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Effect of replacement of fish meal by poultry byproduct meal and meat and bone meal (regular, packer all beef and low ash renderer) in practical diets for newly weaned pigs on growth and feed utilization.

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Abstract

Three feeding trials were conducted utilizing 590 newly weaned pigs (average age of 28 days) to compare the growth performance of pigs fed the fish meal (FM) control diet vs. FM replacement diets. Fish meal (Peruvian) was substituted by petfood grade poultry byproduct meal (PBM), regular meat and bone meal (MBM), all beef packer MBM and low ash MBM-renderer (18% ash) on an equal protein basis. All diets were similar in content of metabolizable energy (ME), proximate constituents, and digestible essential amino acids. Growth performance (weight gain, feed intake, and feed conversion ratio) and health observations (incidence of scours, mortality) were measure during the 28-Day feeding trial. Results indicate that in practical pig starter diets, the substitution of FM (5%) by PBM or MBM (regular and low ash) increased feed consumption and weight gain (9-11%), and had no effect on feed utilization, and health status. Packer all beef MBM tended to improve weight gain (8%) and feed efficiency (5%) but had no effect on feed consumption. Lowering ash content in MBM by classification did not yield better growth performance than regular MBM. Since all diets were formulated to equal nutritive specifications, the faster growth rate for PBM and MBM diets vs. FM diet is largely due to the increased feed consumption. The other possible reason could be the quality problems of the FM used in these trials. The present trials clearly demonstrated that replacement of FM with PBM or MBM produces a 10% advantage in growth performance and markedly reduces the feed cost for the hog industry.

Introduction

Formulation of pig starter is critical for the performance and profitability of market hog grow out operation. This is particularly important for China, the largest pork producer in the world. Research from UK and US has indicated the requirement of animal proteins in diets for early weaned pigs (21 days or less) due to their incomplete development of the digestive system and the allergic reaction to plant proteins. In China, feedmillers typically include imported fish meal in pig starter at about 5%, regardless the age of weaning. The supply and cost of FM has been becoming prohibitive for the feed industry, and could lost its competitiveness with alternative non-marine animal protein meals such as PBM and MBM. Early research from Dr. Parsons (Univ. of Illinois) has suggested the ash content in MBM may be negatively related to the protein digestibility. Low ash MBM may have an improved feeding value for young pigs. The purpose of the present study was to demonstrate the feasibility and advantage of replacing FM with PBM or MBM in practical diets for newly weaned pigs.

Materials and methods

Research station and partners

After carefully evaluation of capacity and quality of work, the Association selected three local research organizations (Sichuan Agricultural Univ. Guangdong Zhongshan Food Co. and Shenzhen Kondarl Swine Research Farm). A fourth candidate (Guangdong Wan's Food Co.) also agreed to conduct the trial but had postponed the trial due to tight scheduling at research farms.

Protein meals

Other than FM as the control, four rendered protein meals were tested (PBM, regular 50% MBM, all beef packer MBM, and low ash MBM-renderer). Sufficient quantity of each meal was purchased and delivered to each of the research sites. All meals were sampled and analyzed for proximate and amino acid composition (Table 1). Packer MBM was made from all beef materials and had a typical analysis of slightly low in protein (45%) and high in ash (29%) (Table 1). Amino acids content was similar between packer and the regular MBM (Table 1). Ash content was significantly reduced by classification in low

ash MBM (18.1%) and consequently increased the content of protein (53.04 vs 50.6% of regular MBM) and amino acids (+16%). Nutrient analysis of regular MBM, PBM and FM was all within the typical range reported in the literature (NRA, and NRC).

