A Leader in Nutrition Solutions

SWINE NEWSLETTER

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Performance of pigs fed diets formulated with metabolizable or net energy values for ingredients

Swine diets can be formulated on a variety of energy systems. The three predominant systems currently used throughout the world are digestible energy (DE), metabolizable energy (ME), and net energy (NE). Digestible energy is calculated by measuring the total energy in the feed (gross energy) and subtracting the energy left in the feces. Metabolizable energy subtracts both fecal and urinary energy from energy in the feed. Net energy accounts for not only energy left in the feces and urine, but also energy lost as heat increment. Heat is produced during digestion and metabolism of nutrients and during fermentation in the cecum and colon. Heat increment is often wasted energy but can also be used to maintain internal body temperature. Net energy can be separated into two categories: net energy for maintenance (NEm) which is the energy required to sustain life and maintain body temperature, and net energy for production (NEp) which includes processes such as protein/fat synthesis, milk production, and fetal development. The NE system has been touted as the most accurate estimate of the true energy available for formulation purposes. In comparison to the NE system, the ME system theoretically over-estimates energy content of both protein and fiber rich ingredients and under-estimates energy contents of starch and high fat ingredients.

A majority of U.S. diets are formulated on a ME or modified ME (mME) basis. This is due to the lack of high fiber ingredients in the traditional corn-SBM diet fed to growing-finishing pigs in the U.S, and hence a low heat increment value. In European countries, where higher fiber ingredients such as wheat and barely are common, the NE system is slightly more prevalent. Countries such as France and the Netherlands currently use the NE system. With the increased use of fiber containing by-products such as DDGS and wheat midds in grow-finish (GF) diets, there has been increased interest in the NE system in the US. In order to evaluate the accuracy of Akey's current mME system and the NE system, Akey conducted a GF trial comparing both energy systems at various levels of by-product inclusion. If an energy system is assigning the correct energy value to an ingredient, as the level of that ingredient increases in the diet, feed efficiency will not change as long as diets are formulated to an equal energy level (Figure 1). Feed efficiency will get worse if a system is over-valuing energy in an ingredient and efficiency will improve if a system is under-valuing energy in an ingredient (Figure 2).

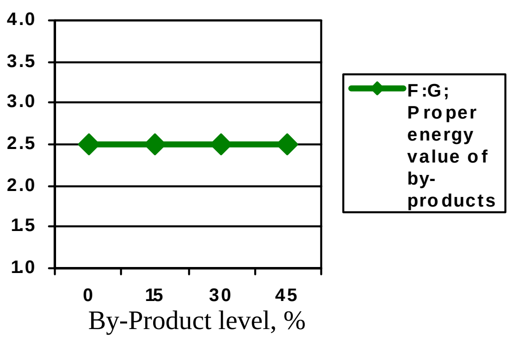

Figure 1. The effect of by-product addition on feed conversion with a correct energy system.

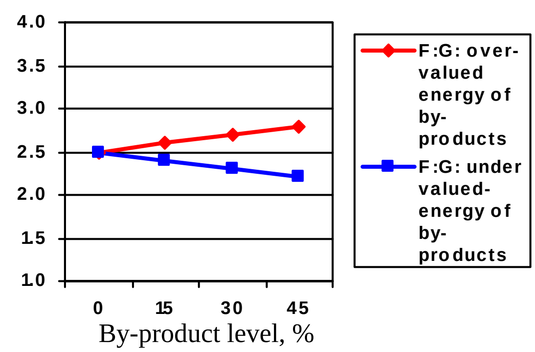

Figure 2. The effect of by-product addition on feed conversion with incorrect energy system.

Methods

In our GF trial, both wheat midds and DDGS were included at 7.5, 15 or 22% for a total by-product level of 15, 30, or 45%. The effects of both by-product inclusion and energy formulation system were evaluated in 60-268 lb pigs. The dietary treatment design is shown in Table 1. All of the dietary treatments formulated on a mME basis were formulated to the same mME value of the 0% by-product diet. All of the diets formulated on an NE basis were formulated to the same NE as the 0% by-product diet. Net energy values for ingredients were determined from equations published by Noblet (1994). Phase 3 dietary mME and NE levels are shown in Figure 3. The mME of diets formulated on a NE basis increased as the level of by-products increased in the diet due to the increase in dietary fat required to maintain an equal NE level.

