Swine Feed Efficiency:
Effect of Dietary Energy on Feed Efficiency

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Introduction

Feed efficiency is typically measured in commercial operations by comparing amount of weight gain of the pigs relative to the amount of feed provided. The energy supplied by the feed is a main factor in producing weight gain. Thus, dietary energy has a large effect on feed efficiency. Also, dietary energy may affect carcass characteristics that are not considered in this fact sheet.

Energy and How Energy Relates to Feed Efficiency

Dietary energy is a characteristic of feed which is different than a nutrient like amino acids, vitamins or minerals. When dietary energy is "burned" or used, various processes occur and heat is given off. The measure of energy in feed or food is the calorie, which is the amount of heat required to raise 1 gram of water 1 degree Celsius.

It is readily accepted, documented in research, and logical that increasing energy concentration in the diet improves feed efficiency. In theory, a 1% increase in dietary energy should result in a 1% improvement in feed efficiency. However, several experiments indicate that the value ranges from a 0.7 % to 2.4 % increase in dietary energy to create a 1% improvement in feed efficiency. The variation is a result of several factors and exactly why it is important to determine what effect energy has on feed efficiency. Also, as feedstuffs that supply dietary energy increase in price, there is more incentive to determine the energetic efficiency in addition to the feed efficiency of the pigs on a particular diet.

Sources of Dietary Energy

Energy can be provided by constituents in feed but some, like starch or fat, have more energy and are more efficiently used than, for example, fiber or protein. More complex carbohydrates like fiber are less digestible and cannot be broken down as easily to provide energy. In fact, fiber can reduce digestibility of other nutrients. Protein is a source of amino acids but can also supply energy. If excess amino acids exist, they will be used to produce energy but not very efficiently. Fats also represent another energy source but they are used in a different manner than either carbohydrates or proteins. These various sources and different methods of utilization result in changes in energy efficiency, thus effecting feed efficiency with different feed sources and energy sources in the diet.

Energy Use in the Pig

Energy in the diet is used in complex and various ways by the pig. When the pigs consume energy, it is used for maintenance and growth. Figure 1 below shows the sources of energy in feed and how the pig utilizes energy and where energy is lost and not available for maintenance or growth. In North America digestible or metabolizable energy has been the common measure of energy in swine diets. There is a move toward using net energy or NE since this is a more precise measure of the energy that is used for maintenance and growth. Net energy addresses some of the feed ingredient variability that DE or ME do not; however, the need to know more about how the pig uses the net energy becomes more important to address efficiency.

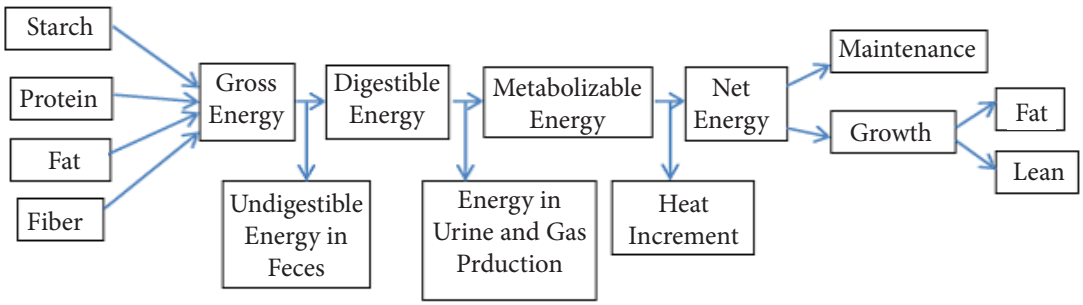

Figure 1: Dietary Energy Sources and Energy Use in the Pig

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How efficiently the pig uses the energy provided from NE can vary depending on whether it is used for maintenance including pig activity, protein or lean gain, and lipid or fat deposition. It is difficult to measure the energy used for maintenance in the pig. Energy is used more efficiently for protein gain than lipid gain. In general, about 30 to 35% of the energy consumed by the pig is used for maintenance, 20% to 25% for protein gain and the remaining 45% to 50% is used for lipid gain. However, many factors can influence how much is used for maintenance, while the stage of production and genetic potential can affect the protein and lipid portion of gain in swine.

Relationship Between Dietary Energy, Energy Intake, and Efficiency

The amount of energy the pig consumes also influences the efficiency of energy use. Increasing dietary energy concentration will typically increase energy intake but only up to a point. Assuming that daily consumption of feed is lower than optimum, increasing the dietary energy concentration increases energy intake. The increase in energy intake also increases growth rate. Because maintenance is relatively constant for a given weight, increasing growth rate dilutes the proportion of energy being used for maintenance and increases efficiency of energy use. The table below shows the effect of energy concentration in the diet.

Table 1: Dietary Energy on pig Performance

Diet ME, kcal/kg	2,700	2,900	3,100	3,300	3,500
ADFI, kg/d	3.31^{a}	3.23^{a}	3.36^{a}	3.28^{a}	2.91^{b}
ADG, kg/d	0.87^{a}	0.93^{ab}	1.01^{bc}	1.04^{c}	1.02^{c}
F:G	3.85^{a}	3.45^{b}	3.33^{bc}	3.13^{c}	2.86^{d}
ME intake, Mcal/d	8.93^{a}	9.36^{ab}	10.41^{c}	10.83^{c}	10.19^{bc}
Mcal ME/kg gain	10.3	10.1	10.3	10.4	9.99

Stein et al., 1996-corn soybean meal based diets
Pig wts 51-112 kg
Different superscripts in row, $P < 0.05$

Conclusion

There are several actions pork producers can take to improve the efficiency of energy use and, thus, feed efficiency. Producers can minimize the portion of energy used for maintenance by providing an optimum environment for the pigs and by minimizing health stress for the pigs. From a nutrition standpoint, particle size reduction, pelleting, or using enzymes to maximize the digestibility of the diet can improve efficiency. Another management practice related to diets would be using feed ingredients that have a low heat increment, like fat, during periods of heat stress. Determining the energy content of the diets being fed and maximizing feed intake can be helpful. Finally, genetic selection of pigs that are more efficient in utilizing energy with lower maintenance requirements and a greater lean gain to fat gain ratio will improve efficiency of use of dietary energy.

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