Effects of feeding dry propylene glycol to early postpartum Holstein dairy cows on production and blood parameters. 2009.Y.-H. Chung[1], I. D. Girard, and G. A. Varga. (In Press, ANIMAL).

ABSTRACT

Eighteen multiparous and 19 primiparous Holstein dairy cows were used in a completely randomized design with restrictions to evaluate the effects of feeding propylene glycol (PG) as a dry product via two delivery methods on production and blood parameters. Propylene glycol treatments were administered from parturition through 21 days postpartum. Treatments were: (1) control: no PG, (2) top dress: 162.5 g/d of PG by top dressing onto the total mixed ration (TMR), and (3) mixing: 162.5 g/d of PG as a part of the TMR by incorporating it into the TMR. Propylene glycol used was a dry product which contained 65% pure PG and 35% silicon dioxide as the dry carrier. Coccygeal blood was sampled on 4, 7, 14, and 21 days in milk (±1.50 pooled s.d.). Supplementation of dry PG by top dressing onto or incorporating into the TMR had no effects on average dry matter intake, milk yield and composition, serum insulin, serum and plasma metabolites, and milk ketones, except for urine ketones. Concentrations of urine ketones tended ($P = 0.10$) to be reduced by PG supplementation from 41.5 to 15.2 mg/dL. This reduction in urine ketones by PG supplementation can be explained by the numerically lower ($P = 0.15$) plasma β-hydroxybutyrate (BHBA) concentrations observed for cows supplemented with PG. Supplementation of PG tended to decrease the incidence for subclinical ketosis from 39 to 24 and 13% for cows fed a TMR supplemented with no dry PG, with dry PG as a top dress and dry PG as a part of the TMR, respectively. It is concluded that supplementing PG as a dry product via incorporating into the TMR is as effective as when used as a top dress based on the efficacies of both delivery methods to numerically reduce urine ketones concentrations and therefore the incidence for subclinical ketosis during the first 21 days of lactation. However, it should be noted that the number of cows used in the current study was minimal, and more cows are needed to confirm the efficacy of supplementing PG as a dry product on reducing the prevalence of subclinical ketosis in dairy cows during the first month of lactation.

Rumen and Blood Metabolites of Holstein Dairy Cows Provided Propylene Glycol during Frequent Feeding. 2009.Y.-H. Chung, C. M. Martinez, N. E. Brown, T. W. Cassidy, and G. A. (In press, J. Dairy Science).

ABSTRACT

The objective of the current experiment was to study responses of rumen and blood metabolites of Holstein dairy cows to propylene glycol (PG) under different methods of delivery. Cows were frequently fed at 12× feeding/d to minimize postprandial influences on blood metabolites. By providing the same amount (200 ml or g) of PG, delivery methods for PG assessed were: (1) control: no PG, (2) mixing: 200 g of PG as a dry product (65% purity; corresponded to 308 g of the dry product) mixed into the TMR, (3) oral-drench: 200 ml of liquid PG (100% purity) orally drenched, and (4) rumen-drench: 200 g of PG as a dry product drenched via rumen cannula. Eight multiparous (lactation no. = 3 ±1 SD) rumen-cannulated Holstein dairy cows (DIM = 204 ±104 SD) were fed PG for 4 days in a replicated 4 × 4 Latin square design with experimental length of 14 days for each period. On the last day of each period, serial blood samples were removed from an indwelling catheter placed in the external right jugular vein immediately before and for 4 h after PG administration. Rumen content were sampled hourly for 4 h. Milk was sampled from two consecutive milkings during each period. Dry matter intake and milk yield were not affected by PG. Percentages of milk lactose were increased by PG delivered by all methods tested in the current experiment. Ruminal concentrations of acetate were decreased and concentrations of propionate and isovalerate were increased by PG, regardless of delivery method; however, total volatile fatty acid concentration was not affected by PG. Ruminal concentrations of butyrate were decreased and concentrations of valerate were increased by PG drench, either via oral or ruminal drench. The degree of reduction in butyrate concentration or increase in valerate concentration was affected by PG dose. Serum insulin peaked more rapidly and to a higher concentration for cows receiving PG via drenching but not when provided as a part of the TMR. Plasma glucose, however, tended to peak more rapidly to a higher concentration for cows receiving PG, regardless of delivery method. Results obtained from the current experiment showed that blood and rumen metabolites responded similarly to liquid or dry PG drench indicating that top dressing dry PG can be as effective as oral drenching.

