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EFFECT OF NUTRIENT DENSITY, PRESENCE OF FISH MEAL AND METHOD OF FEEDING OF UNMEDICATED DIETS ON EARLY-WEANED PIGS

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ABSTRACT

In two experiments, the first with 96 pigs from 5 weeks of age and the second with 384 pigs from 3 weeks of age, high nutrient dense diets (HND) or conventional diet (CONV) were given with (50 g/kg feed) or without fish meal, up to slaughter at 90 kg live weignt. Diets were unmedicated. In both experiments pigs were given food according to scales which equalized digestible energy intakes for the HND and the CONV diets. In experiment 1 pigs were individually fed; in experiment 2 group feeding was practised with pens of 16 pigs either floor or trough fed.

There was no mortality in experiment 1, but the mortality was high in experiment 2, particularly amongst those pigs receiving the CONV diet without fish meal. In experiment 1, in the first 56 days, inclusion of fish meal in the CONV and HND diets significantly improved growth rate but food conversion efficiency was significantly improved in the CONV diet only. Overall, up to slaughter, growth rate and food conversion efficiency were significantly poorer in pigs given the CONV diet without fish meal (cf. the three other diets) but the HND diets were significantly better than the CONV diet with fish meal. In experiment 2, overall there were no significant differences in performance between floor- and trough-feeding methods. CONV diets without fish meal gave significantly poorer growth rates in the first 56 days and overall than the other three diets, between which there were no significant differences. In both periods, for food conversion efficiency, fish meal inclusion was without significant effect in the HND diets but significantly improved the CONV diets, both of which were significantly inferior to the HND diets.

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INTRODUCTION

The trend towards the earlier weaning of pigs raises questions about the most appropriate specifications for their diet, and the bearing, if any, that nutrition in early life may have on their susceptibility to disease. Diets with a higher content of nutrients than conventional diets based on cereals and vegetable proteins, so called high nutrient dense diets, have been found to be beneficial when fed to growing pigs. They can include such ingredients as fat, maize and fish meal. Such diets, even when given to supply the same amount of digestible energy as lower energy, conventional diets, have resulted in increased growth rate as well as improved food conversion efficiency (Cole, Hardy and Lewis, 1972; Curran, Filmer and Trapnell, 1975).

Early-weaned pigs are prone to disease, especially if their environment is less than ideal. Susceptibility to disease is linked to nutrition and adequacy of dietary protein in meeting requirements for amino acids may be important in this respect. Because many research centres have facilities for early-weaned pigs which are better than those on many commercial farms, the challenge from infection may be reduced and thus the results from experiments at such centres may be of limited application to commercial situations.

Most of the experiments reporting comparisons of diets formulated with and without fish meal have used pigs between 8 and 10 weeks of age, when the type of dietary protein may be less critical than for pigs between three and four weeks of age (Pike, 1979). For example the pigs used by Braude and Lerman (1970) were between 9 and 11 weeks of age, and those used by Barber, Braude and Mitchell (1981) were between 9 and 10 weeks of age at the start of their respective experiments.

In the present experiments, pigs between 3 and 5 weeks of age at the start were used. Diets were unmedicated in the belief that this may have increased the susceptibility of the pigs to disease and thereby provided a more critical test of the adequacy of dietary protein. In the first experiment pigs were fed individually. In the second experiment pigs were group-fed to simulate normal commercial practice. Individual pigs could have consumed more or less food than intended and this may have affected adversely carcass composition and health. Furthermore, in commercial practice the opportunity for pigs to over- or under-consume food could be influenced by the method of feeding used. Thus as both trough and floor feeding are used the effects of these two methods of feeding were examined also.

