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Effects of Adding Extra Molasses to a Texturized Calf Starter on Rumen Development, Growth Characteristics, and Blood Parameters in Neonatal Dairy Calves*

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ABSTRACT

A texturized calf starter containing 5 (control) or 12% molasses [on a dry matter (DM) basis] was fed to dairy calves to determine effects on intake, growth, blood parameters, and rumen development. Forty-six Holstein calves (26 male and 20 female) were started at 2 ± 1 d of age and studied for 42 d. Starter DM intake was measured and fecal scoring was conducted daily. Growth and blood parameter measurements were conducted weekly. A subset of 6 male calves (3 per treatment) was euthanized at 4 wk of age, and rumen tissue sampled for rumen epithelial growth measurements. Starter sugar content was significantly increased in the starter containing extra molasses. Postweaning and overall starter DM intake, overall total DM intake, daily heart girth change, and final heart girth were significantly decreased, whereas overall average daily gain tended to decrease when calves received starter containing 12% molasses. However, blood volatile fatty acid concentrations were significantly increased when calves received a starter containing 12% molasses. No significant differences were observed between calves receiving starters containing 5 or 12% molasses for all other variables. The data indicates that adding extra molasses to a texturized calf starter decreases intake and structural growth, possibly causing decreased weight gain, but increases blood volatile fatty acid concentrations and slightly increases ruminal development. However, feed handling and physical prehension problems in addition to the negative influences on calf growth and intake do not support increasing starter molasses content to 12% of the supplement.
(**Key words:** molasses, rumen development, calves)

Abbreviation key: ADG = average daily gain, **BVFA** = blood VFA, **CO** = 5% molasses, **EM** = 12% molasses, **FE** = feed efficiency, **HEM** = blood hematocrit, **HG** = heart girth, **HH** = hip height, **HW** = hip width, **PTP** = plasma total protein, **WH** = withers height.

INTRODUCTION

Calf starter rations commonly contain approximately 5 to 12% liquid molasses to increase palatability, minimize particle separation, and decrease dust (Morales et al., 1989). Reported intake, growth, and rumen parameter alterations suggest that additional molasses may affect calf growth and rumen development. Increased DM or OM intake has been reported with dietary molasses inclusion at 10 to 20% in forage-based diets when fed to mature ruminants (Brown et al., 1987; Morales et al., 1989; Brown and Johnson, 1991). Conversely, molasses inclusion in dairy cow rations has depressed intakes with high quality forage diets and high concentrate diets, and when concentrates and forages were fed separately (Lofgreen and Otagaki, 1960; Komkris et al., 1965; Morales et al., 1989). These results suggest that diet quality influences intake alterations, with additional molasses increasing intake to a greater extent with low quality diets than with high quality diets. Because preweaned calf diets are unlike other diets tested, (containing minimal forage and having a high nutrient concentration), the influence of molasses level on calf intake is uncertain. Dietary molasses inclusion has been reported to increase BW gain in growing and mature beef cattle; with increased intake and improved N use indicated as causative effects (Bond and Rumsey, 1973; Brown et al., 1987; Brown and Johnson, 1991). Improved N use, with dietary molasses inclusion, may be a result of synchronized N and energy availability in the rumen. Conversely, decreased gains, similar to those observed with restricted intake, have been reported with molasses inclusion in mature dairy cattle (Bohman et al., 1954; Lofgreen and Otagaki, 1960; Heinemann and Hanks, 1977).

Increased dietary energy via molasses supplementation has improved feed use efficiency in mature ruminants; however, these results with high forage diets may have limited applicability to the feeding of calves

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(Kellogg and Owen, 1969; Brown et al., 1987; Morales et al., 1989). In contrast, molasses inclusion in high-energy dairy cow diets has decreased feed efficiency (**FE**), possibly due to depressed energy digestibility or energy use efficiency (Lofgreen and Otagaki, 1960; Heinemann and Hanks, 1977). Waldo and Schultz (1960) indicated that sucrose moderately increased in vivo butyrate production in steers. Other studies have reported increased rumen butyrate production with molasses or sucrose supplementation, with similar effects seen between molasses and sucrose (Owen et al., 1967; Kellogg and Owen, 1969; Bond and Rumsey, 1973). The possibility for increased butyrate production with molasses is of interest in rumen development due to findings that sodium butyrate increases rumen epithelium development to a larger extent than sodium propionate or sodium acetate (Flatt et al., 1958; Sander et al., 1959; Tamate et al., 1962). Possible increases in butyrate production suggest the potential for a molasses influence on calf rumen development. However, this possible influence has not been previously researched. Therefore, this study was conducted to determine the effects of adding extra molasses to a texturized calf starter on rumen development, the physical form of the starter, intake, growth characteristics, blood parameters, and scour occurrences.

