Development of Diets for Low Birth-Weight Piglets to Improve Post-Weaning Growth Performance and Optimize Net Returns to the Producer

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SUMMARY

An experiment which utilized 17 weeks of production was designed to examine the response of weanling pigs to diet complexity. Piglets were divided at weaning (28 days) into heavy or light body weights and fed either a simple diet for 14 days or a complex diet for 1 or 4 days, followed by the simple diet. Feeding the complex diet for 4 days improved growth performance for the first week following weaning when compared to feeding it for 0 or 1 day. Pigs which were lighter at birth, lost less body weight at weaning, and showed a greater positive response to the complex diet than heavier birth-weight pigs. Phase 1 diet could be used more efficiently and cost-effectively by targeting it specifically to the lighter pigs at weaning.

INTRODUCTION

Variability in growth is a cost to commercial pork production, especially those utilizing all-in-all-out production systems. In a recent study at PSCI with a large number of litters, we observed an average birth weight of 1.4 kg, however the range was from 0.40 kg to 2.50 kg. The smaller birth weight piglets in this study (defined as piglets 0.85 grams or less at birth) failed to demonstrate any evidence of compensatory growth, and their rate of gain lagged behind their larger cohorts throughout all stages of growth, resulting in an additional 10 days to reach market weight.

Weaning diets, which are expensive, are designed to safely transition the piglet from the liquid milk diet to a solids diet. They are typically complex and contain ingredients providing benefits beyond basic nutrient consideration. We hypothesized that light-weight piglets would show a relatively greater response to a high-quality weaning diet, specifically one containing blood products, than their heavier birth-weight counter-parts. This would reduce overall variability at nursery exit.

The feed must obviously be consumed to provide any benefit and it takes some piglets more than 24 hours to commence consumption of solid food. The overall objective of this experiment was to optimize the dietary regime fed to piglets immediately post-weaning for greatest overall net return. We focused on adaptation to the solid feed immediately post-weaning.

"Light weight piglets appraoch the feeder sooner after weaning than heavier pigs and made more visits to the feeder in the first 4 days"

EXPERIMENTAL PROCEDURES

Diets were formulated to meet or exceed nutrient requirements for piglets of this age and weight (NRC 1998). The "complex" diet included spray-dried whey, plasma and blood meal and fish meal (Table 1).

There were 3 dietary treatment regimes, and 2 weight group treatments. The 3 dietary regimes consisted of a simple or a complex diet offered as. A: Complex diet day 0 – 1, simple diet, day 2-14, B: Complex diet day 0 – 4, simple diet day 5-14, C: Simple diet day 0 – 14. Day 0 is weaning (Table 2). Individual body weight and feed intake was determined on day 0, 2, 4, 7 and 14.

Pre-Weighting Experiemntal Diets into bags to ensure speed and accuracy at time of feeding

Table 1. Experimental diets

Ingredient, %	Simple	Complex
Wheat	29.86	24.2
Soymeal	25.00	16.90
Peas	10.00	10.00
Canola Meal	7.80	-
Corn	-	20.00
Corn DDGS	20.00	-
SD Whey	-	14.29
SD Plasma	-	2.50
SD Blood Meal	-	2.50
Menhaden Fishmeal	-	5.00
Canola Oil	2.80	1.75
Limestone	0.85	0.70
Mono Calcium Phosphate	1.15	0.15
PSCI Vitamins	0.60	0.60
PSCI Minerals	0.60	0.60
Salt	0.40	0.25
Lysine HCl	0.385	0.02
L-Threonine	0.245	0.19
DL Methionine	0.09	0.130
LS20	0.10	0.10
Choline Chloride	0.08	0.08
$CuSO_4 * 5H_2O$	0.04	0.04
Analyzed Nutrient Content, %		
Moisture	11.74	11.92
Crude Protein	25.45	25.35
ADF	6.35	4.00
NDF	13.52	11.67
Crude Fat	6.17	4.33
Ca	0.92	0.93
P	0.78	0.68
Mg	0.26	0.20
K	1.03	0.99
Na	0.19	0.33
Cst ($ per tonne, ingredient prices, Nov 2010)	343.17	723.02

Table 2. Dietary regime treatments

	Feeding Regime	
Treatment	Complex Diet	Simple Diet
A	Day 0-1	Day 2-14
B	Day 0-4	Day 5-14
C	---------	Day 0 - 14

Each week, for 17 weeks, the entire weaning group was weighed and pigs ranked according to body weight within gender. The 24 heaviest and 24 lightest pigs were assigned to a pen, 4 pigs per pen. Pens were then randomly assigned to a treatment. Thus each week there were 6 pens of the heaviest and 6 pens of the lightest pigs and 2 pens per treatment per weight group. Care was taken to ensure that the time between the removal of the piglets from the sow and access to feed in the nursery was the same for all piglets and all weeks.