MATERIAL AND METHODS

Experiment 1

Animals and design. Ninety-six Landrace × Large White pigs (48 gilts and 48 castrates) were weaned at 5 weeks of age and accommodated in individual pens. Twenty-four pigs were randomly allocated to each of the four initial treatments, sex and presence or absence of fish meal in the diet, in a 2 × 2 factorial design. From the 3rd week of the experiment, pigs on each treatment were further allocated at random to two groups, one group receiving a high nutrient dense diet (HND) and the other a conventional diet (CONV) with nutrient density becoming a third factor according to a 2 × 2 × 2 factorial design. Pigs received either HND or CONV diets from the 3rd week to the end of the experiment.

Diets and feeding. Details of the four dietary treatments, (i) HND with 50 g fish meal per kg diet (ii) HND without fish meal (iii) CONV with 50 g fish meal per kg diet and (iv) CONV without fish meal, are given in Table 1. The HND diets were isocaloric and isonitrogenous and were formulated to have energy, protein, mineral and vitamin contents which were proportionately approximately 0·2 more than in the CONV diets. In the HND diets there was, proportionately approximately 0·25 more lysine than in the CONV diets and this reflected the concentration of lysine in high nutrient dense diets produced by food

TABLE 1
Composition of diets

	Experiment 1				Experiment 2			
	High nutrient dense diets		Conventional diets		High nutrient dense diets		Conventional diets	
Components of diets (g/kg)								
Fish meal	+	−	+	−	+	−	+	−
Barley	208	95	590	593	291	185	595	606
Wheat	—	—	—	—	100	100	—	—
Maize	245	300	—	—	239	300	—	—
Sorghum	200	200	—	—	—	—	—	—
Wheat middlings	—	—	250	180	—	—	250	180
Maize gluten (230 g/kg protein)	—	—	19·7	27·6	—	—	15	22
Soya	193	297	33	133	177	267	33	133
Herring meal	50	—	50	—	50	—	50	—
Molasses	20	20	25	25	20	20	25	25
Fat	50	50	—	—	50	50	—	—
Fat carrier	—	—	—	—	40	40	—	—
Calcium dihydrogen phosphate	11·2	13·7	—	—	11·4	14·0	—	3·5
Limestone	7·6	8·0	17·6	24·1	6·4	6·8	14	14
Salt	1·4	2·5	0·7	3·3	1·4	2·4	0·7	1·8
Methionine	—	—	—	—	0·3	0·6	—	—
Binder	12	12	12	12	12·5	12·5	12·5	12·5
Mineral/vitamin supplement†	2·4	2·4	2	2	1·5	1·5	1·5	1·5
Chemical composition‡								
Dry matter (DM) (g/kg)	891	886	890	891	876	876	870	859
Crude protein	212	222	189	187	211	207	187	189
Ether extract	82	70	29	26	74	73	32	25
Calcium	130	122	126	138	110	112	100	101
Phosphorus	67	69	65	55	67	62	68	68
Sodium chloride	5·4	4·5	5·3	6·3	5·0	4·7	4·5	4·3
Digestible energy (MJ/kg DM)§	17·6	17·7	14·9	14·9	17·6	17·5	15·3	15·6
Lysine§	11·2	11·4	8·5	8·1	11·4	10·9	8·6	8·5
Threonine§	8·4	8·8	7·0	7·0	8·3	8·0	7·0	7·1
Methionine + Cystine§	6·8	6·9	5·9	5·6	7·5	7·4	6·0	5·8

† Providing per kg of diet: Cu, 25 mg; Mn, 40 mg; Zn, 100 mg; I, 1 mg; Fe, 50 mg; retinol, 3 mg; cholecalciferol, 50 μg; α-tocopherol, 8 mg; menadione, 1·5 mg; thiamine, 4 mg; nicotinic acid, 10 mg; pantothenic acid, 10 mg; cyanocobalamin, 15 μg.
‡ From chemical analysis (g/kg DM unless stated otherwise).
§ Calculated values (g/kg DM unless stated otherwise).

compounders in the UK. The CONV diets were isocaloric and isonitrogenous. None of the diets were medicated. Pigs were fed twice daily throughout, and had access to water at all times.