Diet formulation

Special attention was given to nutrient specifications and the fortification of special ingredient (e.g. whey and plasma protein) since the target animals were relatively young, stressed (due to weaning) and were less tolerable in digesting plant sources. All diets were formulated to have similar content of ME, CP, Ca, P, and also digestible essential amino acids (i.e. lysine, methionine, threonine, and tryptophan). Nutrient specifications and ingredient selection were guided by Dr. Li. D.F. of China Agricultural University. The hypothesis of the design was that pigs should perform equally among diets since variation in nutrient profile had been reduced to minimum through formulation. The FM inclusion rate in the control diet was selected at 5% in reflecting the reality of most practical or commercial diets and also the age of the pigs. Replacement of FM by PBM and MBM was done on an equal protein basis. Diets formulation and calculated analysis are given in Table 2. All diets were palletized.

Animals

A total of 590 cross bred (LxLWxD) newly weaned (21 days) pigs (both barrows and gilts) were used. Pigs were given a 7-10 days adjustment period prior to the trial. Each dietary treatment was replicated with three pens. Pigs were weighted at the beginning and ending (28 days) of the trial. Feed consumption was recorded by pen daily. Mortality and health problems (e.g. sourings) were recorded daily during the trial.

Results

Growth data from three trials are given in Table 3,4 and 5. It is unfortunate that trial 3 lasted for only 13 days due to management difficulty. Data from Trial 3 (Table 5) should be regarded only as reference.

In trial 1, feed consumption and daily weight gain were higher for pigs fed PBM and MBM diets as compared with FM diet (Table 3), although the difference was not statistically significant ($P>.05$). Feed utilization efficiency was not different ($P>.05$) among diets. Results of growth response from Trial 2 (Table 4) were very similar to Trial 1. Daily weight

gain of pigs fed alternative proteins were significantly (P<.05) faster (6-12%) than pigs fed FM. This better weight gain was combined effect of improved feed intake (1-6%) and feed utilization (4 to 6%). Mortality and scouring rate was slightly higher for pigs fed regular MBM while very little effects were noted for the other four treatment groups.

Incidence of sourings or other health problems was minimum for all treatments. Growth performance was generally better for Trial 2 than Trial 1.

Growth data from Trial 3 are listed in Table 5. There was no significant difference among treatments in feed intake, weight gain, feed efficiency or incidence of sours.

Performance data from Trial 1 and 2 were adjusted to a relative basis, i.e. FM control being 100% (Table 6). It appears that weight gain of PBM and MBM groups was 8-11% faster than the FM control, and was largely due to an parallel increase in feed intake except for the packer MBM which showed no change in feed intake but an improvement in feed utilization by 5%.

Discussions

It is unclear why FM group had lower feed intake than PBM and MBM groups considering the fact that all diets were formulated to the same levels of nutrient, including digestible amino acids. Amino acid analysis of FM (Table 1) did not indicate any obvious abnormality. Some quality problems may be involved.

Although rendering industry can produce a variety of animal protein meals, the stringent and comprehensive formulation excises minimize the nutritive profile difference of the protein meals and provide all the test diets of equal nutritive value and consequently the growth performance. Value of any particular protein meal therefore can only be compared with other meals within the formulation system of a particular diet and also the availability and prices of complementing feed ingredients (e.g. crystalline amino acids).

Low ash MBM by classification process could have distinct advantage over regular MBM in aquafeeds, but gives an equal performance as regular MBM in pig starter. However, based on protein digestibility work done with poultry high ash MBM should be avoided. Unlike regular MBM (Renderers), all beef packer MBM had no effect on feed intake but improved feed efficiency by 5%, and weight gain by 8%. While no apparent reasons for explanation, these advantages could produce a greater feed savings for packer

MBM than regular MBM. More research work in this area is needed.

It is well known by the hog industry that growth advantage in starter phase usually carries over to the later growing/finishing phase. The present study indicates that replacing FM with PBM and MBM in starter diets could provide producers with additional benefit in reducing days to market.

Although not being the main objective of the present study, results indicate clearly the importance and value of formulating pig starter diets on digestible nutrients basis, particularly with byproducts.

