Environmental Science Graduate Program Seminar Series

Using dietary strategies to reduce environmental impacts related to dairy production

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Abstract

There are several ways to manipulate ruminant diets to improve efficiency of production and reduce environmental impacts. Some of them include feeding ingredients that will optimize starch fermentation in the rumen and allow a reduction in enteric methane (CH4) production, others include balancing the diet for amino acids (AA) to supply 'more precisely' the animal requirements, which in turn reduces nitrogen excretion (through feces and urine). To balance diets for AA, a better understanding of the metabolism of major limiting AA [e.g., Lysine (Lys)] is needed. The results of 2 studies evaluating independently the previously mentioned feeding strategies will be discussed. In the first study, corn that was developed to contain high alpha-amylase expression (i.e., Enogen corn) was evaluated on nutrient digestibility, production, and CH4 emission in lactating cows. For that, 15 cows were used in a replicated 3×3 Latin square design (LSD) with 3 treatments: CON, a diet containing isoline corn silage (CS) and isoline corn grain (CG); ECS, a diet with Enogen CS and isoline CG; ECSCG, a diet with Enogen CS and Enogen CG. Total tract digestibility of nutrients were not different among treatments. Milk yield increased only for ECS compared with CON (36.5 vs. 33.1 kg/d; P=0.03). Milk protein yield was greater (P=0.02) for ECS vs. CON and ECSCG (no difference between CON and ECSCG). Milk fat content tended to be lower (P=0.06) for ECS vs. CON and ECSCG (no difference between CON and ECSCG). Methane yield decreased (11.5 vs. 13.5 g/kg dry matter intake; P=0.04) only for ECS vs. CON. In the second study, Lys utilization, excretion, and contribution to other AA (transamination after oxidation) were explored using a stable isotope technique. For that, 4 ruminally-cannulated cows in a 4×4 LSD (17-d periods) received Lys at 0, 25, or 50 g/d into the abomasum via continuous infusion for the last 5 d (L0, L25, or L50, respectively) or rumen-protected Lys at 105 g/d (42 g/d Lys) for 17 d in each period. Increasing Lys supply from L25 to L50 increased digestible Lys (dLys; P=0.05) from 132 to 152 g/d and increased dLys that was utilized for milk (108.1 to 117.5 g/d, P=0.02) and numerically increased that was excreted in urine (23.6 to 34.2 g/d; P=0.21). Proportion of dLys transferred to milk (80%) and urine (20%) were not affected by dLys supply. 15N enrichment occurred in almost all milk AA and was significantly or numerically greater for L50 vs. L25. In conclusion, for the first study, ECS increased milk and protein yields and lowered CH4 yield compared with CON, possibly because of greater starch availability in the rumen. However, ECSCG had only numerical effects on milk yields compared with CON. For the second study, our results confirmed large flexibility of the mammary glands to supply AA through transamination. Increasing dLys increased Lys uptake by the mammary gland but also increased Lys oxidation contributing to other AA for milk protein.

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