The use of high cost weaner diets to improve post weaning growth performance

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Rebecca Morrison, John Pluske, Rob Smits, Dave Henman, Cherie Collins

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Abstract

Seven hundred and twenty weaners (360 males and 360 females) were selected at weaning (average age 27 days) and allocated to pens of 10 pigs based on individual weaning weight (light weaning weight: pigs below 6.5 kg; medium weaning weight: 6.5 to 8 kg; heavy weaning weight: above 8.5 kg). Pens were allocated to a 3 x 2 x 2 factorial experiment with the respective factors being weaning weight (heavy, medium and light), weaner diet complexity (high cost and low cost) and sex (male and female). Pigs allocated to the high cost feeding program were offered highly digestible diets during the initial 2 weeks post weaning, with the diets containing high levels of milk proteins and other quality protein sources along with cooked cereals. The diets in the low cost feeding program consisted primarily of wheat, with small amounts of milk protein, meatmeal, fishmeal and bloodmeal. Common diets were fed to both treatment groups during the final 4 weeks of the weaner period. During the initial 6 days post weaning, pigs offered the high cost diets gained weight faster and more efficiently than those offered the lower cost program (74.0 and 52.3 g/d respectively P=0.031). Outside of this time period, there were no other main effects of weaner feeding program on growth performance through to slaughter. Weight at weaning had a profound influence on lifetime growth performance and weight at 123 days of age, with the pigs classified as 'heavy' at weaning increasing their weight advantage over the medium and light weaning weight pigs (101.3, 97.1, 89.6 kg respectively for the heavy, medium and light weaning weight pigs respectively, P<0.001). Economic analyses suggests that there is minimal benefit in offering the high cost feeding program to heavy weight weaner (above 8.5 kg weaning weight) when weaned at 27 days of age, and possibly the medium weight weaners (above 6.5 kg). The results from this investigation once again confirm the impact of weaning weight on lifetime growth performance, and suggest that the high cost feeding program should be focused on the light weight weaners (weaning weight less than 6.5 kg at 27 days of age) in order to maximise returns.

Introduction

Weaning of the piglet from the sow imposes a number of environmental and social stresses on the piglet as it adapts to a new environment and feed source. The piglets digestive system must adapt to allow the digestion of complex carbohydrates found in creep diets rather than the high fat, highly digestible sows milk previously on offer (Williams 2003). These physiological adaptations occur at the same time as the additional stresses associated with the mixing of unfamiliar piglets, typically resulting in a growth check due to underfeeding while the piglet acclimatises to the new conditions and feed source (Le Dividich and Seve 2000; Smith and Lucas 1957). This growth check in the days immediately post weaning has been shown to have detrimental impacts on lifetime growth performance, with pigs that either maintain or loose weight during the initial 7 to 10 days post weaning requiring an additional 10 days to reach market weight compared to pigs that gain 250g/day during this initial post weaning period (Tokach *et al*. 1992). The use of high cost weaner diets during the first three weeks post weaning is extensively practised throughout the USA and Europe and aims to reduce the growth check post weaning and enhance growth performance from weaning to slaughter. These diets often contain high quality raw materials such as spray dried blood plasma and milk proteins. Essential oils as well as sweeteners may also be added to enhance feed intake of these diets. Specialist manufacturers in the USA and Europe are improving processing of these specialty diets by developing equipment to produce small diameter pellets using high levels of milk products without damaging the fragile milk proteins.

The costs of feeding these diets can be justified if the return in subsequent performance is substantial, with the feeding of these high cost diets during the early weaner period adding up to $5 per pig to the cost of production. The use of these expensive feeds in Australia is not widely accepted due to the lack of ability to source the raw material (with the exception of the milk powders) and the higher costs associated with securing these ingredients compared to that of the USA or even Europe. In addition, there is no robust cost-benefit analysis on the use of such a feeding program in Australia. The benefits associated with feeding these high cost/ highly digestible diets immediately post weaning may also differ depending on the weight of the pig at weaning. Therefore, it is necessary to evaluate the true benefits of using high cost weaner diets during the period immediately post weaning for pigs of different weight classes at weaning. This study tests the hypothesis that lifetime growth performance will not be influenced by weaner feeding program, and that pigs of different weight classes at weaning will respond similarly to the two feeding programs. Lifetime growth performance and the economic costs /benefits associated with this feeding strategy in Australia will be assessed, providing recommendations for pigs of different weight classes at weaning.

Materials and Methods

Animals and treatments

Seven hundred and twenty weaners (360 males and 360 females) were selected at weaning (av age 27 days) and allocated to pens of 10 pigs based on individual weaning weight (light weaning weight: pigs below 6.5 kg; medium weaning weight: 6.5 to 8 kg; heavy weaning weight: above 8.5 kg). Pens were allocated to a 3 x 2 x 2 factorial experiment with the respective factors being weaning weight (heavy, medium and light), weaner diet complexity (high cost and low cost) and sex (male and female). Pigs were selected over a three week period (240 pigs per week) commencing July 2008. Average weights at weaning for the light, medium and heavy weaners were 5.49, 7.26 and 9.57 kg respectively ($P<0.001$). The ingredient profile and nutrient compositions of the high and low cost weaner diets offered during the initial two weeks post weaning are displayed in Table 1. Common weaner diets were offered to both the high and low cost treatment groups during weeks three to six, as displayed in Table 2. The nutrient composition of the commercial grower and finisher diets are displayed in Table 3.

