Energy for Swine
Michigan State University
Cooperative Extension Service

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January 1977
4 pages

Fact Sheet 19.47.02
Extension Bulletin E-1065, Jan. 1977

pork industry handbook

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

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The value of a feedstuff is based on several factors: acceptability (how well the material will be consumed by an animal), energy availability and as a source of other nutrients (protein, vitamins, minerals). Should a swine producer buy corn or wheat or oats as a feed ingredient? This will depend primarily on the cost of these ingredients and their value as a source of energy for the animal.

The pig requires energy to maintain normal body processes, to grow and to reproduce. Energy is the major component of all swine diets, and the intake of many other nutrients is related to the energy content of the diet. Carbohydrates from cereal grains are the most abundant energy source in swine rations. Fats and oils contain more energy than carbohydrates but are used to a lesser extent. Protein may serve as an energy source only if included in the ration in excess of the animal's requirement for protein.

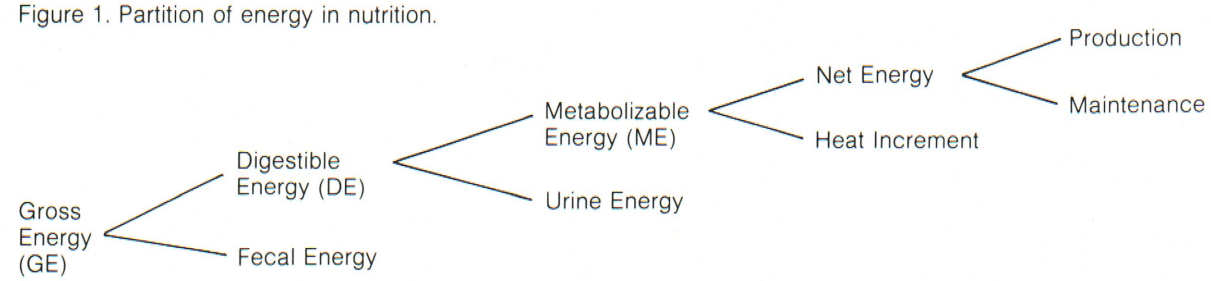
Definition of Energy

To make sound decisions in selecting feed ingredients it is desirable to have an understanding of the system by which feedstuffs are rated for their energy content and the value of these ratings toward the pig's growth and production. The gross energy (GE) of a feed ingredient is defined as the heat produced when a substance is burned and is expressed as calories per unit weight. A calorie is the amount of heat required to raise the temperature of 1 gram of water from 14.5°C. to 15.5°C. A kilocalorie is 1,000 calories, and a megacalorie is 1,000 kilocalories. Since not all of the feed consumed is digested, some energy is lost in the fecal material (Fig. 1). GE is a poor estimate of energy for the pig.

The amount of energy remaining after subtracting the fecal energy loss from total energy intake is designated as digestible energy (DE). The difference between GE and DE may be quite large. The greater the digestible energy value (DE/GE) the greater its value as a source of energy to the animal. This is a much more meaningful measure for livestock producers. In the production and excretion of urine additional energy is lost. Digestible energy minus the urinary energy loss is termed metabolizable energy (ME).

In most cases, metabolizable energy represents approximately 95% of the digestible energy content, so the conversion from DE to ME can be made very easily. Metabolizable energy is the "usable" energy of a feed for

Figure 1. Partition of energy in nutrition.



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the pig to live and grow. Some heat is produced by metabolism of the nutrients. This is called the heat increment (HI) and can be used to keep the animal warm. The remaining energy is called net energy (NE) and is used for maintenance and production. Determination of these energy values require special equipment and/or animal feeding trials.

Major Energy Sources

The basic energy sources for swine are the cereal grains: corn, milo, barley, wheat, and their by-products. Cereal grains are high in carbohydrates, are palatable, and are highly digestible. They usually contain less protein, minerals and vitamins than swine require; therefore, the rations must be supplemented with other feeds to increase the levels of these nutrients to recommended levels. Although somewhat bulkier than the cereal grains, grain by-products have much the same characteristics as the grains from which they originate.

Corn contains less protein but more energy than the other cereals. Like all other cereals, the composition of corn is influenced by variety, growth conditions, method of harvesting, and storage. Because of its abundance and readily available energy, corn is used as the base cereal for comparing the nutritive value of other cereal grains. Milo or grain sorghum is very similar in quality to corn and can completely replace corn in swine rations. Its energy value is about 95% the value of corn except for some bird resistant varieties which may only be 80-90% of corn. Grinding is recommended since the grain is rather small and hard.

Barley contains more protein and fiber than corn, but its relative feeding value is 85-95% of corn. It is less palatable than corn. Grinding or rolling barley and pelleting the ration will improve its utilization by 5-10%.

Wheat is equal to corn in feeding value and is very palatable. But because of its use in human diets, it may be too expensive to use in swine rations.

Oats contain more protein than corn, but their value in swine rations is only 80-90% of corn because of their higher fiber content and lower energy content. They are useful in lactation rations as they are bulky and have a laxative effect.

Fats and oils such as lard, beef tallow, corn oil and soybean oil contain about 2.25 times as much energy as the cereal grains. These high energy products may be used at levels up to 5% of the ration for pigs weighing over 50 pounds. Rations containing fat may become rancid during prolonged storage or when feed is exposed to high temperatures. An antioxidant should be added to rations containing fat. In addition, use of high fat rations during the finishing period (125 pounds and above) may result in more backfat than occurs with the normal finishing rations. Because of its high cost, fat is generally not recommended for swine rations.

