Lysine titration in finisher pigs – commercial validation

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Executive Summary

Pigs have a nutritional requirement for energy, amino acids, vitamins and minerals. The correct ratio of available lysine to digestible energy in the diet is one of the fundamental requirements for efficient fast growth. The modern lean genotype that predominates in commercial production within Australia has significant genetic potential for growth and there is a growing pool of evidence that our current recommendations are understated. The objective of this study was to quantify the growth response of commercial finisher pigs to increased levels of dietary lysine.

This experiment was one component of a multi-site project to try to determine the optimum lysine requirements of finisher pigs. The experiment was a randomised block design with sex (immunocastrated male and female) and dietary treatment as factors, with entry weight being a blocking factor. There were four treatments differing in lysine concentrations based on previous experimental results (e.g. 0.58, 0.64, 0.70 & 0.76 g available Lysine per MJ of digestible energy). Pigs entered the experiment at approximately 60 kg and finished when top pigs reached approximately 95 kg.

Immunocastrated males consumed significantly more feed and grew significantly faster than female finisher pigs, but did not convert feed significantly faster. There was no interaction between sex and lysine treatments. Increasing the level of lysine in the diet from 0.58 to 0.64 to 0.70 to 0.76 grams of available lysine per MJ digestible energy had no significant effect on the performance of finisher pigs. Numerical results fall in line with previous research (Moore *et al.*, 2012) indicating that levels above 0.64 grams do not further improve performance.

Performance of the whole group was acceptable for commercial production for finisher pigs with an average growth rate for the period of 995 g/day, although feed conversion was slightly higher than would normally be expected at 2.75 kg/kg.

The lack of difference in performance when lysine levels were increased was somewhat unexpected. The statistically significant difference detected between the two sexes investigated gives us confidence that the data is robust. Although not statistically significant the growth performance of both immunocastrated male and female pigs does not appear to be enhanced when lysine concentrations are raised above 0.64 g available lysine per MJ of digestible energy. This commercial finding is in line with the experimental work of Moore *et al.* (2012) who determined 0.63 g available lysine was the optimum level.

Project Objectives

Quantify the growth response of commercial finisher pigs to increased levels of dietary lysine.

Project Background

Recent research by Edwards et al. (2011) and Moore and Mullan (2009) indicate that the Single Diet performs similarly overall as the various phase feeding treatments but appears to offer considerable feed cost savings over current three phase programs and considerable logistical enhancements for both the milling and production components of the supply chain. However, the results suggest these outcomes may be an artefact of the experimental design rather than a confirmation of the validity of the Single Diet approach. The lysine requirement assumptions adopted for these experiments appear to have been understated. Research by Edwards et al. (2011), confirm that feeding a single 0.58 gm Av. Lysine/MJ DE diet below 60 kg live weight results in a marked retardation of growth. Beyond 60 kg live weight the pigs on this diet grew normally with no evidence of any compensatory growth, so the weight gain foregone prior to 60 kg live weight is unlikely to be recovered in the subsequent growth phases. However, we have still not witnessed the full potential growth response facilitated by a dietary programme that met the amino acid requirements in each phase. It may well be that the current concept of a smooth declining requirement curve is too simplistic. Whatever the explanation it would appear that amino acid requirements in modern pig genotypes are not only elevated relative to previous estimates but the animal's appear very sensitive to amino acid supply and the higher requirements persist well into the current finisher phase before easing.

The diversification of our feed grain supply, through the development and promotion of pig-preferred grain varieties and alternatives for key production regions, coupled with increasing the efficiency with which the industry utilises feed resources is a key strategy in reducing on-farm input costs and enhancing the productivity and viability of pork farms in Australia.

Methodology

The experiment was a randomised block design with sex (immunocastrated male and female) and dietary treatment as factors, with entry weight being a blocking factor. There were four treatments - differing lysine concentrations (ratios to other amino acids to be maintained as per standard formulation practices) based on experimental results (e.g. 0.58, 0.64, 0.70 & 0.76 g available Lysine per MJ of digestible energy).

Pigs were expected to enter the experiment at 15 weeks of age (~ 60 kg) and finish the experiment at 20 weeks of age (~95 kg), with an interim weigh at 18 weeks of age. However, after the first replicate, pigs from the large entry weight groups were found to be achieving finisher weights at four weeks of treatment, the subsequent replicate ran for four weeks, with an interim weigh after two weeks.