Husbandry and management

All piglets were individually identified at selection using ear tags. Pigs were grouped housed in commercial weaner pens of 10 pigs per pen of the same sex and weaning weight category. Pens were then randomly assigned within sex and weight category to either the high cost or low cost feeding program. Pigs were offered *ad libitum* access to feed from weaning through to slaughter. Pigs were individually weighed at weaning (day 0), one week post weaning (day 6), mid point of the weaner (day 20), end of the weaner period (day 39), end of the grower period (day 88) and at the end of the finisher period (day 123). Feed intake was recorded periodically during this time as measured by feed disappearance. Pigs were slaughtered at a commercial abattoir and carcass weight, carcass P2 and dressing percentage recorded.

Statistical analyses

Differences in growth performance due to the effects of weaning weight and/or diet complexity were analysed using residual maximum likelihood (REML) mixed model analyses. The model included the fixed effects of weaning weight category, diet and sex, and the random effect of replicate. The experimental unit for all analyses was the pen of animals. All replicates were included in the analyses for the growth performance data up to the end of the finisher period. Unfortunately, the slaughter data for the final two replicates were not collected due to an outbreak of *Actinobacillus pleuropneumoniae* (APP) in the final week before their scheduled slaughter and the subsequent withhold due to the necessary medications.

Economic analyses

Economic analyses were undertaken to compare the costs/ benefits associated with the weaner feeding programs for the three weight classes of pigs. The analyses utilise the average daily feed intake data for each of the treatment groups, the raw material costs of each of the weaner to finisher diets (as displayed in Tables 1 to 3), the live

weight gains for each production period and the carcass data. Unfortunately, the carcass data was obtained from only the first replicate of animals due to a medication withhold on the other two replicates. As such, from an economic analyses point of view, the cost per kg of gain for the entire experimental period (weaner to finisher) may provide a more accurate representation of the costs/benefits associated with each of the feeding program, rather than the net return which includes the carcass data.

Table 1. Ingredient composition and nutrient profile of the weaner diets offered during the first two weeks post weaning, % of diet (as fed basis)

	High cost		Low cost
Ingredient, %	Week 1	Week 2	Week 1 and 2
Wheat		19.42	52.55
Cooked cereals	30.00		
Groats	18.47	29.90	2.00
Lupin kernels		2.50	6.00
Canola meal			4.00
Soybean meal		3.50	5.00
Meatmeal	3.25	3.17	6.90
Fishmeal	7.10	4.00	5.00
Bloodmeal	1.00	2.00	2.20
Skim milk	3.00		
Soycomil	4.17	4.17	
Whey powder	28.00	25.00	8.35
Water	1.00	1.00	1.00
Canola oil	2.20		
Tallow		2.67	5.10
Salt	0.20	0.20	0.20
Limestone		0.50	
Lysine HCL	0.27	0.33	0.37
Dl-methionine	0.08	0.12	0.08

	High cost		Low cost
Ingredient, %	Week 1	Week 2	Week 1 and 2
Threonine	0.14	0.17	0.15
Isoleucine		0.06	0.02
Tryptophan	0.07	0.06	0.03
Zinc oxide	0.28	0.28	0.28
QAF creep premix	0.30	0.30	0.15
Endox	0.06	0.02	0.02
Formi R	0.30	0.30	0.30
Lysoforte	0.08	0.08	0.08
Biofix	0.05	0.05	0.05
Adimix 30 %	0.20	0.20	0.20
CTC	0.20	0.20	0.20
Pulmotil 200 premix	0.20	0.20	0.20
Estimated nutrient composition, %*			
Crude protein	20.23	21.48	24.07
Crude fat	5.26	6.01	7.56
Crude fibre	1.43	1.60	2.40
DE, MJ/kg	15.1	15.1	15.1
Total Lysine	1.48	1.51	1.54
Available lysine	1.36	1.37	1.36
Available lysine: DE	0.90	0.90	0.90
Diet cost ($/t)	1212	1004	677

*Estimated from composition of ingredients (SCA 1987)

Table 2. Ingredient composition and nutrient profile of the weaner diets offered during weeks 3 to 6 post weaning, % of diet (as fed basis).

Ingredient, %	Week 3 and 4	Week 5 and 6
Wheat	51.77	42.51
Groats	5.00	
Millmix		5.00
Lupin kernels	7.00	12.87
Sorghum		10.00
Canola meal	4.00	5.50
Soybean meal	4.00	4.77
Hominy		3.63
Meatmeal	6.50	8.00
Fishmeal	5.60	
Bloodmeal	2.20	2.07
Whey powder	8.33	
Water	1.00	1.00
Tallow	2.07	2.70
Salt	0.20	0.20
Limestone		0.50
Lysine HCL	0.39	0.38
Dl-methionine	0.08	0.13
Threonine	0.16	0.13
Isoleucine	0.03	
Tryptophan	0.03	
Zinc oxide	0.28	0.17
QAF creep premix	0.15	

Ingredient, %	Week 3 and 4	Week 5 and 6
QAF weaner premix		0.10
Ronozyme P Liquid		0.02
Porzyme		0.02
Endox	0.02	0.01
Adimix 30 %	0.20	
Biomin acid blend		0.30
CTC	0.20	
Pulmotil 200 premix	0.10	
Rumensin 100	0.10	0.10
Estimated nutrient composition, %*		
Crude protein	24.46	23.73
Crude fat	5.87	6.08
Crude fibre	2.45	3.36
DE, MJ/kg	14.8	14.5
Total Lysine	1.58	1.41
Available lysine	1.40	1.20
Available lysine: DE	0.94	0.83
Diet cost ($/t)	673	512

