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

*A. D. Beaulieu, J. Shea, D. Gillis and J. Marriott*

Denise Beaulieu

## INTRODUCTION

Despite years of breeding for specific characteristics, variation still exists within our population of pigs with respect to growth, feed intake and feed efficiency. This trial is part of a series of experiments designed to improve our understanding of energy metabolism in growing and finishing pigs. The overall objective of this experiment was to determine if early growth rate (potential growth rate, PGR) is predictive of efficiency of energy utilization later in life. Understanding the differences in energy utilization among fast and slow growing pigs will help us to manage and develop cost-effective feeding programs that most closely meet the specific requirements of these groups of pigs.

## MATERIALS AND METHODS

Sixty barrows were assigned to either a slow, average or fast PGR group based on growth rate from birth to nursery exit. When the pigs reached 30 kg BW they were placed in individual pens and assigned to receive either a low or a high energy diet at 100 or 85 % of ad libitum intake. The experiment therefore, had a total of

*"Segregating pigs and feeding based on potential growth rate does not improve the ability to match feed to requirements"*

3 x 2 x 2 = 12 treatments, (3 growth potentials, 2 dietary energy concentrations and 2 intake levels). Diets are described in Table 1. The high energy diet had more wheat and canola oil and less barley than the low energy diet. Diets were formulated with a comparable standard ileal digestibility (SID) % lysine, therefore the lysine/energy ratio was lower in the high energy diet. Lysine, however, was formulated to be non-limiting in both rations. Diets contained 0.4% celite, a source of acid-insoluble ash used as a marker for digestibility calculations.

The pigs were slaughtered when they reached 60 kg BW, the carcasses ground, and analyzed for nutrient content. Comparing the data with a group of pigs slaughtered at the beginning of each experiment allows the calculation of nutrient retention within each growth period. Dietary NE was calculated as RE + FHP where RE = energy retained in the carcass and FHP = fasting heat production estimated as 179 kcal/kg BW0.6 (Noblet et al. 2003).

Faeces were collected throughout the growing period to allow for the measurement of DE and estimation of NE using the equations developed by Noblet (2004) and the CVB (2005) which are predictive equations based on nutrient content and digestibility.

## RESULTS

The pigs were selected for PGR based on growth rate in farrowing and nursery. The targeted body weight to begin the experiment

**Table 1.** Ingredient and nutrient composition of experimental diets

| | Formulated NE Conc., Mcal/kg | |
|---|---|---|
| Item | 2.18 | 2.40 |
| Ingredient, % as-fed | | |
| Barley | 65.61 | 4.00 |
| Wheat | 4.00 | 63.03 |
| Soybean Meal | 25.60 | 25.60 |
| Canola Oil | 1.00 | 3.50 |
| Limestone | 1.15 | 1.15 |
| Mono / di Ca / P | 1.35 | 1.35 |
| Vitamin premix[1] | 0.056 | 0.056 |
| Mineral premix[1] | 0.075 | 0.75 |
| Salt | 0.50 | 0.50 |
| DG200 Sel | 0.15 | 0.15 |
| L-Lysine HCl | 0.105 | 0.155 |
| L-Threonine | 0.00 | 0.03 |
| DL-Methionine | 0.00 | 0.005 |
| Celite | 00.40 | 0.40 |
| Nutrients, formulated | | |
| DE, Mcal/kg | 3.25 | 3.56 |
| NE,[2] Mcal/kg | 2.18 | 2.40 |
| Dlys, % | 0.93 | 0.96 |
| Dlys/DE, g/Mcal | 2.89 | 2.69 |
| Dlys/NE, g/Mcal | 4.27 | 4.00 |

**Table 2.** Performance of barrows growing from 30 to 60 kg BW selected for potential growth rate and fed a high or low energy concentration diet at 85 or 100 % of ad libitum intake.

| Item | Projected Growth Rate | | | Dietary Energy Conc. | | Feeding Level (FL), % Ad Lib. | |
|---|---|---|---|---|---|---|---|
| | Slow | Average | Fast | Low | High | 85 | 100 |
| n | 32 | 32 | 32 | 48 | 48 | 48 | 48 |
| BW per day of age, g | 0.31 | 0.38 | 0.44 | 0.38 | 0.38 | 0.38 | 0.38 |
| Initial BW, kg | 30.3 | 29.9 | 30.4 | 30.2 | 30.13 | 30.3 | 30.1 |
| Final BW, kg | 60.1 | 60.2 | 60.0 | 60.2 | 60.1 | 60.1 | 60.1 |
| No. Days on Test | 32.3 | 32.1 | 31.3 | 31.9 | 31.9 | **35.9** | **27.9** |
| ADG, kg | 0.94 | 0.95 | 0.97 | 0.95 | 0.96 | **0.83** | **1.07** |
| ADFI, kg | 2.02 | 1.99 | 1.96 | **2.06** | **1.93** | **1.79** | **2.19** |
| FCE (G:F), kg/kg | 0.47 | 0.49 | 0.50 | **0.47** | **0.50** | **0.47** | **0.50** |
| FCE (F:G), kg/kg | 2.13 | 2.04 | 2.00 | **2.13** | **2.00** | **2.13** | **2.00** |