Table 1. Dietary treatment design

Diets	By-Product Inclusion, %[1]	Fat inclusion, %	Formulation System[2]
1	0	1.0	mME
2	15	2.0	mME
3	15	2.4	NE
4	30	3.0	mME
5	30	3.9	NE
6	45	4.0	mME
7	45	5.4	NE

[1]By-products were a 50:50 mixture of DDGS and wheat midds
[2]mME = Akey's modified ME system is not equivalent to NRC ME values

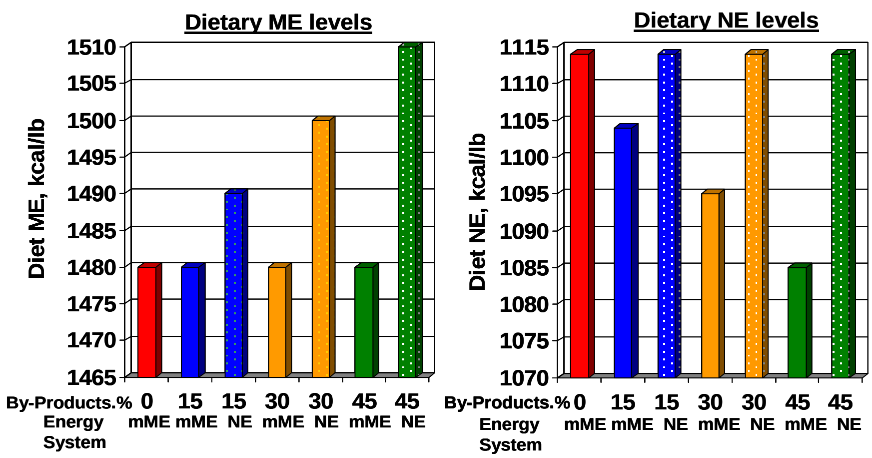

Figure 3. ME and NE levels for dietary treatments in Phase 3.

Results

Regardless of the energy formulation system, feeding increasing levels of by-products had no effect on ADG. Feed intake was reduced as the level of by-products increased in the diet. Formulating diets on a mME basis did not change ADG or ADFI compared to pigs fed diets formulated on an NE basis. Feeding increasing levels of by-products resulted in an improvement in feed conversion (Figure 4). There was also a significant effect of energy formulation system on feed conversion.

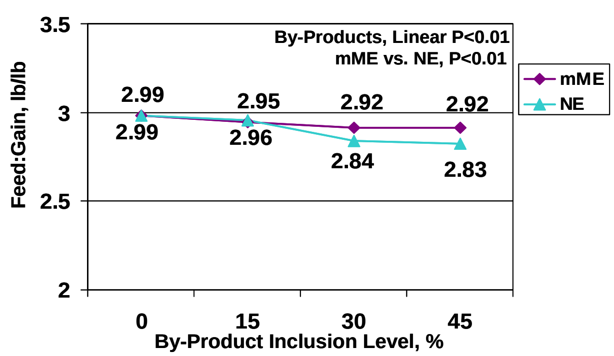

Figure 4. The effect of by-product inclusion level and energy formulation system on feed conversion.

Pigs fed diets formulated on a NE basis had a greater change in feed conversion as the level of by-products increased in the diet compared to pigs fed diets formulated on a mME basis. Since neither energy system resulted in a constant feed conversion, and both improved feed conversion, neither system is perfect. However, feed conversion of pigs fed diets formulated on the mME system was closer to predicted F:G than pigs fed diets formulated on the NE system.

This indicates that at by-product inclusion levels of 30% or greater, both energy systems are under-estimating the energy from DDGS, wheat midds, or fat. Since DDGS, wheat midds, and fat were increasing in the diets, it is impossible to determine in which ingredient mME was under-estimated the most. However, the mME system was closer to estimating the correct energy value for ingredients compared to the NE system. Formulation system had no effect on carcass weight or carcass yield.