Video-cameras set up over the pens recorded individual feeder approach which was defined as a pig placing their head over and down into the feeder. Pens were recorded for the 24 hours following each diet change (days 0-1, 1-2, and 4-5). Piglets were numbered on their backs for identification. To accommodate the video-recording, lights were on continuously.

RESULTS AND DISCUSSION

This experiment used approximately 40% of each weaning group; we selected the 20% heaviest and lightest from each weaning group. Light piglets weighed almost 4 kgs less (40 %) than their heavier littermates on day 0 ($P < 0.0001$) and 25% less on day 14 post-weaning ($P < 0.0001$).

All piglets lost weight over the first 24 hours following weaning, however, body weight loss was less in the light weight piglets (Table 3). This was true even when body weight loss was expressed as a proportion of body weight [(ADG/d 0 BW)*100) = 2.5 % vs 0.3 % for heavy vs light piglets respectively]. Average daily gain of the light weight piglets was approximately 13 % greater than their heavier litter-mates throughout the trial ($P < 0.0001$). Despite this increased rate of gain, heavier pigs weighed 3.25 kgs more (almost 35 %) than the light-weight pigs at weaning.

Piglets on treatment C, receiving the "simple" diet, lost more BW and had reduced feed intake immediately following weaning (d 0-1) than those on treatments A or B. Switching from the complex to the simple diet on day 4 (treatment B) did not have an adverse effect on gain or feed intake in the following days. During the second week of the experiment, dietary treatment had minimal effects on either feed intake or body weight gain and by day 14, body weight was comparable, regardless of treatment (Table 4).

The light-weight pigs responded more to dietary treatment on day 0 than their heavier litter-mates (Figure 1). In fact, light-weight piglets receiving the complex diet immediately following weaning maintained their body-weight over the initial 24 hours. This contrasts with the light-weight pigs receiving the simple diet and the heavy pigs, receiving either simple or complex diets.

Following weaning, the light-weight piglets immediately began approaching the feeder and throughout the initial 4 days of the experiment visited the feeder more than their heavier litter-mates (Figure 2, Table 5). Feed intake was greater in the light-weight piglets, indicating that these feeder visits did result in feed intake. These pigs were housed, 4 pigs of similar body-weight per pen.

During the first 24 hours, the simple diet (trt C) had 20% fewer visits, however this did not approach statistical significance. Switching diets from the complex to the simple (day 1 trt A and day 4, trt C) resulted in a reduction in feeder visits. (Table 6)

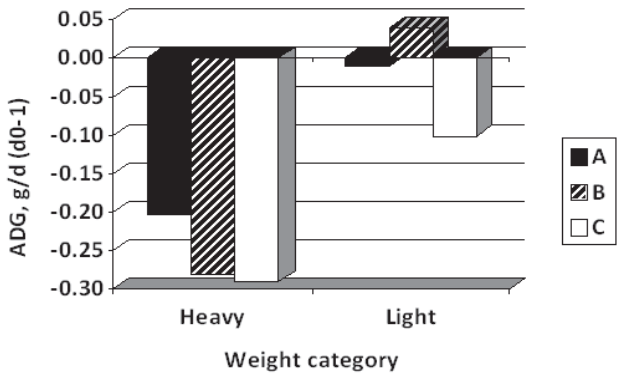

Figure 1. The interaction between weaning weight and feeding regime on the growth and feed intake of piglets day 0 to 1 post-weaning.Treatment A and B piglets were receivng the complex diet and treatment C piglets the simple diet during this period. BW x treatment interaction, $P < 0.01$, ADG, $P < 0.03$, ADFI.

Table 3. The effect of weaning weight on growth, feed intake and feed conversion efficiency

		Weaning weight			
Parameter	Day	Heavy	Light	SEM	P-Value
Weaning wt, kg	0	10.40	6.44	0.07	<0.001
	1	10.15	6.42	0.07	<0.001
	4	10.42	6.76	0.08	<0.001
	7	10.71	7.13	0.10	<0.001
	14	12.73	9.48	0.16	<0.001
ADG, kg/d	0-1*	-0.26	-0.02	0.02	<0.001
	2-4	0.07	0.08	0.00	0.04
	5-14	0.25	0.29	0.01	<0.001
ADFI, kg/d	0-1	0.09	0.13	0.01	<0.001
	2-4	0.13	0.13	0.01	0.14
	5-14	0.32	0.32	0.01	0.81
FCE, G/F	0-1	-5.36	-1.34	0.62	<0.001
	2-4	0.40	0.43	0.10	0.84
	5-14	0.70	0.81	0.02	<0.001

