



Goat Nutrition - Energy

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Energy is used for basal metabolic processes, body heat, physical activity, tissue maintenance and growth, fat deposition, and lactation. Excess energy is stored as fat.

Energy in feedstuffs is contained primarily in the carbohydrate and fat fractions. Proteins can also supply energy when fed in excess or in times of severe malnutrition.

Remember the old physics rule: *Energy can neither be created nor destroyed, merely changed in form.* Long ago, plants must have studied physics because that's exactly what they do - capture solar energy and through the process of photosynthesis, make carbohydrates.

Carbohydrates make up 65-75% of the dry weight of the plant world and supply most of the energy needed by ruminants. Carbohydrates can be subdivided according to chemical structure into 5 basic groups: sugars, starch, cellulose, hemicellulose and lignin.

Crude fiber is a gross estimate of the energy content of a feed. The higher the crude fiber, the lower the digestible energy content. Energy requirements for goats are expressed in more specific terms such as total digestible nutrients (TDN) or net energy (NE).

Determining the energy content of a forage, feedstuff or mixed ration is more difficult than measuring nitrogen and calculating crude protein. Total digestible nutrients, (TDN) is actually calculated as the sum of digestible crude protein, crude fat, crude fiber and nitrogen-free extract (more soluble carbohydrates). TDN does not account for the energy lost in the urine or gas production or that lost as body heat.

TDN is an adequate energy expression for most goat producers, especially when considering supplements for goats grazing native pasture. Since TDN is not listed on feed tags, the general relationship between crude fiber and TDN content is listed in the table below.

Crude Fiber, %	Estimated TDN, %	
8	73	Individual feeds can vary considerably from these values. Estimates are not valid for salt-limited feeds or liquid supplements. (From TAEX Pub. L-2163)
12	67	
16	61	
20	55	
24	49	

Net energy (NE) values account for energy losses and represent the energy that is actually available for maintenance of body functions or production (growth, fattening, lactation). NE is the preferred value to use when formulating a complete balanced diet for goats.

Microorganisms in the rumen use the plant fibers cellulose and hemicellulose as energy. Because of this bacterial fermentation, ruminants can utilize forage as a source of energy much better than monogastrics (swine, humans). In fact, feeds high in cellulose can furnish most of the ruminant's maintenance energy needs. High quality hays (alfalfa, peanut, immature sorghum sudangrass) often meet or exceed the energy and protein requirement of mature, non-lactating does.

Lignin is essentially an indigestible fiber. Young growing plants contain very little lignin. However, lignin content of plants increase with age. Old, dry, mature, weathered forage will have a high lignin content and be of limited use to grazing animals. In fact, in older plants, lignin can bind the more digestible fibers and preclude them from microbial digestion.

The fermentation of fiber is a relatively slow process. Ruminal digestion of the starch contained in grain is a much more rapid and volatile process. Bacteria in the rumen are job specific - some are effective fiber digesters while others handle starch more efficiently.

Normal pH of the rumen (forage diet) is 7.0-7.4; at this pH the fiber digesters are very comfortable and working at max productivity. Small quantities of starch (grain) are not a problem. Large doses of grain can be serious.

If large meals of grain are consumed, the starch digesters take over. A by-product of their digestion is lactic acid. As lactic acids levels in the rumen build, pH drops. A pH of 6.8 and falling means certain death for the fiber digesting bacteria in the rumen. If pH continues to fall, acidosis develops and can be fatal. Excessive starch fermentation can also result in bloat. Herein lies the reason for gradual shifts from one diet to another, especially when moving toward a more energy dense diet.

Fat is an excellent source of energy, but is generally low in forages and roughages. Compared to carbohydrates, fats contain 2.25 times as much energy on a weight:weight basis. This energy density is an asset when formulating rations for high producing dairy goats or cows. By adding fat, the energy content of the diet can be elevated well above the reasonable limit for a

diet limited to grains and roughage only. Fat level should not exceed 5% of the diet. Higher levels will limit consumption and can result in gastrointestinal disturbance.

Fat in a ration aids in the absorption of the fat-soluble vitamins (A, D, E, K). In addition, added fat minimizes dust in a mixed or pelleted feed. Cubes or pellets made with solvent processed oilseed meals (cottonseed meal) often require added fat as a softener and to improve palatability.

The table that follows shows the TDN content of a limited number of hays and feeds. Several points are noteworthy.

Cereal grains and oilseed meals have a greater energy content than forages, hence the term concentrates.

Significant differences exist between types of hay. Weathering of hay reduces its nutrient content. In general, bermudagrass hays are significantly lower in energy content than legume or well prepared sorghum sudangrass hays.

Feed	TDN, %*
Alfalfa	58
Sorghum sudangrass	56
Bermudagrass	46
Whole shelled corn	90
Oats	77
Whole cottonseed	96
Cottonseed meal	76
Soybean meal	84
Cane molasses	72
*100% dry matter basis.	

On a dollar per unit of energy basis, corn is typically the best buy. Two reasons: relatively low price and high energy content.

Whole cottonseed is unique. The lint on the outside is pure cellulose and 100% digestible. The hull or seedcoat is digestible and an excellent fiber source. In addition, it acts as a sustained release capsule in the rumen. Inside the hull is fat, protein and phosphorus.

Although usually thought of as protein sources, the oilseed meals also contain a respectable amount of energy. However, when compared to corn or other cereal grains, oilseed meals are an expensive source of energy.

Molasses provides a readily available source of energy and is very palatable. However, consideration must be given to the moisture content (25% water) when formulating a supplement or balanced ration.

For comparison, the following table shows the daily TDN requirement for a 130 lb doe at different physiological stages and a 44 lb kid gaining 0.33 lb per day.

Energy Requirements 130 lb doe, medium activity*	TDN, lb daily
maintenance, early gestation	2.0
maintenance, late gestation	2.9
lactation	3.5
Energy Requirements 44 lb kid, medium activity*	
maintenance	0.9
maintenance + 0.33 lb/d gain	1.5
*Medium activity - typical of goats on small farms or in slightly hilly, semiarid pastures. (From Nutrient Requirements of Goats, NRC 1984)	