Endogenous Ileal Amino Acid Excretion in Monogastric Animals

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ABSTRACT

A new method for the determination of endogenous ileal amino acid excretion under conditions of peptide alimentation was refined and evaluated with studies involving the laboratory rat. The refined method was used to investigate aspects of endogenous ileal amino acid flow in the pig. Five studies were conducted, three with rats and two involving the growing pig.

1. Preliminary investigations evaluated the filtration efficiency of ultrafiltration devices, and examined three pre-filtration treatments for rat ileal digesta: trichloroacetic acid (TCA) and perchloric acid (PCA) precipitation, and centrifugation (SPIN). The recovery of nitrogen following ultrafiltration (molecular weight exclusion limit 10,000 Daltons) of fifteen purified protein, peptide and amino acid solutions indicated an effective filtration (>90%) on nominal molecular weight by the ultrafiltration devices. Determination of nitrogen and amino acids in the resulting fractions following TCA and PCA precipitation and centrifugation of rat ileal digesta indicated that PCA was the most effective precipitant. Endogenous ileal amino acid excretions in the growing rat fed an enzymically hydrolysed casein (EHC) based diet with subsequent treatment of the digesta using the ultrafiltration technology were then determined. Twelve 100 g male rats were fed either an EHC-based diet or a protein-free diet and samples of digesta were collected after slaughter. The digesta from the 6 EHC-fed rats were ultrafiltered after centrifugation and the high molecular weight fraction added to the precipitate. The protein-free fed rats had significantly ($P<0.05$) lower amino acid flows than those rats fed the EHC-based diet with subsequent treatment of the digesta.

2. The proportions of endogenous protein-, peptide- and free amino acid nitrogen (N) in digesta N from the distal ileum of the rat immediately after collection or following storage frozen (-20°C and -196°C) were compared. Eighteen growing rats were given a protein-free diet for 6 days, euthanased and samples of digesta were collected from the terminal 20 cm of ileum. The storage of digesta did not significantly affect the proportions of N-containing substances in the precipitate plus retentate or ultrafiltrate fractions. On average, 67% of the total digesta N was in the precipitate plus retentate fraction and 33% of total digesta N was in the ultrafiltrate fraction. Free amino acid N and peptide N were 10.4 and 10.6% of total digesta N, respectively.

3. The effect of using different flushing media for the collection of ileal digesta on the composition of endogenous N was examined. Twelve growing rats were given a protein-free diet and samples of ileal digesta were collected from the

euthanased animal using either distilled water or physiological saline as the flushing medium. There was no significant effect of collection method on the levels of N-containing substances in rat endogenous ileal digesta.

4. The effects of state of body nitrogen balance and the presence of dietary peptides and protein in the digestive tract on the excretion of endogenous amino acids from the ileum of the pig were investigated. Endogenous lysine excretion was determined for pigs given a protein-free diet, an EHC-, a zein- or a synthetic amino acid-based diet. Endogenous flows for amino acids other than lysine were determined for pigs on the protein-free and EHC-based diets. Six male pigs (15 kg liveweight) were allocated to each of the four diets and received the diet for 10 days. The mean endogenous ileal lysine flows for the zein and EHC fed pigs were not significantly different but were higher ($P<0.05$) than those for the protein-free and synthetic amino acid fed pigs whose mean flows were not significantly different from each other. The mean endogenous ileal flows for amino acids other than lysine were higher ($P<0.05$) for the EHC fed pigs compared to the animals on the protein-free diet, except for proline, glycine and arginine.

5. The effect of food dry matter intake on endogenous ileal amino acid excretion of the pig under peptide alimentation was determined. Sixteen male pigs (50 kg liveweight) each fitted with a T-cannula in the terminal ileum were fed at 8 levels of food dry matter intake for periods of 8 days. The experiment involved two trials of 8 pigs each, comprising a cross over design. Each trial involved 4 pairs of pigs with each pair receiving one of 4 sequences of treatment. Each sequence comprised 4 levels of food dry matter intake arranged in a Latin square. The food dry matter intakes were 0.06, 0.08, 0.10 and 0.12, and 0.05, 0.07, 0.09 and 0.11 metabolic liveweight ($W^{0.75}$) day^{-1} for the first and second trials, respectively. There was an increase in ileal excretion of amino acids, nitrogen and dry matter with increasing food dry matter. There were significant ($P<0.05$) linear relationships between endogenous ileal amino acid and nitrogen excretion and food dry matter intake except for lysine, glutamic acid and phenylalanine which increased in a curvilinear manner. These relationships, determined under physiologically more normal conditions than under protein-free alimentation, provide preliminary data on the magnitude of small intestinal amino acid losses in the pig.

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CONTENTS

PAGE

PAGE

PAGE

LIST OF TABLES