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Short communication

Coated protease increases ileal digestibility of protein and amino acids in weaned piglets

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ABSTRACT

The objective of this study was to determine the effect of a coated protease on apparent (AID) and standardized (SID) ileal digestibility of crude protein (CP) and amino acids (AA) in weaned piglets. Eighteen barrows with initial body weight (BW) of 13.5 ± 0.2 kg were randomly allotted to 3 diets (control, protease diet, and nitrogen-free diet) with 6 piglets per diet after fitting with a T-cannula in the distal ileum. Control and protease diets were corn–soybean meal based diet supplemented with or without 200 mg/kg of coated protease. The nitrogen-free diet was used to measure basal endogenous losses of AA. The experiment lasted for 7 days, and ileal digesta were collected on days 6 and 7. Results showed that the coefficients of AID and SID of CP and total AA were increased by protease supplementation ($P < 0.05$). For indispensable AA, the coefficients of AID of Ile, Lys, Met and Thr, and the coefficients of SID of Ile, Lys, Met, Thr and Trp were increased by protease ($P < 0.05$). For dispensable AA, both the coefficients of AID and SID of Ala, Asp, Cys, Gly and Ser were increased by protease ($P < 0.05$). In conclusion, dietary supplementation with coated protease increases coefficients of AID and SID of CP and most AAs in weaned piglets.

1. Introduction

Exogenous protease has been widely used in feed industry. Dietary protease supplementation is an effective method to reduce cost by increasing nutrient digestibility, especially crude protein (CP) and amino acids (AA) (Guo, 2014). Previous study indicated that protease increased the apparent ileal digestibility (AID) of CP and AA in weanling pigs (Guggenbuhl et al., 2012). However, some other studies observed that protease had no effect on AA digestibility (Mc Alpine et al., 2012; O'Shea et al., 2014). It is well known that stomach acid and pepsin result in the degradation of protease in the stomach, and decrease available exogenous protease in the small intestine (Gheorghe et al., 2015; Schindler et al., 2015). The content of

Abbreviations: AA, amino acids; AID, apparent ileal digestibility; Ala, alanine; Arg, arginine; Asp, aspartic acids; BW, body weight; CP, crud protein; Cys, cysteine; DM, dry matter; Glu, glutamate; Gly, glycine; His, histidine; HPLC, high performance liquid chromatography; Ile, isoleucine; Leu, leucine; Lys, lysine; Met, methionine; Phe, phenylalanine; Pro, proline; Ser, serine; SID, standardized ileal digestibility; Thr, threonine; Trp, tryptophan; Tyr, tyrosine; Val, valine.

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Table 1
Ingredient composition of experimental diets, as-fed basis.

Ingredient (g/kg)	Treatment[a]		
	Control	Protease diet	N-free
Corn	356.6	356.4	–
Extruded corn	270.0	270.0	–
Corn starch	–	–	818.6
Soybean meal	177.0	177.0	–
Extruded soybean	89.0	89.0	–
Soybean oil	21. 0	21.0	21.0
Fish meal	30.0	30.0	–
Cellulose[b]	–	–	30.0
L-Lysine-HCl	3.6	3.6	–
DL-Methionine	1.3	1.3	–
L-Threonine	0.9	0.9	–
Tryptophan	0.1	0.1	–
Limestone	3.0	3.0	–
Monocalcium phosphate	10.0	10.0	17.5
Glucose	–	–	50.0
Sucrose	30.0	30.0	50.0
Sodium chloride	3.0	3.0	3.0
Choline chloride	1.0	1.0	1.0
Potassium carbonate	–	–	4.0
Magnesium oxide	–	–	1.0
Vitamin premix[c]	0.5	0.5	0.5
Mineral premix[d]	3.0	3.0	3.0
Protease	–	0.2	–
Calculated composition (g/kg)Digestible energy (MJ/kg)	14.58	14.58	14.62
Calcium	7.1	7.1	7.0
Total phosphorus	6.1	6.1	6.2
Available phosphorus	4.3	4.3	4.1
Analyzed values (g/kg)[e]	–	–	–
Crude protein	174.2	175.2	–
Lysine	12.4	12.6	–
Methionine + cysteine	9.2	10.1	–
Threonine	7.6	7.6	–
Tryptophan	2.1	1.8	–

[a] Control = diet without protease supplementation, protease diet = diet supplemented with protease 200 mg/kg protease, 8000 U/g.
[b] Sodium carboxymethyl cellulose, supplied by Kelong Corp., Chengdu, China.
[c] Provided the following quantities of vitamins per kilogram of complete diet: vitamin A, 17,500 IU; vitamin D_3, 5,000 IU; vitamin E, 37.5 IU; vitamin K_3, 5 mg; vitamin B_1, 5 mg; vitamin B_2, 12.5 mg; vitamin B_6, 7.5 mg; vitamin B_{12}, 0.05 mg; niacin, 50 mg; folic acid, 2.5 mg; biotin, 0.2 mg.
[d] Provided the following quantities of minerals per kilogram of complete diet: Cu, 12 mg as copper sulfate; Fe, 100 mg as iron sulfate; I, 0.14 mg as potassium iodine; Mn; 30 mg as manganese sulfate; Se; 0.3 mg as sodium selenite; Zn, 100 mg as zinc sulfate.
[e] Standardized ileal digestible amino acid content.

exogenous protease in gut is highly correlated with the protease bioavailability (Plapied et al., 2011). Enteric coating is a new technology applied to protect oral medication or feed additives from gastric acid digestion (Shen et al., 2014). Though coated proteases have appeared on the market for a while, little is known about the effect of coated protease on the AID and standard ileal digestibility (SID) of CP and AAs. Therefore, this study was aimed to assess the effect of a coated protease on the AID and SID of CP and AAs in weaned piglets.

2. Material and methods

2.1. Animal, experimental design, and diets

The experiment protocol was approved by the Institutional Animal Care and Use Committee of Sichuan Agricultural University. Eighteen Duroc × (Landrace × Yorkshire) crossbred barrows with an initial body weight (BW) of 13.5 ± 0.2 kg were surgically fitted with a T-cannula in the distal ileum following procedures adapted from Stein et al. (1998). Pigs were randomly allocated to 3 diets with 6 replicates per diet. Each pig was individually kept in a stainless-steel metabolism cage (1.2 m × 0.7 m × 0.5 m) equipped with a feeder, a nipple drinker and fully slatted steel floor. The temperature and humidity were maintained at 25–27 °C and 55–75%.

Diets were formulated following the requirements of pigs (NRC, 2012), and all diets contained 3 g/kg chromic oxide as an indigestible marker (Table 1). Control and protease diets were corn–soybean meal based diet with or without 200 mg/kg coated protease (8000 U/g, Kemzyme Protease™, Kemin Industry), and a nitrogen-free diet was used to measure basal endogenous losses of AA and CP. The chemically analyzed AA and CP composition of the diets are shown in Table 2.