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Short communication: Effects of molasses supplementation on performance of lactating cows fed high-alfalfa silage diets

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ABSTRACT

Twelve Holstein cows were used in a replicated Latin square experiment to determine the effect of adding dried molasses to high-alfalfa silage diets on dairy cow performance. Three isonitrogenous diets were formulated with a 68:32 forage:concentrate ratio, with alfalfa silage as the only forage source. Dietary treatments were a control diet with no added molasses and 3 and 6% dried molasses diets. Three lactating Holstein cows fitted with ruminal cannulas were used to determine the effects of dietary treatments on ruminal fermentation. Dietary treatments had no effect on dry matter (average 23.3 kg/d), crude protein (average 4.4 kg/d), or neutral detergent fiber (average 7.4 kg/d) intake. Milk yield, energy-corrected milk (average 35.4 kg/d), and 4% fat-corrected milk (average 33.8 kg/d) were not influenced by dietary treatments. Cows fed the control diet produced milk with less milk urea nitrogen concentration than those fed molasses-supplemented diets. Ruminal pH, NH_3-N concentration, and total volatile fatty acids were not different among dietary treatments. The molar proportion of acetate linearly increased, whereas the molar proportion of propionate linearly decreased as the level of dried molasses increased. It was concluded that addition of dried molasses to high-alfalfa silage diets at 6% of the diet (dry matter basis) increased milk urea nitrogen but had no effect on animal performance.
Key words: alfalfa silage, dairy cow, milk yield, molasses

Short Communication

Diets based on alfalfa silage contain high levels of NPN and other sources of rapidly ruminally degraded protein, which may reduce the efficiency of protein utilization by lactating cows (Broderick, 1995). When high-alfalfa silage diets are fed to lactating cows, the rate of ruminal carbohydrate fermentation may be too slow to allow ruminal bacteria to capture readily available protein for microbial protein synthesis. Under these conditions, increasing the rate of carbohydrate fermentation could increase microbial protein synthesis and therefore improve the supply of MP to dairy cows (Broderick et al., 2002). Given that sugars are more rapidly fermented in the rumen than starch, these could serve as an effective supplement for high-alfalfa silage-based diets. Molasses in dry or liquid form is a practical source of rapidly fermented sugars for feeding dairy cows. Previous studies showed positive effects of added dry or liquid molasses on FCM, milk fat concentration, ruminal NH_3-N, MUN, and fiber digestibility (Broderick and Radloff, 2004). Those authors recommended an optimum inclusion rate of 2.4% liquid or dried molasses to diets formulated with alfalfa and corn silages. However, feeding higher levels of molasses was found to reduce cow performance (Broderick and Radloff, 2004). Data regarding the effects of molasses inclusion in high-alfalfa silage diets on the performance of dairy cows are limited. The objectives of this study were to determine the effects of adding dried molasses to high-alfalfa silage-based diets on performance, ruminal fermentation, and total-tract nutrient utilization by lactating dairy cows.

Twelve multiparous cows in early to mid lactation (702.8 ± 77 kg of BW, 96.5 ± 43 DIM, and 39.9 ± 4.62 milk yield; average ± SD) were blocked into 4 groups of 3 by parity and milk yield. Dietary treatments were a control diet without dried molasses and 3 and 6% dried molasses diets. Cows were housed in tie-stalls with free access to water. Three isonitrogenous diets were formulated, with a 68:32 forage:concentrate ratio to meet the nutrient requirements of dairy cows in early lactation (NRC 2001; Table 1). Diets were offered ad libitum twice daily at 0800 and 1600 h. Experimental periods (n = 3) consisted of 14 d of diet adaptation and 7 d of data collection. Cows were milked 2 times daily at 0500 and 1700 h, and milk yield and feed intake were recorded daily. Individual milk samples were collected 2 times per period. Diets were sampled daily and composited by period. Orts were measured daily to determine daily feed intake for each cow.

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Table 1. Ingredients and chemical composition (±SD) of dietary treatments (DM basis)

