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SWINE NEWSLETTER

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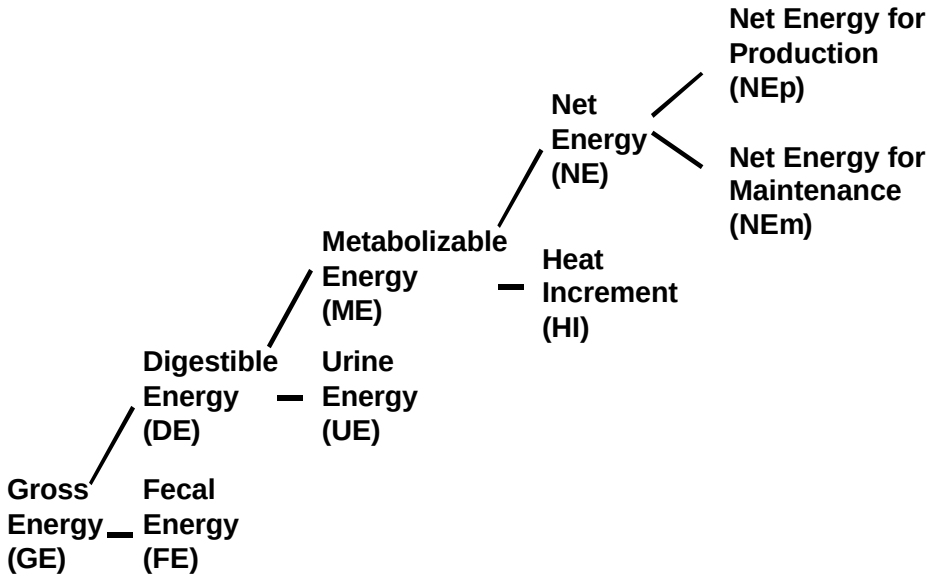
Dietary Energy Systems: Part I

Energy is a major nutrient in swine feeds, and as such, contributes to a large portion of the cost of diets. In the US, major sources of energy in swine feeds are corn, fat, and soybean meal (SBM). Other ingredients are utilized based on cost and availability, including wheat midds, bakery by-products, distiller's dried grains, milo, wheat, and barley. The chemical composition of a feed ingredient has a major impact on its energy content. Ingredients high in fat have higher energy levels, whereas ingredients high in fiber and ash have lower energy content. Traditionally, with corn-SBM-based diets, we formulate using metabolizable energy (ME). A system describing energy utilization by pigs is outlined (Figure 1) and summarized below.

Figure 1. Utilization of Energy by Pigs



Adapted from *Swine Nutrition* (1991), Edited by Miller, Ullrey and Lewis.

Gross Energy (GE): This is the energy released from a feedstuff when it is totally burned in a bomb calorimeter. The GE content of an ingredient is dependent upon how much carbohydrate, fat, and protein it contains. Carbohydrate, fat, and protein contain 4.2, 5.6, and 9.4 kcal/g, respectively of GE. The GE content of a feedstuff does not give any indication as to how digestible or available the energy is to the pig for productive purposes.

Digestible Energy (DE): Dietary GE minus the GE in feces equals DE. Pigs are simple-stomached animals and as such, do not digest fiber very well except for limited hind-gut fermentation by bacteria that populate the large intestine. Nutrients such as fat, starch and protein are digested quite well in the stomach and small intestine of pigs, so they are relatively high in DE. Fibrous ingredients on the other hand, have a lower DE content.

Metabolizable Energy (ME): DE minus the GE in urine and gaseous products of digestion (which are often assumed to be zero) is defined as ME. ME is the energy available to pigs for metabolic purposes. If swine diets are formulated using a low quality protein source, or if protein is in excess of the requirement, the ME level of the diet will decrease. This occurs because amino acids (AA) not used for protein synthesis are broken down (catabolized) and used as a source of energy. The nitrogen produced as a by-product of AA catabolism is excreted as urea. Therefore, as the nitrogen content of the urine increases, the energy losses in the urine increase and the ME contribution of the diet decreases. In general, ME averages about 96% of DE in corn-SBM based diets.

Net Energy (NE): NE is the ME minus the energy in heat increment. Heat increment is the amount of heat released due to digestive and metabolic processes. Pigs can use heat increment to help maintain body temperature in cold environments, but otherwise it is not used for productive processes. Although very difficult to measure, NE gives the best indication of the dietary energy available to the animal for both maintenance and productive purposes.

DE and ME levels of feedstuffs are derived from direct measurement in live animals. Accuracy of ME values is good for most of the ingredients commonly used in swine feeds in the US. Conversely, NE values are often calculated (not measured in live animals) based on specific nutrient contents (i.e., ether extract, starch, crude protein, ash, and acid detergent fiber) of a feedstuff. Assumptions are made about digestibility of nutrients and heat increment that may or may not be correct. Thus, there is a possibility that these calculations and assumptions may result in erroneous NE values for ingredients. If NE values are not accurate but are used to formulate diets, pig performance could be compromised.

Use of the NE system for diet formulation is increasing in many parts of the world. Research work has added to our knowledge and application of the NE system. In the US, adoption of the NE system has lagged. Using primarily corn and SBM to formulate swine diets discourages changes in energy systems, as there is no perceived advantage to using NE over ME in simple diets. In the past, no measurable benefits of the NE system have been detected when it is applied under practical conditions in North America. This situation may be changing, however, with increased use of high fiber ingredients such as wheat midds and distillers dried grains, and increasing popularity of low crude protein, high crystalline AA diets.

In a future Akey Swine Newsletter, *Dietary Energy Systems: Part II*, we will explore how ME vs. NE systems can affect diet formulation.