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Title: Effect of Peptiva SEW as a replacement for Plasma Protein in Phase I Nursery Diets

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Objective: To determine if Peptiva SEW can be a cost-effective replacement for more expensive ingredients in swine nursery diets.

Background:

At weaning, pigs are typically fed diets high in animal protein sources such as whey, fish meal and plasma or blood products. These ingredients have clearly been established as providing better performance than plant based ingredients. However, these are the most expensive ingredients used at any time during the production of pigs. This results in nursery diets being several fold greater in cost that grower and finisher diets. Ingredients that can offer equivalent growth performance but at a lower cost are of great interest in the industry.

The primary objective of this work was to evaluate the Peptiva SEW product as an alternative to plasma protein. The standard phase I diet used in our unit contains 27.5% whey, 5% spray dried plasma protein and 3 % fish meal. The phase II diet contains 10% whey, 2.5 fish meal and 2.5% spray dried blood cells. The lysine content in phase I and II is 1.50 and 1.35%, respectively. In this study, Peptiva SEW was substituted for all or part of the plasma protein in the phase I diet. Pigs were fed phase I diets for 2 weeks post-weaning and then switched to common Phase II and III diets.

Methods:

Animals. Pigs from the University of Georgia Swine unit research nursery were used. The nursery facility has 20 pens capable of housing 8-12 pigs each. The study was conducted in 2 identical trials using pigs born in May and July that were weaned on June 7th and August 2nd, respectively. At weaning (approximately day 21), pigs were allotted by weight, gender and ancestry to one of 20 pens with 8 - 10 pigs per pen in the first trial (180 pigs total) and 7-8 pigs in the second trial (150 pigs total). The number of pigs and the distribution of genders was balanced across treatments. Within each trial, pigs were blocked by weight such that there was a heavy and light group in each trial. Pens within a block were randomly assigned to dietary treatments. There were 4 pens per dietary treatment in each replicate and thus a total of 8 pens per diet in both replicates. Pigs had unlimited access to feed and water. Pigs were weighed initially and on d 7, 14, 21, 28 and 35. Intake was monitored at weekly intervals and diets changed on d 14 (phase I to II) and 28 (phase II to III).

Experimental Diets. Diets were formulated with the goal of maintaining at least an ideal pattern of essential amino acids. For the 5-20 kg pig this pattern is: lysine (100), total sulfur (60%), threonine (65%), tryptophan (18%). The phase I diet was fed for 14 days. The reference diet was the standard UGA phase I diet that is formulated to contain 1.5% lysine, and has 5% plasma protein (SDPP) and 3% fish meal. This diet is supplemented with 0.12% crystalline lysine and 0.12% DL-methionine. The negative control diet has these same levels of amino acids, but no SDPP. The ingredient composition used in formulating the diets is shown in Table 1. Composition of phase I diets is shown in Table 2.

Dietary Treatments:

1. Negative control (no plasma)
2. Reference diet (5% plasma protein)
3. Peptiva SEW 1.5% (no adjustment for amino acids)
4. Peptiva SEW 1.5% (adjusted for amino acids)
5. Peptiva SEW 5.0% (no adjustment for amino acids)

The first test diet (diet 3) will have 2.5 % plasma protein and 1.5% Peptiva SEW. In this diet, crystalline lysine and were maintained at the same level as in the reference diet group. This will result in the reduction in total lysine to approximately 1.37%. A second test diet (diet 4) will include 1.5% Peptiva with 2.5% SDPP where the diet is adjusted for total amino acid level. The third test diet (diet 5) will be 5% Peptiva and no SDPP.

Pigs were fed phase I diets for 14 days. Pigs were fed a common phase II and III diet (Table 3) and performance monitored through day 35 to determine if there are any residual effects of the phase I treatments. All pigs were returned to the Swine Unit herd upon completion of the trial.

Statistical Analysis. Results were analyzed with pen as the experimental unit using the Proc GLM procedure in SAS. The model included effects of dietary treatment, block, trial and their interactions. Results are reported as least squares means. Differences were considered to be significant when P was less than 0.05.

Results

Growth Performance

Of the 330 pigs that started the study there were 5 pigs that died (4 in trial 1 and 1 in trial 2). The losses were independent of treatment. The initial weight of the pigs in each trial was similar and averaged 5.62 kg (12.3 lb). Pigs in the heavy block averaged 6.75 kg (14.9 lb) while those in the light block averaged 4.5 kg (9.9 lb). There were no significant diet x block interactions indicating that the effects of diet were similar on large and small pigs.

