RESEARCH ABSTRACT

ANIMAL SCIENCE

Title: Impact of disease on amino acid requirements of growing pigs. NPB 13-082 revised

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Scientific Abstract:

Changes in plasma free AA kinetics reflect modification of AA metabolism in different metabolic states. Exposure to disease-causing agents can alter (increase or decrease) requirements for amino acids (AA), both qualitatively (metabolic demand; i.e. AA use) and quantitatively (dietary AA requirements). The knowledge about the effect of disease/health status on AA requirements of swine is limited and often ignores the relationship between the AA. Thus, the primary objective of the current study was to identify AA whose utilization is influenced by disease. In recent years, there has been debate on developing an industry-applicable model of disease for studying nutrient needs of pigs during immune system stimulation (ISS). Thus, the secondary objective of the study was to compare a pre-established non-pathogenic LPS model of ISS against PRRSV model for studying nutrient metabolism in growing pigs. A total of 40 PRRSV-negative gilts (initial BW 9.4 ± 0.9 kg) of commercially relevant genetics were used in three experiments (Exp). In all Exp pigs were fed a corn-SBM based diet (ME 14 MJ/kg, SID Lys 11.5 g/kg), and feed restricted (550 g/d). In Exp 1, a total of 10 saline-treated gilts were used to establish a base line for N retention and AID of nutrients. In addition, four pigs were surgically catheterized and infused with a bolus dose of [U-^{13}C, U-^{15}N] AA mixture (Lys, Met, Thr, Trp, Ile, Leu, Val, Phe, Gln) to determine the best isotope infusion rate and blood sampling frequency for studying AA kinetics in plasma. In Exp 2 and 3 ten and twenty gilts, respectively, were surgically catheterized in the left and right external jugular. ISS was induced by repeated i.m. injection of increasing amounts of LPS (initial dose of 30 μg/kg BW), and i.m. injection of live PRRSV in Exp 2 and 3, respectively. In Exp 2 and 3, blood samples were collected via the catheters every 48 h during pre- and post-challenge period and assayed for blood chemistry, hematology, and serum viral load. Body temperature was monitored on a daily basis. In both Exp, N-balances were determined during a 3 d pre-challenge period and a 3 d post-challenge period. At the end of each N-balance period a single dose of [U-^{13}C, U-^{15}N] AA mixture was infused i.v. to study plasma AA kinetics. A series of blood samples were taken at 0, 2.5, 5, 7.5, 10, 15, 20, 30, 45, and 60 minutes post-infusion to determine the plasma isotopic enrichments of ^{13}C- and ^{15}N-AA. A double-exponential model was fitted in data in order to estimate parameters from which the plasma AA rate of disappearance (i.e. AA flux) was calculated. At the end of each post-challenge N-balance period pigs were euthanized and ileal digesta was collected for measurement of AID of nutrients. All pigs in Exp 3 became PRRSV-positive within 2-4 d post challenge as assessed by qPCR titers. No differences were observed in body temperature, blood parameters, N-balance, and feed intake between Exp 1 and pre-challenge period of Exp 2 and 3. Blood chemistry, hematology, and body temperature results indicated that both LPS and PRRSV models induced

effective ISS in pigs. However, compared to LPS, PRRSV model elicits a more severe response with a more negative impact on protein retention and AID of dietary protein in pigs. The LPS challenge numerically reduced N retention (from 9.5 to 8.9 g/d), and rate of disappearance (μmol/kg BW/h) of Lys (from 394 to 325) and Phe (from 126 to 79), without having an effect on the rate of disappearance of other AA from plasma. The PRRSV challenge reduced PD from 9.6 to 6.1 g/d, SE 0.73, but increased the rate of disappearance (μmol/kg BW/h) of Met (from 108 to 228) and Thr (from 83 to 129). PRRSV challenge also reduced Lys utilization but had no effect on the rate of disappearance of other AA. The increased Met and Thr utilization in PRRSV-challenged pigs could be associated with enhanced use of Met and Thr for the synthesis of immune system metabolites and increased catabolism of these AA. This may increase dietary Met and Thr requirements of PRRSV-challenged pigs, relative to the requirements for other AA (e.g. Lys). Collectively, results of the current project suggest that LPS and PRRSV model of ISS effectively alter the measures of immune function and metabolism. However, it seems that the effect on AA utilization is either disease-specific, or is a function of disease severity.