*Estimated from composition of ingredients (SCA 1987)

Table 3. Nutrient profile of the grower and finisher diets, % of diet (as fed basis)

Nutrient composition, %*	Grower	Finisher
DE, MJ/kg	13.79	13.78
Crude protein	18.03	13.88
Crude fat	4.19	4.75
Crude fibre	3.83	3.80
Total Lysine	1.11	0.82
Available lysine	0.97	0.72
Available lysine: DE	0.70	0.52
Diet cost ($/t)	415	400

*Estimated from composition of ingredients (SCA 1987)

Results

Weaner growth performance

There were no significant interactions between the weaner feeding program and weight class on growth performance during the weaner period (Table 4). Diet complexity did have an influence on growth performance during the initial 6 days post weaning with the pigs offered the high cost diet gaining faster and more efficiently during this time (Table 5). There were no other main effects of diet complexity on daily gain, feed intake or feed efficiency from weaning to the end of the weaner period at day 39. Although not significant, it is interesting to note that the light weight pigs at weaning gained weight numerically faster than the medium and heavy weaning weight pigs during the initial 6 days post weaning, suggesting that the larger pigs suffer a greater growth check post weaning than the lighter weight pigs. Given the low growth rates during the initial 6 days post weaning, these differences did not have any effect on the overall growth performance of the different weight class pigs during the weaner period, with the heavy weight pigs increasing their weight advantage by the end of the weaner period (weight at day 39: 29.95, 26.19 and 22.70 kg respectively for the heavy, medium and light weaning weight pigs, $P<0.001$). There were no main effects of sex on growth performance, feed intake or feed efficiency during the weaner period (Table 5).

The influence of diet complexity and weaning weight on weaner mortality is displayed in Table 6. During the initial 6 days post weaning there was only one death, which was a sudden death in the light weight weaners offered the low cost diet. Weaner mortality was significantly greater in the light weight weaners compared to those

weaned heavy (x^2=21.40, P<0.001). Weaner mortality was also greater in the treatment groups offered the low cost diet ((x^2=6.08, P=0.014), with the majority of these deaths occurring in the light weight weaners offered the low cost diet

Table 4. Interactive effects of weaning weight and diet complexity on growth performance during the weaner period

	Light weaning weight		Medium weaning weight		Heavy weaning weight		SED	Significance
	High Cost	Low cost	High Cost	Low cost	High Cost	Low cost	Diet x Weaning weight	Diet x Weaning weight
Av weight weaning	5.51	5.47	7.27	7.25	9.54	9.59	0.159-0.162	0.91
Av weight day 39	23.05	22.35	25.98	26.40	30.12	29.79	0.513-0.537	0.31
Average daily gain (g/d)								
Weaning to day 6	83.0	57.3	78.5	52.2	60.4	47.4	17.0-17.3	0.83
Day 6 to day 20	367.4	358.5	436.0	434.7	481.1	465.2	18.66-19.05	0.87
Weaning to day 20	282.1	268.0	328.8	319.9	354.9	339.9	15.7-16.0	0.96
Day 20 to day 39	626.6	616.3	638.5	671.4	709.3	705.3	22.31-23.36	0.36
Weaning to day 39	449.7	434.5	479.6	491.1	527.5	517.9	12.68-13.28	0.31
Average daily intake (g/d)								
Weaning to day 6	125.5	136.5	127.5	123.5	136.7	122.6	13.1-13.4	0.41
Day 6 to day 20	431.6	419.2	480.9	472.7	568.0	534.0	25.33-25.84	0.75
Weaning to day 20	339.6	332.9	372.7	366.7	438.6	410.6	19.99-20.40	0.69
Day 20 to day 39	830.2	786.9	890.5	886.9	1029.0	983.9	29.49-30.87	0.55
Weaning to day 39	575.2	541.8	620.9	615.6	725.7	689.1	21.54-22.55	0.55

	Light weaning weight		Medium weaning weight		Heavy weaning weight		SED	Significance
	High Cost	Low cost	High Cost	Low cost	High Cost	Low cost	Diet x Weaning weight	Diet x Weaning weight
Feed efficiency (g/g)								
Weaning to day 6 (FCE)	0.68	0.30	0.60	0.37	0.44	0.37	0.14-0.15	0.32
Day 6 to day 20 (FCR)	1.19	1.18	1.11	1.09	1.20	1.15	0.068-0.070	0.93
Weaning to day 20 (FCR)	1.22	1.25	1.14	1.15	1.25	1.21	0.069-0.0700	0.75
Day 20 to day 39 (FCR)	1.33	1.29	1.40	1.34	1.46	1.40	0.051-0.054	0.97
Weaning to day 39 (FCR)	1.28	1.25	1.29	1.26	1.38	1.33	0.046-0.048	0.97

Table 5. Main effects of weaning weight and diet complexity on growth performance during the weaner period

