Lysine degradation in the growing pig

Desmond Pink, Rajavel Elango, Walter Dixon and
Ronald O. Ball

[1]Swine Research and Technology Centre, 4-10 Agriculture/Forestry Centre, University of Alberta, Edmonton, AB T6G 2P5, ***Email:*** ron.ball@ualberta.ca

Lysine is typically the first limiting amino acid in cereal-based diets and is one of the most common feed supplements in the pig industry. Most lysine research has focused on requirements of pigs and lysine availability in feeds. Studies using radioactive tracers in whole body models have indicated significant lysine catabolism occurs extra-hepatically; the small intestine has been implicated as a major site of dietary lysine utilization, but has not been studied directly. Surprisingly, there is almost no data on lysine catabolism at the cellular level in any pig tissue.

Our objective was to determine whether lysine could be degraded by the small intestine and whether there was an effect of age on the activity of the rate-limiting enzyme, lysine α-ketoglutarate reductase (LKR) in several pig tissues. Previously published methods for lysine enzymes in the rat were found to be unsuitable and not optimal for pig tissues. New methods were developed and optimized. We optimized methods to isolate mitochondria, the cellular site of lysine degradation, from freshly isolated intestinal mucosal epithelia. LKR activity was measured in several tissues, including the small intestine, using liver LKR activity as a positive control. The capacity of different tissues to completely oxidize lysine was determined by measuring 1-^{14}C-lysine conversion to $^{14}CO_2$. Tissue LKR activity was determined in pigs (n=35) from birth to market weight to determine the effect of age.

Liver LKR activity in market-weight pigs was 4.26 $\pm$ 1.75 (nmol/min/mg mitochondrial protein); kidney, heart and mucosal epithelia LKR activities were ~50% ($P<0.05$) of liver activity (confirmed by HPLC analysis). $^{14}CO_2$ production by mucosal epithelial mitochondria confirmed small intestinal oxidation.

Implications:
The small intestine has both the enzymes required and the capacity to oxidize lysine with a potential capacity of 50% of liver perm mitochondrial protein. Intestinal utilization is about 10% of intake at requirement and appears to be obligatory.

Funded by Alberta Pork and AARI.
