

Comparison of Ileal and Total Tract Digestibilities of Soybean, Peanut and Sesame Meals in Growing Pigs

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Summary

This experiment was conducted to determine the ileal and total tract digestibilities of crude protein and essential amino acids of soybean meal (SBM), peanut meal (PNM) and sesame meal (SM) in growing pigs. Both the true and apparent ileal digestibilities did not differ ($P>0.05$) between SBM and PNM except that the true ileal digestibility of both crude protein and Arginine were higher in SBM. For the apparent total tract digestibility, the values for crude protein and all essential amino acids except Threonine were higher for PNM compared to SBM, whereas the values for true total tract digestibility did not differ ($P>0.05$) between the two protein sources. SBM had higher ($P<0.05$) values than PNM for crude protein, Isoleucine and Phenylalanine. The values for SM were the lowest than the values determined for SBM and PNM. The amino acid constitution of both PNM and SM are quite good compared to SBM. There is potential in using particularly PNM in place of SBM in diets for growing pigs.

Introduction

Nutrient and amino acid digestibilities are increasingly being determined near the end of the small intestine prior to microbial action in the large intestine (Linis, 1992). Just et al. (1985) found that ileal digestible protein and amino acids had slightly higher correlations with deposited protein than was total tract digestible protein and amino acid. The total tract digestibility method measures the difference between the amount of each nutrient consumed from that excreted in faeces. The value so obtained is of apparent digestibility only. The ileal digestibility method is calculated based on the difference of each nutrient consumed from that passing the distal ileum. Apparent digestibility does not take account of the endogenous fraction in faeces or in ileal digesta. Endogenous amino acids are derived from proteins secreted into the digestive tract; for example digestive enzymes and proteins in sloughed intestinal walls. True digestibility takes into account the endogenous contribution. The fermentation process which takes place in the large intestine of pigs does not yield amino acids that can be used by the animal (Just et al., 1981) and these are largely excreted in the faeces.

Objective

To compare the crude protein and amino acid digestibilities of peanut, sesame and soybean meals in growing pigs.

Materials and Methods

3 castrated male and 3 female pigs from the Largewhite x Landrace herd of the Animal Science Department, Chiang Mai University, Thailand were randomly fed one of four diets. The initial average liveweight of the pigs was 50 kg. Simple T-cannulas were surgically prepared about 10-15 cm anterior to ileo-caecal junction. The cannulated pigs were kept in individual stainless steel metabolism cages. The nutrient composition of the experimental diets is shown in Table 1. The Ileal and total tract digestibility of the diets were determined. Titanium dioxide (TiO₂) was included in each diet as an indigestible marker to determine nutrient digestibilities. Daily feed offered was calculated to range from 2.5 to 3 per cent of body weight. Each meal was mixed with water in 1:1 ratio prior to feeding. Additional water was freely available. Faeces and ileal digesta samples were collected and stored frozen at -20°C until freeze-dried. Analyses for nitrogen and dry matter were carried out according to AOAC (1990) procedures. Digesta and feed samples were hydrolyzed for 24 h with 6 N HCL at 110°C before the determination of amino acid content using AccQ Tag Method from Waters HPLC.

Table 1 Nutrient composition of experimental diets (g/kg air dry)

	Protein meal			
Nutrient	Protein-free	Soybean	Peanut	Sesame
Dry Matter	909.50	925.90	899.90	921.60
Crude Protein	5.90	174.90	192.60	199.40
Ether Extract	45.90	50.20	7.50	94.80
Crude fiber	68.70	79.30	74.10	105.70
Essential amino acid				
Lysine	0	6.70	4.50	3.40
Threonine	0	4.20	9.50	11.90
Methionine	0	1.30	4.00	2.80
Leucine	0	9.00	10.80	16.10
Isoleucine	0	2.80	6.90	9.90
Valine	0	3.10	11.50	15.90
Phenylalanine	0	4.10	13.30	12.90
Arginine	0	7.30	37.50	41.30

All digestibilities were calculated based on concentrations of TiO₂ and nutrients in the diets and in the faeces and ileal digesta samples according to following equations (Fan et al., 1994; Marty et al., 1994)

$$AD_D = 100\% - [(I_D \times A_F) / (A_D \times I_F)] \times 100\%$$

$$TD_D = 100\% - \{ [I_D \times (A_F - A_E)] / (A_D \times I_F) \} \times 100\%$$

where: **AD_D** = apparent ileal or total tract amino acid or crude protein digestibility in diet (%), **TD_D** = True ileal or total tract amino acid or crude protein digestibility in test diet (%), **I_D** = Titanium dioxide concentration in diet (%), **A_F** = amino acid or crude protein concentration in ileal digesta or faeces (%), **A_E** = amino acid or crude protein concentration in endogenous excretion (%), **A_D** = amino acid or crude protein concentration in diet (%), and **I_F** = Titanium dioxide concentration in ileal digesta or faeces (%).

