

## Dietary Energy Systems: Part II

In the May 2003 Akey Swine Newsletter, *Dietary Energy Systems: Part I*, we described a system that outlined energy flow in pigs, and defined classes of energy available to swine nutritionists when formulating diets. In this month's newsletter, we explore how the two main classes of energy (metabolizable energy, ME; and net energy, NE) affect diet formulation.

Why should we consider moving to an NE-based system? We are more interested in NE with the increased availability of cost-effective by-products (wheat midds and distillers dried grains with solubles (DDGS)) and crystalline amino acids (AA). For example, using high levels of crystalline AA results in lower crude protein (CP) in feeds from ingredients such as soybean meal (SBM; Table 1). When we replace CP in SBM with AA and maintain ME, NE increases (Table 1). This increase in NE occurs because the pig is no longer metabolizing excess dietary CP (AA), which must be deaminated and the nitrogen excreted, an energy-consuming process. Increased energy available to the pig for productive purposes must be accounted for in formulation or resulting performance may be compromised.

Table 1. Formulation on an Equal NRC<sup>a</sup> ME and Available Lysine Basis

Item	No L-Lysine	Standard L-Lysine	High L-Lysine
Ingredient	---Amount, lb/ton---		
Corn	1232	1342	1419
SBM, 47.5	639	525	444
Fat	86	85	85
L-Lysine HCl	<b>0</b>	<b>3.5</b>	<b>6</b>
Vit/Mineral/Other AA	43	45	46
Nutrient	---Level---		
CP, %	19.8	17.7	16.2
Lysine, %	1.11	1.09	1.08
Avail lysine, %	0.92	0.92	0.92
NRC ME, kcal/lb	<b>1600</b>	<b>1600</b>	<b>1600</b>
NRC NE, kcal/lb	<b>1061</b>	<b>1070</b>	<b>1077</b>
Cost, \$/ton *	143.53	141.06	140.67

<sup>a</sup>NRC: National Research Council, Nutrient Requirements of Swine (1998).

\* Ingredient prices include \$2.80/bu corn, \$200/ton SBM, \$0.15/lb fat, \$0.95/lb L-Lysine, \$1.40 L-Threonine, and \$1.10 DL-Methionine.

Formulation differences using high crystalline AA become even more apparent when balancing diets on a constant NE and available lysine basis (Table 2). In this case, fat levels in diets

decrease as CP from SBM is replaced with high levels of crystalline AA. ME level in the diet decreases, but NE remains constant. The diet cost implications of the two formulation methods are significant. Formulating to a constant NE level using high L-lysine levels results in a diet that costs about \$1.70/ton less than the same diet using standard L-lysine levels (Table 2). In contrast, formulating to a constant ME level using high L-lysine results in a diet that costs only about \$0.40/ton less than the same diet using standard L-lysine levels (Table 1).

Table 2. Formulation on an Equal NRC<sup>a</sup> NE and Available Lysine Basis

Item	No L-Lysine	Standard L-Lysine	High L-Lysine
Ingredient	---Amount, lb/ton---		
Corn	1232	1358	1448
SBM, 47.5	639	524	442
Fat	86	70	58
L-Lysine HCl	<b>0</b>	<b>3.5</b>	<b>6</b>
Vit/Mineral/Other AA	43	45	46
Nutrient	---Level---		
CP, %	19.8	17.7	16.2
Lysine, %	1.11	1.09	1.08
Avail lysine, %	0.92	0.92	0.92
NRC ME, kcal/lb	<b>1600</b>	<b>1584</b>	<b>1572</b>
NRC NE, kcal/lb	<b>1061</b>	<b>1061</b>	<b>1061</b>
Cost, \$/ton *	143.53	139.42	137.74

<sup>a</sup> NRC: National Research Council, Nutrient Requirements of Swine (1998).

\* Ingredient prices include \$2.80/bu corn, \$200/ton SBM, \$0.15/lb fat, \$0.95/lb L-Lysine, \$1.40 L-Threonine, and \$1.10 DL-Methionine.

