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Short communication: Effects of level of rumen-degradable protein and corn distillers grains in corn silage-based diets on milk production and ruminal fermentation in lactating dairy cows[1]

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ABSTRACT

Two of the potential obstacles precluding inclusion of higher levels of dry distillers grains with solubles (DDGS) in corn-based dairy cow diets are the low levels of rumen-degradable protein (RDP) and the fatty acid content and composition of DDGS. Therefore, the objective of this experiment was to evaluate the production and rumen responses to dietary alterations in the level of RDP and DDGS for dairy cows fed a high corn silage diet. The experimental design was a replicated 4 × 4 Latin square with 21-d periods: 14 d of adaptation and 7 d of sampling; 16 uncannulated cows and 4 ruminally cannulated cows were blocked and assigned randomly to treatment sequences. Rations were provided as total mixed rations and were formulated to be high or low in RDP, with or without DDGS replacing soybean-based concentrates: high RDP, no DDGS (HRDP0); low RDP, no DDGS (LRDP0); low RDP, 10% DDGS; and low RDP, 20% DDGS. Body weight (696 kg) and dry matter intake (26.6 kg/d) were not affected by treatment. Rumen ammonia concentration was greater for HRDP0 than LRDP0, but was unaffected by level of DDGS inclusion. The mean and minimum rumen pH and time pH was <5.5 were not different between diets. Milk production tended to be lower for cows fed HRDP0 than LRDP0 and tended to be linearly reduced as DDGS inclusion increased. Milk protein yield tended to be greater for cows fed LRDP0 than HRDP0, but was unaffected by DDGS level. Milk fat production, concentration, and fat-corrected milk were linearly reduced by increasing levels of DDGS. Based on these results, feeding DDGS at 20% of diet dry matter is not recommended for diets based on high corn silage.

Key words: dry distillers grains with solubles, rumen-degradable protein, corn silage

Short Communication

Distillers grains are a by-product of fuel-ethanol production with relatively high levels of CP and RUP (Kleinschmit et al., 2007a). Distillers grains have been studied as a protein source for ruminant animals in the past, and research has generally indicated that this source of feed compares favorably with other protein sources, both for lactating dairy cattle as well as for growing ruminants (Firkins et al., 1985; Schingoethe et al., 1999; Kleinschmit et al., 2006). These properties confer distillers grains with the potential to provide a substantial amount of AA postruminally. Two of the major obstacles precluding high inclusion of distillers in the diet of dairy cows are the high level of RUP and imbalance of AA relative to the requirements of milk protein secretion. Although the higher RUP in distillers does make it an attractive feedstuff to allow AA to bypass rumen fermentation, feeding too much RUP at the expense of RDP can limit microbial protein synthesis (Ipharraguerre and Clark, 2005).

When diets for dairy cows contained corn silage as the only forage, milk yield was depressed at the highest level of dry distillers grains with solubles (**DDGS**; 36% DM; Owen and Larson, 1991), but not the lowest level used in that experiment (18% DM). When alfalfa hay or silage is fed, however, milk production has been unaffected (18 to 30% distillers grains; Schingoethe et al., 1999; Liu et al., 2000) or enhanced (10 to 20% distillers grains; Nichols et al., 1998; Anderson et al., 2006; Kleinschmit et al., 2006) by additional levels of DDGS or wet distillers grains compared with control protein supplement. Given the AA composition of soy-based and corn-based rumen bypass proteins, the potential limitation of microbial protein synthesis, and the potential influence of the forage component of the diet, the objective of this experiment was to evaluate the production and rumen responses to dietary alterations in the level of RDP and DDGS for dairy cows fed a high-corn silage diet.

