

## The Effect of Protein Source and Diets Formulated based on Ileal Digestible Amino Acids on Nitrogen Excretion of growing and finishing pigs

Wandee Tartrakoon<sup>1</sup>, Tinnagon Tartrakoon<sup>2</sup>, Udo ter Meulen<sup>3</sup> and Therdchai Vearasilp<sup>1</sup>

<sup>1</sup>Department of Animal Science, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

E-mail: [twandee@hotmail.com](mailto:twandee@hotmail.com)

E-mail: [agiskch@cmu.chiangmai.ac.th](mailto:agiskch@cmu.chiangmai.ac.th)

<sup>2</sup>Rajamangala Institute of Technology, Phitsanulok Campus, Phitsanulok 65000, Thailand

E-mail: [ttin15@yahoo.com](mailto:ttin15@yahoo.com)

<sup>3</sup>Institute for Animal Physiology and Animal Nutrition, Georg-August- University, Kellnerweg 6, 37077 Göttingen, Germany

E-mail: [umeulen@uni-goettingen.de](mailto:umeulen@uni-goettingen.de)

### Abstract

The studies were conducted at Rajamangala Institute of Technology, Phitsanulok Campus, Thailand, using 4 growing pigs (initial BW approx. 39 kg) and 4 finishing pigs (initial BW approx. 60 kg). Four growing and 4 finishing pig diets containing soybean (SBM), peanut (PNM) and/or sesame (SM) meals were formulated and fed to the pigs in two separate 4x4 Latin Square Design experiments. Diet 1 (the control diet) was formulated with SBM based on its total protein and amino acids content. Diet 2, 3 and 4 were formulated with SBM, SBM+10% PNM and SBM+10% SM based on the apparent ileal digestibility of protein and amino acids in SBM, PNM and SM meals respectively. Total urine and faeces of each pig fed each diet were collected separately and analysed for total N content. The total N-excretion and the ratio of urinary N: faecal N of growing pigs fed diet 1, 2, 3 and 4 were 13.167, 14.282, 10.502, 10.380 g/d and 1.578, 2.893, 0.916, 0.916 respectively. The results showed that pigs fed with diet 3 and 4 had significant ( $p<0.05$ ) lower total N-excretion and urinary N: faecal N ratio than pigs fed with diet 2, whereas there was no significant difference ( $p>0.05$ ) to the control group. There was a direct relation between N-excretion and N-retention. The pigs fed with diet 4 had the highest N-retention ( $p<0.05$ ). For finishing pigs, the total N-excretion and the urinary N: faecal N ratio of pigs fed with diet 1, 2, 3 and 4 were 16.530, 22.001, 14.899, 16.791 g/d and 5.973, 6.021, 3.996, 2.802 respectively. The pigs fed with diet 3 and 4 tended to have a lower total N-excretion and urinary N: faecal N ratio than pigs fed with diet 2, although the differences were not statistically significant. It is concluded, that when diets are formulated with SBM (diet 1 and 2) as the main source of protein the use of apparent ileal digestibility of protein and amino acids in the formulation (diet 2) as compared to total protein (diet 1) tended to cause a increased N-excretion. However, was apparent ileal digestible protein and amino acids used to formulate diets where PNM and SM substitute part of the SBM (diet 3 and 4) N-excretion in growing pig was not affected. The results for finishing pigs showed the same tendency.

**Keywords:** Nitrogen excretion, Ileal digestibility, Soybean meal, Peanut meal, Sesame meal

## **Introduction**

Pig manure is primarily a mixture of urine and faeces, and it contains undigested dietary components, endogenous end products and indigenous bacteria from lower gastrointestinal tract (Sutton et al., 1999). By the formulation of diets for pigs the essential amino acids should not only be provided in an amount needed to support maximal and efficient growth, but it should also be considered to minimize environmental pollution by reducing N excretion in pig manure. Due to the low efficiency of N utilization of pigs recorded by some feed ingredients, pig farms are the main contributors of N pollution into environment. A possible solution is improving the efficiency of N utilization. Sauer and Ozimek (1986); Thankley and Knabe (1993) indicated that the measurement of ileal digestibility of amino acids is a more accurate method for estimating their availability than total digestibility. To meet the requirement of pigs, therefore, a better supply of amino acids can be achieved by using ileal digestibility data of feed ingredients in least-cost feed formulation.

## **Objective**

The study was set to determine the N-excretion of pig fed with the diets formulated based on ileal protein and amino acids digestible values in soybean meal (SBM), peanut meal (PNM) and sesame meal (SM).

## **Material and Methods**

Four crossbreed (Largewhite X Landrace) growing pigs (initial BW approx. 39 kg) and 4 finishing pigs (initial BW approx. 60 kg) from Rajamangala Institute of Technology, Phitsanulok Campus, Thailand, were separated into 4x4 Latin square design experiment and fed one of four growing and one of four finishing pig diets. Diet 1 (Control diet) was formulated with SBM based on its total protein and amino acids content. Diet 2, 3 and 4 were formulated with SBM, SBM+10% PNM, and SBM+10% SM based on apparent ileal protein and amino acids digestibilities in SBM, PNM and SM respectively (Table 1). Nutrient composition of all diets (Table 2) was calculated based on NRC (1988). The animals were kept in metabolic cages that allowed the separate collection of urine and faeces. The each 8-d experimental period consisted of a 5-d adaptation period to allow the pigs to become accustomed to the new diets and a 3-d period during which total urine and faeces were collected and analyzed for total N content according to AOAC (1990).

