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Short communication: Effects of molasses products on productivity and milk fatty acid profile of cows fed diets high in dried distillers grains with solubles[1]

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ABSTRACT

Previous research has shown that replacing up to 5% [of dietary dry matter (DM)] corn with cane molasses can partially alleviate milk fat depression when cows are fed high-concentrate, low-fiber rations containing dried distillers grains with solubles. The primary objective of this study was to determine whether dietary molasses alters milk fatty acid (FA) profile or improves solids-corrected milk yield in the context of a more typical lactation diet. A secondary objective was to assess production responses to increasing rumen-degradable protein supply when molasses was fed. Twelve primiparous and 28 multiparous Holstein cows (196 ± 39 d in milk) were blocked by parity and assigned to 4 pens. Pens were randomly allocated to treatment sequence in a 4 × 4 Latin square design, balanced for carryover effects. Treatment periods were 21 d, with 17 d for diet adaptation and 4 d for sample and data collection. Treatments were a control diet, providing 20% dried distillers grains with solubles (DM basis), 35% neutral detergent fiber, 30% starch, and 5% ether extract; a diet with 4.4% cane molasses replacing a portion of the corn grain; a diet with 2.9% molasses supplement containing 32% crude protein on a DM basis; and a diet with 5.8% (DM basis) molasses supplement. Animal-level data were analyzed using mixed models, including the fixed effect of treatment and the random effects of period, pen, period × pen interaction, and cow within pen to recognize pen as the experimental unit. Diets did not alter DM intake, milk production, milk component concentration or yield, feed efficiency (DM intake/milk yield), body weight change, or milk somatic cell count. Milk stearic acid content was increased by the diet containing 5.8% molasses supplement compared with the control diet and the diet containing 2.9% molasses supplement, but the magnitude of the effect was small (12.27, 11.75, and 11.69 ± 0.29 g/100 g of FA). Production data revealed a dramatic effect of period on milk fat content and yield. Milk fat content decreased during the course of the experiment (least squares means = 3.16, 2.81, 2.93, and 2.64 ± 0.09% for periods 1 to 4, respectively), as did milk fat yield (1.20, 1.03, 0.98, and 0.79 ± 0.05 kg/d). Exchanging molasses-based products for corn at 2.9 to 5.8% of dietary DM did not influence productivity and had minute effects on milk FA profile. The limited responses in this study may have been influenced by dietary unsaturated FA content or the advancing stage of lactation of cows in the study.
Key words: biohydrogenation, milk fat depression, sugar

Short Communication

Dried distillers grains with solubles (**DDGS**) have acquired relevance as a feedstuff for the dairy industry due to their highly digestible NDF fraction with low lignin content (NRC, 2001; Getachew et al., 2004). In addition, DDGS are considered an excellent source of RUP (Santos et al., 1998) and are used as an alternative energy source to replace feeds such as corn and soybean meal (Powers et al., 1995). The resulting decrease in dietary starch content can help minimize the incidence of rumen acidosis (Kleinschmit et al., 2006). Inclusion of DDGS is often limited to 10% of DM (Hollmann et al., 2011), despite some references (Janicek et al., 2008; Ranathunga et al., 2010) demonstrating success in proportions up to 30% of DM. The primary limitation is the high unsaturated fat content in DDGS (Sasikala-Appukuttan et al., 2008), which can be detrimental from a milk fat production standpoint (Hollmann et al., 2011). Recent research (Martel et al., 2011) has demonstrated that replacing corn with cane molasses at up to 5.0% of diet DM can partially alleviate milk fat depression (**MFD**) when cows are fed high-concentrate, low-fiber rations containing DDGS; however, this change also decreased milk protein and lactose yields, resulting in no improvement in SCM yield. The diets used by Martel et al. (2011) were extremely low in fiber and high in starch, with the goal of ensuring that MFD occurred in the control treatment. The main objective of the present study was to determine whether molasses products would alter the milk FA profile or improve

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ECM yield in the context of a more typical lactation diet. A secondary objective was to assess production responses to increasing RDP supply when molasses was fed to lactating dairy cows.