Twenty-four pens were investigated in this study, studied over two blocks. Pen was the experimental unit with six pens per treatment and ten pigs per pen. Pigs were stocked at a marginally lower stocking density than the Model Code of Practice (0.73 m^2 *c.f.* 0.66 m^2/pig). Pigs were identified by treatment by the addition of a further letter to the slaughter brand to enable carcase weight and P2 to be recorded at slaughter, however, issues with recording at the abattoir resulted in this data being corrupted.

Feed was delivered via a FeedPro automated feeding system (FeedLogic Corp., Willmar, MN). Two base diets were blended to deliver the four experimental treatments (Appendix 1). Average daily gain, average daily feed intake and feed conversion was calculated for each interval (start to mid, mid to finish) and the whole experimental period (start to finish) for each pen.

Data was analysed by ANOVA with sex and treatment as factors, with entry week being a blocking factor. There were no significant quadratic effects observed. Differences between treatments (P<0.05) were determined by LSD.

Results

There was a significant difference in average daily gain and average daily feed intake between female and immunocastrated male pigs across the whole experimental period. Immunocastrates consumed significantly more feed, and grew significantly faster than females although the improvement in feed conversion observed was not significantly different (Table 1).

Table 1: Performance of all immunocastrated males and female pigs throughout the experimental period

	Start weight (kg)	End weight (kg)	Gain (kg)	ADG (kg/d)	ADFI (kg/d)	FCR (kg/kg)
Male	59.7	88.9	29.2[a]	1.063[a]	2.86[a]	2.69
Female	61.0	86.5	25.5[b]	0.927[b]	2.59[b]	2.81
P value	0.499	0.360	0.001	0.000	0.007	0.176

[ab]Means in a column not having the same superscript are significantly different (*P*<0.05); ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio.

Whilst sex differences were significant, there was no interaction between sex and lysine treatments (Table 2). There was no significant effect of increasing the lysine concentration within the diet with a variable response in average daily gain and feed conversion.

Table 2: Average daily gain (ADG), average daily feed intake (ADFI) and feed conversion (FCR) of immunocastrated male and female pigs fed isoenergetic diets containing 0.58, 0.64, 0.70 or 0.76 g available lysine per MJ of digestible energy throughout the experimental period.

	Start weight (kg)	End weight (kg)	Gain (kg)	ADG (kg/d)	ADFI (kg/d)	FCR (kg/kg)
0.58	59.4	85.3	25.9	0.942	2.64	2.83
0.64	61.0	88.9	27.9	1.013	2.73	2.70
0.70	61.2	88.5	27.3	0.990	2.79	2.81
0.76	59.8	88.3	28.5	1.035	2.75	2.66
P value						
Lysine	0.920	0.802	0.290	0.227	0.776	0.367
Sex	0.557	0.416	0.001	0.001	0.016	0.169
Lysine x Sex	0.952	0.895	0.443	0.358	0.736	0.296

Whilst there were no interactions between sex and lysine concentration, response patterns to increasing levels of lysine were different. Immunocastrate males were generally unresponsive to increasing levels of lysine, with average daily gain (Figure 1), feed intake (Figure 2) and feed conversion (Figure 3) being relatively stable across treatments (Table 3). There was no discernable peak in performance.

Table 3: Average daily gain (ADG), average daily feed intake (ADFI) and feed conversion (FCR) of immunocastrated male pigs fed isoenergetic diets containing 0.58, 0.64, 0.70 or 0.76 g available lysine per MJ of digestible energy throughout the experimental period

	Start weight (kg)	End weight (kg)	Gain (kg)	ADG (kg/d)	ADFI (kg/d)	FCR (kg/kg)
0.58	59.2	88.0	28.8	1.041	2.74	2.64
0.64	60.1	90.3	30.2	1.105	2.96	2.68
0.70	61.2	89.4	28.2	1.016	2.88	2.82
0.76	58.2	88.0	29.8	1.090	2.88	2.64
P value	0.928	0.976	0.738	0.543	0.852	0.629

Whilst again there was no significant difference between treatments when looking at females alone (Table 4), the average daily gain steadily rose with increasing lysine concentration (Figure 1), however, the response in feed intake (Figure 2) and feed conversion (Figure 3) showed a more mixed response.