	Diet complexity		SED	Weaning weight			SED	Significance		
	High Cost	Low cost	Diet	Light	Medium	Heavy	Weaning weight	Diet	Weaning weight	Sex
Av weight weaning	7.44	7.44	0.093	5.49	7.26	9.57	0.113-0.115	0.61	<0.001	0.13
Av weight day 39	26.38	26.18	0.303	22.70	26.19	29.95	0.370-0.372	0.96	<0.001	0.78
Average daily gain (g/d)										
Weaning to day 6	74.0	52.3	9.92	70.2	65.4	53.9	12.1-12.2	0.031	0.39	0.36
Day 6 to day 20	428.2	419.5	10.9	363.0	435.3	473.2	13.34-13.45	0.53	<0.001	0.73
Weaning to day 20	321.9	309.3	9.17	275.0	324.3	347.4	11.2-11.3	0.21	<0.001	0.99
Day 20 to day 39	658.1	664.3	13.2	621.5	654.9	707.3	16.08-16.17	0.51	<0.001	0.76
Weaning to day 39	485.6	481.2	7.48	442.1	485.4	522.7	9.14-9.19	0.80	<0.001	0.89
Average daily intake (g/d)										
Weaning to day 6	129.9	127.5	7.65	131.0	125.5	129.7	9.35-9.43	0.77	0.84	0.37
Day 6 to day 20	493.5	475.3	14.82	425.4	476.8	551.0	18.08-18.27	0.27	<0.001	0.75
Weaning to day 20	383.6	370.0	11.70	336.2	369.7	424.6	14.28-14.42	0.29	<0.001	0.57
Day 20 to day 39	916.5	885.9	17.39	808.6	888.7	1006.5	21.25-21.37	0.16	<0.001	0.12
Weaning to day 39	640.6	615.5	12.71	558.5	618.2	707.4	15.53-15.61	0.11	<0.001	0.13

	Diet complexity		SED	Weaning weight			SED	Significance		
	High Cost	Low cost	Diet	Light	Medium	Heavy	Weaning weight	Diet	Weaning weight	Sex
Feed efficiency (g/g)										
Weaning to day 6 (FCE)	0.58	0.35	0.08	0.49	0.48	0.41	0.10	0.007	0.65	0.48
Day 6 to day 20 (FCR)	1.16	1.14	0.040	1.18	1.10	1.18	0.049	0.57	0.18	0.80
Weaning to day 20 (FCR)	1.20	1.21	0.040	1.23	1.15	1.23	0.049	0.93	0.13	0.74
Day 20 to day 39 (FCR)	1.39	1.34	0.030	1.31	1.37	1.43	0.037	0.12	0.006	0.18
Weaning to day 39 (FCR)	1.32	1.28	0.027	1.27	1.28	1.36	33.39-33.45	0.18	0.016	0.12

Table 6. Influence of diet complexity and weaning weight on weaner mortality

			Deaths 0-20 days post weaning			Removals 0-20 days	Deaths 20-39 days post weaning			Removals 20-39 days	Total weaner deaths and removals
Weaning weight	Dietary program	Total number of pigs commencing weaner period	Unthrifty	E.coli	Twisted bowel	Unthrifty	Sudden death	meningitis	Unthrifty	Unthrifty	
Heavy	High cost	120						1			1
Heavy	Low cost	120					1				1
Medium	High cost	120	1		2	1	1			1	6
Medium	Low cost	120				4	2				6
Light	High cost	120	1						2		3
Light	Low cost	120	1	1		6	2			2	12

Grower and finisher growth performance

There were no interactive effects of weaner diet and weaning weight on growth performance during the grower and finisher periods (Table 7, Figures 1 and 2). Weight class at weaning continued to influence subsequent growth performance, with the heavy weaners consuming the most feed (P<0.001) and gaining weight more rapidly (P=0.023) than the medium weight and the light weight weaners during the grower period (Table 8). Feed intake continued to be greater in the heavy weight weaners during the finisher period (P=0.028), although the differences in daily gain were not maintained during this period (P=0.50). It is likely that the APP disease challenge that these animals suffered during the final weeks of the finisher period impacted on their growth performance during this time. Feed efficiency during the grower and finisher period were not influenced by weight at weaning (Table 8).

The feeding program during the weaner period did not influence feed intake (P=0.70), daily gain (P=0.25) or feed efficiency (P=0.34) during the grower period. Similarly, there was no influence of weaner feeding program on finisher feed intake (P=0.60), daily gain (P=0.57) or feed efficiency (P=0.73). Grower and finisher mortality was similar between the light, medium and heavy weaning weight pigs (x2=0.66, P=0.719) and between the two weaner feeding programs (x2=0.04, P=0.847). There was no influence of sex on grower feed intake, growth performance or feed efficiency. During the finisher period, males gained weight faster than the females (909.8 and 848.3 g/d respectively, sed 23.94, P=0.011), and were more feed efficient (FCR 2.48 and 2.76 respectively, sed 0.049, P<0.001). As a consequence, final live weight was greater for the males than the female finishers (97.1 and 94.8 kg respectively, sed 0.89, P=0.012).

Carcass characteristics

Weight at weaning had a profound influence on carcass weight, with the pigs classified as 'heavy' at weaning increasing their weight advantage over the medium and light weaning weight pigs (76.56, 71.50 and 65.50 kg respectively for the heavy, medium and light weaning weight pigs respectively, P<0.001). Carcass P2 was however similar between the three weight classes (8.9, 8.4 and 8.1 mm respectively, P=0.29), as was dressing percentage (75.9, 75.5 and 74.7 % respectively, P=0.56). Including carcass weight as a covariant in the analyses, carcass P2 was numerically greater in the light weaning weight pigs compared to either the medium or heavy weaning weight pigs (8.2, 8.4, 9.1 mm respectively for the heavy, medium and light weight pigs, P=0.49) although the differences were not significant due to the carcass data being collected from only one replicate of animals.