Conclusions

Under present trials condition, young pigs fed PBM and MBM (regular, packer all beef, or low ash renderer) formulated starter as FM replacement (on an equal protein basis) grew faster than pigs fed FM control diet. With application of proper formulation techniques, all rendered protein meals supported equal growth in young pigs. Substitution of Fm with PBM or MBM should result in substantial savings in feed cost for the hog industry, particularly for China. The fourth trial with Wen's will begin in May 2004.

Table 1. Actual analysis of meat and bone meal (MBM) poultry by product meal (PBM) and fish meal (FM) used in the pig starter trials (Trials 1,2,3)

	MBM[1]			PBM[3]	Fish Meal[4]	
	Regular	All Beef Packer[1]	Low ash Render[2]		Trial 1	Trial 2,3
Moisture %	4.92	6.15	5.75	5.52	9.52	8.54
C. Protein %	50.55	45.14	53.04	66.57	61.24	67.44
Ash %	22.8	29	18.1	14	16	16.7
Calcium %	7.9	6.32	4.71	3.67	4.1	4.27
Phosphorus %	4.01	3.3	2.65	2.25	2.63	2.64
Pepsin dig. %	87	87	89	86	90	95
Arg.	3.32	3.3	3.61	4.33	3.49	3.68
Cys	.48	.56	.56	.95	.62	.67
His	1.07	1.03	1.39	1.37	1.58	1.81
Ile	1.57	1.5	1.87	2.29	2.61	2.6
Leu	3.18	3.24	3.9	4.26	4.58	4.5
Lys	2.68	2.62	3.32	3.95	4.64	4.47
Met	1.09	.84	1.11	1.82	1.72	1.66
Phe	1.85	1.81	2.27	2.54	2.49	2.46
Thr	1.82	1.83	2.15	2.49	2.64	2.68
Trp	.28	.26	.34	.46	.51	.49
Tyr	1.33	1.33	1.69	1.98	2.06	1.98
Val	1.9	197	2.36	2.58	2.71	2.74

[1] Meat and bone meal

[2]Ash content was reduced by passing regular MBM through a classifier

[3]Pet food grade poultry byproduct meal

[4]Peruvian fish meal

Table 2. Experimental diets formulation and nutrient analysis (Trials 1,2,3)

	Test Protein Source				
	FM[1]	PBM	MBM		
			All beef packer	Low ash renderer	Regular
	- - - - - - % - - - - - -				
Corn	**61.5**	**62.32**	**60.6**	**60.3**	**60.38**
SBM (46%)	**22.6**	**21.7**	**22.49**	**22.9**	**22.8**
Whey	**4.6**	**5**	**5**	**5**	**5**
Plasma Protein	**1.72**	**1.8**	**1.8**	**1.85**	**1.7**
FM	**5**				
PBM		**4.92**			
LA MBM-Packer			**5.82**		
LA MBM-Render				**6.4**	
Regular MBM					**5.82**
Soy Oil	**1.53**	**1**	**1.5**	**1.3**	**1.2**
$CaHPO_4$	**1.1**	**1.3**	**1**	**.6**	**.5**
Limestone	**.6**	**.6**	**.5**	**.35**	**.3**
Salt	**.3**	**.3**	**.3**	**.3**	**.3**
Premix	**1**	**1**	**1**	**1**	**1**
L-LysineHcl	**.05**	**.06**	**0**	**0**	**0**
Analysis[3]					
ME (Mcal/kg)	**3.25**	**3.26**	**3.25**	**3.25**	**3.26**
C. Protein %	**20.7**	**20.7**	**20.7**	**20.7**	**20.7**
Calcium %	**.8**	**.81**	**.8**	**.79**	**.81**
Phosphorus %	**.7**	**.7**	**.7**	**.7**	**.7**
Dig. Lysine[4] %	**.95**	**.94**	**.93**	**.97**	**.94**
Dig. Methionine %	**.3**	**.3**	**.31**	**.32**	**.32**
Dig. Threonine %	**.65**	**.65**	**.67**	**.7**	**.68**
Dig Tryptophan %	**.18**	**.18**	**.19**	**.19**	**.19**

