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EVALUATION OF DIETARY PROTEIN SEQUENCES FOR GROWING-FINISHING PIGS

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RINGKASAN

Empat-puluh ekor babi kacukan telah digunakan untuk mengkaji kesan rangkaian paras protein ke atas keberjayaan dan sifat-sifat karkas. Rangkaian paras protein adalah (½ protein untuk tiap-tiap fasa I, II dan III): (a) 16-16-14, (b) 16-16-12, (c) 16-14-14, (d) 16-14-12, (e) 16-12-12, (f) 16-16/14 berselang-seli setiap minggu (g) 16-16/12 berselang-seli setiap minggu dan (h) 16-14/12 berselang-seli setiap minggu. Dalam fasa I, semua babi diberi protein pada paras 16%. Bagi fasa II, pengambilan makanan babi yang menerima paras protein 16% adalah lebih rendah ($P<0.05$) tetapi kecekapan pengubahan makanan adalah lebih baik ($P<0.01$) jika dibandingkan dengan babi yang mendapat paras protein 14 dan 12%. Walau bagaimanapun, pertambahan berat badan tidak dipengaruhi dengan nyata oleh perbezaan paras protein. Rangkaian paras protein tidak menunjukkan perbezaan yang nyata terhadap pertambahan berat badan, pengambilan makanan dan kecekapan pengubahan makanan bagi keseluruhan kajian. Bermula dari berat badan 30 kg, babi-babi yang menerima paras protein yang berselang-seli di antara 16-16/14%, 16-16/12% serta 16-14/12% tidak menghasilkan perbezaan yang berkesan terhadap keberjayaan mereka. Akan tetapi, dalam fasa II, pengambilan makanan adalah lebih tinggi ($P<0.05$) bagi babi-babi yang menerima paras protein yang berselang-seli di antara 16-14/12%.

Sifat-sifat karkas tidak dipengaruhi dengan nyata oleh rangkaian paras protein. Di antara babi-babi yang mendapat paras protein yang berselang-seli, purata ketebalan lemak bagi babi-babi yang menerima paras protein yang berselang-seli di antara 16–14/12% adalah lebih nipis ($P<0.05$) jika dibandingkan dengan babi-babi yang menerima paras protein berselang-seli di antara 16–16/14%, sementara sifat-sifat karkas lain tidak dipengaruhi.

INTRODUCTION

The continuing increases in the cost of protein-rich feedstuff for which our country depends on imports has called for serious redefinition of protein requirements for domestic animals. Reliance on overseas nutritional recommendations can sometimes result in nutrients wastage as these requirements are based on animals under different husbandry methods as compared to our local animals. The importance of genetic factors in relation to protein requirement had earlier been demonstrated by ALLEE *et al.*, (1971) and KORNEGAY, THOMAS and CARTER (1973). DAVEY and MORGAN (1969) also suggested the possibility of a genotype-protein interaction that accounts for the different responses of pigs to certain levels of dietary protein.

Earlier work on the effect of dietary protein on pigs had shown that from 35 kg to marketable body weight, protein levels of 18, 15 and 12% produced no significant differences in their performance (PHUAH and HUTAGALUNG, 1977). The purpose of the following experiment was to phase feed and evaluate the effect of various protein level sequences on the performance and carcass traits of local crossbred pigs.

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MATERIALS AND METHODS

Forty local crossbred pigs averaging 23.00 kg in body weight were used in a randomized complete block experiment to evaluate the effect of different protein sequences. The protein sequences were assigned at random within each block as follows: (1) 16–16–14; (2) 16–16–12; (3) 16–14–14; (4) 16–14–12; (5) 16–12–12; (6) 16–16/14 rotated weekly (7) 16–16/12 rotated weekly and (8) 16–14/12 rotated weekly (percent protein for phases I through III, respectively). Changes in protein level were made according to the following schedule: phase I – initial weight to 30 kg; phase II – 30 to 50 kg; phase III – 50 to market. In phase I, all pigs were given 16% protein diets. All diets were formulated to provide 3,300 kcal DE/kg *(Table 1)*.

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS

	Dietary protein (%)		
	16	14	12
Ingredients, %			
Corn (CP, 8.0%)	30.00	26.00	22.00
Soybean meal (CP, 44%)	12.50	9.00	5.20
Wheat middlings (CP, 17%)	7.00	9.00	11.00
Wheat meal (CP, 12%)	5.00	5.00	5.00
Rice-bran (CP, 10%)	23.50	23.50	23.50
Cassava root meal (CP, 1.5%)	9.60	16.10	22.90
Fishmeal (CP, 50%)	7.00	6.00	5.00
Milk powder (CP, 33%)	1.00	1.00	1.00
Molasses	3.00	3.00	3.00
Salt	0.50	0.50	0.50
Limestone	0.50	0.50	0.50
Vitamin-mineral premix[1]	0.30	0.30	0.30
Antibiotics[2]	0.10	0.10	0.10
Total	100.0	100.0	100.0
Calculated analysis			
Crude protein, %	16.03	14.09	12.05
Digestible energy, kcal/g	3.35	3.33	3.32
L—lysine, %	0.89	0.75	0.61
DL—methionine (plus cystine), %	0.45	0.41	0.31

[1]Super-Vit (Custom mix: Supplied by Vinning Chemical Lanboratory Co., Kuala Lumpur.
[2]Neomix-25 containing 55 g Neomycin sulphate per kg.