The low cost weaner feeding program did not have any significant impact on carcass weight (71.2 and 71.0 kg respectively for the high and low cost diet, P=0.40). Although there were no interactions between weaning weight and dietary feeding program, the carcass weight of the heavy weaners fed the low cost weaner diets were greater than the heavy weaners fed the high cost diets, while the light weaning weight pigs did appear to benefit from the higher cost diet (Figure 3). Feeding program during the weaner period did not influence carcass P2 (8.7 and 8.3 mm

respectively, P=0.40) or dressing percentage (75.7 and 75.3 % respectively for the high and low cost diet, P=0.64).

Table 7. Interactive effects of weaning weight and diet complexity on growth performance during the grower and finisher period and carcass characteristics

	Light weaning weight		Medium weaning weight		Heavy weaning weight		SED	Significance
	High Cost	Low cost	High Cost	Low cost	High Cost	Low cost	Diet x Weaning weight	Diet x Weaning weight
Av weight day 88 (end of the grower)	61.2	58.1	66.5	64.9	70.2	70.5	1.51	0.31
Av weight day 123 (pre-slaughter)	91.2	88.0	98.5	95.6	101.1	101.4	1.55	0.19
Average daily gain (g/d)								
Day 39-88	771.1	730.8	823.8	784.7	812.9	824.5	33.32-33.75	0.49
Day 88-123	858.4	861.3	914.7	871.5	885.0	883.4	41.11-42.19	0.71
Average daily intake (kg/d)								
Day 39-88	1.49	1.46	1.63	1.59	1.66	1.70	0.051	0.45
Day 88-123	2.17	2.25	2.38	2.21	2.34	2.37	0.078-0.080	0.071
Feed efficiency (g/g)								
Day 39-88	1.94	2.00	1.98	2.02	2.04	2.08	0.082-0.084	0.99
Day 88-123	2.55	2.63	2.62	2.55	2.67	2.72	0.083-0.086	0.44
Carcass characteristics*								
Carcass weight	66.0	64.5	71.8	71.1	75.8	77.4	2.17-2.64	0.62
Carcass P2	8.4	7.8	8.6	8.2	9.1	8.8	0.63-0.78	0.94
Dressing percentage	75.7	73.6	75.5	75.5	75.8	76.1	1.13-1.39	0.38

*Obtained from only one replicate

Table 8. Main effects of weaning weight and diet complexity on growth performance during the grower and finisher period and carcass characteristics *Obtained from only one replicate

	Diet complexity		SED	Weaning weight			SED	Significance		
	High Cost	Low cost	Diet	Light	Medium	Heavy	Weaning weight	Diet	Weaning weight	Sex
Av weight day 88 (end of the grower)	66.0	64.5	0.87	59.7	65.7	70.4	1.07	0.12	<0.001	0.88
Av weight day 123 (pre-slaughter)	96.9	95.0	0.89	89.6	97.1	101.3	1.08-1.10	0.056	<0.001	0.012
Average daily gain (g/d)										
Day 39-88	802.6	780.0	19.4	751.0	804.3	818.7	23.71-23.87	0.25	0.023	0.93
Day 88-123	886.0	872.1	23.94	859.8	893.1	884.2	29.07-29.45	0.57	0.50	0.011
Average daily intake (kg/d)										
Day 39-88	1.59	1.58	0.029	1.48	1.61	1.68	0.036	0.70	<0.001	0.092
Day 88-123	2.30	2.27	0.046	2.21	2.29	2.35	0.055-0.056	0.60	0.028	0.134
Feed efficiency (g/g)										
Day 39-88	1.98	2.03	0.048	1.97	2.00	2.06	0.058-0.059	0.34	0.28	0.12
Day 88-123	2.61	2.63	0.049	2.59	2.58	2.69	0.059-0.060	0.73	0.10	<0.001
Carcass characteristics*										
Carcass weight	71.2	71.0	1.35	65.3	71.5	76.6	1.53-1.71	0.40	<0.001	0.63
Carcass P2	8.7	8.3	0.39	8.1	8.4	8.9	0.45-0.50	0.40	0.29	0.97
Dressing percentage	75.7	75.0	0.71	74.7	75.5	75.9	0.80-0.98	0.64	0.56	<0.001