Table 4: Average daily gain (ADG), average daily feed intake (ADFI) and feed conversion (FCR) of female pigs fed isoenergetic diets containing 0.58, 0.64, 0.70 or 0.76 g available lysine per MJ of digestible energy throughout the experimental period

	Start weight (kg)	End weight (kg)	Gain (kg)	ADG (kg/d)	ADFI (kg/d)	FCR (kg/kg)
0.58	59.5	82.6	23.0	0.842	2.55	3.03
0.64	61.9	87.4	25.5	0.921	2.50	2.73
0.70	61.3	87.6	26.3	0.964	2.70	2.81
0.76	61.4	88.6	27.1	0.980	2.62	2.67
P value	0.944	0.654	0.166	0.170	0.487	0.234

Growth in live weight (Figure 4) was basically linear for the period from 15 to 19 weeks, especially in the second batch of pigs.

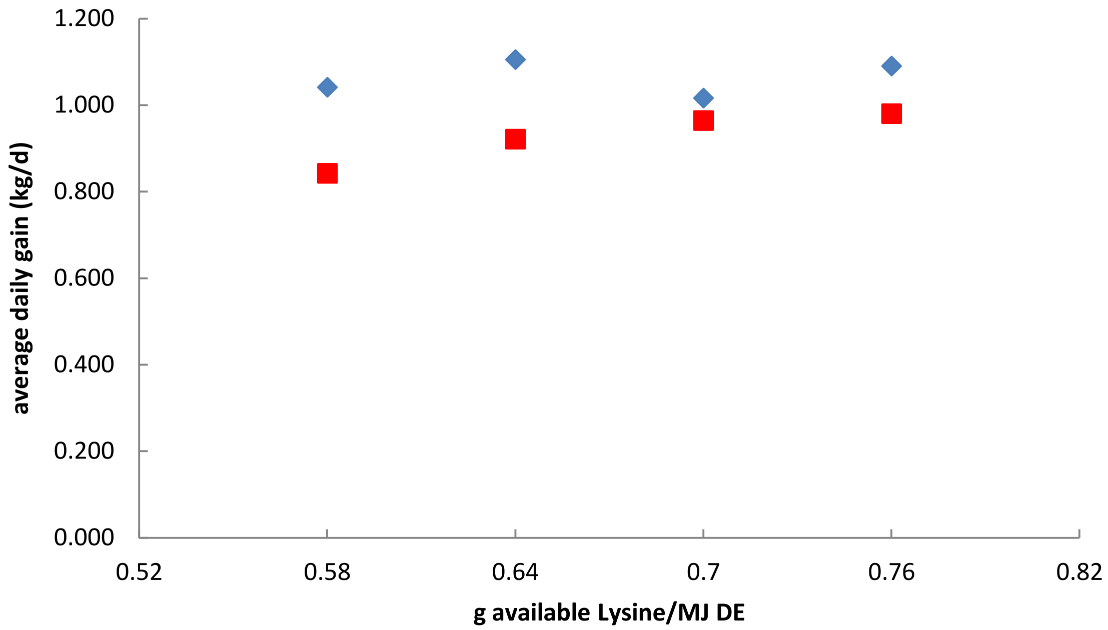

Figure 1: Response in average daily gain of immunocastrate male (♦) and female (■) pigs to increasing levels of lysine in the diet of pigs from 60 – 90 kg live weight.