Results and Discussion

Table 2 . Apparent and true (in brackets) percentage ileal digestibilities of crude protein and amino acid of soybean (SBM), peanut (PNM) and sesame (SM) meals.

Component	Treatment		
	SBM	PNM	SM
Crude Protein	78.62 ^a (98.47 ^a)	80.99 ^a (85.11 ^b)	40.29 ^b (46.65 ^c)
Essential Amino Acid			
Lysine	85.33 ^a (89.44 ^a)	89.55 ^a (89.88 ^a)	66.77 ^b (67.49 ^b)
Threonine	69.49 ^a (87.151 ^a)	70.06 ^a (84.67 ^a)	32.35 ^b (38.82 ^b)
Methionine	80.07 ^b (89.83 ^a)	94.48 ^a (94.94 ^a)	62.69 ^c (63.76 ^b)
Leucine	79.69 ^a (88.35 ^a)	83.87 ^a (88.03 ^a)	54.02 ^b (56.89 ^b)
Isoleucine	49.69 ^b (86.53 ^a)	82.28 ^a (85.44 ^a)	46.48 ^b (50.04 ^b)
Valine	63.16 ^b (78.81 ^a)	80.39 ^a (82.78 ^a)	51.05 ^c (53.89 ^b)
Phenylalanine	84.62 ^a (86.06 ^a)	87.91 ^a (90.09 ^a)	41.49 ^b (45.15 ^b)
Arginine	86.14 ^b (100.00 ^a)	91.85 ^a (93.22 ^b)	73.88 ^c (75.92 ^c)

^{a,b,c} Means in the same row with different superscripts differ (P<0.01).

Table 3. Apparent and true (in brackets) percentage total tract digestibilities of crude protein and amino acid of soybean (SBM), peanut (PNM) and sesame (SM) meals

Component	Treatment		
	SBM	PNM	SM
Crude Protein	77.27 ^b (90.23 ^a)	84.39 ^a (85.85 ^b)	59.85 ^c (61.82 ^c)
Essential Amino Acid			
Lysine	77.35 ^b (91.22 ^a)	86.16 ^a (87.19 ^a)	73.38 ^b (75.29 ^b)
Threonine	73.04 ^a (92.77 ^a)	82.62 ^a (85.35 ^a)	43.85 ^b (46.91 ^b)
Methionine	64.34 ^b (93.37 ^a)	94.18 ^a (94.55 ^a)	73.04 ^b (73.78 ^b)
Leucine	76.72 ^b (89.93 ^a)	81.87 ^a (85.68 ^a)	61.58 ^c (62.74 ^b)
Isoleucine	62.59 ^b (96.56 ^a)	79.35 ^a (81.02 ^b)	54.82 ^c (56.46 ^c)
Valine	71.40 ^b (99.62 ^a)	78.29 ^a (80.16 ^b)	60.28 ^c (62.20 ^c)
Phenylalanine	77.39 ^b (89.23 ^a)	85.86 ^a (87.06 ^a)	47.32 ^c (49.06 ^b)
Arginine	85.66 ^b (90.75 ^a)	92.35 ^a (92.81 ^a)	77.14 ^c (77.73 ^b)

^{a,b,c} Means in the same row with different superscripts differ (P<0.01).

Tables 2 and 3 show that apparent ileal and total tract digestibilities and true ileal and total tract digestibilities of crude protein and essential amino acids varied from 49.69-86.14, 62.59-85.66, 78.10-100 and 89.23-99.62 per cent respectively for SBM, 70.06-91.85, 78.29-94.18, 82.78-94.94 and 80.16-94.55 per cent respectively for PNM and 32.35-73.88, 43.85-77.14, 38.82-75.92 and 49.06-77.33 per cent respectively for SM. The apparent ileal digestibilities of crude protein, lysine, Threonine and Phenylalanine were similar for SBM and PNM, whereas apparent total tract digestibilities of crude protein and all essential amino acids except for Threonine were higher for PNM than SBM and SM (P<0.0001). The values of true ileal and total tract digestibilities were not statistically significant (P>0.05) between SBM and PNM. However, for true ileal digestibilities of crude protein and Arginine and true total tract digestibilities of Isoleucine and Valine, PNM had higher values than SBM (P<0.0001). Further differences were evident when SBM and PNM were compared with SM. All essential amino acids and crude protein were least digestible in SM (P<0.0001). SBM and PNM showed comparable performance whereas SM ranked least.

Conclusion

1. From the crude protein and amino acid profile, PNM and SM showed good constitution and they are promising protein sources which can be used in pig rations.
2. Peanut meal showed comparable performance to SBM and can be used in pig rations in place of SBM.
3. Depending on economics, both PNM and SM can be used in place of SBM in pig rations.
4. Further experiments are being conducted to test correlations of either ileal or total tract digestibility to production response.

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