Pigs were given their food according to a scale starting at 0·64 kg/day in week 1 and increasing to 0·80 kg/day in week 2 of the experiment. Those given CONV diets received 1 kg/day in week 3, increasing by 0·2 kg/day for each week of the trial up to a maximum of 2·6 kg/day in week 12 and thereafter. Pigs given HND diets received proportionately 0·2 less, i.e. up to a maximum of 2·08 kg/day.

Housing and management. Pigs were housed in a well ventilated piggery maintained between 18°C and 21°C, in individual pens each of which contained a feeding trough. Any pig seen to be suffering from digestive disorders was given medication orally. Pigs were weighed every 2nd week and slaughtered shortly after they had reached 90 kg live weight. At slaughter carcass weight, carcass length and fat depth at a distance 6·5 cm from the mid-line of the side at the head of the last rib (P_2 measurement) were measured.

Experiment 2

Animals and design. Three hundred and eighty-four Landrace × Large White pigs, (192 gilts and 192 castrates), weaned at 3 weeks of age, were allocated at random to 24 pens, each containing eight gilts and eight castrates. Pigs in 12 pens were fed from troughs; those in the other 12 pens were fed on the floor. As in experiment 1, pigs were given the HND diet, either with 50 g fish meal per kg, or with no fish meal added. The experiment was designed as a 2 × 2 factorial, the factors being method of feeding and presence or absence of fish meal in the diet. Two weeks after the start of the experiment a further factor was introduced, nutrient density, according to a 2 × 2 × 2 design. Pens were reallocated at random to either the HND or CONV diets, with or without fish meal as before, three pens being allocated to each of the eight treatments.

Diets and feeding. The four diets fed, HND with and without fish meal and CONV with and without fish meal, were similar to those used in experiment 1. Details are given in Table 1. Pigs were given their food twice daily. As they started the experiment at a younger age than those in experiment 1, they started at a different point on the scale of feeding. In week 1 of the experiment those given the HND diet were given 0·32 kg/day, and in week 2, 0·40 kg/day. In week 3 those given the CONV diet received 0·80 kg/day. This was increased by 0·20 kg/day each week up to a maximum of 2·60 kg/day in week 12 and thereafter until slaughter. Those pigs given the HND diet received proportionately 0·2 less food. Thus, at the same age, pigs received daily the same amount of food each day in both experiments. Pigs had access to water at all times.

Housing and management. Pigs were housed in a well ventilated piggery maintained between 18°C and 21°C, with 16 pigs in each of the 24 pens. They were weighed every second week and slaughtered shortly after they reached 90 kg live weight. Measurements taken at slaughter were the same as in experiment 1.

Statistical analysis

In experiments 1 and 2 the data for the main effects of the treatments and their interactions were subjected to analyses of variance.

RESULTS

Experiment 1

There was no mortality in experiment 1 though some pigs were seen to be scouring in the first weeks, particularly amongst those receiving the CONV diet without fish meal. Pigs receiving the HND diet with fish meal in the first 14 days of the experiment grew significantly faster ($P < 0{\cdot}001$) compared with those receiving the HND diet without fish meal (see Table 2). As food intake was the same for pigs on both treatments, pigs receiving the HND diet with fish meal converted food better than those receiving the HND diet without fish meal.