	Dietary treatment		
Composition	0% molasses	3% molasses	6% molasses
Alfalfa silage	68.4	68.2	68.2
High-moisture corn	28.3	25.4	23.0
Dried molasses[1]	0	2.8	5.6
Megalac[2]	1.2	1.2	1.2
Mineral and vitamin mix[3]	2.1	2.1	2.1
Chemical composition, %			
DM	45.2 ± 1.33	45.4 ± 1.05	45.6 ± 0.95
Ash	7.8 ± 0.91	8.1 ± 0.65	8.5 ± 0.60
NDF	31.5 ± 1.04	31.8 ± 0.28	31.9 ± 0.41
ADF	22.1 ± 1.38	21.6 ± 0.87	22.6 ± 0.74
CP	18.7 ± 0.99	18.9 ± 0.20	19.2 ± 0.20
Soluble protein, % of CP	52.5 ± 0.98	55.4 ± 0.82	57.7 ± 1.88
NPN, % of CP	52.3 ± 0.81	55.0 ± 0.97	55.4 ± 0.40
Neutral detergent-insoluble protein, % of CP	13.9 ± 1.34	13.6 ± 1.15	12.8 ± 1.02
Acid detergent-insoluble protein, % of CP	6.0 ± 0.49	5.7 ± 0.47	5.9 ± 0.76
ADL	2.4 ± 0.37	2.8 ± 0.44	2.8 ± 0.40
NE_L,[4] Mcal/kg	1.67 ± 0.05	1.65 ± 0.04	1.64 ± 0.04
RUP,[5] % of CP	22.5 ± 3.08	22.0 ± 3.79	21.4 ± 2.46
Digestible energy, Mcal/kg	2.76 ± 0.08	2.81 ± 0.08	2.94 ± 0.11

[1]Contained 38% total inverted sugars, 30% crude fiber, and 5% CP (Jefo Nutrition Inc., Saint-Hyacinthe, QC, Canada).

[2]Calcium salts of palm FA (Church & Dwight Co. Inc., Princeton, NJ).

[3]Contained 43.28% sodium bicarbonate, 19.37% dicalcium phosphate, 11.59% sodium chloride, 8.14% ammonium phosphate, 0.41% calcium carbonate, 6.18% Mg, 3.49% K, 0.22% Ca, 2.21% Na, 0.45% Zn, 0.38% Mn, 0.15% Cu, 0.01% Co, 0.01% I, 0.01% sodium selenite, 0.82% mineral oil, 2.61% canola meal, 1,095 kIU of vitamin E/kg, 2,400 kIU of vitamin A/kg, and 1,150 kIU of vitamin D/kg.

[4]Calculated according to Weiss et al. (1992).

[5]Estimated from 12-h ruminal incubation.

Three multiparous lactating Holstein cows (not included in the production study; 742.3 ± 34.2 kg of BW) fitted with ruminal cannulas were used in a 3 × 3 Latin square experiment, which consisted of 3 periods with 14 d of diet adaptation and 7 d of data collection. Cows were housed in tie-stalls and had continuous access to water. Dietary treatments were the same as in the production study. Chromic oxide (Cr_2O_3) was used as an external marker to estimate total fecal output. Gelatin capsules containing 10 g of Cr_2O_3 were inserted into the rumen of each cow twice daily in equal intervals starting on d 1 of data collection period. Samples of rumen fluid were collected from various parts of the rumen with a syringe screwed to a stainless steel tube ending with a fine metal mesh (RT Rumen Fluid Collection Tube; Bar Diamond Inc., Parma, ID) on d 3 of the data-collection period before the morning feeding (0 h) and at 2, 4, 6, 8, 10, and 12 h postfeeding and on d 4, rumen fluid samples were collected at 1, 3, 5, 7, 9, and 11 h postfeeding. Ruminal pH was measured immediately using an Accumet pH meter (Fisher Scientific, Montreal, QC, Canada). Following pH determination, two 50-mL rumen fluid samples were preserved by adding 5 mL of 25% metaphosphoric acid and 5 mL of 0.1 *N* HCl to determine VFA and NH_3-N concentrations, respectively. Samples were immediately frozen at −20°C for later analysis. Grabbed fecal samples were collected 6 times daily during the last 2 d of each collection period. Samples were then dried at 60°C in a forced-air oven for 72 h and pooled by cow.

Subsamples (500 g) of feeds were dried in a forced-air oven at 60°C for 72 h and ground through a 1-mm screen using a Wiley mill (Arthur H. Thomas Co., Philadelphia, PA). Ground feed samples were analyzed for DM, ash, and ether extract using standard procedures (AOAC, 1990). Neutral detergent fiber (Van Soest et al., 1991) and ADF (AOAC, 1990) concentrations were determined using an Ankom Fiber Analyzer (Ankom Technology Corp., Macedon, NY). Analysis of NDF was done without the inclusion of sodium sulfite and with the use of a heat-stable α-amylase. Acid detergent lignin was measured according to the Association of Official Analytical Chemists (AOAC, 1990). Crude protein (N × 6.25) was measured using a Leco nitrogen analyzer (TruSpec Nitrogen Determinator System; Leco Corp., St Joseph, MI). Soluble crude protein and NPN concentrations were determined according to Licitra et al. (1996), whereas acid and neutral detergent-insoluble protein were measured by analyzing ADF and NDF residues, respectively, for total N. Starch content was

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