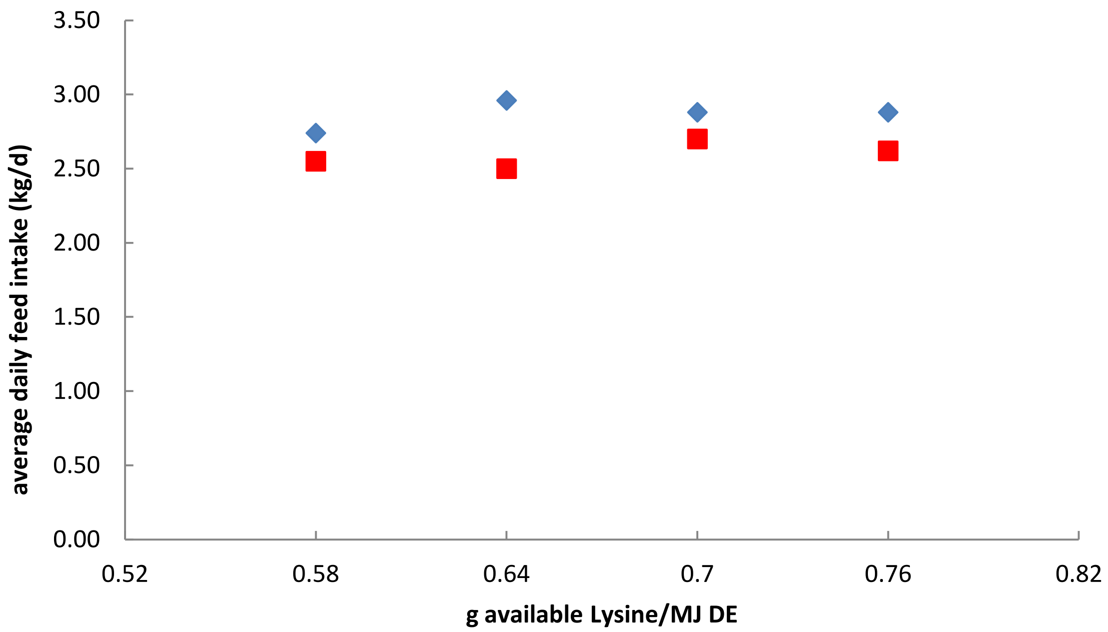

Figure 2: Response in average daily feed intake of immunocastrate male (♦) and female (■) pigs to increasing levels of lysine in the diet of pigs from 60 – 90 kg live weight

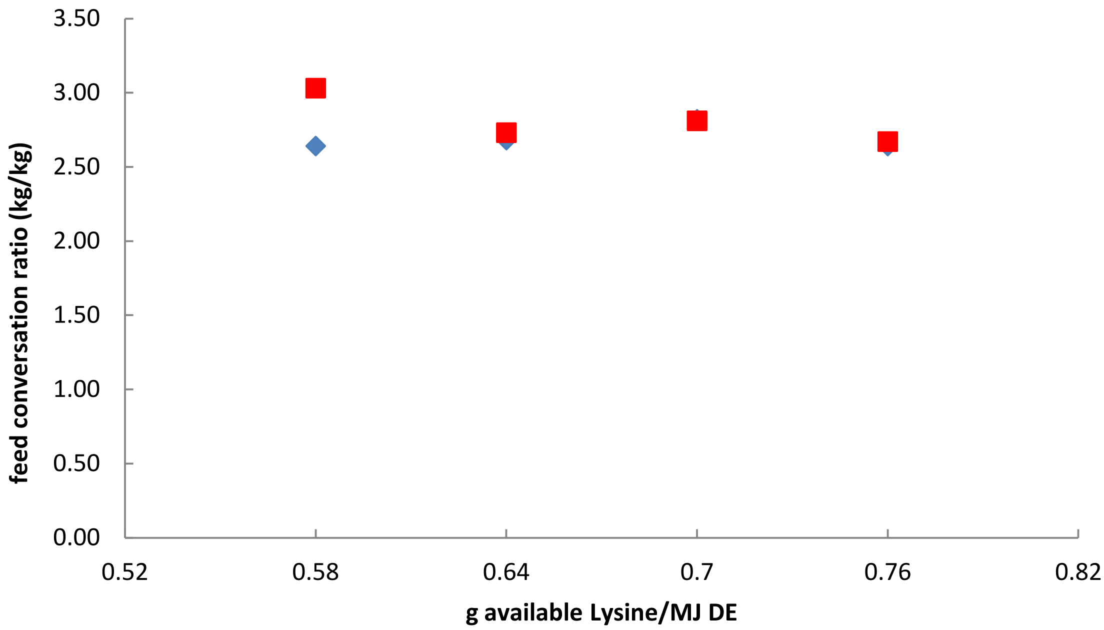

Figure 3: Response in feed conversion ratio of immunocastrate male (◆) and female (■) pigs to increasing levels of lysine in the diet of pigs from 60 – 90 kg live weight