The growth performance is summarized in Table 4. Initial weight was similar across dietary treatments. The typical response to plasma protein was noted in week 1. Despite similar

amino acid content, pigs fed the diet with 5% SDPP had growth rates that were 80% greater than those in the negative control diet. Removing half of the SDP and adding Peptiva resulted in a decrease in growth rate (167 vs 195 g/d) as compared to the diet with 5% SDPP. Balancing the Peptiva diet for amino acids restored growth rate such that it was identical to the 5% SDPP diet. Pigs fed the diet with 5% Peptiva and no SDPP grew at a slower rate than those with SDPP (144 vs 195 g/d). These results suggest that Peptiva can replace SDPP and that when diets are balanced for amino acids, growth rate is equivalent.

Intake was greater in diets with SDPP than without. Intake of the diet with 5% Peptiva was greater than that in the negative control group (193 vs 172 g/d) but was not as great as in the diets with SDPP (average 220 g/d). There was no difference in intake of diets with 1.5 % Peptiva and 5% SDPP, but intake was numerically lower in the Peptiva diet that was not balanced for amino acids.

Feed efficiency, reported as gain: feed, was affected by diet in the first week. Pigs fed the SDPP and the 1.5% Peptiva diets had the best efficiency, while the negative control group had the least. The group fed 5% Peptiva was intermediate.

During the second week of the study, growth rate was similar to that in the first week in pigs fed SDPP (203 vs 193 g/d). In contrast, growth rate tended to be greater in week 2 than in week 1 for the other treatments. Overall for days 0-14, growth rate of pigs in all diets with Peptiva were similar to the SDPP diet and greater than that of the negative control. Thus, a key conclusion of this study is that growth rate is similar in pigs fed diets where all or part of the SDPP is replaced by Peptiva SEW.

Feed intake increased in all groups during the second week of the study as compared to the first. Intake was not different among the pigs fed SDPP or Peptiva and all were greater than the negative control group. Intake of pigs fed diets with Peptiva was numerically greater (395 g/d) than that of pigs fed SDPP (372 g/d) during the second week. As are result, overall intake during the first 2 weeks was similar among pigs fed SDPP or Peptiva (average intake 301 g/d). Overall feed efficiency was best in pigs fed SDPP or 1.5% Peptiva and poorest in the negative control group. It was intermediate in the pigs fed 5% Peptiva. This was largely due to the lower growth rate, but similar intake of pigs fed the 5% diet relative to the SDPP and 1.5% groups.

All pigs were fed common diets from day 14 to 35 of the study. A phase II diet (1.35% lysine) with 2.5% blood cells, 10% whey and 2.5% fish meal was fed for day 14-28. There was a significant main effect of diet on gain for days 14-28. This was largely due to the slower gain in the negative control group (421 g/d) compared to the others. Pigs that had previously been fed the 1.5% Peptiva diet, tended to grow slower than those fed SDPP (434 vs 456 g/d) during this period. In contrast, pigs that had been fed the 1.5% Peptiva diet supplemented with amino acids or the 5% Peptiva diets previously, had numerically greater gains than the pigs fed SDPP (463 g/d vs 456 g/d).

Intake was also different during the period of day 14-28. Again, this was largely due to the lower intake in pigs from the negative control group that at less than those in the other treatments. The numerically highest intakes were in pigs that had been fed 1.5% Peptiva + AA and 5% Peptiva in the first 2 weeks. Feed efficiency was not different during this period.

The phase III diet was fed during the last week of the trial (d 28-35). This diet was a c orn-soybean meal based diet with 1.25% lysine. There were no differences in growth rate, intake

or feed efficiency during this week. Pigs that had been fed any of the diets with Peptiva in the first 2 weeks post-weaning, had numerically greater gain (average 582 g/d) than those fed the SDPP diet (558 g/d). Pigs fed either of the 1.5% Peptiva diets grew similarly (590 g/d) during this period. Although it is not statistically significant, this represents a greater than 5% faster growth rate.

