EFFECT OF DIETARY CRUDE PROTEIN LEVEL AND DEGRADABILITY ON RUMINAL FERMENTATION AND NITROGEN UTILIZATION IN LACTATING DAIRY COWS

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Protein nutrition of dairy cows is critically important for maintaining high and economical milk production, but is also a contributing factor to nitrogen emissions from dairy operations. Effect of dietary crude protein (CP) on milk yield and nitrogen losses has been extensively studied, however, diets with different CP levels often provide varying amounts of metabolizable protein (MP) to the cow, which may determine treatment responses. The objectives of this study were to evaluate the effect of dietary CP level and degradability on ruminal fermentation, nutrient digestibility, efficiency of utilization of ruminal ammonia N for milk protein synthesis, and urinary N losses in dairy cows.

The trial utilized four ruminally and duodenally cannulated multiparous Holstein dairy cows (DIM 257 ± 161; BW 757 kg ± 61) allocated to two dietary treatments in a crossover design. The diets were based on alfalfa hay, triticale silage, whole cottonseed, corn grain, soybean meal, and molasses and were formulated to contain (DM basis): (1) 17.6% CP, 10.8% MP, 11.7% ruminally degradable protein (RDP), and 5.9% ruminally undegradable protein (RUP), HP diet; and (2) 15.7% CP, 10.8% MP, 9.8% RDP, and 5.9% RUP, LP diet. Higher RUP in LP was provided through partial substitution of solvent-extracted SBM HP diet with lignosulfonate-treated SBM (Soypass). Acid-insoluble ash was used as a digestibility marker. Ruminal ammonia was labeled with ^{15}N (from $(^{15}NH_4)_2SO_4$) and excretion of marker in milk protein was determined for a period of 120 h. Actual CP content of the diets was 18.5 and 17.2%, HP and LP, respectively.

Ruminal ammonia concentration tended to be higher ($P < 0.1$) on HP than LP (10.8 vs 8.7 mmol/L, respectively) but pH, protozoal numbers, and VFA did not differ ($P > 0.05$) between treatments. Dry matter intake (23.8 and 23.5 kg/d, HP and LP, respectively), milk yield, fat content, and protein content and yield were not different ($P > 0.05$) between the two diets. Milk fat yield was higher ($P < 0.05$) on HP than LP (0.915 and 0.816 kg/d, respectively. Dietary N intake was higher ($P < 0.05$) in HP than in LP (0.703, 0.645 kg/d, respectively). Fecal N output was not different ($P > 0.05$) between the diets. Dietary N digestibility tended ($P < 0.1$) to be greater on the HP diet than on the LP diet (73.3 vs 71.5 %, respectively). Urinary N excretion was numerically ($P = 0.147$) higher on the HP diet than on the LP diet (0.307 vs 0.253 kg/d, respectively). The cumulative excretion of ammonia ^{15}N into milk protein, as proportion of ^{15}N dosed intraruminally, was not different between the two diets (11.8 vs 14.3%, HP and LP, respectively). The area under the milk protein ^{15}N excretion curve was greater ($P < 0.05$) for LP compared to HP (1.049 vs 0.957 at % exc. × h, respectively). The proportion of milk protein N originating from ruminal bacterial N was not different ($P > 0.05$)

between the two diets (58.2 and 60.8%, HP and LP, respectively). Milk urea N concentration was higher ($P < 0.05$) in HP than in LP (15.8 vs 13.1 mg/dl, respectively).

Excess RDP in the diet resulted in higher ruminal ammonia and milk urea N concentrations but had no significant effect on the efficiency of utilization of ruminal ammonia for milk protein, urinary N losses, or milk yield and -fat and protein content.