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Protein for Swine

Vernon B. Mayrose and James R. Foster, Animal Sciences Department

The proteins are made up primarily of the chemical elements carbon, hydrogen, oxygen, and nitrogen. Some proteins also contain small amounts of other elements such as sulfur, iodine, phosphorus and iron. Proteins are made up of "building blocks" called amino acids. There are at least 22 different amino acids found in animal feeds. Ten of these amino acids are considered essential for swine because they must be supplied in the feed so the animal's needs are met each day. The 10 essential amino acids for swine are:

Arginine
Histidine
Isoleucine
Leucine
Lysine
Methionine
Phenylalanine
Threonine
Tryptophan
Valine

The remaining amino acids, or the non-essential ones, are important in building body tissue, however, if they are not contained in the ration the pig can normally synthesize adequate amounts to meet his requirements.

The amino acids may be compared to letters of the alphabet. Just as letters of the alphabet may be combined into many different words, so may amino acids be combined into different proteins. For example, if the alphabet did not contain the letter "p" it would be impossible to write the word "protein". By the same analogy, if any one of the essential amino acids, such as methionine, is completely absent from the ration, body tissue that normally contains that particular amino acid cannot be formed.

This pig lost two pounds in 28 days because he was on a diet deficient in amino acids.

This pig gained 25 pounds during a 28 day period on a diet of sufficient amino acids.
Functions of Protein

Important functions of protein in the body include: (1) building of new tissues as in growth and reproduction (2) repair worn out tissues (3) production of certain hormones and enzymes that are protein (4) production of antibodies -- elements in the blood that help resist disease. Muscle, internal organs, bone, blood, skin and hair are some of the parts of the body that contain large amounts of protein. A protein deficiency in swine usually results in reduced growth rate, poor feed efficiency and fatter carcasses.

Determination of Protein in the Ration

Amino acids and therefore protein contain about 16 percent nitrogen. When measuring the protein content of a feed, the nitrogen is determined and the amount of nitrogen multiplied by 6.25 (100 ÷ 16 = 6.25). This analysis of total protein may be misleading since it gives no indication as to the amount or kind of amino acids present. If a protein source furnishes the ten essential amino acids in adequate amounts to meet the pig's requirements, the protein quality is said to be high because of the desirable amino acid balance.

There may be some nitrogen in the feed that is not a part of the amino acids. This nitrogen is termed "non-protein nitrogen". If a ration contains a significant amount of non-protein nitrogen the level of protein may be over-estimated, since the chemical analysis measures nitrogen instead of protein. Since this nitrogen analysis includes all sources of nitrogen in the feed, and because it gives no indication of amino acid balance, the term crude protein is used in describing the protein content of a feedstuff.

Choosing a Protein Source

When a pig digests (breaks down) the protein in the feed he reduces the protein to the individual amino acids. These amino acids are then rearranged and recombined to fit the pattern of the pig's own body protein. For example, the protein in the animal body and that in soybean meal is made from many of the same amino acids, however, the proportions of these protein "building blocks" are different. The amino acid is the same, chemically, whether it is present in the feed or in the animal body. Methionine, for example, is the same chemical compound whether it is in a plant protein such as soybean meal or in an animal protein such as meat scraps. Therefore, in choosing a protein source, the question should not be "Is it a plant or animal source?", but rather, "Is it a good, efficient supplier of the proper amino acids?"

There are at least three factors one should consider in selecting a protein source to make up the protein deficiency from a cereal grain such as corn.

The first factor is protein quality. Protein quality refers to the kind and amount of the 10 essential amino acids. Soybean meal ranks high as a quality source of protein for swine. This source is also more uniform in quality than are some of the animal proteins such as tankage. Corn is deficient in three of the ten essential amino acids - lysine, methionine and tryptophan. Soybean meal is an excellent source of amino acids to supplement the energy source corn.

A second consideration is the quantity of other nutrients such as vitamins and minerals supplied by the protein source. For example, most animal protein sources contain a much larger percentage of calcium, phosphorus and trace minerals than do plant proteins.

