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Short communication: Substituting dry distillers grains with solubles and rumen-protected amino acids for soybean meal in late-lactation cows' diets based on corn silage or ryegrass silage

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ABSTRACT

Excess protein in dairy cattle diets increases production costs and contributes to environmental pollution. The objective of the present study was to evaluate the effect of feeding dry distillers grains with solubles (DDGS) supplemented with rumen-protected Lys and Met in place of solvent-extracted soybean meal on the performance of late-lactation cows. Two experiments were carried out, with each using 24 late-lactating dairy cows distributed among 4 pens. In trial 1, corn silage was the main forage source. Control (HP1) total mixed ration (TMR) contained 16.3% crude protein (CP) with soybean meal as the main protein source. Treatment TMR (LP1) had 13.7% CP when soybean meal was replaced with DDGS and rumen-protected Lys and Met. Forage in trial 2 was ryegrass silage; control TMR (HP2; 15.4% CP) contained soybean meal and rumen-protected Met, whereas treatment TMR (LP2; 13.8% CP) contained DDGS and rumen-protected Lys and Met. Trials were analyzed as crossover design using the MIXED procedure of SAS (SAS Institute Inc., Cary NC) with cow as sampling unit and pen as the experimental unit. Treatments were similar in dry matter intake (21.0 and 20.4 kg/cow per day for HP1 and LP1, respectively) and milk yield (20.7 and 20.5 kg/cow per day for HP1 and LP1, respectively) during trial 1. Milk composition was similar between treatments, averaging 4.22, 3.73, 4.54, and 9.15, respectively, for fat, protein, lactose, and solids nonfat. Milk urea nitrogen decreased from 17.2 mg/dL for HP1 to 9.93 mg/dL for LP1. In trial 2, no significant differences were observed for dry matter intake (21.4 and 20.9 kg/cow per day for HP2 and LP2, respectively), milk yield (28.1 and 26.6 kg/d for HP2 and LP2, respectively), fat yield (0.99 vs. 0.92 kg/d for HP2 and LP2, respectively), protein yield (0.94 vs. 0.86 kg/d for HP2 and LP2, respectively) and lactose yield (1.37 vs. 1.28 for HP2 and LP2, respectively). Milk urea nitrogen decreased from 9.88 mg/dL with HP2 to 6.39 mg/dL with the LP2 treatment. Milk N efficiency tended to be higher for LP treatments in trial 1, but not in trial 2. Low milk urea N suggested nitrogen losses to the environment may be lower when cows were fed diets based on DDGS in both trials. The studies indicated that DDGS with rumen-protected Lys and Met could substitute solvent-extracted soybean meal in low-protein corn silage- and ryegrass silage-based diets for late-lactation dairy cows averaging 20.6 or 27.4 kg of milk/d, respectively.

Key words: corn silage, dry distillers grains plus solubles, rumen-protected amino acids, ryegrass silage

Short Communication

Solvent-extracted soybean meal (**SSBM**) price volatility in recent years increased interest for alternative protein sources, such as dry distillers grains with solubles (**DDGS**). Dry distillers grains with solubles contains less CP and higher RUP and Met concentrations but is limited in Lys when compared with SSBM (NRC, 2001). This combination of factors limits RDP intake, microbial protein synthesis in the rumen, and, ultimately, AA supply in the duodenum of high-producing cows. For that reason, complete replacement of SSBM with DDGS can be challenging in early-lactation cows diets, but the goal may be achieved in diets for late-lactation cows in which protein intake and RUP and RDP balance may be less demanding (NRC, 2001).

As economic and environmental pressures mount on dairies to reduce protein inputs and N waste, a necessary corresponding increase in N efficiency hinges on precise protein feeding. Rumen-protected amino acids

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(**RPAA**) are supplemented to deliver essential AA that may be limiting in the duodenum (Colmenero and Broderick, 2006; Lee et al., 2012a). However, discrepancies exist among studies using RPAA at different levels of CP on cow performance when supplementing rumen-protected Met (**RPM**) in the diets (Leonardi et al., 2003; Broderick et al., 2008), rumen-protected Lys (**RPL**) (Paz and Kononoff, 2014), or when using RPL, RPM, and rumen-protected His (Lee et al., 2012b). Two of these studies used a negative balance of MP (Broderick et al., 2008; Lee et al., 2012a,b). Those discrepancies may be the result of forage and feed sources and their interactions influencing AA availability in the small intestine at different production levels (Brito et al., 2006). Therefore, in the current study, 2 experiments were conducted to determine whether late-lactation cows' performance could be maintained when SSBM was replaced with DDGS supplemented with RPL and RPM in low-protein, corn silage- or ryegrass silage-based diets.

