Arginine and Proline Synthesis is Dependent on the Small Intestine in Piglets

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The neonatal piglet is capable of synthesizing proline and arginine, but at a rate insufficient to meet the demands of growth and protein deposition. As a result, these amino acids are considered semi-essential and must be provided in the diet. It has been speculated that the synthesis of these amino acids occurs in the small intestine. Proline is the primary precursor for the synthesis of arginine and vice versa, therefore interconversion of these amino acids represent their overall syntheses. We hypothesized that if small intestinal metabolism is bypassed, that overall syntheses of arginine and proline would be reduced.

Study Design and Results: Ten piglets (1-3 d old; 1.6 kg) were used. All were fitted with gastric catheters for feeding and venous catheters for serial blood sampling during infusions and 5 piglets were also fitted with portal vein catheters. After 4 d, either an intraportal (IP) or intragastric (IG) primed, constant infusion of [guanido-^{14}C]arginine was conducted; the next day, all piglets received primed, constant infusions of [U-^{14}C]ornithine + [2,3-^{3}H]proline. By infusing amino acid isotopes via the stomach versus the portal vein, we were able to isolate small intestinal first pass metabolism in vivo.

Fluxes of arginine, proline and ornithine were lower during IP versus IG infusion, indicating substantial synthesis of arginine and ornithine by the gut. The overall % conversions of proline to arginine and from arginine to proline were much lower in IP than IG infusion. These data demonstrate that when gut metabolism is bypassed (IP), negligible synthesis of arginine from proline or proline from arginine occurs.

Implications: In situations where gut metabolism is compromised, such as low feed intake postweaning and during gastrointestinal disease, dietary arginine and proline requirements are higher because their syntheses are dramatically reduced. Dietary supplementation with arginine and/or proline during periods of gut stress may increase rates of recovery and adaptation, and thus performance. (Supported by NSERC Canada, AARI, Alberta Pork.)