What about diets utilizing high fiber ingredients such as DDGS? Such ingredients may prove problematic because of variation in nutrient content (especially crude fiber levels in DDGS; Table 3) which affects diet formulation.

Table 3. Variation in Nutrient Content for DDGS\*

Item	Average	Low	High	CV, %
Moisture, %	11.7	9.7	13.6	7.8
Crude protein, %	26.6	24.5	28.4	3.6
Crude fat, %	10.1	9.2	11.6	7.0
Crude fiber, %	6.9	5.8	9.1	11.3

\* Representative samples collected from 16 dry-process ethanol plants (University of MN, 2001).

Using NRC nutrient values for DDGS, diets formulated on an equal available lysine and either ME or NE basis are shown in Table 4. Again, formulation implications in terms of cost are significant. Maintaining constant ME using 200 lb/ton of DDGS decreases diet cost \$0.69/ton, whereas maintaining constant NE using 200 lb/ton of DDGS increases diet cost \$0.50/ton.

Table 4. Formulation on Equivalent NRC<sup>a</sup> ME or NE Basis

Ingredient	DDGS, lb/ton		
	0	200	200
	Reference Diet	Equal ME	Equal NE
Corn	1342	1137	1140
DDGS	0	200	200
SBM, 47.5	525	507	508
Fat	85	94	105
L-Lysine HCl	3.5	3.5	3.5
Vit/Mineral/Other AA	50	45	45
Nutrient	Level		
CP, %	19.8	19.2	19.2
Lysine, %	1.11	1.12	1.12
Avail lysine, %	0.92	0.92	0.92
NRC ME, kcal/lb	<b>1600</b>	<b>1600</b>	1611
NRC NE, kcal/lb	<b>1070</b>	1063	<b>1070</b>
Cost, \$/ton *	141.06	140.37	141.56

<sup>a</sup> NRC: National Research Council, Nutrient Requirements of Swine (1998).

\* Ingredient prices include \$2.80/bu corn, \$200/ton SBM, \$0.15/lb fat, \$0.95/lb L-Lysine, and \$100/ton DDGS.

If we formulate on an equal ME and available lysine basis and allow NE to increase, pigs have equal gain but poorer F/G ratios, and no detectable difference in carcass performance (Table 5). It is possible that improper available lysine to NE ratios will increase backfat levels. However, increased carcass fatness may not be due to increasing dietary NE per se, but some other factor. For example, broilers fed low CP/high AA diets have increased lipogenic enzyme activity that results in fatter carcasses.

Table 5. Performance of Pigs Fed Different Levels of Crystalline AA but Constant ME and Available Lysine Levels.

Item	Crystalline lysine added, lb/ton				SEM
	2	4	6	8	
Initial wt, lb	74.7	74.4	74.2	74.6	.42
Final wt, lb	248.0	249.3	247.1	247.6	1.45
ADG, lb	1.72	1.74	1.72	1.72	.015
ADFI, lb	4.69	4.73	4.73	4.77	.033
F/G <sup>a</sup>	2.73	2.73	2.77	2.79	.002
Yield, %	75.9	76.4	76.0	76.2	.29
Lean yield, %	54.1	53.6	53.6	53.6	.22
Backfat, in	.70	.74	.74	.74	.015

Akey trial GF\_02\_03.

<sup>a</sup> Linear response to added L-lysine level, P<.01.

NE is no better than ME when formulating swine feeds using corn, SBM, and fat. Accurate determination of NE levels in high fiber ingredients is critical for formulation with the NE

system. NE values for high fiber ingredients are under development and need to be refined further before moving to an NE based formulation system. If fiber content of an ingredient tends to change frequently (as for DDGS), this will have a negative impact on diet formulation using the NE system.

Akey continues to develop information needed to successfully implement a NE system for its customers and will keep you apprised of new developments in this area. We are committed to providing customers with nutrition technology that works on-farm, is cost-effective, and helps pigs achieve optimal performance at the best cost.