Evaluating Variable Feed Energy Levels for Grow-Finish Pigs

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Introduction

Today's swine genetics have lower feed intakes and higher lean accretion rates than pigs did even 5 to 10 years ago. These changes in pig performance require the evaluation of energy density of the diet at various grow-finish body weights to maximize growth performance. With lysine levels remaining constant, the varying levels of energy will also allow the evaluation of lysine to calorie ratios to achieve optimal growth rates. These ratios could then be applied to different energy and lysine levels to optimize nutrient utilization efficiency and pig growth rates.

Materials and Methods

One hundred fifty-nine pigs, 84 barrows and 75 gilts with an initial weight of 64 lbs, were allotted by sex and weight to evaluate the effects of dietary metabolizable energy (ME) concentrations on growth performance and carcass traits. Pigs were fed one of four dietary treatment sequences *ad libitum* for 97 days. Diet sequences consisted of four phases (64-119, 119-163, 163-216, and 216-254 lbs, respectively), with lysine levels constant in all four dietary energy treatments (total lysine 1.1, .9, .75, and .6% for phases 1 to 4, respectively). The varying energy treatments were:

- Diet sequence 1 (corn-soy + fiber) containing 1450, 1450, 1460, 1415 kcal/lb of feed; low energy diet (LE).
- Diet sequence 2 (corn-soy) containing 1500, 1506, 1510, 1465 kcal/lb of feed; normal energy diet (NE).
- Diet sequence 3 (corn-soy + 3.5% fat) containing 1575, 1583, 1587, 1515 kcal/lb of feed; normal plus diet (NP).
- Diet sequence 4 (corn-soy + 7% fat) containing 1650, 1655, 1660, 1592 kcal/lb of feed; high energy diet (HE).

Example diets are shown in Table 1. Pigs were weighed at the end of each phase and total feed consumed was recorded to determine average daily gain (ADG), average daily feed intake (ADFI), and gain:feed (G:F). Carcass data were obtained at a commercial slaughter facility in Indiana.

Results

Results are summarized in Table 2. During phase 1, all pigs had similar ADFI ($P>.75$); consequently, ADG increased linearly with increasing ME/lb ($P<.001$). However, during phases 2, 3, and 4, pigs adjusted ADFI relative to dietary energy concentration to achieve similar ME intakes ($P>.46$). This demonstrates that today's pigs may not be able to adjust their intakes relative to dietary energy until 100 to 120 lbs of body weight. So the more nutrient and energy dense a diet we can provide in early grow-finish will increase pig ADG and G:F.

During phase 2, ADG and G:F increased linearly ($P<.0001$) as dietary energy concentration increased in the diet, while ADFI linearly decreased ($P<.0001$). During phase 3, ADFI decreased (P<.002) and G:F increased (P<.0001) with increasing dietary energy content. However, ADG during phase 3 was not affected by diet energy density. This was due to the barrows continuing to increase ADG with diets up to 7% fat, while the gilts peaked with the 3.5% fat diet and then actually decreased ADG when fed the 7% fat diets.

During phase 4, dietary fiber content was increased in the LE and NE diets, the NP diet was a corn-soy diet, and the HE diet now only contained 3.5% added fat. Both sexes responded during this late finishing phase, with ADG (linear P<.01) tending to be maximized on a corn-soy diet while G:F (P<.0001) continued to improve with the 3.5% added fat diet.

Increased levels of ME increased the overall (0-97 days) ADG (1.86, 1.92, 1.98, 2.02 lbs/day, respectively; linear, P<.001) and G:F (.32, .34, .36, .39, respectively; linear, P<.001). Overall ADFI decreased as ME levels increased in the diet (5.73, 5.67, 5.49, 5.18 lbs/day, respectively; linear, P<.001). Final BW increased with increasing ME (244.8, 251.4, 255.8, 260.2 lbs, respectively; linear, P<.001). As ME was increased in the diet, backfat depth increased (.74, .73, .82, .88 in., respectively; linear, P<.001), and percent lean decreased (54.6, 54.6, 54.1, 53.5%, respectively; linear, P<.02). Overall, ADG and ADFI were higher in barrows than gilts (2.03 vs. 1.86 lbs/day; 5.78 vs. 5.29 lbs/day, respectively; P<.001). Barrows also had greater backfat thickness than gilts (.86 vs. .73 in.; P<.001), and gilts had a higher percent lean than barrows (54.8 vs. 53.6%; P<.001).

Implications

The early grow-finish period (up to 160 lbs) may require added fat of up to 7% to maximize pig ADG and G:F, regardless of sex. As the grow-finish period continues, ADG does not tend improve, but G:F does with added fat in the diet. Depending on the price of fat and corn, it may be economical to feed higher energy diets from 160 lbs to market. Based on growth rate, optimal dietary lysine:energy ratios for phase 1, 2, 3, and 4 were 3.00, 2.50, 2.25, and 1.80 g lysine/Mcal ME, respectively.