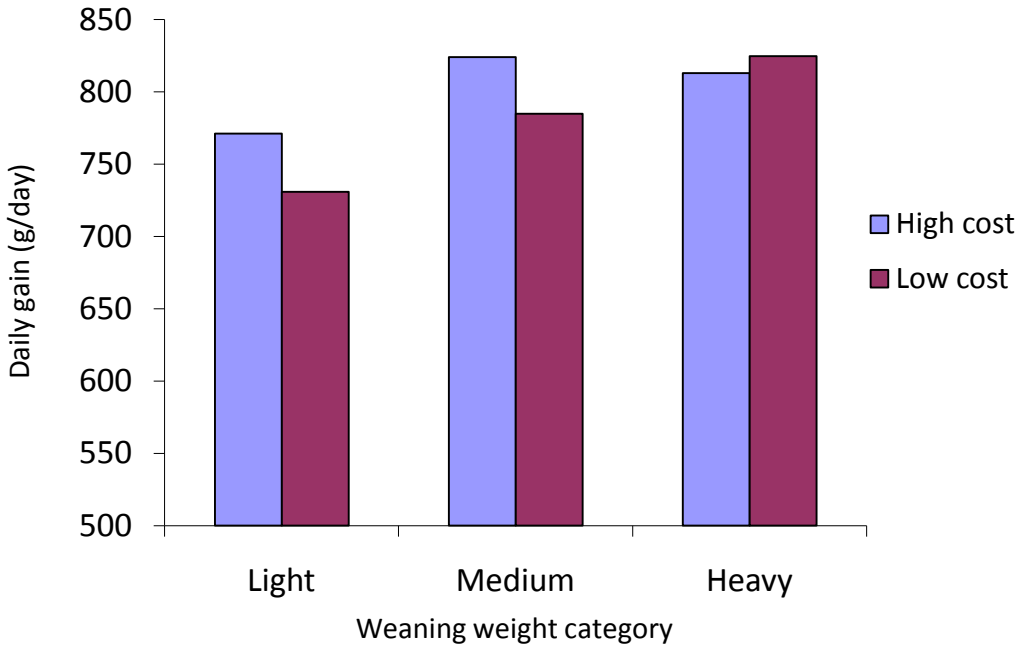

Figure 1. Influence of weaning weight category and weaner diet on growth performance during the grower period (Diet P=0.25, Weaning weight P=0.023, Interaction, P=0.49).

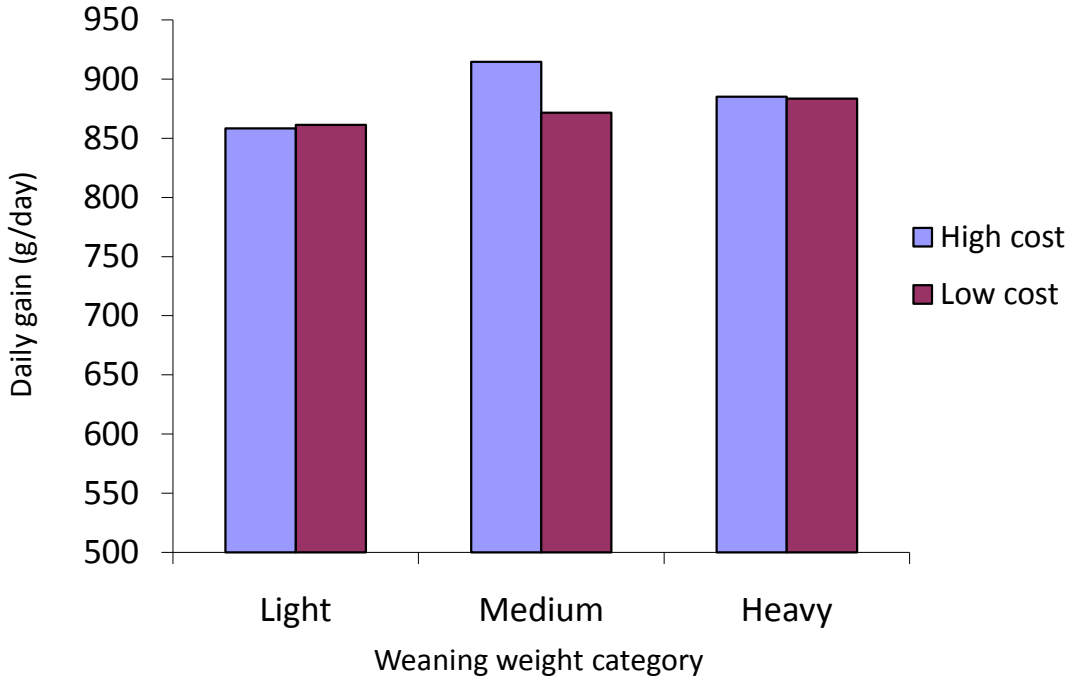

Figure 2. Influence of weaning weight category and weaner diet on growth performance during the finisher period (diet P=0.57, weaning weight P=0.50, interaction, P=0.71).

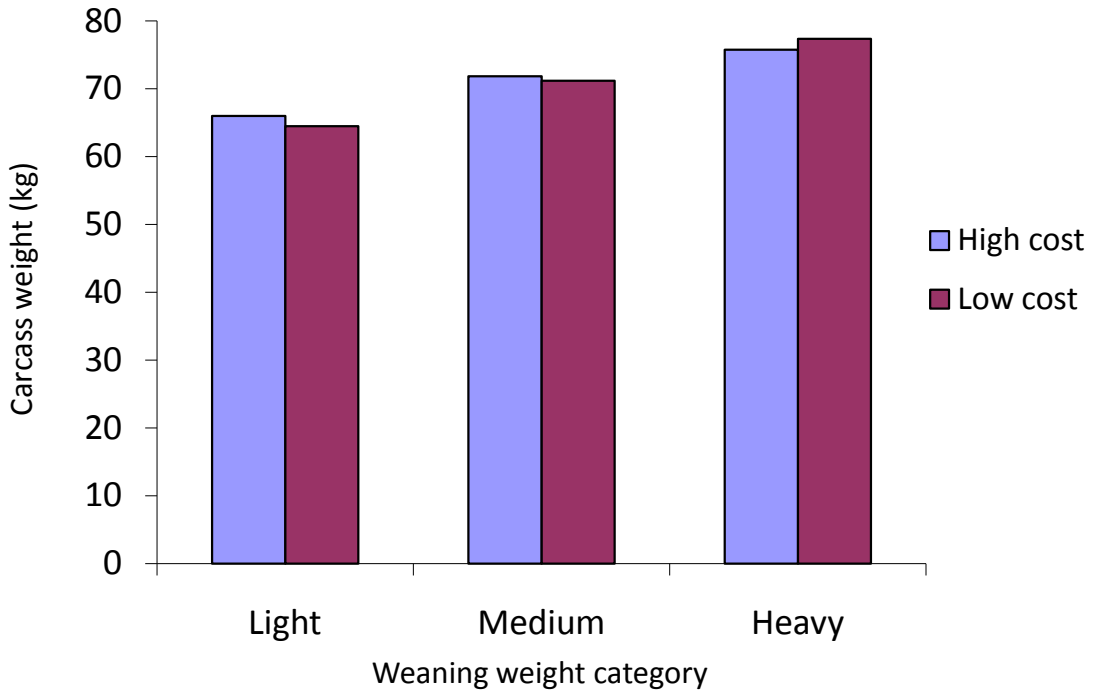

Figure 3. Influence of weaning weight category and weaner diet on carcass weight (diet P=0.40, weaning weight P=<0.001, interaction, P=0.62).

