The Small Intestinal Fractional Protein Synthesis Rate Measured by an Intraperitoneal Injection of a Flooding Dose of a Stable Isotope L-[ring-$^2H_5$]Phenylalanine Tracer as a Rapid and Sensitive Biochemical Marker for Selecting Effective Growth Promoters in Weanling pigs

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Background

Dietary nutrients, especially amino acids, are preferentially utilized by the small intestine, i.e., the "gut", under challenged conditions such as weaning and infection. The gut tissue protein synthesis is a major metabolic process consuming considerable amounts of ATP energy and amino acids. Synthesized gut proteins are primarily lost in the lumen as secreting proteins and sloughed mucosal cells. When gut tissue protein synthesis is activated, less amounts of nutrients such as ATP energy and absorbed amino acids will be available for peripheral tissue protein synthesis and retention. Thus, changes in the gut protein synthesis rate can potentially be a sensitive and rapid biochemical marker for selecting effective growth promoters in weanling pigs.

Objective: This study was conducted to examine if the gut tissue fractional protein synthesis rate (FSR, %/d) could be measured with an intraperitoneal (ip) injection of a flooding dose of a stable isotope amino acid tracer such as L-[ring-$^2H_5$]phenylalanine (Phe) without surgical insertion of a catheter for tracer infusion.

Methods and Procedures: Five blocks of five 24-day-old littermate gilts, weaned at 16 days of age, were injected IP with a bolus dose of 1.5 mmol/kg bodyweight of Phe, 40% enriched with L-[ring-$^2H_5$]Phe, and dissolved in saline according to a randomized complete block design with euthanasia and blood and tissue collection at 15, 30, 45, 60, or 75 min post-injection. The tracer L-[ring-$^2H_5$]Phe enrichments in the free and bound pools were determined by gas chromatography–mass spectrometry using the *n*-propyl hepta-fluoro-butyrate derivative.

Results:

- The isotopic enrichment of L-[$^2H_5$]Phe in the plasma free pool increased logarithmically (P<0.05) from 0 to 33% and reached 99% of maximal tracer enrichment 15 min post-injection. The criterion for reaching 'flooding' is that the tracer enrichments of the free pools in plasma and the gut tissue are similar, which was achieved at 15 min after the IP injection.
- The bound-pool tracer enrichments in all organs increased linearly over time (P<0.05), showing that the IP-injected Phe was used for the gut tissue protein synthesis. The FSR of the gut tissue protein, calculated at each of the five time points, did not differ over time (P>0.05; an average of 33±1%/d).

Take Home Messages

- The study showed that IP injection of a flooding dose of L-Phe, 40% enriched with L-[$^2H_5$]Phe, was effective in measuring FSR of the small intestinal tissue protein, which could be potentially used as a sensitive and rapid biochemical marker for selecting effective growth promoters in weanling pigs.

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