Site, Animals, and Management

Both studies were conducted at the Louisiana State University Agricultural Center Southeast Research Station, located in Franklinton, Louisiana. Animal care and handling were conducted according to Louisiana Agricultural Center Institutional Animal Care and Use Committee Guidelines (IACUC protocol #AE2008–09). For each study, 24 Holstein cows were randomly distributed among 4 pens (northeast, northwest, southeast, and southwest) in the research freestall. Each pen (16.5 × 8.5 m) was enclosed by 6 electronic Calan gates (American Calan, Northwood, NH). Cows were allowed 3 wk of adaptation period for gate training followed by 2 periods of 3 wk each in a crossover design. Each period was comprised of 14 d of treatment adaptation and 7 d for sampling and data recording. Each pen had access to a water trough equipped with flow meter (Recordall model 40, Badger Meter, Milwaukee, WI). Dietary treatments were mixed twice daily using a Super Data Ranger (American Calan) at 0700 and 1300 h. Cows were milked twice daily at 0500 and 1500 h.

Trial 1 was conducted between December 16, 2010, and January 27, 2011, and cows averaged (means ± SD) 334 ± 43 DIM and 22.2 ± 3.8 kg of milk/d immediately before the experimental period. Trial 2 was carried out between June 17, 2011, and July 29, 2011, with cows averaging 244 ± 55 DIM and 30.7 ± 4.8 kg of milk/d. Three fans (150 cm in diameter) on each side of the experimental barn and automatic water soakers were used to attenuate heat stress during trial 2. Soakers were turned off during d 19, 20, and 21 of each period for a concurrent study that required manure collection from the floor.

Diets

Individual feed composition is presented in Table 1. Concentrates and mineral supplements were mixed for each treatment (Table 1) to simplify management. Concentrate mixes contained SSBM (**HP**) or DDGS (**LP**) as main protein sources. Treatment premixes were prepared in batches sufficient for a trial. Premix LP contained RPL, RPM, and DDGS (Table 2). A similar amount of DDGS was added in trial 1 as HP

Table 1. Nutrient composition of feed ingredients used by trial

Ingredient (% of DM, unless otherwise noted)	DM (% as fed)	CP	NDF	ADF	Ca	P	K	Mg
Trial 1								
Corn silage	30.3	8.47	41.0	23.9	0.16	0.26	1.05	0.16
Bermudagrass hay	91.9	8.26	70.9	40.4	0.33	0.29	1.33	0.37
Dry distillers grains with soluble	91.5	27.8	30.3	16.0	0.03	0.86	0.93	0.23
HP1 mix[1]	90.0	25.9	8.50	4.60	2.07	0.69	1.6	0.47
LP1 mix[1]	89.6	13.3	9.37	3.77	2.66	0.61	1.01	0.51
Whole cottonseed	93.2	24.9	58.2	42.4	0.11	0.72	1.03	0.30
Trial 2								
Ryegrass silage	30.4	15.0	56.1	38.6	0.64	0.35	2.52	0.19
Dry distillers grains with soluble	86.8	26.8	32.3	18.6	0.02	0.92	1.09	0.26
HP2 mix[1]	89.9	12.7	18.3	11.5	0.91	0.36	1.15	0.29
LP2 mix[1]	89.8	9.95	18.5	11.5	0.97	0.33	0.94	0.27
Whole cottonseed	92.9	26.2	45.7	39.0	0.10	1.16	0.72	0.27

[1]Concentrate mixes contained dry ground corn, dry distillers grains with solubles, soybean meal, soyhulls, and minerals. Trial 1 treatments: (1) HP1 = formulated to contain 16.5% CP and 340 g of MP balance with soybean meal with no addition of RPAA; (2) LP1 = formulated to contain 13.5% of CP and −50 g of MP balance with dry distillers grains plus solubles supplemented with rumen-protected Lys (RPL, AminoShure-L, Balchem, New Hampton, NY) and rumen-protected Met (RPM, Metasmart, Adisseo, Antony, France). Trial 2 treatments: (1) HP2 = formulated to contain 15.4% CP and 169 g/d of MP balance with soybean meal supplemented with RPM; (2) LP2 = formulated to contain 13.5% CP and –59 g/d of MP balance with dry distillers grains plus solubles supplemented with RPL and RPM.