Effects of Three Ratios of Rumen Available Protein to Microbial Crude Protein on Greenhouse Gases and Ammonia Emissions from Feedlot Beef Steers

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One hundred twelve Black Angus steers (body weight; **BW** = 401 + 3.6 kg) were used in a randomized incomplete block design to evaluate the effects of 3 rumen available protein to microbial crude protein ratios (**RAP:MCP**) on growth performance, and gaseous emissions from feedlot steers. Steers were blocked by initial BW and randomly assigned to 1 of 3 treatment rations. Diets were either Deficient (-150 g/hd/d; **DEF**), Balanced (0 g/hd/d; **BAL**) or Excess (+150 g/hd/d; **EXS**) in RAP: MCP. Steers were allocated and housed in 8 cattle pen enclosures (**CPE**) with 14 steers per CPE, and treatments diets were delivered daily as a total mixed ration. The present study consisted of two 42-day periods. Orts were collected weekly and BW every 14 days. Gas measurements were obtained daily in sequential order from all CPE. Data were analyzed with R statistical software (4.2.3). The linear mixed effect model procedure within the "lme4" package was used with CPE as the experimental unit, treatment and week as fixed effects, and block and period as random effects. Treatment means were estimated for each intermediary point (14 days), and for the duration of the experimental period (42 days). Gaseous emissions data is presented as cumulative emissions, which is the sum of emissions from all days within each intermediary time point. A contrast coefficient matrix was constructed to test for linear and quadratic effects. Initial, intermediary, and final BW were not different for steers receiving the varying RAP:MCP ($P \geq 0.239$). A treatment effect ($P = 0.004$) was observed for DMI on d 0 to 42 where EXS steers consumed 0.46 kg more DM compared to BAL fed steers, but DEF steers had similar DMI to those fed EXS and BAL ($P = 0.189$). Average daily gain (**ADG**) was only affected by treatment ($P = 0.007$) on d 0 to 14 where steers receiving DEF gained 0.6 kg more than those fed BAL ($P = 0.010$), but those fed EXS had similar ADG. Similar to ADG, gain to feed (**G:F**) was affected by treatment ($P = 0.012$) only during d 0 to 14. Methane (**CH_4**) emissions from steers fed DEF and EXS were 22% and 12% greater ($P = 0.010$) compared to those fed BAL, respectively; however, CH_4 from EXS vs. DEF steers was not different ($P = 0.149$). Cumulative NH_3 emissions increased linearly by treatment with EXS steers emitting up to 46% more NH_3 compared to those receiving DEF ($P < 0.001$). Similarly, EXS steers had increased SO_2 emissions of up to 50% compared to those fed DEF ($P < 0.001$). Emissions of CO_2, N_2O, and H_2S were similar across all treatment groups ($P > 0.100$). The manipulation of RAP:MCP in the diets of feedlot steers, can have a significant impact on gaseous emissions from feedlot cattle without negatively affecting growth performance, and may be a valuable tool to reduce air pollution from feedlot systems.

Keywords: Ammonia, greenhouse gases, growth performance, rumen available protein, microbial crude protein.