RESEARCH ABSTRACT

ANIMAL SCIENCE

Title: Improving milk production efficiency and mitigating feed costs in lactating sows through dietary crude protein abatement and crystalline amino acid supplementation under thermo neutral and thermal stress environment model – NPB #13-120

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Date Submitted: January 19, 2016

Scientific Abstract:

Objectives 1 and 2: Forty lactating multiparous Yorkshire sows were used to test the hypothesis that reducing dietary CP and supplementing with crystalline amino acids (CAA) increases dietary N utilization for milk production during early and peak lactation. Sows were assigned to 1 of 4 diets: [1] 16.0% CP (as-fed; analyzed contents; HCP); [2] 15.7% CP (MHCP); [3] 14.3% CP (MLCP); [4] 13.2% CP (LCP); diet HCP was formulated using soybean meal and corn as the only Lys sources. The reduced CP diets contained CAA to meet requirements of the limiting AA. Sow and piglet BW were measured on d 1, 3, 7, 14, 18 and 21 of lactation. Nitrogen retention was measured on sows between d 3 and 7 (early) and d 14 and 18 (peak) of lactation. Milk true protein output was calculated from estimated milk yield and analyzed true protein concentration. Sow BW change (overall mean: −4.2 ± 3.37 kg over the 21-d lactation period) and average daily DM intake (overall mean: 4.05 ± 0.18 and 6.12 ± 0.20 kg/d, early and peak lactation, respectively) did not differ between diets. Nitrogen intake decreased as dietary CP concentration decreased (114.3, 106.0, 107.4, and 99.0 ± 5.29 g/d and 169.5, 168.3, 161.2, and 145.1 ± 5.29 g/d for HCP, MHCP, MLCP, and LCP in early and peak lactation, respectively; L: $P < 0.05$). Sow loin eye area loss tended to increase as dietary CP concentration decreased (Linear (L): $P = 0.082$). Litter growth rate (LGR) over the 21-d lactation period tended to increase with decreasing dietary CP concentration (L: $P = 0.084$). In early lactation, N retention (N intake – fecal and urinary N) and milk true protein and casein output were not affected by dietary treatment. In early lactation, as dietary CP decreased, N retained as percentage of N intake tended to increase (L: $P = 0.093$) and estimated efficiency of using retained N for milk N output was not influenced by dietary CP concentration. In peak lactation, N retention (122.5, 123.8, 121.2, and 109.0 ± 4.88 g/d for HCP, MHCP, MLCP, and LCP, respectively) decreased (L: $P < 0.05$), N retained as percentage of N absorbed (N intake – fecal N) increased (L: $P < 0.05$), milk casein yield increased (P = 0.051), and estimated efficiency of using retained N for milk N output (44.5, 51.0, 54.9, and 62.9 ± 5.9 % for HCP, MHCP, MLCP, and LCP, respectively) increased (L: $P < 0.05$). Feeding lactating diets reduced in CP from 16.0 to 14.3% with CAA inclusion as partial replacement for limiting AA improved N retention and N utilization efficiency for milk protein production in peak lactation, while these effects were less pronounced in early lactation.

Objectives 3 and 4: The objective of this study was to test the hypothesis that feeding a diet containing lower dietary CP and supplemental crystalline AA compared to a diet formulated to meet Lys requirement with not supplemental AA, reduces ammonia emission and maintains lactation performance in sows housed under thermo-neutral and thermal heat stress environments. Thirty-six, parity 2 and 3, Yorkshire sows were allocated to a 2 × 2 factorial arrangement of 2 environmental temperatures, thermo-neutral (21°C; TN) and heat stress (31.5 °C; HS), and 2 dietary treatments, 17.16 (Control) and 11.82% CP (Low), in a randomized complete block design. The HS sows were acclimated between d 107 and 114 of gestation to increasing daytime temperature from 21 to 31.5 °C. During lactation, temperature for HS sows were incrementally changed (24 to 31.5 °C and 31.5 to 24°C) from 0500 to 1500 and 1800 to 0500, respectively. Control diet met SID Lys requirement with no added CAA and Low diet contained added crystalline Lys, Thr, Trp, Val and Phe. Sows were housed in individual environmentally controlled rooms with continuous emissions monitoring. Compared to Control, piglet ADG and sow feed intake (FI), true milk protein concentration (TMP), weight loss (ΔBW), heart rate (HR), and respiration rate (RR) of Low-fed sows did not differ. Compared to Control, MUN and ammonia emissions decreased for sows fed Low ($P < 0.0001$). Change in back fat thickness (ΔBF), body temp (BT), and days post weaning to estrus (WtE) did not differ between Control and Low. Compared to TN, BW loss, HR and RR of HS sows were greater ($P < 0.05$). Compared to TN, piglet ADG of HS sows were less ($P < 0.05$). Neither O_2 consumption nor CO_2 production differed between sows fed Control and Low diets under TN or HS environments. Diet costs increased with increasing dietary AA supplementation when using feed prices from 2012 however when using feed prices from 2012 and AA prices from 2015, diet costs only increased by 5%. In conclusion, feeding reduced CP diet to lactating sows improved N utilization and did not impact lactation performance of sows under either thermo-neutral or thermal heat stress environments. Feeding reduced CP diets does not decrease heat production. These results indicate that reduction of dietary CP in conjunction with aggressive CAA supplementation may be implemented for lactating sows on the basis of mitigating ammonia emissions. Reduced CP diets will be more competitive with higher protein feed cost or increased cost of N excretion. The impact of feeding reduced CP diets to lactating sows is largely the reduced excretion of N and ammonia emissions. The value of this dramatic decrease in N excretion and ammonia emission depends on environmental regulations including implementation of the clean air act (e.g., carbon tax). Given the increasing stringency of environmental regulation in agriculture and the pressure to reduce greenhouse gas emissions, feeding to decrease N excretion using synthetic amino acids is likely to become more economical.