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Pigs to Pork

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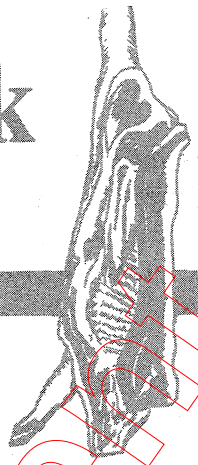

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# Energy for Swine

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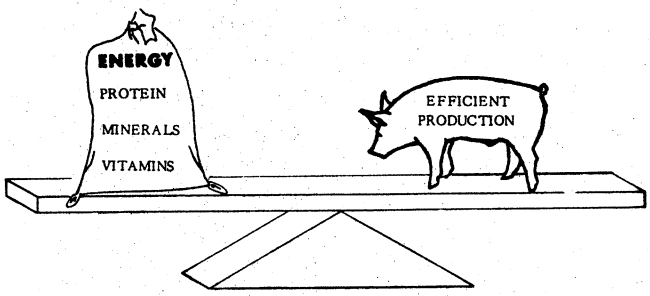


Carbohydrates and fats are the two main classes of nutrients fed to supply energy for swine. Just as an automobile needs fuel as a source of energy, swine also require energy for growth, maintenance and reproduction. Swine rations contain carbohydrates and fats to supply this energy in the form of calories.

## CARBOHYDRATES

Carbohydrates make up the largest percentage of all nutrients in a swine ration. This class of nutrients contains two fractions, fiber and nitrogen-free extract (NFE). The more important component for swine is NFE (sugars and starch) because it is easily digested by swine and yields more energy to the body.

Sugars are soluble in water and are the "building blocks" for carbohydrates. The most common simple sugars are glucose, fructose and galactose. There are three important compound sugars which are formed by the union of two units of the simple sugars. Sucrose is made up of one unit of glucose and one unit of fructose and is the same as cane sugar. Maltose is composed of two units of glucose, and lactose is made up of one unit of glucose and one unit of galactose. Lactose is the sugar present in milk.

Starch is composed of many units of glucose bound chemically to one another and is the chief carbohydrate in plants. Starch is a nutrient because it yields energy as it is digested and utilized in the body. Again, it is like gasoline in a car in that it is useful only as fuel. It does not repair worn-out parts.

Fiber is the second component of carbohydrates and this fraction includes the relatively insoluble carbohydrates such as cellulose and others that are less easily digested by swine. Fiber is broken down by enzymes produced by micro-organisms and not by enzymes secreted by the pig. These micro-organisms are present in the stomach of ruminants such as cattle and sheep, but they are not present in the stomach of the pig. A pig's digestive tract includes a simple stomach of relatively small capacity in contrast to the compound stomach of cattle and sheep. For these reasons as the fiber content of swine rations is increased, feed efficiency is usually reduced.

Important factors in determining the maximum level of fiber for swine rations are the quality of the fibrous feed used and the stage of the life cycle of the animal being fed. For example, high quality alfalfa meal and high quality oats could be tolerated at

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higher levels than ground corn cobs or poor quality roughages. Also, fiber is more acceptable in brood sow rations in order to limit energy intake than for baby pigs or growing-finishing swine.

Carbohydrates are manufactured in plants by means of photosynthesis, the most important chemical reaction in nature. This process may be represented as follows:

Carbon Dioxide + water + energy (from sun) $\longrightarrow$ Glucose + oxygen. The above reaction takes place in plants. The plants "breathe in" carbon dioxide from the air, obtain water from the soil and energy from the sun to produce glucose which is stored in the plant as starch. The plant releases oxygen to the air. An animal then breathes oxygen from the air, consumes starch from the plants (such as a kernel of corn) and eliminates carbon dioxide. The cycle is then repeated.

## Carbohydrate Energy Sources in Swine Rations

Cereal grains are fed to swine primarily for their energy value. These feeds contain less protein than swine require, and the protein quality or the amino acid balance of the protein in these feeds is rather poor. In choosing a carbohydrate source consideration should be given to the energy content, the price per pound, palatability, and availability of the ingredient. Since these feeds are fed primarily for their energy value, prime consideration should be given to the energy furnished per dollar invested. Of the energy feeds listed in Table 1, new corn contains the highest amount of vitamin A activity. All of these feeds are practically devoid of vitamin $B_{12}$ and are deficient in other vitamins and minerals. Cereal grains are especially deficient in calcium.

Corn, grain sorghum and wheat contain more energy than barley and rye, with oats ranking lowest because of their greater fiber content.

The right hand column in Table 2 shows the variation in calories per cent invested between six common feed grains. These figures suggest that grain sorghum and corn are the most economical sources of energy, while oats is the most expensive source of energy.

## Characteristics of Feed Grains

The most common grain used in swine rations in the midwest is corn. Nearly 50 percent of the corn harvested in the United States for grain is fed to swine. Because corn is one of the most economical sources of energy and is very palatable and low in fiber, it is used as a yardstick against which other cereals and carbohydrate feeds for swine are measured.