Table 1. Example diet formulations.

Ingredients, %	Low Energy (LE)	Normal Energy (NE)	Normal Plus (NP)	High Energy (HE)
Grower 1 Period; 64 to 119 lbs body weight				
Corn	62.87	69.97	66.42	62.57
Soybean Meal, 48%	26.73	27.10	27.10	27.42
Soybean Hulls	7.50	--	--	--
Fat		--	3.50	7.00
Lysine-HCL	.15	.15	.15	.15
Vit/Min/Anti	2.75	2.78	2.83	2.86
Total	100.0	100.0	100.0	100.0
Nutrient Content				
Lysine, %	1.10	1.10	1.10	1.10
ME, kcal/lb	1450	1500	1575	1650
Lys:Cal, g/Mcal ME	3.44	3.33	3.17	3.02
Finisher 2 Period; 216 lbs to market				
Corn	71.61	82.53	89.26	85.44
Soybean Meal, 48%	6.69	7.91	8.59	8.91
Soybean Hulls	7.50	7.50	--	--
Dried Beet Pulp	12.30	--	--	--
Fat	--	--	--	3.50
Lysine-HCL	.15	.15	.15	.15
Vit/Min/Anti	1.75	1.91	2.00	2.00
Total	100.0	100.0	100.0	100.0
Nutrient Content				
Lysine, %	.60	.60	.60	.60
ME, kcal./lb	1415	1465	1515	1592
Lys:Cal, g/Mcal ME	1.92	1.86	1.80	1.71

Table 2. Effect of increasing dietary energy on grow-finish growth perfomance.

	Barrows				Gilts					
Item	LE[a]	NE	NP	HE	LE	NE	NP	HE	CV	Significance
Initial BW, lb	64.3	65.3	65.2	65.1	62.7	63.1	63.0	62.6	1.41	Sex .001
Phase 1										
ADG, lb	1.86	1.88	2.01	2.06	1.85	1.88	1.89	2.02	2.78	Lin. .0001, Sex .06
ADFI, lb	4.08	4.18	4.22	4.18	4.10	4.15	4.00	4.11	3.56	NS
G:F	.459	.452	.477	.492	.452	.455	.475	.493	3.94	Lin. .001
Phase 2										
ADG, lb	2.03	2.16	2.14	2.35	1.87	1.92	2.00	2.04	4.04	Lin. .0001, Sex .0001
ADFI, lb	6.16	5.81	5.75	5.63	5.69	5.44	5.11	4.94	6.24	Lin. .002, Sex .001
G:F	.332	.377	.374	.417	.330	.353	.391	.414	5.12	Lin. .0001
Phase 3										
ADG, lb	2.07	2.16	2.19	2.24	1.88	1.95	1.94	1.87	5.53	Sex .0001
ADFI, lb	6.67	6.69	6.36	5.86	6.00	6.05	5.46	5.06	6.49	Lin. .0002, Quad. .11; Sex .0001
G:F	.312	.321	.343	.375	.314	.322	.355	.371	5.16	Lin. .0001
Phase 4										
ADG, lb	1.78	1.83	1.89	1.87	1.53	1.59	1.75	1.69	5.85	Lin. .01, Sex .0001
ADFI, lb	7.44	7.31	7.37	6.62	6.61	6.46	6.38	5.67	8.30	Lin. .01, Sex .001
G:F	.240	.251	.258	.282	.234	.247	.276	.300	7.80	Lin. .0001
Overall										
ADG, lb	1.94	2.00	2.06	2.13	1.79	1.85	1.90	1.91	3.23	Lin. .0001, Sex .0001
ADFI, lb	5.95	5.88	5.81	5.47	5.49	5.44	5.15	4.88	5.12	Lin. .001, Sex .0001
G:F	.326	.340	.353	.383	.322	.335	.367	.388	3.51	Lin. .0001
Final wt., lb	252.1	259.3	265.0	271.5	236.6	242.1	247.0	248.3	2.50	Lin. .0001, Sex .0001
Carcass data[b]										
Fat depth, in	.81	.76	.88	1.00	.68	.71	.77	.76	13.15	Lin. .0001, Quad. .05; Sex .0001; Sex x Trt .003
Loin depth, in	2.57	2.55	2.55	2.52	2.64	2.62	2.67	2.57	5.17	Sex .001
Percent lean	54.1	54.3	53.5	52.6	55.1	54.9	54.7	54.3	3.32	Lin. .02, Sex .001

[a] LE=Low energy (Corn-Soy + Fiber), NE=Normal Energy (Corn-Soy), NP=Normal Plus (Corn-Soy + 3.5% Fat), HE=High Energy (Corn-Soy + 7.0% Fat).

[b] Carcass data adjusted for carcass weight.