Overall, pigs fed SDPP or Peptiva in the first 2 weeks post weaning were more than 1 kg heavier than those fed the negative control diet. Thus, differences in growth rate seen on day 14 were maintained throughout the study. Overall, pigs in these groups gained 375 g/d as compared to 336 g/d in pigs fed the negative control diet. This represents an almost 12% increase in growth rate. None of the pigs in these treatments were different from each other. Pigs that had been fed the 1.5% Peptiva +AA diet had the numerically greatest gain overall (387 g/d). Although the growth rate of pigs in this group was never statistically different from the SDPP control, it was 2% greater in the first (204 vs 200) and second (465 vs 456 g/d) 2 week periods and 5.7 % greater in week 5 of the study.

Overall intake was greater in pigs fed any of the diets with SDPP or Peptiva as compared to the negative control (580 vs 530 g/d). Pigs fed 1.5% Peptiva + AA had the numerically greatest intake (591 g/d) which was 2-3% greater than the other groups. Feed: gain ratio was not different overall between any of the treatments.

Economic analysis

An estimate of the economic value of the performance differences was conducted. Ingredient prices were determined from an industry consultant and other sources in September of 2007. The prices used are shown in Table 5. The cost of diets is shown in Table 6. The price used for SDPP was $2.00/lb and $1.25 for Peptiva SEW. Clearly, SDPP is the most costly ingredient in these diets. It accounts for 5% of the weight of the phase I diet, but approximately 25% of its cost. Replacing SDPP with Peptiva results in a cost savings of about $60 /ton of feed or about 7% of the cost of the phase I diet. Supplementation of the 1.5% Peptiva diet with amino acids reduces the savings to about $54/ton. The diet with 5% Peptiva was $72/ton cheaper than the diet with SDPP and was the least costly of the experimental diets.

The economic value associated with the performance changes is summarized in Table 7. As indicated above, pigs fed any of the diets with SDPP or Peptiva were heavier than those fed the negative control diet at the end of the study. The pigs in these groups were not different from each other and they had similar intake. Thus, the value of Peptiva is that equivalent performance was achieved with a lower cost diet. The estimated value of using Peptiva in place of half of the SDPP was that it saved $ 0.41 per pig (Diet 3 vs diet 2). Balancing the Peptiva diet for amino acids resulted in a loss of this benefit (Diet 2 vs 4). There was a $ 0.25 per pig savings in pigs fed the 5% Peptiva diet (Diet 5 vs 2). While this was the least costly diet, intake was greater for these pigs in phase II which reduced the value somewhat. Calculation of the feed cost per kilogram of gain showed a small advantage (2-3% reduction in cost per unit of gain) for Peptiva containing diets.

Conclusions

Pigs fed phase I diets with similar chemical composition, but no SDPP did not perform as well as those fed 5% SDPP (Diet 1 vs diet 2). This agrees with the literature and illustrates the benefit of SDPP.

Overall, pigs fed phase I diets where a portion of the SDPP was removed and replaced with Peptiva had similar performance (Diet 2 vs 3). There were slight improvements in performance of pigs fed the diet with Peptiva when it was supplemented with amino acids.

Pigs fed phase I diets where there was a complete removal of SDPP and replacement with an equivalent amount of Peptiva (5%) had similar performance over the 5 week study. Pigs fed 5% Peptiva did not gain as well in the first 2 weeks, but recovered in subsequent weeks and were not different from those fed SDPP (Diet 2 vs 5).

The estimated cost of the diets with Peptiva was less than that of the reference diet with 5% SDPP (diet 2 vs diets 3, 4 5). Similar growth performance with a reduced phase I diet cost results in an overall reduction in the cost of production. However, given that consumption of the phase I diet is relatively small, the value of the lower feed cost is small.

Table 1. Ingredient Composition

	SDPP (AP 920)	SD Blood Cells (AP 301)	Fish Meal	Peptiva SEW
Crude Protein	78.0	92	62.3	48.85
ME, kcal/kg	3906	4190	3360	3100
Lysine	6.8	9.0	4.81	2.74
Methionine	0.7	0.8	1.77	0.75
Cystine	2.8	7.1	0.57	0.76
Threonine	4.8	3.6	2.64	1.62
Tryptophan	1.4	1.2	0.66	0.53
Calcium	0.15	0.01	5.21	0.34
Phosphorous	1.3	0.2	3.04	1.02