Table 1. Content (C) of amino acids in protein feedstuffs (g/kg DM) and their apparent ileal digestibility (ID, %)

	<b>Soybean meal</b>		<b>Peanut meal</b>		<b>Sesame meal</b>	
	<i>C</i>	<i>ID</i>	<i>C</i>	<i>ID</i>	<i>C</i>	<i>ID</i>
Crude protein	442	82.37	525	84.85	375	42.21
Lysine	18.5	89.41	14.9	93.82	10.3	69.95
Methionine	3.5	83.49	4.0	98.99	9.0	65.68
Treonine	19.0	72.66	14.5	83.43	17.9	33.89
Isoleucine	20.4	52.85	19.5	86.33	16.1	48.78

**Tartrakoon et al. (1999)**

Table 2. Nutrient composition (diet1) and calculated digestible nutrients in SBM, PNM and SM (diet 2, 3 and 4) of growing and finishing (in brackets) pig diets (g/kg DM)

Items	Diet 1 (Control)	Diet 2	Diet 3	Diet 4
Crude Protein	159.7 (139.5)	149.7 (129.5)	149.7 (129.8)	149.8 (129.8)
Lysine	7.5 (6.0)	7.5 (6.0)	7.5 (6.0)	7.5 (6.0)
Methionine+Cystine	6.4 (5.8)	6.1 (5.5)	6.2 (5.7)	6.4 (5.9)
Treonine	6.3 (5.4)	5.5 (4.7)	4.8 (4.0)	5.5 (4.7)
Isoleucine	7.2 (6.3)	5.2 (4.7)	5.6 (5.1)	5.5 (5.0)

### Results

The results measured during the growth period (Table 3) show that the pigs fed with diet 3 and 4 had significant ( $p < 0.05$ ) lower total N-excretion and urinary N: faecal N ratio than pig fed with diet 2. Whereas there was no significant difference ( $p > 0.05$ ) to the control group. There was a direct relation between N-excretion and N-retention. The pigs fed diet 4 had the highest N-retention. For finishing pigs, the pigs fed with diet 3 and diet 4 tended to have a lower total N-excretion and urinary N: faecal N ratio than pigs fed diet 2, although the differences were not statistically significant ( $p > 0.05$ ).

Table 3. Results of the nitrogen balance experiment conducted during 32 days on pigs (about 39 kg initial BW) fed four experimental diets (n=4)

Variables	Diets				
	Control	Diet2	Diet3	Diet4	SEM
N intake, g/d	36.360 <sup>b</sup>	37.551 <sup>b</sup>	31.287 <sup>c</sup>	40.475 <sup>a</sup>	0.843
Urine, g/d	3724	2900	2726	3566	405.754
Urinary N, g/d	7.851 <sup>ab</sup>	9.939 <sup>a</sup>	4.919 <sup>b</sup>	4.824 <sup>b</sup>	1.193
Faeces, DM g/d	203.52 <sup>a</sup>	191.16 <sup>ab</sup>	199.34 <sup>ab</sup>	167.19 <sup>b</sup>	9.124
Faecal N, g/d	5.316	4.342	5.583	5.556	0.779
Urinary N : Faecal N	1.578 <sup>ab</sup>	2.893 <sup>a</sup>	0.916 <sup>b</sup>	0.901 <sup>b</sup>	0.458
N excretion, g/d	13.167 <sup>ab</sup>	14.282 <sup>a</sup>	10.502 <sup>b</sup>	10.380 <sup>b</sup>	0.877
N excretion (% of intake)	36.140 <sup>a</sup>	38.570 <sup>a</sup>	34.337 <sup>ab</sup>	25.874 <sup>b</sup>	2.569
N retention, g/d	23.192 <sup>b</sup>	23.270 <sup>b</sup>	20.185 <sup>b</sup>	30.096 <sup>a</sup>	1.375
N retention (% of intake)	63.860 <sup>b</sup>	61.430 <sup>b</sup>	65.663 <sup>ab</sup>	74.126 <sup>a</sup>	2.569

<sup>a,b,c</sup> Means in the same row with different superscripts differ ( $P < 0.05$ ).

Table 4. Results of the nitrogen balance experiment conducted during 32 days on pigs (about 60 kg initial BW) fed four experimental diets (n=4)

Variables	Diets				
	Control	Diet2	Diet3	Diet4	SEM
N intake, g/d	27.949 <sup>b</sup>	31.282 <sup>ab</sup>	27.895 <sup>b</sup>	31.899 <sup>a</sup>	0.975
Urine, g/d	4475	4984	5050	5401	959.22
Urinary N, g/d	12.775	18.904	11.831	11.720	3.217
Faeces, DM g/d	124.15	115.36	115.95	152.51	20.842
Faecal N, g/d	3.775	3.097	3.067	5.072	0.582
Urinary N : Faecal N	5.973	6.021	3.996	2.802	1.584
N excretion, g/d	16.530	22.001	14.899	16.791	2.999
N excretion (% of intake)	59.075	70.150	53.045	53.401	10.540
N retention, g/d	11.419	9.281	12.996	15.108	3.315
N retention (% of intake)	40.925	29.850	46.995	46.599	10.54

<sup>a,b</sup> Means in the same row with different superscripts differ (P<0.05).

## Conclusion

1. For the diets formulated with SBM (diet 1 and 2) as the main source of protein, the use of apparent protein and amino acids ileal digestibility in the formulation (diet 2) as compared to total protein and amino acids (diet 1) tended to cause an increased N-excretion.
2. Use of apparent protein and amino acids ileal digestibility in the formulation of diets where part of SBM is substituted with PNM and SM (diet 3 and 4), did not affect N-excretion in growing pig. The results for finishing pigs showed the same tendency.

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