A third important factor to consider in choosing a protein source is the cost per unit of protein. For example, in choosing between two soybean meal supplements, 44 percent and 50 percent, one would normally buy the supplement that provides the greatest amount of protein per dollar invested. If 44 percent
soybean meal sells for $3.75 per cwt. and 50 percent soybean meal sells for $4.00 per cwt. we would make the following calculations.

(1) $3.75 \div 44 = 8.5\$ \text{ per pound of protein}$

(2) $4.00 \div 50 = 8\$ \text{ per pound of protein}$

In this example the 50 percent soybean meal would probably be the best buy, since it furnishes a pound of protein for less money. The major differences between 44 percent and 50 percent soybean meal is the protein content. The above example has less application when comparing two sources that vary considerably in protein quality or mineral and vitamin content. However, it may be less expensive to purchase minerals and vitamins separately rather than trying to buy them all in a natural feedstuff such as meat scraps.

![Energy, Protein, Minerals, Vitamins, Efficient Production]

The correct protein quantity and quality are essential for efficient production.

**Protein Requirements for Swine**

Although the term "protein requirement" is commonly used, it is more important to think in terms of amino acid requirements. Actually, swine do not require protein as such in the diet. Experiments at Purdue University have demonstrated that weanling pigs will grow at a normal rate when fed only purified amino acids and an additional source of nitrogen. However, it is simpler to consider a certain level of protein in the ration necessary to meet the amino acid requirements. The protein requirements for the various stages of growth and production in swine are shown in Table 1.

<table>
<thead>
<tr>
<th>Stage of growth</th>
<th>Weight (lb.)</th>
<th>% Protein in ration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter</td>
<td>10-25</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>25-50</td>
<td>18</td>
</tr>
<tr>
<td>Grower</td>
<td>50-75</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>75-125</td>
<td>14</td>
</tr>
<tr>
<td>Finisher</td>
<td>125-175</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>175-225</td>
<td>12</td>
</tr>
<tr>
<td>Gestation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilts</td>
<td>300</td>
<td>16</td>
</tr>
<tr>
<td>Sows</td>
<td>500</td>
<td>14</td>
</tr>
<tr>
<td>Lactation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilts</td>
<td>350</td>
<td>15</td>
</tr>
<tr>
<td>Sows</td>
<td>450</td>
<td>13</td>
</tr>
<tr>
<td>Boars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>300</td>
<td>15</td>
</tr>
<tr>
<td>Adult</td>
<td>500</td>
<td>13</td>
</tr>
</tbody>
</table>

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*a/ Nutrient Requirements of Swine, 1964, National Research Council, National Academy of Sciences, Publication 1192

**Frequency of Feeding Protein**

Animals do not have the ability to store surplus protein as they do vitamins and minerals. Therefore, it is important that swine have a daily supply of protein. Feeding protein at 36 hour intervals has been shown to result in slow gains and poor feed efficiency.

Any excess protein eaten by the pig undergoes a process by which the nitrogen is removed from the protein leaving a chemical compound similar to carbohydrates and fats. This compound is then used for energy. Therefore, excess protein in the ration is not wasted, but, it is used as an expensive source of energy. Since a pound of corn costs less money and contains more energy
than a pound of protein supplement, corn is a more economical source of energy.

**Protein Poisoning**

Many tests have been conducted attempting to show toxicity symptoms in swine fed rations containing high levels of protein. However, experiments where rations were fed containing a protein content of 50 percent and higher have failed to support the theory that high levels of protein in swine rations cause protein poisoning. In cases where there is a bacterial infection, higher than recommended levels of protein may aggravate a scouring condition.

Cooperative Extension Work in Agriculture and Home Economics
State of Indiana, Purdue University
and the United States Department of Agriculture Cooperating
H. G. Diesslin, Director, Lafayette, Indiana
Issued in furtherance of the Acts of May 8 and June 30, 1914.