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Table 1. Ingredient composition of diets fed with high (HRDP) or low (LRDP) RDP and increasing levels of dried distillers grains with solubles (DDGS)

	HRDP	LRDP		
Item	0% DDGS	0% DDGS	10% DDGS	20% DDGS
Ingredient, % of DM				
Corn silage[1]	47.00	47.00	47.00	47.00
Grass hay[2]	3.00	3.00	3.00	3.00
DDGS[3]	0.00	0.00	10.00	20.00
Ground corn	15.33	16.40	14.20	12.00
Soy Choice[4]	4.00	4.00	4.00	4.00
Canola meal	7.50	7.50	7.50	7.50
Soybean meal (48%)	3.45	0.00	0.00	0.00
Soy Pass[5]	0.00	4.15	2.08	0.00
Soybean hulls	6.00	4.75	2.38	0.00
Roasted soybeans	6.40	5.82	2.91	0.00
Cottonseed hulls	2.00	2.00	2.00	2.00
Alifet[6]	0.82	0.88	0.44	0.00
Urea	0.50	0.50	0.50	0.50
Mineral mix[7]	4.00	4.00	4.00	4.00
Composition, % of DM or as indicated				
CP	17.6	17.5	17.5	17.6
RDP[8]	10.5	9.6	9.8	9.9
RUP[8]	7.1	7.9	7.7	7.7
MP supplied,[8] g/d	3,093	3,291	3,185	3,187
RDP supplied,[8] g/d	2,784	2,588	2,584	2,647
RUP supplied,[8] g/d	1,886	2,119	2,035	2,041
Lys,[8] %MP	6.22	6.05	5.86	5.63
Met,[8] %MP	1.77	1.72	1.77	1.82
Lys:Met	3.51	3.51	3.31	3.09
Ether extract	5.4	5.4	5.4	5.4
NDF	32.3	32.7	33.5	34.4
ADF	19.8	19.2	19.5	19.8
NE_L, Mcal/kg	1.60	1.59	1.60	1.59
NFC	41.3	42	40.6	39.3

[1]Corn silage contained (% of DM) 38.1% NDF, 8.1% CP, and 48.4% NFC.

[2]Grass hay contained (% of DM) 70.1% NDF and 7.5% CP.

[3]Dried distillers grains with solubles contained (% of DM) 28.7% CP, 33.0% NDF, 4.3% neutral detergent-insoluble CP, and 11.9% ether extract.

[4]Soy Choice (expeller soybean meal from Wenger's Feed Mill Inc., Rheems, PA) contained (% of DM) 47.7% CP, 16.3% NDF, and 27.5% NFC.

[5]Soy Pass is nonenzymatic browned, solvent-extracted soybean meal (Borregaard LignoTech USA Inc., Rothschild, WI).

[6]Alifet (Alifet USA Inc., Cincinnati, OH) is hydrogenated tallow mixed with wheat starch and crystallized (92% fat).

[7]The premix contained (%, as-is basis) trace mineral mix, 0.88; MgO (54% Mg), 8.3; NaCl, 6.4; vitamin ADE premix, 1.73; limestone, 35.8; selenium premix, 1.09; and corn DDGS, 45.8. Composition: Ca, 14.1%; P, 0.35%; Mg, 4.58%; K, 0.41%; S, 0.31%; Mn, 1,071 mg/kg; Cu, 358 mg/kg; Zn, 1,085 mg/kg; Fe, 181 mg/kg; Se, 6.67 mg/kg; Co, 5.4 mg/kg; I, 13.4 mg/kg; vitamin A, 262,101 IU/kg; vitamin D, 65,421 IU/kg; and vitamin E, 1,971 IU/kg.

[8]Composition based on chemical composition of feedstuffs and as predicted by NRC (2001), based on actual milk production, BW, milk composition, and intakes.

The experimental design was a replicated, 4 × 4 Latin square with 21-d periods: 14 d of adaptation and 7 d of sampling; 20 cows were used for the study, with 5 total cows and 1 ruminally cannulated cow per treatment; cows were blocked and assigned randomly to treatment sequences. Diets (Table 1) were fed once daily at 0800 h for a 5% refusal rate, and water was offered ad libitum. Diets consisted of increasing levels of DDGS that replaced soybean meal or soy-based ingredients [high RDP, no DDGS (**HRDP0**); low RDP, no DDGS (**LRDP0**); low RDP, 10% DDGS; and low RDP, 20% DDGS]. This strategy was used to vary the level of RDP and RUP across treatments while keeping energy and protein similar across diets. Feedstuffs and TMR samples were collected daily and composited every 15 d and monthly, respectively; concentrate samples were collected once per week. Immediately after collection, samples were dried in a forced-air oven (55°C) for 3 consecutive d and then stored for further analyses. Feedstuffs and TMR were ground through a