Table 2. Experimental Diet Composition

	Phase I diets (Day 0-14)				
	Negative Control	Reference (Standard UGA Diet)	Peptiva SEW 1.5%	Peptiva SEW 1.5% + AA	Peptiva SEW 5%
Corn	43.88	41.03	41.03	40.75	39.60
Soybean meal	18.75	18.75	18.75	18.75	18.75
Whey	27.50	27.50	27.50	27.50	27.50
Fish Meal	3.00	3.00	3.00	3.00	3.00
SDPP (AP 920)	-	**5.00**	**2.50**	**2.50**	0
Fat	2.41	2.00	2.08	2.10	2.54
Peptiva SEW	-	-	**1.50**	**1.50**	**5.00**
L-lysine	0.56	0.12	0.12	0.29	0.12
Methionine	0.29	0.12	0.12	0.18	0.12
Threonine	0.10	-	-	0.04	-
Tryptophan	0.03	-	-	-	-
Limestone	0.31	0.46	0.38	0.41	0.39
Dicalcium Phosphate	1.42	1.13	1.21	1.21	1.21
Zinc Oxide	0.38	0.38	0.38	0.38	0.38
Vitamin Premix	0.25	0.25	0.25	0.25	0.25
Mineral premix	0.15	0.15	0.15	0.15	0.15
Antibiotic	1.00	1.00	1.00	1.00	1.00
Calculated Composition			3		
Energy, kcal ME/kg	3310	3310	310	3310	3310
Crude Protein, %	18.84	21.82	20.54	20.54	20.32
Lysine, %	1.50	1.50	1.36	1.50	1.30
TSAA, %	0.90	0.90	0.84	0.90	0.80
Threonine	0.97	1.03	0.93	0.97	0.87
Tryptophan	0.27	0.31	0.28	0.28	0.26
Ca, %	0.90	0.90	0.90	0.90	0.90
P, Total %	0.80	0.80	0.80	0.80	0.80
P, avail %	0.51	0.51	0.51	0.51	0.51

Table 3. Composition of Phase II and III diets

	Phase II	Phase III
Corn	55.73	63.07
Soybean meal	21.82	29.41
Whey	10.00	-
Fish Meal	2.50	-
Blood Cells	2.50	-
Fat	3.05	2.98
L-lysine	0.12	0.20
Methionine	0.11	0.05
Limestone	0.48	0.64
Dicalcium Phosphate	2.00	1.93
Zinc Oxide	0.25	-
Vitamin Premix	0.25	0.25
Mineral premix	0.15	0.15
Antibiotic	1.00	1.00
Calculated Composition		
Energy, kcal ME/kg	3310	3310
Crude Protein, %	20.56	19.86
Lysine, %	1.35	1.25
TSAA, %	0.81	0.75
Threonine	0.88	0.81
Tryptophan	0.25	0.24
Ca, %	0.90	0.75
P, Total %	0.80	0.70
P, avail %	0.51	0.41

Table 4. Effect of Peptiva SEW on Nursery performance

Diet	1	2	3	4	5		
	Negative Control	Reference (Standard UGA Diet)	Peptiva SEW 1.5%	Peptiva SEW 1.5% + AA	Peptiva SEW 5%	SEM	P Value
Body Weight, kg							
Day 0	5.67	5.58	5.63	5.63	5.62	0.03	NS
Day 7	6.42 [a]	6.95 [c]	6.80 [bc]	6.99 [c]	6.63 [b]	0.11	0.0001
Day 14	7.41[a]	8.38[c]	8.36[c]	8.49 [c]	8.10[b]	0.10	0.0001
Day 21	9.92[a]	11.11[b]	10.90[b]	11.21[b]	10.77[b]	0.17	0.0001
Day 28	13.6[a]	15.00[b]	14.68[b]	15.25[b]	14.84[b]	0.20	0.0001
Day 35	17.66[a]	18.91[b]	18.80[b]	19.38[b]	18.83[b]	0.28	0.005
Average Daily Gain, g/d							
Day 0-7	108 [a]	195 [c]	167 [bc]	195 [c]	144 [b]	11	0.0001
Day 7-14	140[a]	203[b]	222[b]	213[b]	209[b]	11	0.0001
Day 0-14	124[a]	200 [c]	195[c]	204[c]	177[b]	7	0.0001
Day 14-28	421[a]	456[b]	434[ab]	465[b]	461[b]	9	0.01
Day 28-35	582	558	589	590	568	21	NS
Day 0-35	336[a]	375[b]	370[b]	387[b]	371[b]	8	0.005
Average Daily Intake, g/d							
Day 0-7	172[a]	223 [b]	207 [b]	229 [b]	193 [ab]	9	0.0006
Day 7-14	326[a]	372[b]	400[b]	391[b]	395[b]	13	0.005
Day 0-14	249[a]	298[b]	303[b]	310[b]	294[b]	8	0.0005
Day 14-28	609[a]	680[b]	643[ab]	715[b]	700[b]	19	0.005
Day 28-35	933	926	944	926	917	18	NS
Day 0-35	530[a]	576[b]	567[b]	595[b]	581[b]	11	0.005
Gain:Feed							
Day 0-7	0.63[a]	0.86 [c]	0.79[bc]	0.86[c]	0.74[b]	0.035	0.0004
Day 7-14	0.41[a]	0.51[b]	0.52[b]	0.51[b]	0.51[b]	0.019	0.002
Day 0-14	0.49[a]	0.66[c]	0.64[c]	0.66[c]	0.59[b]	0.011	0.0001
Day 14-28	0.69	0.67	0.68	0.65	0.66	0.01	0.10
Day 28-35	0.63	0.60	0.62	0.64	0.62	0.02	NS
Day 0-35	0.64	0.65	0.65	0.65	0.64	0.01	NS