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Effects of Feeding Dry Glycerin to Early Postpartum Holstein Dairy Cows on Lactational Performance and Metabolic Profiles

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ABSTRACT

Effects of feeding a dry glycerin product (minimal 65% of food grade glycerol, dry powder) to 39 multiparous Holstein dairy cows (19 control and 20 glycerin-supplemented; lactation number = 2.2 ± 1.3 SD) on feed intake, milk yield and composition, and blood metabolic profiles were investigated. Dry glycerin was fed at 250 g/d as a top dressing (corresponding to 162.5 g of glycerol/d) to the common lactating total mixed ration from parturition to 21 d postpartum. Individual milk was sampled from 2 consecutive milkings weekly and analyzed for components. Blood was sampled from the coccygeal vein at 4, 7, 14, and 21 (±0.92, pooled SD) d in milk and analyzed for urea nitrogen, glucose, insulin, nonesterified fatty acids, and β-hydroxybutyrate. Urine was tested for the acetoacetate level weekly by using Ketostix. Average feed intake, milk yield and components, blood metabolites, and serum insulin concentrations were not affected by dry glycerin supplementation. Glycerin-supplemented cows experienced a more positive energy status (higher concentrations of plasma glucose, lower concentrations of plasma β-hydroxybutyrate, and lower concentrations of urine ketones), which was observed during the second week of lactation, suggesting that energy availability may have been improved. This glucogenic effect of dry glycerin did not result in an increase in feed intake or milk yield during the first 3 wk of lactation, likely because of the relatively less negative energy status of cows transitioning into lactation. The tendency toward higher milk yield for glycerin-supplemented cows during wk 6 of lactation (52 vs. 46 kg/d) after the supplementation period (dry glycerin was terminated at wk 3 of lactation) suggested a potential benefit of dry glycerin on subsequent milk production, perhaps through changes in metabolism, which requires further investigation.

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Key words: glycerol, early postpartum dairy cow, milk yield, blood metabolic profile

INTRODUCTION

Glycerol is an important structural component of triglycerides and phospholipids. The glucogenic property of glycerol is well established (Cori and Shine, 1935). When the body uses body fat reserves as a source of energy, glycerol and fatty acids are released into the bloodstream. The glycerol component can be converted to glucose by the liver (Krebs et al., 1966) and kidneys (Krebs and Lund, 1966) and provides energy for cellular metabolism. As early as the 1950s, glycerol was used to treat ketosis in dairy cows via drenching orally, feeding with concentrates, or both, with a relatively large dose (Johnson, 1951, 1954). At that time, however, the cost of glycerol made it less economically feasible as a treatment for ketosis compared with propylene glycol. More recently, surplus production of glycerin (or glycerol) from biodiesel fuel production has made various forms of glycerin an attractive glucogenic substrate for feeding livestock.

Surplus glycerin from biodiesel fuel production will likely flood glycerin supplies for the traditional uses, although there are many applications for glycerin, such as using it as an energy source in livestock diets. From very limited research, glycerin has been fed as a feed ingredient to replace energy sources such as corn for up to 10% of the total ration DM for broiler chickens (Simon et al., 1996) without negatively affecting feed intake, weight gain, and feed conversion ratio and up to 15% of the total ration DM for Holstein dairy cows (Donkin et al., 2007) without deleterious effects on milk production or composition. Glycerin has been fed to early postpartum dairy cows (Fisher et al., 1973; DeFrain et al., 2004; Ogborn, 2006) or cows in early (Fisher et al., 1971) to midlactation (Khalili et al., 1997) as an energy supplement rather than as a major feed ingredient. Glycerin, when fed as a glucogenic supplement, did not improve milk yield when compared with propylene glycol (Fisher et al., 1971, 1973) or when it was substi-