*Interaction between body weight and diet, P = 0.01 (shown in Fig 1)

Table 4. The effect of dietary treatment regime on growth and feed intake of growing pigs

		Dietary Treatment				
Parameter	Day	A	B	C	SEM	P-Value
Body wt, kg	0	8.43	8.43	8.41	0.07	0.92
	1	8.32	8.32	8.22	0.08	0.07
	4	8.45^{b}	8.90^{a}	8.43^{b}	0.08	<0.001
	7	8.79^{b}	9.18^{a}	8.78^{b}	0.10	<0.001
	14	10.96	11.25	11.10	0.17	0.14
ADG, kg/d	0-1*	-0.11^{b}	-0.12^{b}	-0.20^{a}	0.02	0.002
	2-4	0.03^{b}	0.14^{a}	0.06^{b}	0.01	<0.001
	0-14	0.18	0.20	0.19	0.01	0.14
ADFI, kg/d	0-1	0.12a	0.12a	0.08b	0.01	0.002
	2-4	0.10b	0.17a	0.12b	0.01	<0.001
	0-14	0.24	0.27	0.25	0.01	0.002

*Interaction between body weight and diet, P = 0.01 (shown in Fig 1)

CONCLUSION AND IMPLICATIONS

In conclusion, in a non-competitive environment, light-weight piglets can perform equal to their heavier litter-mates. This indicates that environmental factors (feeder access) need to be examined to improve the poor performance of these piglets.

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Table 5. The effect of weaning weight on feeder visits

24 hour period	Weaning weight group			P-Value	
	Heavy	Light	SEM	Weight	Hour by weight
Day 0	5.61	9.35	0.44	0.08	0.07*
Day 1	6.83	9.28	0.32	0.10	0.07
Day 4	7.37	8.00	0.27	0.007	0.03

*Weaning weight by diet regime, P = 0.05.

Table 6. The effect of dietary regime (Table 2) on feeder visits

24 hour period	A	B	C	SEM	P-Value
Day 0	8.13	8.01	6.30	0.55	0.25
Day 1	7.31	9.43	7.41	0.40	0.004
Day 4/5	7.71	8.48	6.87	0.35	0.05

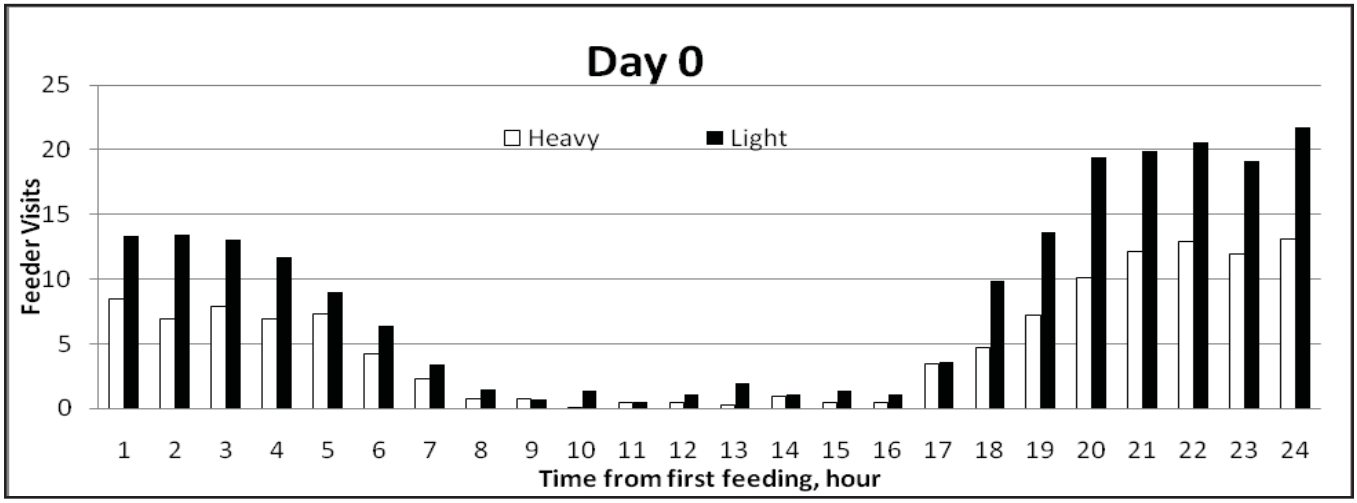

Figure 2. The effect of body weight on feeder visits (per pen, 4 pigs/pen) over the first 24 hours post-weaning.