Impact of low energy diets on the bottom line

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Introduction

Feed is the largest single cost of pork production (65 – 75%), and dietary energy is the most costly component of feed. Therefore, nothing impacts the profitability of pork producers more than the dietary energy level of feed. But what are the feed energy requirements of pigs of different ages and physiological status (growing, pregnant, lactating)? In 2012, the National Research Council (NRC) released the Nutrient Requirements of Swine. As per previous releases, no energy requirements are stated. Requirement tables show a 'standard' 2475 kcal/kg of net energy (NE) and are footnoted 'dietary energy content relates to corn and soybean meal (SBM)-based diets'. So is this value considered enough, high, or low? Maybe the answer is *'it depends…'*. There are American reports showing that hogs fed corn-SBM diets respond to fat inclusion by growing faster, meaning that the energy level provided by corn-SBM diets may limit growth performance. And what about diets based on Prairie grains instead of corn-SBM? We would like to share results of two commercial-scale trials where we evaluated how Prairie grain diets stacked to feed energy levels similar to a corn-SBM diet and lower and how that affected profitability.

Constant feed energy levels for hogs

Dietary energy intake is genotype and gender specific and is affected by stocking density, feeder space, housing, and barn environment. Thus defining the dietary energy level for each genotype and gender under typical housing, stocking and environmental conditions of a particular barn is critical to optimize tissue growth and maximize profitability. Our first experiment evaluated feeding lower than conventional, constant NE levels throughout to market weight with the aim of comparing small grain-based dietary regimens where the high would provide similar performance to corn-SBM diets.

In total, 1008 pigs (30 kg) housed in 48 pens of 21 barrows or gilts were fed diets providing 2.4, 2.3, 2.2, or 2.1 Mcal NE/kg over 5 growth phases. Wheat DDGS inclusion decreased from the Grower (25%) to Finisher (16.5%) phases. Wheat grain, field pea, and canola oil were included in high energy diets (2.4 Mcal/kg), whereas barley and oat grains were included in the low energy diets

(2.1 Mcal/kg). Feed was delivered to each pen and tracked using a robotic system. Pen BW and feed disappearance (ADFI) were measured at day 0, 21, 42, 56, 70, weekly thereafter, and slaughter weight (120kg). Pigs were slaughtered at Maple Leaf, Brandon, MB where warm carcasses were weighed and graded (Destron) to measure loin and backfat depth, from which pork lean yield, gain and index were calculated.

For the entire trial (d 0-70), decreasing dietary NE by 0.1 Mcal/kg linearly increased ADFI by 43 g and linearly decreased feed efficiency (gain/feed) by 0.007. Neither BW nor daily weight gain (ADG) was affected by NE level. The proportion of pigs remaining in pens after start of shipping for slaughter (d70) was greatest for pigs fed 2.1 Mcal/kg. Decreasing dietary NE by 0.1 Mcal linearly increased BW at market by 0.7 kg, but decreased carcass dressing by 0.25%-points. Carcass weight was greater for pigs fed 2.1 vs. those fed 2.2 or 2.3 Mcal/kg NE. Carcass backfat, loin depth, lean yield, index, and carcass lean gain (CLN) were not affected by NE level. Pigs fed 2.1 reached market weight 4.6 days after those fed 2.2 or 2.3 Mcal NE/kg, partly due to the higher body weight at market. Decreasing dietary NE by 0.1 Mcal linearly increased caloric efficiency by 1.5 g CLN/Mcal NE and lysinic efficiency by 0.5 g CLN/g SID lysine.

Table 1. Effects of feeding diets with decreasing net energy (NE) level

Mcal NE /kg	2.4	2.3	2.2	2.1
Diet cost, $/1000kg	249.51*a*	233.13*b*	216.22*c*	198.81*d*
Feed cost per kg gained, $	0.67*a*	0.63*b*	0.60*c*	0.57*d*
Feed cost per pig, $	62.50*a*	59.58*b*	56.72*c*	54.66*d*
Income per hog after subtracting feed cost, $	61.02*d*	63.50*c*	65.93*b*	71.43*a*

Decreasing NE by 0.1 Mcal/kg linearly decreased feed cost by $17/tonne, feed cost per kg gained by 3¢, feed cost per hog by $2.6, and increased income over feed cost by $3.5 (Table 1). Feeding 2.1 vs. 2.4 Mcal/kg resulted in over **$10 greater profitability per hog**. This trial showed that pigs performed well feeding decreased net energy levels in the Grower and Finisher phases.

