

Both Weaning Weight and Post-weaning Growth Performance Affect Nutrient Digestibility and Energy Utilization in Pigs

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Summary and Implications

A total of 96 weaning barrows were selected to represent the 10% lightest, median, and heaviest pigs at weaning (n=30 per weaning weight category). Barrows utilized in a 27-d growth and metabolism study, where total urine and fecal grab samples were collected on d 30, 31, and 32 post-weaning. At the completion of the experiment, pigs in each weaning weight (WW) category were divided into the slowest, median, or fastest 33% average daily gain (ADG) category, yielding a nested design. The digestibility of dry matter (DM), nitrogen (N), and gross energy (GE) differed, resulting in different digestible energy (DE) and DE intakes across WW and ADG categories. Pigs with a lighter WW and slower ADG within WW had lower energy requirements for maintenance and were more efficient at converting energy into gain. Together, these data suggest that both weaning weight and post-weaning growth performance affect nutrient digestibility and utilization in nursery pigs. This research increases our understanding of nutrient use in nursery pigs, and will allow us to make more strategic dietary recommendations in the future.

Introduction

Little is known about how dietary energy and nutrient availability changes due to variations in piglet weaning weight or its interactions with post-weaning growth performance. In particular, there is little data examining nutrient digestibility and energy utilization differences in fallback pigs. Fallback pigs are those that fail to achieve performance in the barn equal to that of their contemporaries. There are many causes for this underachievement, such as light birth weight or health challenges, but many causes are still undetermined. With increasing litter sizes and ever evolving disease challenges, the prevalence of fallback pigs and the associated drain on a producer's net income are both escalating, which underscores the importance of research to create more strategic solutions.

The current industry standard for managing these pigs is to offer additional quantities of Phase 1 and Phase 2

starters and sometimes preferential environmental conditions. These management practices assume that fallback pigs are nothing more than smaller versions of pigs in the barn and do not differ biologically or physiologically from their heavier contemporaries. This seems unlikely; yet to our knowledge there have been no studies to confirm or deny this assumption. Understanding these differences will allow us to best manage fallback pigs to maximize their contribution to the financial success of the pig farm. In this way, fallback pigs may be converted from drains on a producer's net income to profit contributors. The objective of this particular experiment was to evaluate the effects of both pig weaning weight category and post-weaning average daily gain on nutrient digestibility and nutrient utilization in order to more fully determine the core physiological disruptions of fallback pigs.

Materials and Methods

This study was conducted at the Iowa State University Swine Nutrition Farm under the approval of the university Institutional Animal Care and Use Committee (#9-09-6807-S). Through four replicates, a total of 960 weanling pigs (PIC C22/C29 × 337; ages 18-21 d) were individually tagged and weighed for this experiment. From this general population, 96 barrows, representing the 10% lightest, median, and heaviest pigs at weaning were selected for the experiment (n = 30 per WW category; BW = 4.6, 6.2, and 8.1 kg, respectively). Barrows were housed in individual stainless steel metabolism crates and fed *ad libitum* quantities of a commercial nursery phase feeding program during a 27-d growth and metabolism study. Diets contained 0.40% titanium dioxide as an indigestible marker.

Total urine and fecal grab samples were collected on d 30, 31, and 32 post-weaning. Urine was acidified, pooled, subsampled, and analyzed for N. Feed and fecal samples were pooled, subsampled, ground through a 1-mm screen, and analyzed for DM, N, and GE nutrient digestibility. At the completion of the experiment, pigs in each WW category were divided into the slowest, median, or fastest 33% ADG category, yielding a nested design.

At the completion of the study, pigs in each WW category were divided into the slowest, median, or fastest 33% ADG category, yielding a nested design with 9 treatments plus an initial slaughter group. Data were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). The model consisted of the fixed effects of WW category and WW category nested within ADG category and the random effects of replicate and crate. Least squared means were calculated, and treatments were compared using the SLICE and SLICEDIFF procedures.

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Tukey-Kramer corrections were used to adjust for multiple comparisons among treatments.

Results and Discussion

Nutrient digestibility and energy utilization are reported in Table 1. Surprisingly, the digestibility of dry matter, gross energy, and nitrogen was maximized ($P < 0.01$) by pigs in the median ADG categories, as was the DE ($P = 0.004$). This follows similar trends of published research from the Prairie Swine Centre, but was still of particular interest because nutrient use is generally thought to be correlated with increases in body weight and gain. This research suggests that managing the variation in a group (both light and heavy) may prove to be the most successful strategy to improve nutrient utilization and cost-efficiency in a barn.

Both DE intake and DE required for maintenance was highest ($P < 0.0001$) in pigs with the heaviest WW and fastest post-weaning growth rate. This resulted differences ($P = 0.001$) in energy efficiency for gain among treatments, suggesting that heavier, faster growing nursery pigs have decreased maintenance costs and utilize energy more

efficiently than their lighter, slower growing counterparts. This was in agreement with our initial hypothesis, and provides further evidence that fallback pigs differ physiologically from their contemporaries.

This research will lead to the establishment of environmental, nutritional, and/or health interventions that may help control the prevalence of fallback in pigs. Consequently, this proposal has economic implications as it will provide Iowa and U.S. pork producers a competitive advantage in the industry. The management strategies that result from this research will minimize the incidence of fallback pigs and their drain on net profit, thereby maximizing the production efficiency, throughput, and profit of a barn.

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Table 1. Effects of WW and ADG on nutrient digestibility and energy utilization of weanling pigs.

	% DM Digestibility	% GE Digestibility	% N Digestibility	DE, Mcal	DEi, Mcal/d	DEm, Mcal	Energy efficiency for gain, Mcal/kg
Lightest 10% WW							
Slowest ADG	84.1	85.2	81.3	3.47	1.47	0.76	1.79
Median ADG	86.4	87.5	84.9	3.56	2.15	0.95	2.34
Fastest ADG	85.9	86.9	84.6	3.54	2.39	1.02	2.40
Median 10% WW							
Slowest ADG	85.1	85.8	81.9	3.50	1.60	0.89	1.18
Median ADG	86.2	87.4	85.3	3.56	2.49	1.08	2.41
Fastest ADG	84.6	85.8	82.0	3.50	2.96	1.19	2.66
Heaviest 10% WW							
Slowest ADG	85.8	86.9	84.1	3.54	2.33	1.05	2.32
Median ADG	85.9	86.8	84.5	3.54	2.69	1.21	2.34
Fastest ADG	85.4	86.4	84.0	3.52	3.06	1.31	2.39
Pooled SEM	0.72	0.70	1.16	0.029	0.135	0.033	0.297