Energy for Dairy Cows

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Except for water, nutrients supplying energy make up the largest part of the diet for all domestic livestock. A dairy cow can consume and utilize large amounts of energy feeds. She may take in as much as four times the amount of energy needed for maintenance. Since all animals must use a certain amount of feed for maintenance, the dairy cow's ability to consume large amounts over the maintenance requirements and to use the excess makes for efficient, economical production. Our goal in feeding dairy cattle is to select economical sources of energy and to feed these sources in sufficient amounts to support high, economical production.

Sources of Energy

Energy can come from several groups of nutrients. The important sources are discussed below.

Carbohydrates

Carbohydrates are the most important source of energy for dairy cows. There are several general types of carbohydrates.

One of these is sugars, which occur in such feed ingredients as molasses. Also, some forages and grains have a considerable amount of pentose sugars. The sugars are well utilized by rumen bacteria, but large amounts may adversely affect the digestion of other nutrients.

Starch is the form in which most of the energy is stored in cereal grains such as barley or corn, and dairy cows use starch efficiently. In some rations, starch may be the major source of energy.

Crude fiber, also a carbohydrate group, is an important source of energy for the dairy cow. Though simple-stomached animals do not use crude fiber well, the cow, because of the bacteria in her rumen, can make excellent use of some sources of fiber. Since the analysis for crude fiber is not precise, there is great variation in its digestibility. The fiber in beet pulp or early-cut forage is highly digestible, while that in late-cut forages or some grain hulls is nearly indigestible.

Metabolizable energy = energy loss through work of living (heat) = net energy for production and maintenance

Fat is multiplied by 2.25 because it has that much more energy than protein or carbohydrates.

A calorie is a measure of heat.

The TDN system is used commonly in the United States. It has the advantages of being simple and of having many values already determined on common feedstuffs. Its chief disadvantage is the tendency to overvalue poorer quality forages in relation to cereal grains and all other concentrates.

Though some researchers have proposed either a digestible energy system or a metabolizable energy system, neither of these have been accepted widely for formulating rations. The NE system has found fairly wide acceptance, however, and has the potential of being more precise than the other systems.

Measures of Energy

Several systems are used to compare the energy value of feeds in the United States and Europe. The two most widely used in the United States today are the “Total Digestible Nutrient” (TDN) system and the “Net Energy” (NE) system.

Comparison of Total Digestible Nutrients to Net Energy

<table>
<thead>
<tr>
<th>Total Digestible Nutrients (TDN)</th>
<th>Net Energy (NE)</th>
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<tbody>
<tr>
<td>Measured in pounds</td>
<td>(Measured in calories)</td>
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<tr>
<td>Total digestible energy = digestible protein + digestible carbohydrates + digestible fat x 2.25</td>
<td>Gross or total energy - energy in feces = digestible energy (comparable to TDN)</td>
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<tr>
<td>Net Energy (NE) = digestible energy in urine and rumen gases = metabolizable energy</td>
<td>Digestible energy - energy loss through work of living (heat) = net energy for production and maintenance</td>
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fibers are found in the cell wall structure, the indigestible fiber in overmature forages will interfere with the digestibility of other nutrients inside the cell.

**Protein**

Protein in excess of requirements for building body or milk protein can be used for energy. This source of energy is not relied upon because it is usually too expensive. An exception is when legume hay is priced low enough to furnish energy cheaply. Then it is likely that low- to medium-producing cows will receive more protein than required and use the excess for energy. One pound of protein furnishes the same amount of energy as a pound of carbohydrate of comparable digestibility. It is unlikely that soybean oil meal or cottonseed oil meal will be economical sources of energy.

**Fats**

Fats are another source of energy for dairy cows. However, fats are less important to ruminants than to simple-stomached animals because of relative capacity. That is, simple-stomached animals such as the pig, man, have a smaller digestive tract and depend on the concentrated energy in fats and oils. Fats are well utilized by young ruminants. The calf uses whole milk, which is approximately 30 percent fat on a dry basis. However, levels of fat exceeding 5 percent of the ration may cause digestive disturbances in mature cows. Animal fats may have an adverse effect on palatability and limit ration intake. Research shows that feeding highly unsaturated fats such as cod liver oil will lower the butterfat test. The true fats or oils found in grains, particularly oil seed meals, are well digested, but the fatty substances in forages are not all true fats and are often used poorly.

Fats have two and one-fourth times as much energy as carbohydrates or protein; hence, correction is made in calculating TDN of a feed. The use of fats in dairy rations depends on their price in relation to small grains and their effect on palatability. A very small amount of fat is essential to transport fat-soluble vitamins.

**Essential carbohydrates**

In most species of animals no single carbohydrate group is essential. That is, starch or sugar can be used internally or for energy. However, dairy cattle have a requirement for crude fiber for normal ruminal function and butterfat test. While low-fiber rations are used efficiently for fattening, they lower the butterfat test. The total dairy ration should have at least 17 percent crude fiber in a long or coarsely chopped form, as ground or pelletted forages do not supply fiber in a form that maintains normal rumination. When the forage is limited, it may help to use fibrous feeds such as beet pulp or wheat bran in the grain mix.

Since most forages and grain supplements are used primarily for their energy, it is important to consider their palatability. Fortunately, many cereal grains such as corn or barley are highly palatable when they are free from mold or foreign material and are freshly ground or rolled. Some grains, such as wheat or milo, grind to a floury consistency, so they are more palatable when crushed or rolled.

These latter grains may be more acceptable if stored and fed at 30 percent moisture (high-moisture grain).

Some by-products used in grain mixes must be limited because they lower palatability. Such is the case with malt sprouts or wheat standard middlings.

By far the largest variability in acceptability by dairy cows occurs in forages. Early-cut, immature forages are more nutritious per unit of weight and also are consumed in larger quantities than late-harvested or weather-damaged forages. Some forage evaluation systems consider the animal's voluntary take as well as the chemical analysis of the forage. A dairy cow must consume a large amount of feed for high production therefore, make maximum use of highly palatable feeds.

**Conclusions**

Nutrients to supply energy are needed in large amounts except for water, in the ration of the dairy cow. Consequently, a lot of energy-containing feeds are used by the dairymen, and the opportunity to save money is relatively great.

Energy (TDN) is furnished through sugars, starches, fiber, fat, and protein. These are found in both forages and grains. The TDN in forage often is economical, but is too dilute for high-producing cows. Consequently, grains more concentrated in energy are necessary supplements for the high-producing cow.

Fats, the most concentrated energy source, have not been used extensively in dairy feeds, probably because they lower palatability. Also, unsaturated fats have an adverse effect on butterfat test.

The usual high protein feeds, such as soybean oil meal, can furnish TDN, but they are too expensive compared to small grains.

Crude fiber, a part of the carbohydrate fraction of feeds, will furnish energy effectively to ruminants because the bacteria break it down in the rumen. In fact, a certain amount of crude fiber is necessary for normal rumination and butterfat test.

Since TDN is needed in large amounts, care should be used to select a majority of feeds that are highly palatable to the cow. The judicious selection of energy feeds offers an opportunity to reduce feed costs per unit of milk.