Pigs were housed individually in concrete floored pens equipped with feed troughs and water-drinkers. Feeding was done twice daily. For each feeding sufficient feed was provided to enable the pigs to continue eating *ad libitum*. Pig weights and feed consumption were determined biweekly. All pigs were slaughtered at the end of a 12-week feeding period. The carcasses were weighed before being chilled overnight at 5°C. Chilled carcass weight, carcass length, backfat thickness and *l. dorsi* area at 4th rib and 5th lumbar regions were measured. Dressing percentage was calculated. The variance technique was used in the statistical analysis.

RESULTS AND DISCUSSION

Means for average daily gain, feed intake and feed/gain of pigs given different protein sequences are shown in *Table 2*. From 30 to 50 kg liveweight (Phase II), pigs fed 16% protein diets consumed less (P/_0.05) but utilized feed more efficiently (P/_0.01) compared to those receiving 14 and 12% protein diets. Among those on the 14 and 12% protein diets, there was no significant difference in daily intake and feed conversion efficiency.

TABLE 2. PERFORMANCE OF GROWING-FINISHING PIGS FED ON DIFFERENT PROTEIN SEQUENCES

Protein sequences (%)	Dietary variables				
	16–16–14	16–16–12	16–14–14	16–14–12	16–12–12
To 50 kg. Liveweight:					
Avg. daily gain[1], kg.	0.54	0.55	0.55	0.52	0.53
Avg. daily intake[2], kg.	1.64[a]	1.73[a,b]	1.98[c]	1.84[b,c]	1.85[b,c]
Feed/gain[3]	3.04[a]	3.15[a,b]	3.60[c]	3.54[c]	3.49[b,c]
Overall:					
Avg. daily gain[1], kg.	0.52	0.50	0.55	0.50	0.51
Avg. daily intake[1], kg.	1.89	1.81	1.97	1.86	1.94
Feed/gain[1]	3.63	3.62	3.58	3.72	3.80

[1]Not significant
[2]Significant at P/_0.05
[3]Significant at P/_0.01
[a,b,c]Values along the same row bearing different superscripts are significantly different at (P_0.05)

Protein sequences of 16–16–14, 16–16–12, 16–14–14, 16–14–12 and 16–12–12% had no significant effect on the daily gain, feed intake and feed/gain. Earlier, AUNAN, HANSON and MEADE (1961), GREELEY *et al.*, (1964), PHUAH and HUTAGALUNG (1977a,b) also reported little difference in growth response when pigs were fed high and low protein regimes.

Comparison of the lysine and methionine requirement (N.R.C., 1973) with calculated dietary lysine and methionine reveals that methionine (plus cystine) is limiting in the 12% protein diet. However, this deficiency did not adversely affect the performance of the pigs. This indicates that methionine plus cystine requirement for the local growing-finishing pigs is lower than the N.R.C. (1973) recommendation. ORR (1973) also postulated that the methionine plus cystine requirement is lower than the N.R.C. (1973) requirement of 0.41% for pigs in the 60–100 kg bodyweight range. Calculated lysine level of the 16, 14 and 12% protein diets were 0.89, 0.75 and 0.61%, respectively, showing that even the lowest dietary protein was already adequate in lysine for growing-finishing pigs (N.R.C. 1973). Higher dietary lysine than the recommended requirement did not result in better growth response was in agreement with those reported earlier (MAGRUDER, SHERMA and REYNOLDS, 1961; MEADE, DUKELOW and GRANT, 1966; WAHLSTROM and LIBAL, 1974 and PHUAH and HUTAGALUNG, 1977b).

Rotational feeding with combination of 16–16/14%, 16–16/12%, and 16–14/12% protein diets on a weekly basis beginning at 30 kg liveweight did not significantly influence the performance of pigs *(Table 4)*. However, between 30–50 kg liveweight, pigs given diets with 16–14/12% dietary protein consumed more (P/_0.05) feed than those given diets with 16–16/14 and 16–16–12% protein levels. This shows that for early growth (Phase II) dietary protein level below 14% is probably inadequate for optimal growth.

TABLE 3. EFFECT OF PROTEIN SEQUENCES ON CARCASS TRAITS

Protein sequences (%)	Dietary variables				
	16–16–14	16–16–12	16–14–14	16–14–12	16–12–12
Pre-slaughter wt.[1], kg.	72.40	74.30	73.30	70.40	72.00
Dressing (warm carcass)[1], %	77.49	76.66	75.95	77.80	75.68
Dressing (chilled carcass)[1], %	75.12	74.43	73.21	75.00	72.93
Avg. backfat thickness[1], cm.	2.73	2.75	2.82	2.93	2.68
L. dorse areas, cm^2					
at 4th rib[1]	14.69	13.09	12.57	13.84	12.79
at 5th lumbar[1]	29.00	28.72	27.95	26.75	26.29
Carcass length, cm.	70.00	69.60	72.30	69.10	70.10

[1]Not significant.