Results are least squares means for 8 pens per diet with 7-10 pigs per diet (total = 330 pigs).
NS = not significant (P > 0.10). Pigs were fed experimental diets (Table 2) for 2 weeks post-weaning. All pigs were fed a comon diet from day 14-35 (Phase II diet, 14-28 d; Phase III diet, 28-35 d).

Table 5. Ingredient Prices Used in Cost Estimates

	old	**updated**		old	**updated**
Ingredient	$/cwt		Ingredient	$/cwt	
Corn, Grain	6.84	**7.50**	Limestone	3.67	**6**
threonine	110	**136**	Dical. Phos.	15.4	**20**
Soybean Meal -48%pig	12.45	**15**	Common Salt	6	**6**
Poultry Fat	25	**25**	Vitamin Premix	168	**168**
Menhaden Meal	45	**45**	Mineral Premix	26	**26**
Blood, spray-dried	35		DL-Methionine	130	**147**
Spray dried plasma	163	**200**	zinc oxide	300	**121**
Peptiva SEW	125	**125**	L-Lysine HCl	123	**125**
Whey, Dehydrated	69	**70**	tryptophan	2000	**1000**
			Antibiotic	320	**320**

Table 6. Estimated Diet Costs

	Old	**Revised**	
Diet	**$ /ton**		**$ /kg**
Phase I			
Negative Control	661	**666**	**0.734**
Positive Control (UGA S-1)	787	**832**	**0.917**
1.5% Peptiva	745	**772**	**0.851**
1.5% Peptiva + AA	751	**778**	**0.858**
5% Peptiva	751	**760**	**0.838**
Phase II	424	**438**	**0.483**
Phase III	261	**286**	**0.315**

Table 7. Revised Cost Estimates

Diet:	1 Negative Control	2 Reference (Standard UGA Diet)	3 Peptiva SEW 1.5%	4 Peptiva SEW 1.5% + AA	5 Peptiva SEW 5%	SEM	P
Total gain, kg/pig (Day 0-35)	11.96	13.33	13.18	13.75	13.75	0.28	0.005
Feed consumed, kg/pig							
Phase I (day 0-14)	3.49	4.17	4.25	4.34	4.12	0.12	0.001
Phase II (day 14-28)	8.52	9.52	9.00	10.01	9.80	0.26	0.005
Phase III (day 28-35)	6.53	6.48	6.61	6.49	6.42	0.13	NS
Total feed	18.5	20.2	19.9	20.8	20.3	0.4	0.005
Feed cost, $ / pig							
Phase I (day 0-14)	$2.56	3.83	3.62	3.72	3.45		
Phase II (day 14-28)	4.12	4.60	4.35	4.83	4.73		
Phase III (day 28-35)	2.06	2.04	2.08	2.04	2.02		
Total feed cost per pig	8.73	10.46	10.05	10.60	10.21		
Cost of Gain, $ /kg gain	0.736	0.791	0.768	0.775	0.776		