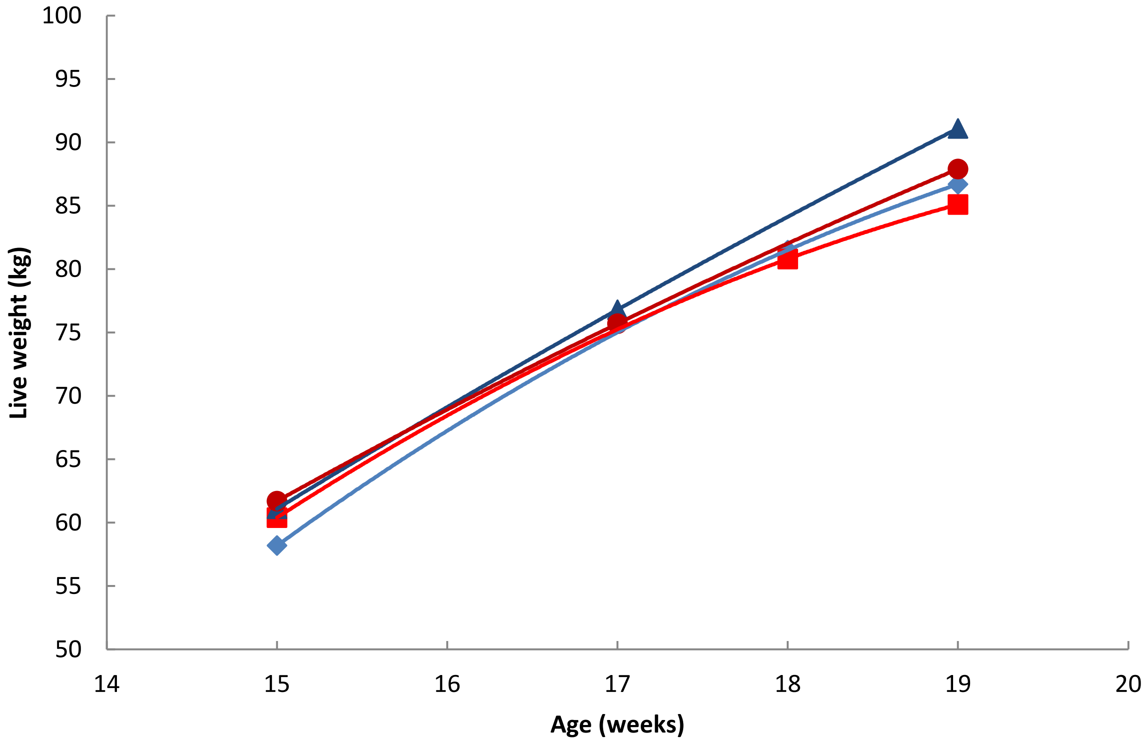

Figure 4. Growth curves of immunocastrate males, block 1 (◆) and block 2 (▲) and female pigs, block 1 (■) and block 2 (●) across the experimental period.

Discussion

Performance of the whole group was acceptable for commercial production for finisher pigs with an average growth rate for the period of 995 g/day, although feed conversion was slightly higher than would normally be expected at 2.75 kg/kg.

The lack of difference in performance when lysine levels were increased was somewhat unexpected. The statistically significant difference detected between the two sexes investigated gives us confidence that the data is robust. Although not statistically significant the growth performance of both immunocastrate male and female pigs does not appear to be enhanced when lysine concentrations are raised above 0.64 g available lysine per MJ of digestible energy. This commercial finding is in line with the experimental work of Moore *et al.* (2012) who determined 0.63 g available lysine was the optimum level.

Implications and Recommendations

The lack of difference in performance when lysine levels were increased makes it difficult to make firm recommendations. The data generated supports the continued focus of separate feeding programs for male and female pigs when possible, although both sexes had a similar response to increasing lysine concentration which did not appear to be enhanced when lysine concentrations were raised above 0.64 g available lysine per MJ of digestible energy, in line with prior experimental work (Moore *et al.,* 2012).

Publications Arising from the Project

There have been no publications arising from this project to date. With this project being part of a larger project coordinated by Dr Bruce Mullan, any publications are likely to arise from the multi-site data being compiled.

References

Moore, K.L., Mullan, B.P., Campbell, R.G. and Kim, J.C. (2012) the response of entire male and female pigs from 20 to 100 kg liveweight to dietary lysine. *Animal Production Science* **53:**67-74.