Minimizing feed cost/pig is more important than ever. To compare the economics of NE vs mME, an analysis was run on pigs fed either the 15% or 45% by-product inclusion levels formulated on both the mME and NE basis. The economic analysis was completed at both a 3:1 (Figure 5) and 4.5:1 (Figure 6) fat to corn ratio. The following ingredient prices ($/ton) were used: corn, $180; SBM (47.5%), $350; DDGS, $136; wheat midds, $143. Feed cost/pig was determined using the actual feed conversion values obtained for each phase during the trial.

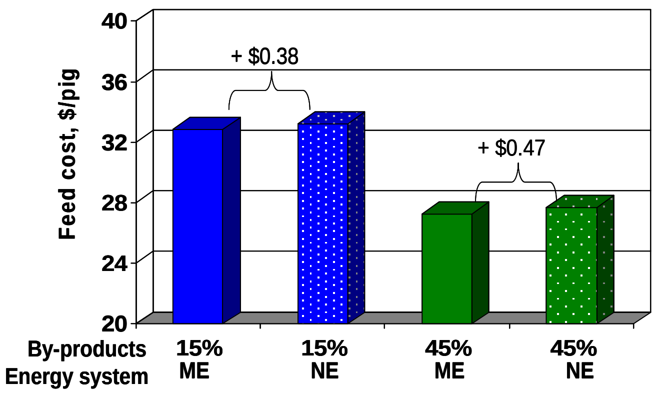

Figure 5. Feed cost/pig when formulating on a mME or NE method at 3:1 fat to corn price ratio.

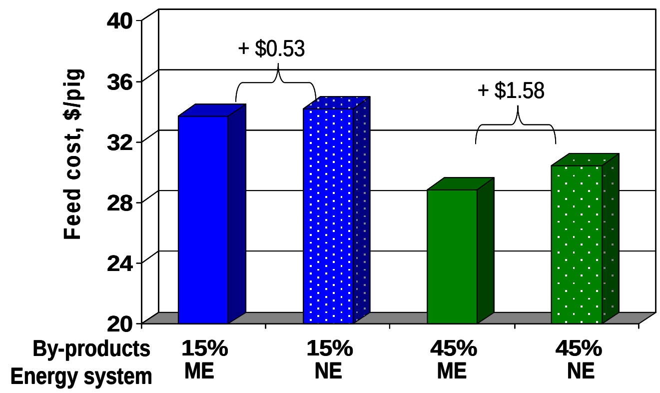

Figure 6. Feed cost/pig when formulating on a mME or NE method at a 4.5:1 fat to corn price ratio.

As expected, feed cost/pig was reduced as the level of by-products was increased in the diets and increased as the fat to corn price ratio increased. However, regardless of the fat:corn ratio, feeding diets formulated on a NE basis resulted in a higher feed cost/pig at both 15 and 45% by-product inclusion levels. At a 3:1 fat to corn price ratio including either 15 or 45% by-products, formulating diets on a NE basis cost $0.38 and $0.47 more per pig, respectively compared to diets formulated on a mME basis. If a producer was finishing 60,000 pigs/year, this would result in a cost increase of $22,800 and $28,200 respectively for the 15 and 45% by-product inclusion levels. The higher the fat to corn ratio, the higher the cost/pig when formulating diets on a NE basis vs. a mME basis. So, formulating diets with 15% and 45% by-products with a 4.5:1 fat to corn ratio on a NE basis would increase feed costs by $31,800 and $94,800, respectively for a producer finishing 60,000 pigs/year. From these data, by-products appear to be worth less when formulating on a NE basis compared to a mME basis, and this problem is further exacerbated when fat prices are high.

Based on this trial, Akey will continue to formulate diets using a mME system since that system more accurately values energy in ingredients, and results in a lower feed cost/pig at all by-product levels and fat to corn price ratios greater than 3:1. Akey nutritionists will continue to evaluate the NE systems and any new equations predicting NE value of ingredients. When a more accurate and predicable energy system is developed that offers advantages to our customers, we will implement it.

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