[1]Fish Meal

[2]Pet food grade poultry product meal

[3]Calculated analysis

[4]Digestibility coefficients were derived from NRC, 1998

Table 3. Growth response of newly weaned pigs fed diets containing fish meal, poultry byproduct meal or meat and bone meal – Trial 1 (Sichuan)

	Test protein source				
	FM[1]	PBM[2]	MBM[3]		
			All beef packer	Low ash renderer	Regular
No. of pigs[4]	18	18	18	18	18
Initial wt (kg)	7.07	7	6.99	7.15	7.21
Final wt. (kg)	15.12	15.94	15.75	15.65	16.27
ADG (g)	287.5	319.4	312.7	303.8	323.4
Feed intake (g/d)	521.9	586.3	523.9	571.4	600.6
Fed/gain	1.81	1.83	1.69	1.89	1.90
Survival (%)	94	94	89	100	83
Scours (%)	1.45	1.05	1.19	2.38	3.51

[1] Fish meal

[2] Pet food grade poultry byproduct meal

[3] Meat and bone meal

[4] 21 days weaned pigs, starting age was about 28 days, 6 pigs/pen, 3 pens/treatment, trial duration was 28 days

Table 4. Growth response of newly weaned pigs fed diets containing fish meal, poultry byproduct meal or meat and bone meal – Trial 2 (Guangzhou)

	Test protein source				
	FM[1]	PBM[2]	MBM[3]		
			All beef Packer	Low ash Renderer	Regular
No. of pigs[4]	80	80	80	80	80
Initial wt (kg)	8.17	8.21	8.29	8.26	8.24
Final wt. (kg)	22.44	24.11	23.42	24.21	23.56
ADG (g)	510[a]	570 [b]	540 [b]	570 [b]	550 [b]
Feed intake (g/d)	919	966	931	973	941
Feed/gain	1.8	1.7	1.72	1.71	1.71
Scours (%)	1.25	1.07	.7	.54	1.07

[1] Fish meal

[2] Pet food grade poultry byproduct meal

[3] Meat and bone meal

[4] 21 days weaned pigs, starting age was about 28 days, 20 pigs (1:1 barrows:gilts)/pen, 4 pens/treatment, trial duration was 28 days

Table 5. Growth response of newly weaned pigs fed diets containing fish meal, poultry

byproduct meal or meat and bone meal – Trial 3 (Shenzhen)

	Test protein source				
	FM[1]	PBM[2]	MBM[3]		
			All beef packer	Low ash renderer	Regular
No. of pigs[4]	20	20	20	20	20
Initial wt (kg)	10.6	10.6	10.7	10.7	10.5
Final wt. (kg)	16.5	16.3	15.7	16.8	16.2
ADG (g)	384.6	380	378	389	381
Feed intake (g/d)	635	628	622	624	640
Feed/gain	1.65	1.66	1.62	1.58	1.68
Scours (%)	1.15	0	0	2.23	3.67

[1] Fish meal

[2] Pet food grade poultry byproduct meal

[3] Meat and bone meal

[4] 21 days weaned pigs, starting weight was about 9 kg, 5 pigs/pen, 4 pens/treatment, trial duration was 13 days

Table 6. Relative weight gain and feed conversion ration of newly weaned pigs fed diets containing poultry byproduct meal or meat and bone meal in comparison with fish meal based control diets (Trials 1,2)

	Test protein source				
	FM[1]	PBM[2]	MBM[3]		MBM
			All beef packer	Low ash renderer	
Feed intake					
Trial 1	100	112	100	109	115
Trial 2	100	105	101	106	102
Avg.	100	109	100	108	109
Weight gain					
Trial 1	100	111	109	106	113
Trial 2	100	112	106	112	108
Avg.	100	111	108	109	111
Feed/gain					
Trial 1	100	101	93	104	105
Trial 2	100	94	96	95	95
Avg.	100	98	95	100	100

[1] Fish meal

[2] Pet food grade poultry byproduct meal

[3] Meat and bone meal