The Efficiency of Energy Utilization by Growing Pigs Selected for Potential Growth Rate

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SUMMARY

Feeding pigs specific diets based on potential growth rate as determined by growth rate in the nursery may decrease variability in grow-out and finishing. In our study, however, pigs separated into slow, average or fast potential growth rates by determining growth rate in the nursery had comparable growth rates, feed intake and rates of protein and lipid deposition in late finishing.

INTRODUCTION

The normal variability in growth rate that exists within a group of pigs causes inefficiencies in nutrient utilization and contributes to variation in carcass composition. Managing this variability is a significant challenge for the pork industry. We have conducted a series of experiments designed to develop cost-effective feeding regimes which minimize the negative effects of variability on the producer's bottom line. The specific objective of the reported experiment is to characterize the utilization of energy by pigs of differing potential growth rate (PGR).

MATERIALS AND METHODS

This experiment used a total of 120 finishing (90 to 120 kg BW) barrows. Twenty-four pigs were assigned to an initial slaughter group (ISG) and 96 pigs were assigned to one of 12 treatments (n = 8 pigs/treatment). The treatments were arranged as a 3 × 2 × 2 factorial and consisted of 3 potential growth rates (PGR; slow, average or fast), 2 dietary energy concentrations (EC; 2.18 or 2.40 Mcal NE/kg) and 2 levels of feed intake (FL; 85 or 100% of ad libitum intake).

Barrows were identified at nursery exit as having a slow, average or fast PGR, based on their body-weight per day of age from birth to nursery exit. When the pigs reached 90 kg BW they were randomly assigned, within PGR, to the EC and FL treatments.

Dietary energy concentration was adjusted by changing the relative proportions of wheat, barley and canola oil (Table 1). Diets were formulated to meet or exceed the pigs' nutrient requirements (NRC, 1998) and to provide a constant SID lysine-to-NE ratio and minimum essential amino acid-to-lysine ratios. Celite was included in both diets as a source of acid insoluble ash, to be used as a digestibility marker.

Table 1. Ingredient and nutrient composition of experimental diets

	Formulated NE Conc., Mcal/kg	
Item	2.18	2.40
Ingredient, % as-fed		
Barley	67.83	11.20
SBM	23.20	22.00
Whean	4.00	59.16
Canola Oil	1.00	3.50
Mono / di Cal / P	1.40	1.45
Limestone	1.10	1.00
Salt	0.50	0.50
Vitamin premix[1]	0.06	0.06
Mineral premix[1]	0.08	0.08
DG200 Selenium	0.15	0.15
Celite	0.40	0.40
L-Lysine HCl	0.20	0.34
L-Threonine	0.04	0.10
DL-Methionine	0.05	0.07
Nutrients, as fed		
Dry Matter, %	88.93	89.81
Crude Protein, %	21.45	21.32
Crude Fat, %	2.76	5.19
Total Lysine, %	1.16	1.20
TID Lysine, %	0.95	1.02
g TID Lys/Mcal NE	4.37	4.24
DE, Mcal/kg	3.20	3.52
ME, Mcal/kg	3.01	3.29

[1]Obtained from Master Feeds, Saskatoon, SK

Table 2. The effects of potential growth rate, dietary energy concentration and feeding level on the performance of barrows growing from 90 to 120 kg

Item	Potential Growth Rate (PGR)			NE Conc. (EC), Mcal/kg		Feeding Level (FL), % Ad Lib.	
	Slow	Average	Fast	2.18	2.40	85	100
n	32	32	31	47	48	48	47
BW per day of age, g	**335.3**	**396.8**	**457.1**	392.5	400.3	393.7	399.1
Initial BW, kg	89.6	90.2	90.8	90.0	90.4	90.2	90.2
Final BW, kg	119.1	119.7	119.2	119.3	119.4	119.3	119.5
No. Days on Test	33	32	31	32	33	**35**	**30**
ADG, kg	0.93	0.93	0.93	0.95	0.91	**0.86**	**1.01**
ADFI, kg	3.04	3.01	3.02	**3.09**	**2.96**	**2.79**	**3.26**
G:F, kg/kg	0.31	0.31	0.31	0.31	0.31	0.31	0.31

Bold font indicates P < 0.05

"Pigs separated into slow, average or fast potential growth rates by determining growth rate in the nursery had comparable growth rates, feed intake"

Except for the ISG group, pigs were slaughtered when they reached 120 kg BW. Carcasses were ground and analyzed for nutrient content. Dietary NE (NECST) was calculated as the sum of the energy retained in the carcass (RE) and fasting heat production (FHP), estimated according to Noblet et al. (2003) as 179 kcal/kg $BW^{0.60}$. Dietary NE was also estimated based on nutrient content and digestibility using prediction equations from the French National Institute for Agricultural Research (INRA; Sauvant et al., 2004).

