

Quality of Milk from Lactating Dairy Cattle Fed Dried Distillers Grains with Solubles

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Summary and Implications

Healthy mid-lactation Holstein dairy cows (n=24) were fed total mixed rations containing dried distillers grains with solubles (DDGS). The objective of this study was to examine the effect of feeding DDGS to lactating dairy cows on production parameters and flavor and oxidative stability of milk. Cows were assigned to two groups and fed one of three treatment diets (0% DDGS, 10% DDGS, 25% DDGS by dry matter (DM)) as a total mixed ration. Each group was fed all three of the diets after a wash-out period of 7 days. Milk yield was unaffected by both the 0% and 10% DDGS diets but decreased significantly when fed the 25% DDGS diet. Rumen volatile fatty acids were unaffected by treatment. Milk protein and solids-not-fat (SNF) increased with increasing inclusion of DDGS, but milk fat decreased concomitantly. Milk fatty acid composition was affected with milk fat from cows fed higher concentrations of DDGS producing milk with higher concentrations of unsaturated fatty acids. Milk oxidative stability was unaffected by dietary treatment, and milk flavor, as determined by a trained sensory panel, also was unaffected. The results of this study indicate that feeding of DDGS to lactating dairy cows, under controlled conditions, does not have negative effects on milk oxidative stability or flavor; however, feeding 25% DDGS did negatively impact milk production and changed milk fatty acid profile.

Introduction

DDGS are a co-product of commercial ethanol production. Feeding of DDGS to lactating dairy cows has been shown previously to increase the concentration of unsaturated fatty acids in milk fat. An increased concentration of unsaturated fatty acids may be of interest from a consumer “healthfulness” perspective; however, unsaturated fatty acids also have been shown previously to be more susceptible to light-induced fatty acid oxidation. Oxidation of fatty acids leads to the development of off-flavors in foods, thereby decreasing consumer acceptance of those food products. When milk is stored in the dairy case at the grocery store, it is exposed to light, and, consequently, milk that is less oxidatively stable could be more prone to development of off-flavors, thereby decreasing consumer

acceptance of this milk. The objective of the study was to not only evaluate production parameters of cows fed DDGS, but to also evaluate oxidative stability of milk from cows fed DDGS using both sensory and chemical analyses.

Materials and Methods

Experimental Design

Twenty-four healthy mid-lactation Holstein dairy cows were blocked by parity and days in milk into 2 groups of 12 cows each and assigned to one of three dietary treatments: 0% DDGS (control), 10% DDGS, and 25% DDGS by DM. Both groups received one of the three experimental diets each period. Diets were formulated to be isoenergetic. Both groups received all three diets over the course of the three experimental periods allowing for each cow to serve as her own control. Cows were group fed and allowed *ad libitum* access to feed. To eliminate carryover effects associated with this type of experimental design (two-group three-period crossover), milk was not collected until day 14 of each treatment period, and the first 7 days of each period were excluded from statistical analysis of daily milk yield.

Sample Collection and Analysis

Rumen fluid was collected on approximately day 24 of each experimental period, strained through cheesecloth, and frozen until analysis. Rumen fluid was acidified prior to analysis of volatile fatty acid content by gas chromatography coupled with flame ionization detection (GC-FID).

Feed was collected once per treatment period and sent to Dairyland Laboratories (Arcadia, WI) for proximate analysis.

Milk was collected, pooled, and pasteurized on days 14, 21, and 28 for sensory and chemical analyses. Sensory analysis was conducted by a trained sensory panel where 10 panelists evaluated milk for presence of seven off-flavors on days 1, 3, and 7 post-collection. Oxidative stability of milk was evaluated by the ferric-reducing antioxidant power assay. Chemical analysis (peroxides and free fatty acids (FFA)) of milk was performed using SAFtest™ (MP Biomedicals, OH). Individual milk samples were collected on days 14, 21, and 28 for milk fatty acid analysis. Milk fatty acids were extracted, butylated, and analyzed by GC-FID. Milk protein, SNF, and fat were quantified by Lacticheck™ (QCL Scientific, MA). “Health promoting index” (HPI), a measure of the healthfulness of milk fat, was calculated by using the following formula: $HPI = [\sum \% \text{ of unsaturated fatty acids}] / [\% C12:0 + 4 \times \% C14:0 + \% C16:0]$. Daily milk yield was compiled from records collected at the ISU Dairy Farm.

Statistical Analysis

Data were analyzed as a two-group, three-period crossover design by using IBM SPSS V19. Milk yield was analyzed by mixed model with treatment and treatment sequence being fixed effects, cow nested within treatment sequence being a random effect, and days in milk as a covariate. Milk yield data were contrasted by least squared differences. The remaining data analysis was conducted by one-way ANOVA.

