA Lysine[3]	0.00	0.11
Vitamin and mineral premix	3.81	3.42

[1] Dairy Nutrition Plus, Des Moines, IA.
[2] Quality Liquid Feeds, Dunlap, IA. Custom vitamin and mineral supplement.
[3] Kemin Industries, Des Moines, IA.

Table 2. Effects of feeding RF-DDGS to lactating Holstein dairy cows on milk composition.

	Treatment		
Item	Control	DDGS	*P*-Value
Milk yield, kg/day	35.9	36.0	0.92
Milk fat, kg/day	1.30	1.26	0.18
Milk fat, %	3.70	3.63	0.18
Milk protein, kg/day	1.08	1.07	0.13
Milk protein, %	3.05	3.15	<0.0001
Lactose, kg/day	1.67	1.65	0.78
Lactose, %	4.78	4.78	0.78
Milk solids, %	12.32	12.37	0.58
Milk urea nitrogen, mg/dl	14.14	12.78	<0.0001

Table 3. Effects of feeding RF-DDGS to lactating Holstein dairy cows on body weight, plasma non-esterified fatty acid (NEFA) concentration, rumen pH, dry-matter intake (DMI), milk production, and milk production efficiency.

	Treatment			
Item	Control	DDGS	SEM	*P* - Value
Body wt gain or loss, kg	11.9	17.0	2.5	0.10
NEFA, μeq/L	163.1	158.1	6.3	0.51
Rumen pH	6.55	6.49	0.06	0.37
DMI, kg/d	20.68	21.09	0.22	0.02
Milk, kg/d	35.9	35.6	0.5	0.92
ECM, kg/d[1]	37.0	37.1	0.4	0.85
FCM, kg/d[2]	36.8	36.5	0.4	0.25
Milk efficiency, kg milk/kg DMI	1.74	1.69	0.01	0.11
ECM efficiency, kg ECM/kg DMI	1.79	1.78	0.01	0.13
FCM efficiency, kg FCM/kg DMI	1.78	1.73	0.01	0.02

[1] Energy-corrected milk; (0.327×Milk)+(12.95×Milk Fat)+(7.65×Milk Protein).

[2] Fat-corrected milk; (0.432×Milk)+(16.23×Milk Fat).