TABLE 2

Experiment 1. Mean starting weights and daily live-weight gains for first 14 days

Diet	High nutrient dense		s.e. of mean
Fish meal	+	−	
Live weight at start (kg)	11·6	11·7	0·24
Daily live-weight gain (g/day)	304	177***	15·7

From the start of the experiment to 56 days, and over the whole experimental period, pigs receiving HND diets tended to grow faster, and convert food better than those receiving the CONV diets. Those receiving fish meal tended to grow faster and convert food better than those receiving no fish meal in their diets (Table 3). However, over the whole experimental period there was a significant interaction between nutrient density and fish meal content of the diet for both growth rate ($P < 0{\cdot}05$) and food conversion efficiency ($P < 0{\cdot}05$). Using Duncan's Multiple Range Test (Ridgman, 1975) the CONV diet without fish meal was found to be significantly poorer than the other three diets. The differences between the HND diets were not significant ($P < 0{\cdot}05$) but both were significantly better than the CONV

TABLE 3

Experiment 1. Mean daily growth rates, food conversion efficiencies and carcass measurements

Diet	High nutrient dense		Conventional		s.e. of a treatment mean
Fish meal	+	−	+	−	
Live weight at start (kg)	11·6	11·4	11·6	12·0	0·34
Live-weight gain, start to 56 days (g/day)	556^{a}†	493^{b}	467^{b}	434^{d*}	15·7
Food conversion efficiency, start to 56 days (g food per g growth)	1·68^{a}	1·87^{a}	2·41^{b}	2·64^{c*}	0·079
Live-weight gain, start to slaughter (g/day)	686^{a}	674^{a}	649^{b}	599^{c*}	9·2
Food conversion efficiency, start to slaughter (g food per g growth)	2·25^{a}	2·24^{a}	3·00^{c}	3·24^{d*}	0·049
Killing out proportion	0·718^{a}	0·708^{a}	0·718^{a}	0·712^{a}	0·0035
Carcass length (mm)	809^{a}	807^{a}	813^{a}	806^{a}	3·9
Shoulder fat depth (mm)	40·4^{a}	40·0^{a}	40·1^{a}	40·2^{a}	0·16
Loin fat depth (mm)	20·8^{a}	20·5^{a}	20·4^{a}	20·8^{a}	0·26
'P_2' fat measurement (mm)	14·8^{a}	15·4^{a}	14·7^{a}	15·5^{a}	0·46

† Means with the same superscript are not significantly different ($P > 0{\cdot}05$).

TABLE 4

Experiment 2. Mortality† and incidence of digestive disorders (number of cases)‡

Diet	Start to 14 days		14 to 56 days				56 days to slaughter			
	High nutrient dense		High nutrient dense		Conventional		High nutrient dense		Conventional	
Fish meal	+	−	+	−	+	−	+	−	+	−
No. of pigs	192	192	96	96	96	96	96	96	96	96
Mortality	0	2	0	3	7	9	0	0	0	1
No. of pigs with digestive disorders	16	20	—	—	—	—	—	—	—	—
No. of cases of pigs with digestive disorders	—	—	49	51	85	138	0	0	4	13

† No. of pigs that died.
‡ As a pig may show signs of digestive disorders on several occasions, expressing the number of cases can exceed the total number of pigs.

diet containing fish meal. For the first 56 days of the experiment the HND and CONV diets containing fish meal gave significantly better growth rates than those containing no fish meal but there was a significant interaction for food conversion efficiency in which the CONV, but not the HND diet, with fish meal gave the best response.

Throughout the experiments the growth rates of gilts and castrates were not significantly different ($P < 0{\cdot}05$). There were no significant interactions between sex and dietary treatments for any of the variables investigated.

Carcass measurements (killing out proportion, carcass length and fat measurements) were not affected by the density of the diet. Pigs receiving diets containing fish meal had slightly longer carcasses and thinner P_2 fat thickness, indicating slightly leaner carcasses, but the differences were not significant. Fat thickness (loin and P_2 measurements : mm) were significantly greater for castrates than for gilts [20·9 *v.* 20·3 ($P < 0.05$) and 15·7 *v.* 14·5 ($P < 0.01$) respectively].