In selecting energy sources for swine rations, consider protein quality and content. Since the amino acids lysine, methionine, tryptophan and threonine are most likely to be limiting in a swine ration, the levels of these amino acids in cereal grains add to their overall value. Although sugar, molasses and fats or oils are good energy sources, they provide little or no protein to the ration.

The amount of feed or energy per unit of gain is not the most important factor in swine nutrition. Cost per unit of gain is more important; therefore, it is necessary to use the most economical energy sources available for swine rations. The relative feeding values shown in Table 1 can be used to determine which feed is cheapest. For example, if corn costs 5.0 cents per pound, barley is worth about 4.5 cents (5.0¢ x 90%) per pound ($2.16/bu.). If barley can be purchased for less than this, it is a better buy.

Fiber Content

Some energy sources are relatively high in fiber and will reduce gain and efficiency if included at excessive levels in the ration. Growing-finishing pigs 40 pounds and heavier can usually tolerate up to 5% of a high fiber feed such as alfalfa in their ration without a noticeable effect on performance. As the pig matures more and more low energy-high fiber feeds can be fed, especially to sows during gestation and post-weaning. Fiber feeds such as wheat bran and beet pulp are especially useful in gestation and lactation rations because of their laxative effects.

Moisture Content

High moisture grains contain less energy per pound of feed because of the water content. More pounds of a high moisture grain must be fed to get the same amount of dry matter consumed. Studies with most high moisture grains indicate similar performance when efficiency is measured on a dry matter basis to dried grains for growing-finishing swine when fed in a complete ration. Free choice feeding of the grain and a supplement often results in poorer efficiency.

Grinding

With the possible exception of high moisture corn, grinding improves all grains for feeding, especially the higher fiber grains such as oats or barley. Finer grinding usually results in improved efficiency, although finely ground corn tends to increase the incidence of ulcers in finishing swine. Pigs under 40 pounds get the most advantage from a fine grind.

Pelleting

Pelleting a ration may increase gains up to 5% and feed efficiency from 5 to 10%. A high energy cereal such as corn or milo will benefit less from pelleting, and fibrous feeds like barley or oats will benefit more. When a complete ration is being purchased, pelleting may be more economical than a meal. However, the advantage of pelleting probably will not offset the cost of hauling corn or milo from the farm to a pelleter and home again.

Table 1. Relative feeding values*

Ingredient (air dry)	Metabolizable energy Kcal/lb.	Relative feeding value vs. corn†	Maximum recommended percent of complete ration‡				Remarks
			Gestation	Lactation	Starter	Grow-finish	
Alfalfa meal (dehydrated)	543	45-50	90	10	0	5	Low energy, good source of B vitamins
Alfalfa meal (sun-cured)	460	30-40	50	10	0	5	Unpalatable to baby pigs
Animal fat (stabilized)	3,550	210-220	5	5	5	10	High energy, reduces dust
Bakery surplus material	1,600	75-90	40	40	20	40	High energy, about 13% fat
Barley (48 lb./bu.)	1,275	85-95	80	80	25	85	Corn substitute, lower energy
Barley (West Coast)	1,280	80-85	80	80	25	85	Corn substitute, lower energy
Beet pulp, dried	1,020	70-80	10	10	0	0	Bulky, high fiber, laxative
Buckwheat	1,220	80-90					Bulky, high fiber, laxative
Corn (yellow)	1,500	100	80	80	60	85	High energy, low lysine
Corn (high lysine)	1,520	100-105	90	90	60	90	Lysine analysis recommended
Corn and cob meal	1,200	80-90	70	10	0	0	Bulky, low energy
Corn gluten feed	1,440						
Corn grits by-product (hominy)	1,400	100-105	60	60	0	60	Subject to rancidity
Corn silage (25-30% D.M.)		20-30	90	0	0	0	Bulky, low energy, feed to mature animals only
Emmer	1,139		80-90				
French fry waste (48% D.M.)			20	0	0	20	Bulky, low energy
Millet (Proso)	1,227	90-95	80	80	60	85	Low lysine
Milo (grain sorghum)	1,425	95-100§	80	80	60	85	Low lysine
Molasses (77% D.M.)	1,060	55-65	5	5	5	5	Energy source, used for pelleting
Oats (36 lb./bu.)	1,200	80-90	70	15	0	20	Low energy, partial grain substitute
Oats (high protein)		90	70	30	20	50	Low energy, partial grain substitute
Oat groats	1,500	110-115			20		Palatable
Potatoes (22% D.M.)	370	20-25	80	0	0	30	Should be cooked, low protein
Rice grain	1,074	75	40	15	0	20	Low energy, low lysine
Rye	1,300	90	20	20	0	25	Possible ergot toxicity, low palatability
Spelt	1,182	85	40	15	0	25	Low energy, low lysine
Sugar	1,383	80-85	0	0	5	0	High palatability, no protein
Triticale	1,450	90-95	80	80	20	85	Possible ergot
Wheat, hard	1,500	100-105	80	80	60	85	Low lysine
Wheat, soft	1,500	90-95	80	80	60	85	Low lysine
Wheat, high protein	1,500	100-105	80	80	60	85	Low lysine
Wheat bran	890	60-65	30	10	0	0	Bulky, high fiber, laxative
Wheat midds	1,300	90-95	30	10	5	10	Partial grain substitute
Whey, dried	1,445	100-110	5	5	20	5	High lactose content, variable salt content

*Based on an air dry basis unless otherwise noted. High moisture feedstuffs must be converted to an air dry equivalent of 88-90% dry matter to determine energy and substitution rates. Complete data on all ingredients are not available.

† When fed at no more than maximum recommended % of complete ration.

‡ Higher levels may be fed although performance may decrease.

§ Some "bird resistant milos" are 80-90% vs. corn.