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Effect of growth period at about 15 and 25 kg body weight on amino acid ileal digestibility in young pigs

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ABSTRACT

The experiment was carried out on twelve pigs with an initial body weight (BW) of about 10 kg. After adaptation the pigs were fitted with a PVTC cannula and fed either of two basal diets (6 pigs each) differing in metabolizable energy content (diets A and B, 13.5 and 14.5 MJ ME/kg, respectively). The diets were formulated (using the same ingredients) to contain 0.6 g ileal digestible lysine/MJ ME and the recommended level of other essential amino acids (AA). Apparent ileal digestibility coefficients of AA were determined for two growth periods at about 15 kg (period I) and 25 kg body weight (period II). Similar digestibility values were found for both diets. The average AA digestibility coefficients were somewhat higher in period II, as compared with period I, however, the differences were not significant. Of the limiting essential AA, digestibility values for both diets and periods were highest for methionine (80.9 to 82.9%) and lowest for threonine (71.1 to 73.9%). Intermediate values were found for lysine and tryptophan (78.6 to 80.0 and 75.2 to 78.6%, respectively). It was concluded that average AA digestibility values of both periods should be used for formulation of experimental diets in a subsequent experiment on pigs from 10 to 30 kg body weight.

KEY WORDS: growth period, ileal digestibility, amino acids, young pigs

INTRODUCTION

There is limited information on digestion and absorption of nutrients in the small intestine of young pigs given natural feeds, although there have been extensive studies on piglets between 7 and 35 d of age (Wilson and Leibholz, 1981a,b,c). Using semisynthetic diets, the authors found that substitution of milk protein by soyabean protein reduced digestibility of nutrients. A detailed study showed that the apparent digestibility of dry matter, N and amino acids (AA) to the ileum of

piglets given soyabean protein increased with increasing age of pigs, while no changes in the digestibility was observed in milk-fed piglets.

Less documented changes in the ability to digest nutrients with increasing age were found for older piglets. In an investigation on the digestibility of carbohydrates, protein and fat in the small intestine of 8-12 week-old piglets with ileal cannulas, Gdala et al. (1997) found no significant changes in digestibility during four weekly periods when pigs were fed two diets with a relatively high dietary fibre content: cereal-soyabean meal diet or cereal-pea-soyabean meal-rapeseed cake diet. Supplementation of the diets with protease (among other enzymes) did not improve the digestibility of protein, which may suggest that there was adequate proteolytic activity in the digestive tract of 8-week-old piglets. However, the loss of non-starch polysaccharides anterior to the terminal ileum was far lower than reported earlier in studies with older pigs (Bach-Knudsen and Hansen, 1991; Bach-Knudsen et al., 1993), which was probably due to lower microbial activity in the upper intestine of young pigs.

The objective of the present investigation was to determine the apparent ileal digestibility of AA in pigs between 10 and 30 kg of body weight fed two basal diets differing in the content of metabolizable energy. Based on the results, experimental diets were formulated and used in subsequent experiments on the optimal ratio of the main essential AA to metabolizable energy in diets for young pigs (Urynek and Buraczewska, in preparation).

MATERIAL AND METHODS

Animals and facilities

The experiment was carried out on twelve castrated male pigs (synthetic line 990) with initial body weight (BW) of about 10 kg (7 weeks old). The pigs were kept in single metabolic cages in a temperature-controlled room. After 7 days of adaptation to the new environment, the pigs were surgically fitted with a post-valvular T-caecum cannula (PVTC) according to van Leeuwen et al. (1991). After a recovery period of 7 days, the groups of 6 pigs each were fed two experimental diets during two periods at about 15 kg (10 weeks old) and 25 kg BW (12 weeks old) according to the cross-over design. Each experimental period consisted of at least 7-days adjustment to the diets, followed by 3 days (12 h each) of ileal digesta collection.

Diets and feeding program

Two starter diets A and B were formulated of the same ingredients to contain 13.5 or 14.5 MJ ME/kg and 0.6 g ileal digestible lysine/MJ ME; other essential

AA were balanced according to Degussa-Hüls ideal protein recommendations and tabular values of apparent ileal AA coefficients of feedstuffs (Rademacher et al., 1999). The diets were composed of good quality cereals and high-protein feeds (Table 1). Chromic oxide (Cr_2O_3) was used as a marker. The pigs were fed twice a

TABLE 1

Composition (g kg^{-1}) and content of nutrients in the experimental diets, %

Ingredients	Diet A	Diet B
Wheat	519.0	467.5
Barley	144.5	119.2
Soyabean meal, 48%	171.9	141.2
Full fat soya	10.0	51.7
Maize meal	65.2	71.4
Fish meal	25.2	46.0
Soyabean protein concentrate	19.2	25.0
Soyabean oil	3.1	40.0
Starch	16.0	16.0
Limestone	4.3	3.2
Premix[1]	10.0	10.0
Dicalcium phosphate	5.4	5.4
Salt	3.2	3.2
Chromic oxide	3.0	3.0
Nutrients analysed		
crude protein	20.55	21.52
total lysine	0.976	1.009
total methionine	0.316	0.336
total methionine and cystine	0.690	0.697
total threonine	0.719	0.734
total tryptophan	0.245	0.250
Nutrients calculated		
ileal digestible lysine	0.810	0.870
ileal digestible methionine	0.272	0.292
ileal digestible methionine and cystine	0.572	0.583
ileal digestible threonine	0.561	0.588
ileal digestible tryptophan	0.198	0.201
Ca	0.81	0.81
total P	0.55	0.55
available P	0.31	0.31
Na	0.152	0.152
MJ ME kg^{-1}	13.45	14.45