RESULTS

Pigs were identified as having either a slow, average or fast PGR based on their BW per day of age from birth to nursery exit. Previous studies conducted at the Prairie Swine Centre have demonstrated a correlation ($r^2 \sim 0.35$) between BW at nursery exit and growth rate in the grow-finish barn. Interestingly, in the present study performance, expressed in terms of ADG, ADFI and FCE was unaffected by PGR ($P > 0.05$; Table 2).

Pigs receiving the high energy diet had reduced ADFIs ($P < 0.05$); however ADG was similar across EC treatments. By design, ADFI was greater in pigs fed at 100% of ad libitum than those fed at 85 %, which led to an increase in ADG ($P < 0.05$; Table 2).

The efficiencies with which pigs used dietary energy for BW gain and for accretion of protein and lipid in the carcass were unaffected by PGR (Table 3). Pigs fed the low energy diet were more efficient (g protein deposited/ g Mcal intake) in their accretion of carcass protein than pigs fed the high energy diet ($P < 0.05$).

Although pigs fed at 100% of ad libitum grew faster and took fewer days to reach 120kg than those fed at 85% of ad libitum, the latter were more efficient in their use of dietary energy for BW gain ($P < 0.05$) and for carcass protein accretion ($0.50 < P < 0.10$; Table 3).

CONCLUSIONS

Growth performance and the efficiency of energy utilization for growth and for carcass nutrient accretion in finishing (90 to 120kg) pigs was similar among pigs identified at nursery exit as having a slow, average or fast potential growth rate. This suggests that segregating pigs at nursery exit based on PGR is not an effective tool to manage variability in the grow-finish herd.

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Table 3. The effects of potential growth rate, dietary energy concentration and feeding level on energy utilization for nutrient retention in the carcasses of barrows slaughtered at 120 kg[1]

Item	Potential Growth Rate (PGR)			NE Conc. (EC), Mcal/kg		Feeding Level (FL), % Ad Lib.	
	Slow	Average	Fast	2.18	2.40	85	100
n, pigs	32	32	30	47	47	47	47
Body-Weight Gain, kg/Mcal							
DE	0.16	0.16	0.16	0.16	0.15	**0.16**	**0.15**
NE*CST*	0.14	0.15	0.14	0.15	0.14	0.15	0.14
NE/INRA2	0.24	0.25	0.24	**0.26**	**0.23**	**0.25**	**0.23**
NE/INRA4	0.24	0.24	0.24	**0.25**	**0.23**	**0.25**	**0.23**
Energy retention, Mcal retained/Mcal consumed							
DE	0.39	0.39	0.39	**0.37**	**0.41**	**0.37**	**0.41**
NE*CST*	0.40	0.40	0.40	**0.38**	**0.42**	**0.38**	**0.42**
NE/INRA2	0.54	0.55	0.55	0.53	0.56	**0.52**	**0.57**
NE/INRA4	0.95	0.97	0.96	0.99	0.99	0.97	0.95
Protein deposition, g/Mcal							
DE	15.51	16.29	15.22	**17.05**	**14.33**	16.57	14.80
NE*CST*	15.81	16.59	15.54	**17.16**	**14.83**	16.88	15.10
NE/INRA2	21.76	22.87	21.30	**24.38**	**19.60**	23.24	20.75
NE/INRA4	38.80	38.80	37.53	**43.04**	**35.38**	***43.43***	***34.98***
Lipid deposition, g/Mcal							
DE	31.28	32.32	32.45	**29.43**	**34.59**	***29.27***	***34.75***
NE*CST*	31.97	33.05	33.13	**29.62**	**35.79**	***29.90***	***35.51***
NE/INRA2	43.68	45.11	45.38	42.10	47.32	***40.89***	***48.53***
NE/INRA4	76.12	79.19	78.92	**72.89**	**83.23**	75.85	80.26

[1] Refers to the utilization of energy available for BW gain, calculated as energy intake minus the maintenance energy requirement

Bold font indicates $P < 0.05$