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Effects of rumen-protected choline and dry propylene glycol on feed intake and blood parameters for Holstein dairy cows in early lactation

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ABSTRACT

A 6 × 6 Latin square design was used to test 3 sets of comparisons simultaneously to study response in dry matter intake, milk yield, and blood parameters to propylene glycol (PG) supplementation delivered by 2 methods [incorporating PG into the total mixed ration (TMR) vs. top dressing; comparison I]; individual or combined dietary choline and PG supplementation as a 2 × 2 factorial (comparison II); or increasing amounts of dietary choline (comparison III). Six multiparous (lactation number = 1.5 ± 0.8 SD) Holstein dairy cows were at 41 d in milk (± 9 SD) at the start of the experiment. Propylene glycol used was a dry product containing 65% PG, and choline was a rumen-protected choline product (RPC; estimated to be 50% rumen-protected) containing 50% choline chloride. In comparison I, treatments compared were 1) control: no PG; 2) PG-TMR: 250 g/d of dry PG (corresponding to 162.5 g/d of PG) incorporated into the TMR; and 3) PG-top dress: 250 g/d of dry PG top-dressed onto the TMR. In comparison II, treatments compared were 1) control: no PG and no RPC; 2) PG: 250 g/d of dry PG incorporated into the TMR; 3) RPC: 50 g/d of RPC top-dressed onto the TMR; and 4) PG+RPC: combination of treatments 2 and 3. In comparison III, treatments compared were 0, 25, and 50 g/d of RPC top-dressed onto the TMR. Each experimental period lasted 10 d with 9 d of adaptation followed by 1 d of serial blood sampling. Dry matter intake and milk yield were recorded daily. During the serial blood sampling, jugular blood was sampled every 20 min for the first 4 h and at 8 and 12 h after treatment administration. Results obtained from comparison I showed that feeding 250 g/d of PG as a dry product decreased plasma β-hydroxybutyrate (BHBA) concentration (mean ± SEM) from 701 ± 81 (control) to 564 ± 76 μmol/L without affecting serum insulin, plasma glucose, or plasma nonesterified fatty acid concentrations. Top-dressing PG decreased plasma BHBA concentrations more than by incorporating it into the TMR [527 vs. 601 μmol/L (± 81 pooled SEM)]. Results obtained from comparison II showed that supplementing choline as RPC, PG, or both had no effect on dry matter intake, milk yield, or any of the blood parameters measured. Results obtained from comparison III showed that milk yield tended to increase linearly with increasing amounts of dietary choline as RPC. We concluded that feeding PG as a dry product reduced plasma BHBA concentration but top-dressing PG was more efficient at reducing plasma BHBA level than incorporating PG into the TMR. Dietary choline as RPC tended to increase milk yield linearly. However, a combined effect of dietary PG and choline was not evident and therefore not beneficial.

Key words: rumen-protected choline, dry propylene glycol, feed intake, blood parameter

INTRODUCTION

Johnson (1954) demonstrated the ability of propylene glycol (**PG**) to effectively treat ketosis in dairy cows. Supplementation of PG by incorporating it into the concentrate has been shown to decrease blood concentrations of NEFA and BHBA (Fisher et al., 1971; Hoedemaker et al., 2004) and increase blood concentrations of glucose and insulin (Sauer et al., 1973; Patton et al., 2004). Feeding PG instead of routine oral drenching may be better accepted by dairy producers, as PG is a readily available energy supplement to alleviate negative energy balance and subsequently prevent subclinical ketosis. Lewis and Price (1957) demonstrated the ability of choline, via subcutaneous injection, to treat cows suffering from fatty infiltration in the liver after parturition. More recently, Cooke et al. (2007) demonstrated the ability of dietary choline to prevent and alleviate hepatic lipid accumulation in cows with experimentally induced fatty liver. The first hypothesis of the current study was that feeding PG as a dry product can improve energy status as indicated by key blood parameters. The first objective was to study responses of DMI, milk yield, and blood parameters to dry PG supplementation. Two delivery methods (top-dressing vs. incorporating into the TMR) for dry PG supplementation were studied to compare efficacy

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