Abrupt vs. gradual decreases in feed energy level for hogs

In young pigs, appetite or digestive capacity restricts dietary energy intake limiting protein deposition. As pigs grow, they overcome this limitation, but fat accretion then increases progressively faster. Dietary energy level could therefore potentially be reduced as pigs grow to mitigate feed cost. But it is not clear 1) at what dietary energy level pigs should start, 2) how long it should be fed for, 3) if it should drop down from the starting level, and if so, 4) how aggressively feed energy level should drop down as pigs grow to slaughter weight. An early drop in dietary energy level as pigs grow would limit lean deposition. A late drop in dietary energy level as pigs grow near slaughter weight could aggravate fat accretion and increase feed cost. Our experiment thus evaluated the response of barrows and gilts to initially constant, but varying NE levels in the Grower phases and then different curvilinear decreases in dietary NE (aggressive or gradual) in the Finisher phases as pigs grew to slaughter weight (120 kg).

We compared the response of 2016 pigs to feeding one of 5 curvilinear patterns (drops) of NE (3 aggressive: R2, R4, R6; 2 gradual: R3, R5; Figure 1) vs. a constant NE level (R1; similar to a corn-SBM diet) over 6 growth phases to 120 kg, 8 barrow and 8 gilt pens per NE regimen, 21 pigs/pen. Pigs were initially fed wheat-based diets progressively replaced by barley and even oats in R2 and 6 Finisher diets with lentil and wheat DDGS as supplemental protein meals (30 and 20% initially, decreasing to 10% in Finisher). Ratios of standardized ileal digestible (SID) lysine:NE were constant within phase. Pen body weight and feed disappearance were measured at approximately 30, 45, 60, 75, 90, 105, 120 kg and at shipping for slaughter. Pigs were slaughtered at Britco Pork Inc., Langley, BC, where individual warm carcasses were weighed and graded (Destron).

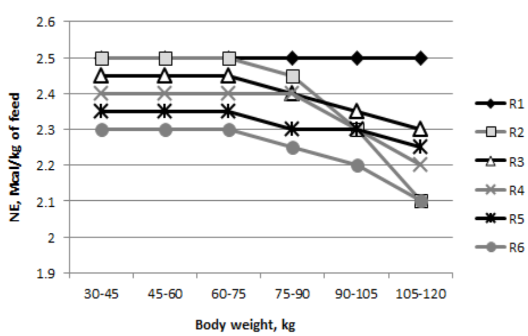

Figure 1. Barrows and gilts were fed 1 of 6 dietary net energy (NE) regimens from 30 to 120 kg live weight:

R1: Constant 2.5 Mcal NE/kg to market wt (control)

R2: 2.5 Mcal NE/kg to 75 kg → abrupt decrease to 2.1 Mcal/kg

R3: 2.45 Mcal NE/kg to 75 kg → gradual decrease to 2.3 Mcal/kg

R4: 2.4 Mcal NE/kg to 75 kg → abrupt decrease 2.2 Mcal/kg

R5: 2.35 Mcal NE/kg to 75 kg→ gradual decrease to 2.3 Mcal/kg

R6: 2.3 Mcal NE/kg to 75 kg→ abrupt decrease to 2.1 Mcal/kg

There were no interactions between dietary NE level and sex. For the entire trial (day 0-92), decreasing NE level increased ADFI (8.6% greater for R6 vs. R1). Caloric intake was 5.6% greater for pigs fed R1 and 2 than for those fed R3-6, whereas lysine (SID) intake was 4.6% greater for pigs fed R1 and 5 than those fed R2, 3 or 4. For the entire trial, body weight (BW) and ADG (kg/d) were not affected by NE regimen. For the entire trial, decreasing NE level decreased feed efficiency (G:F, 8% better R1 vs. R6).

Ship weight was not different between NE regimens. Carcass dressing was 1%-point lower for R2-6 compared with R1 due to greater fibre intake, resulting in 1% lower carcass weight for R2, 4, 5, and 6 compared with R1. Backfat depth, loin depth, lean yield and lean gain were not affected by NE regimen. Index was only 0.6% greater for R4, and 6 than R1 and 3. Carcass lean gain per Mcal NE was 5.6% greater for R3 than R1 and 2. Carcass lean gain per g of SID lysine were 4% greater for R2, 3, 4 and 6 compared with R1 and 5.

