

Beef Cattle Nutrition



Essential Nutrients

The nutrients utilized by beef cattle are (1) water, (2) protein, (3) carbohydrates, (4) fats, (5) minerals and (6) vitamins. Producers should understand the digestive system of the ruminant animal and the nutrient requirements of the various classes of beef cattle (see Table 6-2).

Water

Water's importance to sustainment of life results in it being classified as a nutrient, and it is the most important nutrient. Water is involved in all digestive and metabolic processes. Cattle producers often take water for granted because in most cases there is a pond or stream available for cattle to have uninterrupted access to water. Mature cows will consume 6 to 12 gallons per day during cooler times of the year and 15 to 20 gallons per day during hotter times of the year. One common concern with farm ponds is blue-green algae blooms. Nitrates can also be a concern with farm ponds that catch a lot of agricultural field drainage. Wells provide another source of water for beef cattle. Salts and other well water contaminants can affect water intake and herd performance. When using streams to water cattle, the streams should be fenced to provide limited access points, protecting streambanks from erosion. Cattle producers sometimes choose to pump water from streams instead of allowing direct access by cattle. Stagnant and slow-flowing streams present some of the same water quality concerns as ponds. Water can be tested for quality standards to determine if contents are within acceptable levels for beef cattle.

Protein

Protein is important in all tissue building and in cell functions of the body of beef cattle. Good quality grass forages grown on fertilized pastures and hay meadows will almost always supply the protein needs of dry pregnant cows and much of the time the protein needs of nursing cows. Legume forages usually have a protein level that exceeds protein needs of all classes of beef cattle.

Carbohydrates and Fats

Carbohydrates (sugars), fats and, in some instances, proteins provide the energy in all animal rations. Failure to provide energy represents the most serious feeding problem among Arkansas cattle producers. Cattle on a forage-based diet are receiving most of their energy supply from microbial digest of plant carbohydrates. Plant fiber is a structural carbohydrate. One of the greatest causes of low fertility is inadequate energy in beef cattle rations. This occurs during drought or because of poor hay digestibility throughout the winter feeding period. While there are essential fats needed in the diet, the fat content of beef cattle diets is generally low < 3 percent (diet dry matter). Fats are sometimes added to feed rations and supplements to increase the energy content because fat has 2.5 times the energy value of a carbohydrate. Too much fat (> 6 percent diet dry matter) in the total diet should also be avoided.

Minerals for Beef Cattle

Minerals are essential in beef cattle diets. Deficiencies in any of the required minerals will reduce production efficiency. The mineral content of the animal's body makes up approximately 5 percent of its weight. Minerals are classified into two general categories – macro and trace or micro minerals – based on their relative amounts present in the animal's body and secondly on the amounts needed in the ration. The macro minerals are calcium, phosphorus, magnesium, potassium, sodium, chlorine and sulfur. The trace minerals most often needed in the beef animal's diet are iron, manganese, copper, iodine, cobalt, zinc and selenium.

Macro Minerals

Calcium (Ca)

Calcium is the major element of bones; approximately 99 percent of the body's calcium supply is in bones and teeth. In addition to its role in the skeletal system, calcium is also required for many other functions in the body. A major role is in the

muscle contraction process. Calcium is usually present in adequate amounts in forage and is quite high in legume plants; however, calcium may be limited in feedlot rations as grains and most by-product feed-stuffs are low in calcium.

Phosphorus (P)

Approximately 80 percent of the body's supply of phosphorus is in the skeleton and teeth. In addition to its obvious role in these areas, phosphorus has been shown to be very important in absorption and transport of various compounds within the body. It is also involved in energy transfer. Because of this, phosphorus may be viewed as the most versatile mineral element. A phosphorus deficiency is often characterized by poor reproductive performance in beef cows. Grains are considered to be moderate to high in phosphorus while forages usually contain low to moderate amounts. Supplementation of phosphorus is often needed in a grazing situation. The level of phosphorus supplementation will be dependent upon forage species and soil fertility. A forage test can help determine phosphorus supplementation needs. Certain minerals must be kept in proper ratio to one another in the ration because their roles in metabolism and body functions are interrelated. For this reason, a Ca:P ratio of 1:1 to 5:1 should normally be maintained.

Magnesium (Mg)

Magnesium is closely associated with calcium and phosphorus in its distribution and metabolism in the animal's body. Under normal conditions, Mg is not a problem; however, the condition "grass tetany" is related to Mg deficiency. This is most likely to occur with mature beef cows grazing lush spring pasture. When there is risk of tetany, cattle producers will often feed a high magnesium mineral. Feeding a high magnesium mineral should start at least one month in advance of the period tetany is most likely to occur. Mineral mixes designed to help prevent grass tetany usually contain 10 percent magnesium. In some situations, a custom feed mix may need to be formulated to provide greater levels of magnesium than that available in common mineral mixes.