Economic analyses

Total feed costs during the weaner period (based on feed intake and diet costs) were greater for the pigs offered the high cost feeding program, regardless of weaning weight (Table 10). Interestingly, the differences in total live weight gain during the weaner period were minimal for the heavy and medium weaning weight treatment groups, with only the light weight pigs appearing to benefit from the higher cost feeding program. The cost per kg gain during this time was greater for the high cost feeding program. Total live weight gain from weaning to the end of the finisher period was greater in the light and medium weight pigs when offered the high cost feeding program, while the weaner feeding program did not appear to influence the lifetime growth performance of the heavy weaning weight group. Total feed costs were however greater in all three weight categories when the pigs were offered the high cost feeding program. Differences in costs per kg live weight gain were minimal across all three weaning weight categories. Care must be taken when comparing returns on carcass weight and net returns for each of the treatment groups given that the carcass data was obtained from only one replicate. The net return based on actual carcass data from this one replicate is included in Table 10. Unfortunately, the differences in final live weight observed across the treatment groups are not fully evident in the carcass data from this sub set of animals. A more accurate reflection of the influence of weaner feeding program on net return may be to utilise a standard dressing percentage to calculate carcass weight and hence returns, also displayed in

Table 10. These results indicate that there is minimal (or no) benefit in offering the high cost feeding program to medium and heavy weight weaners (weaners above 6.5 kg) when weaned at 27 days of age.

Table 10. Cost Analyses of the weaner feeding programs for heavy, medium and light weaning weight pigs

Weaning weight	**Light**		**Medium**		**Heavy**	
Weaner feeding program	**High**	**Low**	**High**	**Low**	**High**	**Low**
Total feed costs weaner period ($/pig)	15.83	13.85	17.13	15.49	19.89	17.23
Live weight gain weaner period (kg)	17.54	16.88	18.71	19.15	20.58	20.20
Cost/kg gain weaner period ($/kg)	0.90	0.82	0.92	0.81	0.97	0.85
Total feed costs grower period ($/pig)	30.30	29.68	33.15	32.33	33.76	34.57
Live weight gain grower period (kg)	38.15	35.75	40.52	38.50	40.08	40.71
Cost/kg gain grower period ($/kg)	0.79	0.83	0.81	0.84	0.84	0.85
Total feed costs finisher period ($/pig)	30.38	31.50	33.32	30.94	32.76	33.18
Live weight gain finisher period (kg)	30.00	29.90	32.00	30.70	30.90	30.90
Cost/kg gain finisher period ($/kg)	1.01	1.05	1.04	1.01	1.06	1.07
Total feed costs wean-finisher ($/pig)	76.51	75.04	83.60	78.76	86.40	84.98
Live weight gain wean - finisher (kg)	85.69	82.53	91.23	88.35	91.56	91.81
Cost/kg gain wean - finisher ($/kg)	0.89	0.91	0.92	0.89	0.94	0.93
Net return based on actual carcass data*:						
Carcass weight	66.0	64.5	71.8	71.2	75.8	77.4
Return on carcass weight ($/kg)	158.4	154.8	172.4	170.8	181.8	185.7
% pigs above 12mm back fat	7.7	0	7.4	0	6.9	15.4
Discount for P2	1.27	0	1.33	0	1.30	2.98
Income per pig	157.1	154.8	171.0	170.8	180.5	182.7
Net return	80.6	79.8	87.4	92.1	94.1	97.7

Weaning weight	Light		Medium		Heavy	
Weaner feeding program	**High**	**Low**	**High**	**Low**	**High**	**Low**
Net return based on calculated carcass weight:**						
Carcass weight	69.3	66.9	74.9	72.7	76.8	77.1
Return on carcass weight ($/kg)	166.3	160.5	179.7	174.4	184.4	185.0
Net return	89.8	85.5	96.1	95.6	98.0	100.0

*Carcass data obtained from one replicate only
** Carcass weight calculated from final liveweight and a dressing percentage of 76%. Return on carcass weight does not take into consideration any price penalties for excess P2.

Discussion

Growth performance

These data clearly indicate that weight at weaning is a major determinant of lifetime growth performance. The pigs weaned heavier were heavier at every weigh point from weaning though to slaughter, with the weight difference between the light and heavy weaning weight groups increasing from 4.1 kg at weaning to 11.7 kg at the end of the finisher period. These results are very similar to Dunshea *et al.* (2003) in which the pigs heavy for age at weaning were 13 kg heavier at slaughter than the pigs light for age at weaning. The results also support the observations in a previous 2B-103 project (weaning age interactions with creep feeding), in which the pigs born at weights at or below 1.2 kg grew almost 9 % slower from birth to slaughter compared to their heavier born counterparts. Given the strong association between weaning weight and birth weight (Dunshea *et al.* 2003), strategies to increase birth weight, and /or reduce the variation in birth weight within the litter continue to be required.