Effect of moisture level - Numerous experiments have been conducted comparing dry corn (less than 15 percent moisture) and high moisture corn (more than 15 percent moisture) for growing-finishing swine.

Feeding high moisture corn to swine results in:

1. Average daily gain about equal to that of dry corn.
2. Higher daily feed consumption (on equivalent dry matter basis)
3. More pounds feed required per pound of gain (on equivalent dry matter basis)
4. Less supplement consumed per day.

Because of these results the merits of feeding high moisture corn should be evaluated on how this practice supplements the over-all farm management program. Factors such as the desired methods of harvesting and storing the corn should guide a person in making this decision, and not the expectation of improved performance by swine fed high moisture corn.

Effect of grinding corn - Corn should be ground for creep or starter rations and rations fed to swine up to 75 pounds. From

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75 pounds to market weight, grinding the corn and feeding a complete mixed ration may result in slightly faster gains, however, feed efficiency may be improved where shelled corn and supplement are fed free-choice. Factors to consider in deciding whether or not to grind the corn include the condition of the corn and the feed handling system being used. If the corn is extremely dry, hard, and therefore, unpalatable it should be ground. Also, with some automatic feeding systems it is more convenient to feed a complete mixed ration.

Recent experiments have demonstrated an improvement in feed efficiency when the corn is finely ground compared to a medium or a coarse grind. There may be a slight increase in rate of gain due to fineness of grind. Difficulty of "feeding-down" in the self feeders and also the possibility of increased incidence of stomach ulcers are disadvantages to fine grinding of feed.

Protein quality of corn - The nutrient analysis of the feed grains in Table 1 show that corn contains the least amount of crude protein of the six feed grains compared. The feed grains are deficient in some of the amino acids (building blocks of protein). The kind and amount of the amino acid indicate the quality of the protein. Corn is deficient in lysine, tryptophan and the sulfur-containing amino acids, methionine and cystine. This means that corn is not a satisfactory feed for hogs unless it is fed with a high quality protein source.

Recently, corn containing the opaque -2 mutant gene (high-lysine corn) was found to contain a different amino acid pattern and a much higher amount of the amino acid, lysine, than normal corn. In the future, high-lysine corn may become an important source of protein as well as energy for swine.

Grain Sorghum - Several varieties of grain sorghum can be fed successfully to swine. Grain sorghum is about as palatable as corn and can be substituted either partly or completely for corn.

Grain sorghum has about the same feeding value, but it contains slightly more protein and almost as much energy as corn. Since the protein quality of milo is rather poor, about the same amount of high quality protein supplement is required as in the case of corn. The main nutritional difference between grain sorghum and new yellow corn is that sorghum usually contains less vitamin A activity, therefore, a greater amount of vitamin A must be added to the rations containing grain sorghum. Since grain sorghum is small and rather hard it is recommended that this cereal grain be ground for swine.

Wheat - Wheat is used in human diets and is generally higher in price than other grains. Therefore, its use has been limited in swine rations. Wheat is higher in protein, lower in fat and has no vitamin A activity as compared to corn. Wheat contains about as much energy as corn, is very palatable and can be used as a partial or complete replacement for corn. Grinding wheat will normally increase the feeding value, however, it should be ground coarse. Fine grinding produces a sticky mass in the mouth of the pig.

Wheat that has been damaged by frost, insects or disease, can be used in swine rations, however, the damaged wheat will likely be worth less than heavy wheat.

Wheat contains more crude and higher quality protein than corn. However, a supplemental high quality protein is needed if wheat is fed. Since wheat contains no vitamin A activity, it is important that adequate vitamin A be added to the ration.

Barley - In certain areas of the United States such as the northwest, barley is the major feed grain produced. It can be used satisfactorily in swine rations. Compared to corn, barley contains more crude protein, more fiber, less energy, no vitamin A activity, and has about 10 percent less feeding value.

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Barley normally contains about 6 percent fiber. The kernels are rather small and hard, and it is somewhat less palatable than corn. For these reasons the feeding value is increased about 15 percent by grinding or rolling. A medium degree of fineness is preferable to merely cracking or fine grinding. Because of the higher fiber content there is more advantage in pelleting a barley ration than a corn ration.

If barley is available it can be used to replace a part or all of the corn in the ration. However, if barley replaces all the corn one can expect slower, less efficient gains.

Rye - Of the six feed grains discussed in this bulletin, rye is probably used the least in swine rations. Although the chemical composition of rye indicates a feeding value similar to corn, there are two reasons why its use is limited. The first is that rye is not a very palatable feed, and the second reason is that rye is frequently contaminated with the fungus ergot. The ergot contamination makes rye a potentially dangerous feed because this fungus causes abortion in pregnant sows. Also, ergot infested rye should not be used in lactation rations or creep rations fed to pigs.

The rye kernels are smaller and harder than most grains and should be ground. For best results rye should be limited to about 20 percent of the ration.

Oats - Oats are grown widely in the United States and are used frequently in swine rations. Compared to corn, oats has more crude protein and fiber, less energy and no vitamin A activity.