Potassium (K)

Potassium is usually found in the intracellular (within the cell) fluids. It functions primarily to maintain osmotic pressure within the cell, maintain proper pH and the transfer of nutrients across the cell wall. Forages usually contain excessive amounts of this mineral, thus grazing cattle are not usually supplemented with K.

Sodium (Na) and Chlorine (Cl) (Salt)

Sodium (Na) and Chlorine (Cl), more commonly known as salt, are used in the body to regulate osmotic pressure in cells and contribute to buffering systems. Sodium is also essential in the transmission of nerve impulses. Cattle will normally consume more than their requirements if given free access to either loose salt or blocks. Since the storage of these two elements in the body is rather limited, a regular supply should be self-fed.

Salt is sometimes used as an intake limiter for a self-feeding ration. In this situation, an abundant supply of fresh water is a must to prevent salt toxicity.

Trace Minerals

The level of trace minerals in the basic diet is ignored many times in ration formulations and 100 percent of the animal's requirements are added. This is done because of the tremendous variability that exists in the trace mineral composition of feeds and the minimal cost involved in adding these elements to the ration. Iodine, copper and selenium are all deficient in many soils of the United States. Cobalt may need to be supplied because of its role in the formation of vitamin B12 by rumen microorganisms. Copper has been shown to be deficient in the coastal plains region where heavy stocking rates and high nitrogen fertilization have occurred. Arkansas forages can be marginal in copper, and there are several copper antagonist, including sulfur, molybdenum and iron, that affect copper's absorption. Supplementing copper is recommended. Selenium deficiencies have been found in fescue pastures in north Arkansas. Trace mineral supplements are categorized as two types: inorganic and organic. The common inorganics include sulfates, oxides and chlorides. The bioavailability of these are generally good with the exception of copper and iron oxide. Copper oxide should be avoided in free-choice mineral supplements. Organic forms include elements bound to simple amino acids or more complex organic structures. Organics often have a greater bioavailability than inorganics; however, in mineral supplements they are seldom used as the sole source of a trace mineral.

Vitamins for Beef Cattle

Pasture and average to excellent quality roughages usually contain sufficient quantities of

the vitamins needed by beef cattle to support body maintenance, production and reproduction. Beef cattle may need vitamins A, D and E supplementation where the forage supply consists of crop residue, over-mature or weather-damaged hay or dry winter forage.

Vitamins are classified as fat soluble or water soluble. The water soluble vitamins include vitamin C and the B vitamins. B vitamins are produced by microbes during rumen fermentation and are seldom deficient in beef cattle. Vitamin C is only needed in the diets of humans, monkeys and guinea pigs.

The fat soluble vitamins include vitamins A, D, E and K. Vitamin K is synthesized in the rumen under most feeding conditions. Thus, the animal has little need for supplemental K. Vitamins A, D and E are routinely included in mineral mixes.

Vitamin A

Vitamin A is strictly a product of animal metabolism. Its counterpart in plants is known as carotene. The beef animal transforms carotene into vitamin A. Cattle store vitamin A and carotene in the liver and body fat during periods of abundant intake. These periods occur when animals are grazing green forage. The stored reserves may be adequate to meet the animal's needs for two to four months. Vitamin A deficiencies may cause night blindness, watery eyes and, in pregnant animals, abortions. Weak calves, retained placentas and rebreeding problems may also occur. If animals are on a prolonged diet of bleached or weathered roughage, vitamin A stores may be depleted from the body. This vitamin may be provided to the cow herd by injection, added to the mineral mix or in their regular ration. Pregnant cows that are being fed low-carotene feeds should receive the equivalent of 30,000 international units (IUs) of vitamin A daily while lactating cows should receive 45,000 IUs.

Vitamin D

Beef cattle usually receive adequate amounts of this vitamin by exposure to direct sunlight or through consuming sun-cured forages. Vitamins D and E are usually included with vitamin A supplements or injection solutions administered to cattle. Only cattle kept indoors and not fed sun-cured hay are likely to show symptoms of vitamin D deficiency.

Vitamin E

Under most conditions, natural feedstuffs supply the requirements of vitamin E. Cereal grains, grain forages and good quality hay are all excellent sources of this vitamin. Vitamin E is usually added to mineral-vitamin supplements because of its antioxidant properties which facilitate the uptake and storage of Vitamin A.

Balancing Rations

Several terms used in balancing beef cattle rations are:

Diet – The feed an animal receives in a 24-hour period.

Ration – The feed an animal receives in a 24-hour period.

Balanced Ration – A ration that furnishes the nutrients needed in the proper amounts to allow the individual to perform a certain function such as maintenance, growth, gestation or lactation.

Dry Matter (DM) – The feed remaining after all water is removed. Dry matter averages about 35 percent in silages, 90 percent in No. 2 corn and 90 percent in hay.