was 30 kg for all pigs, therefore pig age differed. The slow-growing pigs were about 98 days of age, almost 4 weeks older than the fastest growing pigs, who had reached 30 kg BW at only 71 days of age. The average PGR group was 78 days of age. Despite this, ADG from 30 to 60 kgs BW was only slightly higher for the fast PGR pigs. A lower daily feed intake for these pigs resulted in a tendency for an improved feed efficiency ($P = 0.07$; Table 2). Energy concentration of the diet had no effect on growth rate; feed intake was reduced on the high energy diet, therefore feed efficiency (kg/kg) was improved for pigs fed this diet.

As expected, pigs fed the diet at 100 % had improved growth relative to pigs allowed only 85 % of ad libitum. Feed efficiency (kg/kg) was also improved at the higher feed intake.

The efficiency of utilization of energy for growth, protein or lipid deposition was numerically lower for the fast growing pigs relative to the average or slower growing pigs, however, this difference was not significant (Table 3). The efficiency of energy utilization for protein or lipid deposition (g /Mcal intake) was improved with the low energy diet. Pigs fed the diet at 85% ad libitum utilized energy more efficiently relative to those allowed 100 % intake, regardless of PGR or dietary energy concentration. The ad libitum fed pigs had fewer days to reach 60 kg, grew faster, ate more and had improved feed efficiency. However, the efficiency of energy utilized for protein or lipid deposition was improved with the lower intake.

**Table 3.** The efficiency of energy used for retained energy or protein or lipid deposition in barrows growing from 39 to 60 kg BW.

| Item | Projected Growth Rate | | | Dietary Energy Conc. | | Feeding Level (FL), % Ad Lib. | |
|---|---|---|---|---|---|---|---|
| | Slow | Average | Fast | Low | High | 85 | 100 |
| Energy retention, Mcal retained/Mcal consumed | | | | | | | |
| $De_{ig}$ | 0.60 | 0.58 | 0.56 | 0.67 | 0.49 | 0.67 | 0.49 |
| $NE_{CSTig}$ | 0.81 | 0.79 | 0.76 | 0.86 | 0.71 | 0.91 | 0.66 |
| $NE_{INRAig}$ | 0.92 | 0.90 | 0.86 | 1.04 | 0.75 | 1.05 | 0.74 |
| Protein deposition, g/Mcal energy in | | | | | | | |
| $De_{ig}$ | 41.2 | 39.4 | 36.9 | 45.3 | 33.0 | 45.5 | 32.8 |
| $NE_{CSTig}$ | 56.1 | 53.5 | 50.0 | 58.5 | 47.8 | 62.6 | 4.3.8 |
| $NE_{INRAig}$ | 63.8 | 60.8 | 56.7 | 70.1 | 50.8 | b | 50.0 |
| Lipid deposition, g/Mcal energy in | | | | | | | |
| $De_{ig}$ | 37.6 | 35.2 | 33.7 | 41.8 | 28.5 | 39.6 | 31.3 |
| $NE_{CSTig}$ | 51.0 | 47.6 | 45.4 | 54.8 | 41.2 | 54.1 | 41.9 |
| $NE_{INRAig}$ | 58.1 | 54.3 | 51.7 | 65.7 | 43.7 | 62.1 | 47.3 |

The experimental DE and NE values obtained are shown in Table 4 The DE content of the diets was much lower than expected. We don't have an explanation for this. These diets were representative of others we have used and energy digestibility was higher. The NE values calculated using the INRA (French) equation were similar to the formulated NE concentration. The values used in our formulations are largely obtained from the INRA data base so this is evidence that this data base is useful for feedstuffs obtained in Western Canada.

## CONCLUSIONS

The efficiency of the utilization of dietary energy for growth was comparable among pigs selected for high or low potential growth rate. This implies that segregating pigs and feeding based on PGR is not a tool that will improve our ability to match feed to requirements.

**Table 4.** Experimentally derived DE and NE values

| Determined Energy Conc. Mcal/kg | Forumulated NE Conc., Mcal/kg | | Determination Method |
|---|---|---|---|
| | 2.18 | 2.40 | |
| DE | 2.86 | 3.25 | Total tract digestibility with marker |
| $NE_{CST}$ | 2.37 | 2.47 | NE = RE + FHP (carcass slaughter method) |
| $NE_{INRA2}$ | 2.14 | 2.38 | NE = 0.121*Dig. CP + 0.350*Dig EE + 0.143*St + 0.119*Sugars + 0.086*Residue (Sauvant et al., 2004) |

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