The main limitation to the use of oats in swine rations is the high fiber and low energy content. Oats (Table 2) are the most expensive source of energy. Since these grains are fed primarily for their energy value, it is often difficult to justify the use of oats where emphasis is on fast, efficient gains.

If used, it is recommended that oats not constitute more than 30 percent of the grain portion of the ration. Because of the fibrous hull around the oat kernel it is necessary to grind oats for best results. Grinding the oats will increase the feeding value about 30 percent.

Any process that will make the hull less apparent will increase the palatability of oats. Rolled oats or oat groats (edible part of the kernel) contain only about 2 percent fiber, are very palatable and have a high feeding value. Cost is the major limitation of hull-less oat feeds. Because rolled oats is very palatable, it can be used effectively in baby pig starter or creep rations.

Summary of Feed Grain Sources

Of the six feed grains discussed, corn is the most widely used. Corn is by far the major energy source in swine rations in Indiana because it is palatable, an economical source of calories, and well adapted to production in Indiana. Compared to corn, grain sorghum is less readily available, wheat is less economical, barley, rye and oats are lower in energy and barley and rye are somewhat less palatable.

## FATS

Fats are combinations of fatty acids and glycerol and are concentrated forms of energy. In nutrition the terms fat, ether extract and lipid are used interchangeably. Fats and oils are much alike in composition and properties with the exception that fats are solid at room temperature, while oils are liquid. A given weight of fat contains about 2 1/4 times as much energy as an equal weight of protein or carbohydrate. The reason that fats are a more potent source of energy is that they contain a higher proportion of carbon and hydrogen to oxygen than do carbohydrates. Oxygen inhaled through the lungs and transported to body cells reacts with nutrients and combines with the carbon and hydrogen to form the end products,

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carbon dioxide and water, with the simultaneous release of energy. Since fats contain little oxygen, more oxidation occurs and more energy is released than in the case of carbohydrates.

Practical swine rations contain adequate amounts of fat to prevent fat deficiency symptoms. However, semi-purified rations containing only 0.06 percent fat have produced fat-deficiency symptoms manifested by scaly dandruff-like dermatitis and an unthrifty appearance.

The main reason for adding fat to a ration is to increase the energy content. However, other advantages of adding fat to rations include: (1) increase palatability (2) reduce dustiness of the feed (3) increase ease of pelleting (4) improve the appearance of feed. Usually the amount of fat added to a swine ration is from 1 to 2 percent.

Since fats are fed primarily for energy they must compete with corn or other energy feeds. Table 2 shows that a cent invested in corn would yield 810 calories of metabolizable energy. Tallow contains about 3200 calories of metabolizable energy. From this relationship it appears that on an energy basis tallow would be worth about 4 cents per pound (3200 - 810 = 3.95). Current prices for tallow and other fats such as yellow grease range from 6 to 8 cents per pound. Thus, it is probably difficult to justify the addition of fat to swine rations with present price relationships, except in the case of baby pig rations where fat will improve the physical appearance of the feed and enhance palatability.

Since fats are solid at room temperature, it is usually necessary to melt the fat prior to mixing so it can be evenly dispersed throughout the feed during the mixing process.

When fats are used in rations, antioxidants are often added to prevent rancidity.

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Table 1. Nutrient analysis of feedstuffs used for energy in swine rations

| Ingredient | Protein | Fat | Fiber | Calcium | Phosphorus | Metabolizable energy in calories/lb. |
|---|---|---|---|---|---|---|
| | | | PERCENT | | | |
| Corn | 8.8 | 3.8 | 2.5 | .01 | .25 | 1530 |
| Grain sorghum | 10.5 | 2.5 | 2.5 | .02 | .30 | 1500 |
| Wheat | 12.0 | 1.5 | 2.5 | .05 | .40 | 1450 |
| Barley | 11.0 | 1.8 | 6.0 | .06 | .35 | 1200 |
| Rye | 11.5 | 1.5 | 2.4 | .05 | .36 | 1319 |
| Oats | 12.0 | 4.0 | 12.0 | .10 | .33 | 1140 |

Table 2. Cost comparisons of feed grains used in swine rations

| Ingredient | Cost per bushel [a] | lb. per bushel | Cost per lb. (cents) | Metabolizable Energy | |
|---|---|---|---|---|---|
| | | | | Calories/lb. [b] | Calories per cent invested |
| Corn | $1.02 | 56 | 1.82 | 1530 | 841 |
| Grain sorghum | $0.94 | 55 | 1.71 | 1500 | 877 |
| Wheat | $1.32 | 60 | 2.20 | 1400 | 636 |
| Barley | $0.85 | 48 | 1.77 | 1190 | 672 |
| Rye | $1.08 | 56 | 1.93 | 1319 | 683 |
| Oats | $0.69 | 32 | 2.16 | 1140 | 528 |

a/ Average price received by Indiana Farmers in 1965.
b/ Source: FEEDSTUFFS Analysis Table - 1966.

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