Table 2. Effect of feeding different feed net energy regimens (R1-6) to growing-finishing barrows and gilts

	R1	R2	R3	R4	R5	R6
Diet cost, $/1000kg	261.6*a*	248.5*b*	244.0*c*	238.7*d*	235.1*e*	226.7*f*
Feed cost per kg BW gain, $	0.71*a*	0.70*b*	0.68*c*	0.67*d*	0.67*d*	0.66*d*
Feed cost per kg lean gain, $	1.51*a*	1.51*a*	1.47*b*	1.44*b*	1.45*b*	1.44*b*
Income per hog after subtracting feed cost, $	62.2*b*	62.5*b*	63.7*b*	65.5*a*	65.5*a*	65.9*a*

Diet cost was different among NE regimens (Table 2), $35 lower for R6 vs. R1. Feed cost per kg gained was 66 vs. 71¢ and feed cost per kg lean gain was 1.44 vs. 1.51 for R6 vs. R1. Hogs fed R6 profit $3.65 more than those fed R1. Days to slaughter were not different among dietary regimens.

It was not clear whether abrupt drops in feed energy level had advantages to gradual decreases by phase. This trial did show again, however, that hogs can perform well feeding lower net energy diets than equivalent NE level to corn-SBM diets resulting in greater profit margin for producers.

Summary

In a farrow-to-finish operation, more than 80% of feed is consumed by growing-finishing pigs. It was eye-opening to see how hogs responded fed decreased net energy levels. Firstly, we realized hogs can indeed be fed lower energy diets than equivalent corn-SBM, so no need to be as high as US in feed energy. It also means that we can feed lower cost diets **without** supplemental dietary fat. Pigs increased feed intake instead of reducing gain. Carcass backfat, loin depth, lean yield, index, and carcass lean gain were not affected by NE regimen. Although reducing NE decreased feed efficiency, it improved caloric and lysinic efficiency for lean gain. Secondly, we can achieve lower feed energy by incorporating lower cost cereal grains like oats, and food- and bio-industrial co-products like canola meal, DDGS, or wheat millrun highlighting the ability of the omnivorous pig to convert co-products into human food protein. However, by including these, there is a penalty on dressing % that requires increasing live ship weight by 1-2 kg to sustain target carcass weight. This heavier ship weight may extend barn utilization by some days, but lower feed cost per hog likely makes up for it. Lastly, feeding small cereal Prairie grains results in whiter and firmer pork fat than feeding corn grain and corn DDGS giving Prairie producers a consumer pork preference advantage in export markets.

These two experiments were not conducted in summer time when feeding denser, low energy diets may mitigate drops in feed intake in part related to heat increment of feeding. We also did not evaluate the effect of health status, stocking density or feeder space availability. Feeding fibrous diets to hogs likely increases manure production. Feed commodity and pork prices vary and profitability shown may not be consistently repeatable. The reader is thus cautioned to consider health, housing, environmental and economic factors to guide decisions regarding feeding lower feed energy levels.

References

Beaulieu, A.D., Williams, N.H. and Patience, J.F. 2009. Response to dietary digestible energy concentration in growing pigs fed cereal grain-based diets. J. Anim. Sci. 87: 965-976.

De La Llata, M., Dritz, S.S., Tokach, M.D., Goodband, R.D., Nelssen, J.L. and Loughin, T.M. 2001. Effects of dietary fat on growth performance and carcass characteristics of growing-finishing pigs reared in a commercial environment. J. Anim. Sci. 79: 2643-2650.

De La Llata, M., Dritz, S.S., Tokach, M.D., Goodband, R.D. and Nelssen, J.L. 2007. Effects of increasing lysine to calorie ration and added fat for growing-finishing pigs reared in a commercial environment: I. Growth performance and carcass characteristics. Professional Animal Scientist 23: 417-428.

National Research Council 2012. Nutrient requirements of swine. 11th ed. National Academy Press, Washington, DC.

Patience, J.F. 2013. Managing energy intake and costs of grow-finish pigs. Adv. Pork Prod. 24: 29-36.

Smith, J.W., 2nd, Tokach, M.D., O'Quinn, P.R., Nelssen, J.L. and Goodband, R.D. 1999. Effects of dietary energy density and lysine:calorie ratio on growth performance and carcass characteristics of growing-finishing pigs. J. Anim. Sci. 77: 3007-3015.

Whittemore, C.T., Green, D.M. and Knap, P.W. 2001. Technical review of the energy and protein requirements of growing pigs: food intake. Anim. Sci. 73: 3-17.