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Evaluating standardized ileal digestibility of amino acids in growing pigs

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Abstract

The ileal digestibility coefficient (CSID) of amino acids (AA) and crude protein (CP) in 40 feedstuffs for growing pigs were determined with the protein-free (PF) and enzyme-hydrolyzed casein (EHC) methods. The 40 feedstuffs that were used earlier were 10 samples of cereals and cereal by-products, 12 samples of legumes, 6 samples of animal protein feedstuff and 12 samples of oil seed meals. Six growing pigs (initial body weight of 35 ± 1.5 kg), fitted with T-cannula at the terminal ileum, were randomly allocated to either a PF or a EHC diet according to a crossover design during two ileal digesta collection periods. In each period, pigs were adjusted to the experimental diets for 5 days. On days 6 and 8, ileal digesta were collected continuously for 24 h to determine ileal endogenous AA and CP losses. Pigs fed the EHC diet had a higher ileal flow of endogenous CP and of most of AA ($P<0.05$) than pigs fed the PF diet. Among the ileal endogenous AA flows (g/kg dry matter intake for pigs), methionine excretion was the lowest in pigs (0.09 and 0.25 g/kg dry matter intake) fed the PF and EHC diet, respectively, whereas glutamate (1.83 g/kg dry matter intake) and proline (1.22 g/kg dry material intake) excretion were the highest in pigs fed the EHC and the PF diet, respectively. Endogenous losses of CP and AA determined in the current study and previously published data on apparent ileal digestibility [Yin, Y.L., Huang, R.L., Zhong, H.Y., Chen, C.M., Li, T.J., Pan, Y.F., 1993. Nutritive value of feedstuffs and diets for pigs: 1. Chemical

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composition, apparent ileal and fecal digestibilities. Anim. Feed Sci. Technol. 44, 1–27] were used to calculate CSID coefficients. For most cereals and cereal by-products, the CSID coefficients of CP determined by the EHC method were higher than those determined by the PF method. Arginine, lysine, methionine, threonine, valine, alanine, aspartate, glutamate, glycine, proline and serine in some cereals and cereal by-products; methionine, valine, alanine and proline in some legumes; and methionine, alaline and proline in some oilseed meals had higher CSID determined by the EHC method than the PF method indicating that there are methodological differences when evaluating the CSID of feed ingredients.

Keywords: Endogenous losses; Enzyme-hydrolyzed casein diet; Protein-free diet; Standardized ileal digestibility

1. Introduction

The ultimate goal of swine production is the conversion of dietary protein into tissue protein that eventually can serve as a nutritious source of food for humans. There are economical and environmental interests to increase the efficiency of protein utilization (Sauer and Ozimek, 1986; Deng et al., 2007a,b; Yin et al., 2002). It is accepted that ileal methods are preferred to faecal methods to determine amino acid (AA) digestibility coefficients in feedstuff for pigs (Yin, 1994; Yin et al., 1994; Yin et al., 2000a,b; Moughan, 2003). Many studies have been carried out to determine apparent ileal digestibility (AID) of AA in a wide variety of feedstuffs. However, there is considerable variability in AID among samples of the same feedstuff (Yin et al., 1993). In addition, the variability in AID of AA is higher in cereal grains than in high-protein feedstuffs (Sauer and Ozimek, 1986). The level of AA in the basal assay diet can have a significant impact on AID as found by Fan et al. (1994) and Fan and Sauer (1995).

Values for endogenous losses are needed to convert AID to ileal digestibility coefficient (CSID) and are important components in the factorial approach for calculating AA requirements (Nyachoti et al., 1997a; Moughan, 2003). Traditionally, the endogenous losses of CP and AA from the small intestine of pigs are determined following the PF method. However, this method is criticized because of the abnormal physiological nature of the protein-free state (Low, 1980; Moughan and Rutherfurd, 1990). Methods used for determining ileal endogenous excretions of AA in pigs, include the casein or EHC based method (Moughan et al., 1990; Hodgkinson et al., 2003; Yin et al., 2004a), the homoarginine technique (Hagemeister and Erbersdobler, 1985; Nyachoti et al., 2002), regression analyses (Furuya and Kaji, 1986), and the ^{15}N-isotope dilution techniques (de Lange et al., 1992; Hodgkinson et al., 2003). The EHC method allows for the direct determination of endogenous ileal flows of nitrogen (N) and AA, because it simulates products of normal digestive breakdown (Moughan, 2003; Hodgkinson et al., 2003). Therefore, the objective of this study was to study the ileal endogenous CP and AA losses of growing pigs determined by either the PF or the EHC method and to convert the published AID coefficients (Yin et al., 1993) to CSID for practical swine formulation.