Experiment 2

The incidence of digestive disorders and mortality were particularly high during the first 56 days of the experiment (Table 4). There were no deaths amongst pigs receiving HND diets with fish meal, whereas two pigs died in the first 14 days and three pigs died, between 14 and 56 days, on the HND diet without fish meal. Mortality occurred amongst pigs receiving CONV diets with and without fish meal, deaths being greater amongst pigs receiving the latter diet. Deaths occurred despite oral medication of individual pigs showing signs of digestive disorders. The incidence of digestive disorders was greater amongst pigs receiving CONV diets compared with HND diets from the 14th to the 56th day of the experiment. Also the incidence was particularly high amongst pigs receiving the CONV diet without fish meal and there was further mortality and digestive disorders in the period between 56 days and slaughter for pigs receiving this diet.

In calculating food conversion, allowance was made for the food consumed by pigs which died within the first 56 days of the experiment. It was assumed that these pigs consumed only sufficient food to provide for two thirds of their maintenance energy requirement. This was calculated from the regressions: (Agricultural Research Council (ARC), 1981):

(1) $MEm = 719 \text{ MJ } M^{0.63}$ and
(2) $DE = 0.96 \text{ ME}$

where MEm is the metabolizable energy requirement for maintenance, M is live weight and DE is digestible energy. From (1) and (2) above, and from the DE values of the diets given in Table 1, the amounts of food estimated to have been consumed during the period pigs were seen to be unwell were, at live weights of 5, 10, 15, 20, 25 and 30 kg, and for HND (and CONV) diets, 0·10 (0·10), 0·13 (0·14), 0·16 (0·18), 0·19 (0·21), 0·22 (0·24) and 0·25 (0·28) kg/day respectively.

The live weight of the pigs in experiment 2 at the start (5·8 kg — Table 5) reflects the younger age of these pigs (3 weeks) compared with those in experiment 1, where mean live weights of 11·7 kg at 5 weeks of age (Table 2) were recorded. During the first 14 days of the experiment when all pigs received HND diets, those receiving the diet with fish meal grew significantly faster than those receiving the diet containing no fish meal ($P < 0.05$). They also converted food more efficiently, all pigs consuming the same amount of food.

TABLE 5

Experiment 2. Mean starting weights and daily live-weight gains for first 14 days

Diet	High nutrient dense		s.e. of a treatment mean
Fish meal	+	−	
Live weight at start (kg)	5·7	5·8	0·02
Daily live-weight gain (g/day)	341	317*	6·2

Over the period from the start to 56 days, and over the whole experiment, pigs receiving HND diets tended to grow faster and convert food better than those receiving CONV diets. Also those pigs receiving diets with fish meal tended to grow faster and convert food better than those receiving diets without fish meal. However, as in the first experiment, there was a significant interaction up to 56 days with respect to growth rate ($P < 0.01$) and food conversion efficiency ($P < 0.001$), and over the whole experiment with respect to food conversion efficiency ($P < 0.05$). Using Duncan's Multiple Range test the CONV diet without fish meal was shown to be significantly worse than the other diets for growth rate ($P < 0.05$) and food conversion efficiency ($P < 0.05$) in both periods. All

TABLE 6

Experiment 2. Mean daily growth rates, food conversion efficiencies and carcass measurements

Diet	High nutrient dense		Conventional		s.e. of a treatment mean
Fish meal	+	−	+	−	
Live-weight gain, start to 56 days (g/day)	406[a]†	396[a]	372[a]	278[b]*	11·3
Food conversion efficiency, start to 56 days (g food per g growth)	2·18[a]	2·24[a]	2·91[ab]	4·11[c]*	0·09
Live-weight gain, start to slaughter (g/day)	631[a]	617[a]	599[a]	555[b]*	11·0
Food conversion efficiency, start to slaughter (g food per g growth)	2·44[a]	2·52[a]	3·25[b]*	3·69[c]*	0·08
Killing-out proportion	0·719[a]	0·715[a]	0·723[a]	0·716[a]	0·001
Carcass length (mm)	812[a]	821[b]	819[ab]	816[ab]*	3·0
Shoulder fat depth (mm)	40·4[a]	40·6[a]	40·7[a]	40·4[a]	0·13
Loin fat depth (mm)	20·7[a]	20·9[a]	21·4[a]	21·0[a]	0·25
'P_2' fat measurement (mm)	15·7[ab]	15·1[a]	16·6[b]	16·6[b]*	0·42