Appendix

Lysine Requirements Diet 1 (Low Lysine) – 60-95 kg

Raw material	%	[Kg]
13180 SORGHUM 9.5	20.0	300.0
14180 WHEAT 11.5	50.946667	764.2
16020 MILLRUN 16.0	10.0	150.0
33140 CANOLA MEAL 37.0	10.0	150.0
40100 BLOOD MEAL 90.0	1.4	21.0
40680 MEAT MEAL 51.0	5.333333	80.0
45581 STOCKFEED BLENDED OIL	0.8	12.0
47000 LIMESTONE (FINE)	0.233333	3.5
48000 DICALPHOS	0.4	6.0
49005 SALT (FINE)	0.2	3.0
52810 CHOLINE CHLORIDE 60%	0.04	0.6
53020 M.H.A.Calcium	0.026667	0.4
53100 LYSINE HCL	0.3	4.5
53200 L-THREONINE	0.02	0.3
61200 DEODORASE FARM PACK	0.1	1.5
90500 BN GROWER PREMIX	0.2	3.0
	100.0	1500.0

Analysis

[VOLUME]	%	:	100.0	PHENYL	%	:	0.753196	W3_FA	%	:	0.158904
DRYMATTER	%	:	89.160267	THREONINE	%	:	0.61128	W6_FA	%	:	1.245707
MOISTURE	%	:	10.839733	TRYPTOPHAN	%	:	0.178595	W3+W6_FA	%	:	1.044611
PROTEIN	%	:	17.35226	M+C	%	:	0.625994	#FAW6:W3		:	7.839366
C_FIBRE	%	:	3.81816	CALCIUM	%	:	0.915635	C18:2W6LIN	%	:	0.885707
DE_PIG_MJ	MJ/KG	:	13.603393	PHOSPHORUS	%	:	0.762957	#AILYS/DEP		:	0.057992
DE_PIG_MC	MCAL/KG	:	3.17115	AV_PHOS	%	:	0.451068	#MET/LYS		:	0.300122
LEUCINE	%	:	1.330739	#CAL/PHO		:	1.200113	#M+C/LYS		:	0.636617
ISOLEUCINE	%	:	0.569982	#CAL/AVPHO		:	2.029926	#TRY/LYS		:	0.181626
LYSINE	%	:	0.983313	CHOLINE	MG/KG	:	1111.54	#THR/LYS		:	0.621653
METHION	%	:	0.295114	FAT/EE	%	:	3.48504	#ISO/LYS		:	0.579654

Lysine Requirements Diet 2 (High Lysine) – 60-95 kg

Raw material	%	[Kg]
13180 SORGHUM 9.5	20.0	300.0
14180 WHEAT 11.5	42.273333	634.1
16020 MILLRUN 16.0	10.0	150.0
33140 CANOLA MEAL 37.0	10.0	150.0
34630 SOYBEAN MEAL 47.5	7.4	111.0
40100 BLOOD MEAL 90.0	2.2	33.0
40680 MEAT MEAL 51.0	6.333333	95.0
45581 STOCKFEED BLENDED OIL	0.6	9.0
47000 LIMESTONE (FINE)	0.086667	1.3
48000 DICALPHOS	0.2	3.0
49005 SALT (FINE)	0.2	3.0
52810 CHOLINE CHLORIDE 60%	0.006667	0.1
53020 M.H.A.Calcium	0.066667	1.0
53100 LYSINE HCL	0.3	4.5
53200 L-THREONINE	0.033333	0.5
61200 DEODORASE FARM PACK	0.1	1.5
90500 BN GROWER PREMIX	0.2	3.0
	100.0	1500.0

Analysis

[VOLUME]	%	:	100.0	PHENYL	%	:	0.953945	W3_FA	%	:	0.151292
DRYMATTER	%	:	89.258733	THREONINE	%	:	0.782192	W6_FA	%	:	1.16372
MOISTURE	%	:	10.741267	TRYPTOPHAN	%	:	0.227612	W3+W6_FA	%	:	1.000612
PROTEIN	%	:	21.132667	M+C	%	:	0.750852	#FAW6:W3		:	7.691881
C_FIBRE	%	:	4.104347	CALCIUM	%	:	0.953957	C18:2W6LIN	%	:	0.84932
DE_PIG_MJ	MJ/KG	:	13.59538	PHOSPHORUS	%	:	0.795215	#AILYS/DEP		:	0.075903
DE_PIG_MC	MCAL/KG	:	3.184818	AV_PHOS	%	:	0.452651	#MET/LYS		:	0.298177
LEUCINE	%	:	1.655195	#CAL/PHO		:	1.199621	#M+C/LYS		:	0.594001
ISOLEUCINE	%	:	0.733767	#CAL/AVPHO		:	2.107491	#TRY/LYS		:	0.180065
LYSINE	%	:	1.264058	CHOLINE	MG/KG	:	1087.953333	#THR/LYS		:	0.618794
METHION	%	:	0.376913	FAT/EE	%	:	3.35692	#ISO/LYS		:	0.580485