MATERIALS AND METHODS

Animals, Housing, and Diet

Treatments consisted of a texturized calf starter containing 5% (**CO**) or 12% (**EM**) molasses, as a percentage of starter DM. Starter containing EM was prepared by hand by mixing 10% (as fed) additional liquid cane molasses (74.0% DM; 4.7% CP, 60.6% sugars as invert, 12.2% ash, all on DM basis) into the CO starter. Forty-six Holstein calves (26 male and 20 female) were separated from their dams shortly after birth, randomly assigned by sex to a treatment, blocked by birthdate (23 blocks/treatment), and placed on study at 2 ± 1 d of age. Calves were cared for and maintained according to guidelines stipulated by The Pennsylvania State University Animal Care and Use Committee. Abrupt weaning occurred at 28 ± 1 d of age, with calves maintained on the study until 42 ± 1 d of age. Calves were housed in a naturally and mechanically ventilated barn from February through July, and kept in 1.2 × 2.4 m individual pens bedded with wood shavings. Nose to nose contact between calves was minimized by pen arrangement. All calves received 4 L of colostrum within 12 h of birth, followed by 4 feedings of colostrum. Calves received a 20% CP, 20% fat, nonmedicated milk replacer containing all-milk protein (Land O' Lakes Animal Milk Products Co., Arden Hills, MN) from 3 d of age until weaning. Milk replacer was provided in 2 equal feedings at 10% of birthweight until abrupt weaning. Texturized calf starter was offered ad libitum and intake was measured daily, beginning when calves were placed on the study. Water was provided ad libitum and changed twice daily.

Starter Nutrient Composition and Particle Size

Starter samples were collected twice weekly, composites made biweekly, and stored at –20°C for further analysis. Samples were then dried at 55°C in a forced air oven and ground (1-mm screen; Wiley mill, Arthur A. Thomas Co., Philadelphia, PA). All feeds were analyzed in duplicate for moisture (AOAC, 1990). Crude protein (AOAC, 2000) was analyzed using a Leco FP-528 Nitrogen Combustion Analyzer (Leco, St. Joseph, MI) with soluble CP determined as described by Krishnamoorthy et al. (1982), where insoluble protein was recovered on 7-cm (diameter) filter paper (Whatman 541, Fisher Scientific, Pittsburgh, PA) and introduced into a Leco FP-528 Nitrogen Combustion Analyzer for determination of CP (AOAC, 2000). Energy values were calculated using the NRC (2001) model. Starter samples were analyzed for NDF (Van Soest et al., 1991), ADF (AOAC, 1990), and crude fat (AOAC, 1990) using a Tecator Soxtec System HT 1043 Extraction unit (Tecator, Foss NA, Eden Prairie, MN). Ash and mineral content were determined (AOAC, 1990) utilizing a Perkin-Elmer 3300 XL ICP (Perkin-Elmer, Shelton, CT). Starch and sugar content were determined according to Holm et al. (1986) and Dubois et al. (1956), respectively. Samples were extracted for 4 h using a 90:10, ethanol:water extract for sugar analysis. Values for nonstructural carbohydrates were calculated by addition of starch and sugar content. Particle size distribution was determined using an Analysette 3 PRO Vibratory Sieve Shaker (Fritsch, Oberstein, Germany). Approximately 330 g (DM) of starter was placed on a series of stacked sieves arranged in descending order and shaken for 2 min at an amplitude of 0.7 mm. Following separation, retained particles were weighed to determine the amount and percentage of DM retained on each sieve.

Fecal Scoring and Experimental Measures

Fecal scoring for determination of fecal fluidity, consistency, odor, and days scoured was conducted daily using the procedure of Larson et al. (1977). Scoring was as follows: for fecal fluidity, 1 = normal, 2 = soft, 3 = runny, and 4 = watery; for fecal consistency, 1 = normal, 2 = foamy, 3 = mucousy, 4 = sticky, and 5 = constipated; for fecal odor, 1 = normal, 2 = slightly offensive, or