† Means with the same superscript are not significantly different ($P > 0{\cdot}05$).

differences between the two HND diets were not significant ($P > 0{\cdot}05$). Carcass fat measurements were generally unaffected by dietary treatment although the P_2 fat thickness was slightly, though significantly, greater for pigs receiving CONV diets than for those receiving HND diets ($P < 0{\cdot}05$) (Table 6). Carcass length was significantly greater in pigs that had been given fish meal in their HND diet compared with those that had been given their HND diet with no fish meal included.

The method of feeding affected growth and food conversion in different ways at different stages of the experiment. Initially (start to 14 days) growth rate was significantly better with trough feeding, ($P < 0{\cdot}01$) (Table 7). From 14 days to 56 days growth rate and food conversion efficiency were significantly better with floor feeding ($P < 0{\cdot}05$ in each case) whereas from 56 days to the end of the experiment trough feeding resulted in better growth and food conversion efficiency, though differences were not significant. Over the whole experiment, growth and food conversion efficiency of pigs trough-fed were similar to those of pigs that were floor-fed.

There were no indications of interactions between method of feeding and dietary treatments for any measurements at any stage of the experiment.

TABLE 7

Experiment 2. Effect of feeding on the floor, or in a trough, on growth rate and food conversion efficiency

Method of feeding	Floor	Trough	s.e of mean
Live-weight gain start to 14 days (g/day)	307[a]†	352[b]**	6·3
Live-weight gain from 14 to 56 days (g/day)	400[a]	347[b]	10·5*
Food conversion efficiency from 14 to 56 days (g food per g growth)	3·16[a]	3·66[b]	0·09*
Live-weight gain 56 days to slaughter (g/day)	707[a]	727[a]	16·2
Food conversion efficiency 56 days to slaughter (g food per g growth)	3·20[a]	3·16[a]	0·07
Live-weight gain start to slaughter (g/day)	601[a]	599[a]	7·8
Food conversion efficiency start to slaughter (g food per g growth)	2·94[a]	3·00[a]	0·06

† Means with the same superscript are not significantly different ($P > 0{\cdot}05$).

DISCUSSION

In both experiments pigs receiving high nutrient dense diets tended to grow faster and convert food more efficiently than those receiving conventional diets. As the diets provided approximately the same daily intake of digestible energy the better growth of pigs receiving the HND diets suggests a more efficient use of digestible energy. On the other hand a better supply of amino acids from the HND diet could have been a further factor accounting for the better results with those diets.

The diets in both experiments were formulated to be adequate in nutrient content according to the recommendations of the ARC (1967) and current commercial practice. However, diets in both experiments provided less lysine and threonine (the totals were approximately 0·6 g and 0·5 g/MJ DE respectively) than required by pigs up to 15 kg live weight according to the ARC (1981) (approximately 1·0 g and 0·6 g/MJ DE respectively). In the CONV diet 0·75 of the total protein was of cereal origin compared with only 0·5 of the total protein in the HND diet. As, according to ileal digestibility figures (Lenis, 1983), soya bean protein and/or fish meal protein provide a superior supply of essential amino acids for the pig than do cereal proteins, this may in part have accounted for better growth and food conversion efficiency of the HND fed pigs.

Approx. 0·17 of the dietary energy in the HND diets was provided by fat, compared with less than 0·05 in the CONV diets. It is recognised that in poultry the metabolizable energy content of fats is better utilized than that derived from other components of the diet such as proteins and carbohydrates (Carew and Hill, 1958; Infield, Annison and Lewis, 1973; Scheibel, Coon and Kelley, 1979). The better utilization by pigs of the energy from high nutrient dense diets, with added fat, was noted almost 20 years ago (Bayley and Lewis, 1963). Subsequent work (Cole, 1971; Curran *et al.*, 1975) confirmed this finding.