TABLE 4. PERFORMANCE OF GROWING-FINISHING PIGS FED ON ROTATED DIETARY PROTEIN LEVELS

Protein (%)	Dietary variables[1]		
	16–16/14	16–16/12	16–14/12
To 50 kg. liveweight:			
Avg. daily gain[2], kg.	0.63	0.59	0.59
Avg. daily intake[3], kg.	1.72[a]	1.61[a]	1.93[b]
Feed/gain[2]	2.73	2.72	3.27
Overall:			
Avg. daily gain[2], kg.	0.56	0.50	0.57
Avg. daily intake[3], kg.	1.89[a,b]	1.78[a]	1.97[b]
Feed/gain[2]	3.38	3.56	3.46
Total protein intake, kg.	23.81	20.93	21.51
Protein/gain, kg.	0.51	0.50	0.45

[1]The dietary protein levels were rotated on weekly basis.
[2]Not significant.
[3]Significant at P/_ 0.05
[a,b]Values along the same row bearing different superscripts are significantly different at (P/_ 0.05).

Means of carcass data are summarized in *Tables 3* and *5*. Dressing percentage, backfat *thickness*, *l. dorsi* area and carcass length were not significantly different between pigs given different dietary protein sequences.

TABLE 5. EFFECT OF ROTATED DIETARY PROTEIN LEVELS IN DIETS ON CARCASS TRAITS

Protein (%)	Dietary variables		
	16–16/14	16–16/12	16–14/12
Pre-slaughter wt.[1], kg.	79.20	73.80	74.90
Dressing (warm carcass)[1], %	75.69	76.18	76.52
Dressing (chilled carcass)[1], %	74.13	72.82	73.68
Avg. backfat thickness[2], cm.	2.93[a]	2.74[a,b]	2.42[b,c]
L. dorsi areas, cm.[2]			
at 4th rib[1]	12.91	12.25	12.65
at 5th lumbar[1]	28.66	29.56	27.49
Carcass length[1], cm.	71.10	69.81	72.40

[1]Not significant.
[2]Significant at P≤ 0.05.
[a,b,c]Values along the same row bearing different superscripts are significantly different at (P≤ 0.05).

With the exception of average backfat thickness, rotational feeding of rations with different protein levels did not result in any significant difference in the carcass traits (*Table 5*). Backfat, however, was thinner (P≤0.05) in carcasses of pigs given 16–14/12% dietary protein than those from pigs given 16–16/14% dietary protein (*Table 5*). Earlier experiment using the same type of crossbred animals, dietary protein levels also failed to produce significant differences in carcass traits (PHUAH and HUTAGALUNG, 1977a,b). KORNEGAY, THOMAS and CARTER (1973) found no difference in backfat thickness and dressing percent between pigs fed various protein sequences, while other workers like CLAYSON *et al.*, (1962), GREELEY *et al.*, (1964) and LUCAS *et al.*, (1971) found no differences in carcass muscling.

The results obtained supported the hypothesis of DAVEY and MORGAN (1969) that there is a genotype-protein interaction that influence the performance of pigs in response to dietary protein levels. Results reported showed that pigs used in this study generally lack the genetic potential to fully utilize high-protein diets for body weight gain. These results also show that optimal performance (within the genetic potential) can also be obtained on lower protein level sequence as long as the essential nutrients such as lysine and methionine-plus-cystine are adequate. Similarly, rotating dietary protein level on a week-to-week basis does not affect growth so far as the lowest protein levels involved are adequate in essential nutrients.

SUMMARY

Forty crossbred pigs were used to evaluate the effect of various protein level sequences on performance and carcass traits. Protein level sequences were (% protein, respectively for phases I, II and III): (a) 16–16–14, (b) 16–16–12, (c) 16–14–14, (d) 16–14–12, (e) 16–12–12, (f) 16–16/14 alternated weekly, (g) 16–16/12 alternated weekly and (h) 16–14/12 alternated weekly. In phase I, all

pigs were given 16% protein diet. During phase II, pigs fed 16% protein diet consumed less ($P \leq 0.05$) but utilized feed more efficiently ($P \leq 0.01$) than those receiving 14 and 12% protein diets. However, weight gain was not affected by variation in dietary protein level. Throughout the entire trial, average daily gain, feed intake and feed efficiency were not affected by the various protein sequences. There was no significant differences in performance of pigs on rotational feeding with combination of 16–16/14%, 16–16/12% and 16–14/12% protein diets on weekly basis beginning at 30 kg liveweight. However, in phase II, diets with protein level rotating between 14 and 12% consumed more ($P \leq 0.05$) feed than the other combinations.

Carcass traits were not significantly different among pigs fed the various protein level sequences. Among the pigs on protein level rotation, average backfat was thinner ($P \leq 0.05$) in carcasses of pigs fed the 16–14/12% dietary protein compated to those from pigs fed the combination of 16–16/14% protein; whereas other carcass traits were not affected.

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