The Kansas State University Institutional Animal Care and Use Committee approved all experimental procedures. Forty Holstein cows (12 primiparous and 28 multiparous; 196 ± 39 DIM) from the Kansas State University Dairy Cattle Teaching and Research Unit (Manhattan) were stratified by parity (primiparous vs. multiparous) and milk fat concentration on the previous DHIA test day. Within strata, cows were randomly assigned to 1 of 4 pens (10 cows/pen; 7 multiparous and 3 primiparous), and pens were randomly assigned to a treatment sequence in a 4 × 4 Latin square design, balanced for carryover effects. Treatments were designed to contain between 2.5 and 5.0% molasses (DM basis) to potentially alleviate MFD (Martel et al., 2011). Treatments were a control (**CON**) diet, including (on a DM basis) 20% DDGS, 35% NDF, 30% starch, and 5% ether extract; a diet with 4.4% cane molasses replacing a portion of ground corn grain (**MOL**); a diet with 2.9% molasses supplement (**MS3**; Dairy TMR 20; Quality Liquid Feeds, Dodgeville, WI); and a diet with 5.8% of the same molasses supplement (**MS6**). Each diet (Table 1) was formulated to meet NRC (2001) requirements for all nutrients for cows of 645-kg BW producing 45 kg of milk/d with 3.5% milk fat and 3.3% milk protein. Corn silage DM was determined twice weekly to adjust its inclusion rate. Rations were delivered as TMR, and cows were fed once daily (630 h) for ad libitum intake and milked 3 times daily (0600, 1300, and 2000 h) throughout the experiment. Treatment periods were 21 d, with 17 d for diet adaptation and 4 d for sample and data collection, and the study was conducted between April 16 and July 8, 2009.

During the final 4 d of each period, feed offered and refused were measured for each pen daily to determine feed intake. Samples of TMR and each feed ingredient were collected daily and stored frozen. Samples were composited by period, dried in a 55°C forced-air oven for 48 h, and ground through a 1-mm screen (Wiley mill; Arthur H. Thomas Co., Swedesboro, NJ) before analysis of DM, CP, NDF, crude fat, and starch (Dairy One Laboratories, Ithaca, NY). Samples were dried in a forced-air oven for 16 h at 105°C to determine

Table 1. Ingredient and nutrient composition of diets

	Treatment[1]			
Item	CON	MOL	MS3	MS6
Ingredient[2]				
Corn silage	45.6	45.6	45.6	45.6
Alfalfa hay	9.2	9.2	9.2	9.2
Corn DDGS[3]	20.1	20.0	19.9	20.1
Ground corn grain	14.8	10.7	13.5	12.2
Soybean hulls	2.5	1.5	2.5	2.5
Cane molasses		4.4		
Molasses supplement[4]			2.9	5.8
Soybean meal	3.0	3.8	1.5	
Expeller soybean meal[5]	3.0	3.0	3.0	3.0
Limestone	0.82	0.81	0.81	0.82
Trace mineral salt	0.35	0.35	0.35	0.35
Micronutrient premixes[6]	0.16	0.16	0.16	0.16
Nutrient[2]				
DM (%, as fed)	57.7	57.1	57.0	56.8
CP	16.3	17.0	16.4	16.8
RDP[7] (% of CP)	60.2	60.8	61.8	63.4
NDF	34.6	33.4	33.4	32.9
Starch	29.5	24.8	28.0	26.3
Ether extract	5.0	4.9	4.8	4.8
NE_L[7] (Mcal/kg)	1.81	1.81	1.79	1.81

[1]CON = control; MOL = 4.4% molasses replacing corn; MS3 = 2.9% molasses product replacing corn; MS6 = 5.8% molasses product replacing corn.

[2]Values are expressed as a percentage of diet DM, unless otherwise specified.

[3]DDGS = dried distillers grains with solubles.

[4]Dairy TMR 20 (Quality Liquid Feeds, Dodgeville, WI).

[5]Soy Best (Grain States Soya Inc., West Point, NE).

[6]Premix consisted of 26.1% magnesium oxide, 22.4% selenium premix (600 mg of Se/kg), 25.8% 4-Plex (Zinpro Corp., Eden Prairie, MN), 17.2% vitamin E premix (44 IU/g), 6.9% vitamin A premix (30 IU/g), and 1.7% vitamin D premix (30 IU/g).

[7]Predicted according to NRC (2001) at 3× maintenance intake.