Addition of fish meal to the CONV diet markedly improved growth and food conversion efficiency. Fish meal addition to HND diets also tended to improve growth and food conversion efficiency, especially during the first 14 days. The responses with the HND diet to fish meal addition over the whole experiment (proportionately up to 0·03 improvement) whilst not significant were similar to those found when experiments in which fish meal had been given to growing pigs were reviewed (Pike, 1979). Two experiments in which pigs were under 20 kg live weight initially (Gropp, Erbersdobler and Zucker, 1970; Kjeldsen, Danielsen and Nielsen, 1981), also showed very marked beneficial responses to fish meal feeding over 3 weeks (Gropp *et al.*, 1970) and 6 weeks (Kjeldsen *et al.*, 1981). These findings, along with the results from the present experiments, indicate that the younger the pig the greater the response in growth and food conversion efficiency to fish meal replacing soya bean meal in the diet.

Possible explanations for the responses to fish meal feeding include a better amino acid supply (uptake from the small intestine) and balance, an under-estimation of the energy contribution of fish meal, and the contribution of selenium within the fish meal (Pike, 1979).

The adequacy of the amino acid supply in the second experiment with group feeding may have had a marked effect on the susceptibility of the pigs to disease in the early part of that experiment. The combined effects of increasing nutrient density and fish meal inclusion resulted in a much lower incidence of disease and no mortality. Comparing the HND diet with fish meal with the CONV diet without fish meal, the overall mortality (number of pigs that died) and incidence of digestive disorders were 0 and 65 and 12 and 171 for the HND and CONV diets respectively. None of the diets were associated with any mortality in the first experiment where pigs were individually penned. Clearly the combined effects of group feeding and unmedicated diets in the second experiment increased the susceptibility of pigs to disease. In practice, pigs are group fed medicated diets but some farms have standards of hygiene which are far from ideal. The results of the second experiment suggest that the form in which the nutrients are supplied, either as fat, maize and wheat, or with sorghum replacing barley and wheat middlings, or with fish meal replacing soya bean meal, is an important contributory factor affecting conditions under which digestive disorders may proliferate. Had competitive feeding from troughs resulted in certain pigs over-eating, particularly with high nutrient dense diets, more carcass fat would have been expected. With floor feeding, a more equal food distribution would have been expected. The carcass measurement results from experiment 2 indicated that the method of feeding did not adversely affect carcass fat content significantly with any of the diets given.

Although method of feeding (floor or trough) in the experiment in its entirety did not affect growth or food conversion efficiency, the results indicated that floor feeding is likely to result in better growth and food conversion efficiency only between 5 weeks and 11 weeks of age (day 14 to day 56 of the experiment). In the larger, multi-centre co-ordinated, experiment of Braude and Rowell (1966), in which the performance of pigs fed pelleted food in a trough or from the floor was compared, no differences in either growth or food conversion efficiency were found when pigs were grown to 55 kg or 80 kg live weight. However, the pigs in Braude and Rowell's experiment were 9 to 11 weeks of age initially, whereas in the present experiment 2 the benefit of floor feeding was seen only up to 11 weeks of age.

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FISH MEAL SCIENTIFIC ADVISORY SERVICE

The International Association of Fish Meal Manufacturers (IAFMM) announces the establishment of a permanent Scientific Advisory Service mainly for Feed Compounders and Concentrate Manufacturers and Agricultural Institutions. The staff of the IAFMM, in conjunction with its Scientific Committee, representing an international group of experts in nutrition, bacteriology, engineering and product development, will provide up-to-date information on any aspect of Fish Meal and its uses. All enquiries should be directed to:

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