Results and Discussion

Rumen volatile fatty acids were unaffected by treatment (data not shown). Results for milk proximate analysis and yield are shown in Table 1. Milk protein and SNF increased as dietary inclusion of DDGS increased. As observed in other studies involving the feeding of DDGS to lactating dairy cows, significant milk fat depression was observed when cows were fed both the 10% and 25% diet as compared with the 0% DDGS diet. Degree of milk fat depression did not differ significantly between the 10% and the 25% DDGS treatments. Mean daily milk yield was not different for the 0% and 10% DDGS treatments ($P = 0.636$), but decreased significantly when cows were fed the 25% DDGS diet ($P = 0.046$). Feed analysis (data not shown) confirmed that, as intended, diets were isoenergetic; however, feed intake was not measured in this experiment, which could account for some of the observed differences in daily milk production.

Milk fatty acid composition was altered (Figure 1) by treatment. The ratio of saturated to unsaturated fatty acids decreased as dietary inclusion of DDGS increased (0 % DDGS = 1.72:1, 10% DDGS = 1.41:1, 25% DDGS = 1.27:1). The decrease in the proportion of saturated to unsaturated fatty acids was accompanied by a concomitant increase in HPI as dietary DDGS increased (0% DDGS =

0.47, 10% DDGS = 0.65, 25% DDGS = 0.72), indicating that the fatty acid composition of milk from cows fed DDGS may be more desirable from a health perspective. As was hypothesized and has been previously reported, milk from cows fed DDGS contained higher concentrations of unsaturated fatty acids. The increased concentration of unsaturated fatty acids in the milk from the cows fed 10% and 25% DDGS, however, did not result in a decrease in oxidative stability or an increase in development of off-flavors in the milk. No meaningful differences in FFA, peroxides, or oxidative stability of milk from any treatment were detected. Additionally, no significant differences in any off-flavor attributes, as evaluated by a trained sensory panel, occurred as a result of treatment or treatment by storage time (data not shown). These results indicate that the feeding of DDGS to lactating dairy cows did not result in milk that was less oxidatively stable and, consequently, more prone to development of off-flavors. In addition, milk from cows fed DDGS may be “healthier” as indicated by the HPI data. Finally, it is worthy to note that the feeding of 25% DDGS by DM to lactating dairy cattle resulted in a significant decrease in milk production, indicating that a 25% DDGS diet by DM may not be advisable.

Acknowledgments

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Table 1. Milk Proximate Analysis and Yield.

Item	Diet		
	Control	10% DDGS	25% DDGS
Fat %	3.22 ± 0.57 ^a	2.74 ± 0.66 ^b	2.75 ± 0.41 ^b
SNF %	9.88 ± 0.30 ^a	10.07 ± 0.34 ^b	10.29 ± 0.34 ^c
Protein %	3.71 ± 0.13 ^a	3.78 ± 0.12 ^b	3.86 ± 0.13 ^c
Mean milk yield (kg/day)*	34.03 ± 1.66 ^a	34.83 ± 1.66 ^a	30.59 ± 1.66 ^b

^{a, b, c}, Different superscripts on the same line indicate a significant difference ($P < 0.05$)

*N=18 cows

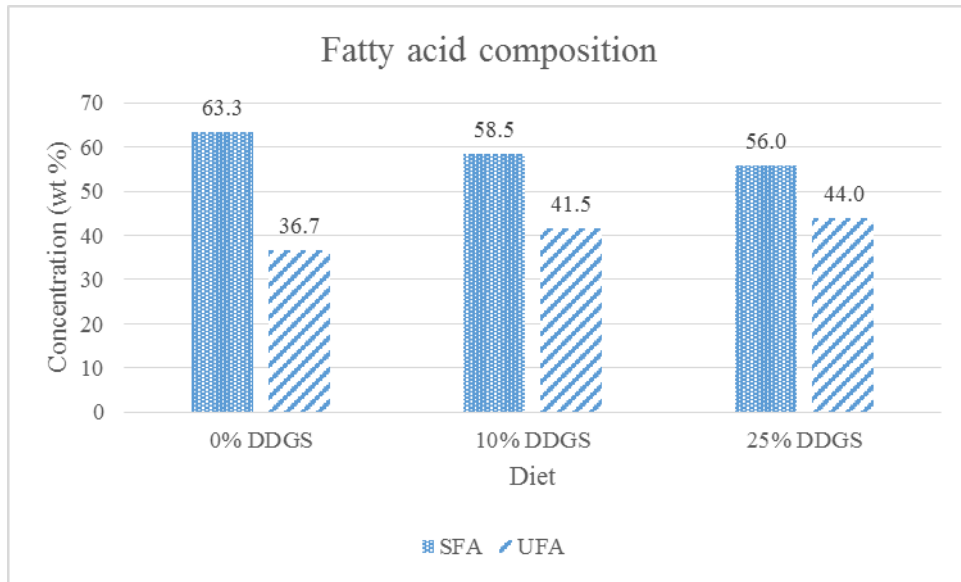


Figure 1. Milk fatty acid composition n = 18 cows. SFA = saturated fatty acids, UFA = unsaturated fatty acids.