[1] vitamins and trace elements supplied per kg of diet: vit. A 8000 IU, vit. D_3 1000 IU, vit. E 25 mg, vit. B_1 1 mg, vit. B_2 4 mg,, biotin 0.06 mg, vit. B_6 2 mg, vit. B_{12} 0.02 mg, vit. K 1 mg, nicotinamide 2000 mg, folic acid 0.2 mg, calcium pantothenate 12 mg, choline chloride 100 mg, Mg 10 mg, Mn 30 mg, Zn 80 mg, Co 0.1 mg, Se 0.1 mg, Fe 100 mg, J 0.4 mg, Salinomycin 60 mg

day with equal portions at 08.00 and 20.00 h. The feeding level was adjusted to 5% of BW. The diets were fed in meal form mixed with water (1:1) just before feeding. Water was available *ad libitum*.

Sampling, analysis and calculations

Sampling of ileal digesta and methods for analysis of ingredients, diets and digesta were as described in Urynek and Buraczewska (2001).

Statistical analysis

One-way analysis of variance was carried out on the experimental data using period as an independent variable. All calculations were performed using the SPSS program.

RESULTS AND DISCUSSION

As shown in Table 2, similar AA digestibility values were found for both diets. Digestibility coefficients were slightly higher for period II as compared with period I, however, the differences were not significant. The increasing tendency in AA digestibility may result from more active bacterial fermentation with increasing age (Graham et al., 1988). It is supposed that bacterial enzymes can lead to

TABLE 2

Ileal apparent digestibility coefficients of some dietary AA at about 15 kg (period I) and 25 kg BW (period II), %

	Diet A			Diet B		
	Period I	Period II	SEM	Period I	Period II	SEM
Metionine	81.6	82.9	1.057	80.9	82.2	1.392/1.271[1]
Cystine	76.8	78.2	1.139	74.7	77.5	1.598/1.459
Lysine	78.7	80.0	1.048/0.970[1]	78.6	79.5	1.427/1.344
Threonine	71.4	73.9	1.380	71.1	73.6	1.814/1.656
Tryptophan	76.0	78.0	1.151	75.2	78.6	1.533/1.399
Arginine	87.3	88.1	0.609	87.2	87.7	0.991/0.905
Isoleucine	80.3	82.5	1.016	79.8	81.6	1.422/1.298
Leucine	81.0	82.8	0.956	80.6	81.9	1.474/1.345
Valine	77.4	79.6	1.112	76.8	78.9	1.662/1.517
Histidine	82.4	83.1	1.160	80.4	82.8	1.070/0.977
Phenylalanine	81.8	83.1	0.964	81.2	82.3	1.321/1.206

[1] two values of SEM if numbers of observations varied

partial degradation of endosperm cell walls in feeds and increase the proportion of dietary nutrients digested in the small intestine. Of the limiting essential AA, digestibility coefficients for both diets and periods were highest for methionine (ranging from 80.9 to 82.9%) and lowest for threonine (from 71.1 to 73.9%). Intermediate values were found for lysine and tryptophan (from 78.6 to 80.0 and from 75.2 to 78.6%, respectively).

It was concluded that average AA digestibility coefficients of both periods should be used for formulation of experimental diets in a subsequent experiment on pigs from 10 to 30 kg body weight.

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STRESZCZENIE

Wpływ okresu wzrostu od 15 do 25 kg na strawność jelitową aminokwasów u młodych świń

Doświadczenie przeprowadzono na 12 prosiętach o początkowej masie ciała (m.c.) ok. 10 kg. Po adaptacji prosiętom założono kaniule PVTC i podawano dwie podstawowe mieszanki (każdą dla 6 prosiąt) różniące się zawartością energii metabolicznej (mieszanki A i B, 13,5 oraz 14,5 MJ EM/kg, odpowiednio). Mieszanki przygotowano z tych samych składników tak, aby ilość pozornie strawnej lizyny wynosiła 0,6 g/MJ EM i zalecany poziom pozostałych aminokwasów (AA) niezbędnych. Współczynniki pozornej strawności jelitowej AA określono dla dwóch okresów wzrostu, przy ok. 15 kg (okres I) i 25 kg m.c. (okres II). Strawności AA obydwóch mieszanek była podobna. W okresie II średnie współczynniki strawności AA były nieznacznie wyższe niż w okresie I, lecz różnice nie były statystycznie istotne. Wśród ograniczających niezbędnych AA, współczynniki strawności mieszanek w obydwóch okresach były największe w przypadku metioniny (od 80,9 do 82,9%), najmniejsze – treoniny (71,1-73,9%). Pośrednie wartości otrzymano dla lizyny i tryptofanu (odpowiednio od 78,6 do 80,0 i od 75,2 do 78,6%).

Podsumowując, średnie współczynniki strawności AA dla obydwóch okresów powinny być użyte do sformułowania mieszanek doświadczalnych w kolejnym doświadczeniu na świniach od 10 do 30 kg m.c.