The growth performance data during the initial six days post weaning suggests that the light weaning weight animals may have outperformed the medium and heavy weight pigs in terms of weight gain during this time, although the differences were not significant. These results were similar to those observed by Morrison *et al.* (2009) where the weaning weight was negatively correlated with rate of gain in the first five days post weaning. The estimates of feed intake during this initial period post weaning were similar across the different weaning weight groups, however other investigations have reported light pigs to consume more feed during the initial 3 days post weaning compared to either medium or heavy weaning weight pigs (Bruininx *et al.* 2001). More specifically, Bruininx *et al.* (2001) observed light weaning weight pigs (mean body weight 6.7 kg) to consume more feed during the 24 hrs following their first feeding event compared to medium (mean body weight 7.9 kg) or heavy weaning weight pigs (mean weight 9.3 kg). This may suggest that either the heavy weaning weight pigs spend more time fighting and establishing social hierarchies during the initial post weaning period than the lighter weaning weight pigs or that the heavy

weight pigs find it more difficult to adapt to the changes in environment and feed source at weaning.

Diet complexity did not have a major impact on growth performance from weaning through to slaughter, with the benefits of the high cost diet confined to the initial six days post weaning. These results are in agreement with Whang *et al.* (2000) in which the starter feeding program influenced growth performance in the period immediately post weaning, but did not influence lifetime performance. In this case the authors observed a reduction in weaner performance with the low quality starter feeding regime, but subsequent compensatory growth during the grower and finisher periods such that protein gain for the entire growth period was not influenced by the weaner feeding program. In this present study, non-significant differences in grower and finisher growth performance did result in a trend for the pigs offered the high cost diet to be heavier at the end of the finisher period (P=0.056), with the differences greatest in the light and medium weaning weight pigs.

The growth performance and carcass data both suggest that heavy weaning weight pigs do not benefit from the use of the high cost weaner feeding program, and in fact that greater carcass weights may be achieved through the use of the lower cost feeding program. These results are supported by Dritz *et al.* (1996) in which pigs were weaned at 9 or 19 days of age were offered low, medium or high complexity diets during the weaner period. The high complexity diets consisted of high levels of milk products and quality protein sources (spray dried plasma and blood meal), while the medium complexity diets contained lower concentrations of these ingredients and the low complexity diets consisted primarily of corn and soybean meal with a small amount of dried whey. In this study Dritz *et al.* (1996) observed that diet complexity did not influence feed intake or daily gain from 7.0 kg to 18.7 kg. In addition, growth performance from 18.7 to 109 kg was greater in the animals offered the medium complexity weaner feeding regimen regardless of age at weaning. For the animals weaned at 9 days of age, feed efficiency from 18.7 to 109 kg was improved when the animals were offered the medium and low cost diets. This study did not however provide any economic analyses of the most cost effective weaner feeding program based on lifetime performance and carcass returns. The economic analyses from this present investigation supports the use of the lower complexity diets during the weaner period for animals weaned at 28 days of age and above 8.5 kg, and possibly for the pigs weaned above 6.5 kg. The high cost feeding regime should continue to be utilised for piglets weaned light (below 6.5 kg weaning weight at 27 days of age).

Carcass composition

Dietary feeding regime during the weaner period did not influence carcass composition, supporting previous observations by Dritz *et al.* (1996) and Lawlor *et al.* (2002). Lawlor *et al*. (2002) observed similar carcass weights and lean meat contents at commercial slaughter weights when pigs were offered different starter feeding programs, while Dritz *et al.* (1996) observed similar carcass compositions of pigs slaughtered at 11.9, 18.7 and 109 kg following the feeding of high, medium or low complexity starter diets. Dritz *et al.* (1996) did however observe that pigs weaned at 9 days of age and fed the low complexity regimen had greater carcass lipid and

reduced carcass protein at 109 kg, again supporting the use of high complexity weaner diets for pigs weaned at light weights.

Weaning weight continues to have a profound influence on carcass weight, with the carcasses of the light weaning weight pigs 14.4 % lighter than those of the heavy weaning weight pigs. Birth weight has been reported to influence carcass composition, with light birth weight pigs producing carcasses with a greater percentage of adipose tissue than their heavier born counterparts at a given slaughter weight (Collins 2007; Rehfeldt and Kuhn 2006). Given the close association between birth weight and weaning weight, it is likely that light weaning weight pigs would also display the same trends in carcass composition. Unfortunately, the small number of animals in which the carcass data was collected in this investigation was not large enough to detect differences due to weaning weight. Birth weight has however been observed to influence carcass composition in previous 2B-103 experiments (weaning age interactions with creep feeding), with P2 back fat depths significantly greater in light birth weight pigs across a range of slaughter weights. Further investigation is required to assess management strategies to improve lifetime growth performance and carcass composition of these light birth weight animals. Practically, such strategies are likely to involve identifying pigs that are light at weaning and focusing on measures to improve their lifetime growth performance and carcass composition.

Conclusion

The results from this investigation once again confirm the impact of weaning weight on lifetime growth performance. The economic analyses suggests that there is minimal benefit in offering the high cost feeding program to heavy weight weaners (weaners above 8.5 kg) when weaned at 27 days of age and possibly the medium weight weaners (above 6.5 kg). The high cost feeding program should still be utilised for the light weight weaners (weaning weight less than 6.5 kg at 27 days of age) to maximise their lifetime growth performance.

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