Supplement – A concentrate feed added to a ration to provide one or more nutrients not adequately supplied by the usual feed.

Nutrient – Any feed component or group of feed components of similar chemical composition that aid in the support of animal life. Protein, carbohydrates, fat, minerals and vitamins are examples. Carbohydrate, fat and excess protein are all used in the animal body as energy.

Total Digestible Nutrients (TDN) – A term used as a measure of energy (caloric content of feedstuffs). On an as-fed basis, grains usually contain 65 to 80 percent TDN, hays usually 50 percent and less, and silages about 20 percent.

Crude Protein – The crude protein content of a feed is determined by analyzing the feed for nitrogen. Protein in a feed contains approximately 16 percent nitrogen; therefore, multiplying N by 6.25 gives the total protein content of the feed.

Since purchased feeds are usually expensive, home-raised forages should supply the major source of nutrients needed by beef cattle. Purchased supplements, whether for energy or protein, should be fed only to supply those nutrients not furnished by home-grown forages. Forage and grain diets almost always need to be supplemented with minerals for maximum production.

To formulate a balanced ration, you should know (1) the nutrient requirements of the beef cattle to be fed and (2) the nutritive value of feedstuffs available. Table 6-2 gives a partial listing of the National Research Council's (NRC) nutrient requirements of beef cattle.

Average composition values of Arkansas-produced feeds are presented in Table 6-3. While the average nutritive content of many feedstuffs is known, the nutritive content of roughages is highly variable. Therefore, it is very important to have an analysis conducted on these feeds to determine their exact nutrient content so that rations may be balanced accurately. An analysis is inexpensive and often prevents expensive mistakes in underfeeding or overfeeding. **DON'T GUESS – FORAGE TEST.**

To formulate a ration for a 1,100-pound mature, lactating beef cow (2 months since calving, 20 pounds peak milk), first list (as shown in Table 5-1) the nutrient requirements of this class of cattle from Table 6-2. Next, assume that grass hay is available for feeding with the following analysis on a dry matter basis: 10 percent protein, 58 percent TDN, 0.35 percent calcium and 0.18 percent phosphorus. Assume daily intake of grass hay will be 26.4 pounds. Calculate the daily intake of each nutrient by multiplying the daily intake by the hay analysis (for protein, $26.4 \times 0.10 = 2.64$ pounds).

	Pounds				
	DM	Protein	TDN	Calcium	Phosphorus
Requirements	26.4	2.88	15.9	0.084	0.055
Grass hay	26.4	2.64	15.3	0.092	0.048
Deficiency (-)/Excess (+)		-0.24	-0.6	+0.008	-0.007

Grass hay alone supplies inadequate amounts of protein, TDN and phosphorus. From Table 6-3, corn and cottonseed meal are chosen as good sources of TDN and protein, respectively. Next, the net gain by feeding supplemental corn and cottonseed meal is determined.

One pound of grass hay dry matter contains 0.58 pounds of TDN, while one pound of corn dry matter contains 0.90 pound of TDN. The net effect of replacing one pound of grass hay with one pound of corn dry matter is a net gain of 0.32 pound of TDN ($0.90 - 0.58 = 0.32$).

A deficiency of 0.6 pound of TDN exists. Dividing the pounds of nutrient deficiency by the pounds of nutrient gain gives the pounds of dry matter to substitute. For example:

$$\frac{0.6 \text{ pound TDN needed}}{0.32 \text{ pound TDN net gain}} = \frac{1.9 \text{ pounds of corn dry matter substituted for 1.9 pounds of grass hay dry matter}}{1.9 \text{ pounds of corn dry matter substituted for 1.9 pounds of grass hay dry matter}}$$

The protein deficit of 0.24 pound does not change because corn and the grass hay contain the same amount of crude protein.

Next, determine how much cottonseed meal is needed to meet the protein deficit. One pound of cottonseed meal substituted for one pound of grass hay gives a net gain of 0.36 pound ($0.46 - 0.10 = 0.36$) of protein when 1 pound of cottonseed meal is substituted for 1 pound of hay.

$$\frac{0.24 \text{ pound protein needed}}{0.36 \text{ pound protein net gain}} = 0.67 \text{ pound of cottonseed meal}$$

The amount of grass hay in the ration is reduced to 23.8 pounds due to the substitution of 1.9 pounds of corn and 0.7 pound of cottonseed meal. The balanced ration is as follows in Figure 5-2:

	Pounds					
	DM (lbs)	Total Feed (as-fed)	Protein (lbs)	TDN (lbs)	Ca (lbs)	P (lbs)
Requirements	26.4	---	2.88	15.9	0.084	0.055
Ration:						
Grass hay	23.8	26.4	2.38	13.8	0.083	0.043
Corn	1.9	2.1	0.19	1.7	---	0.006
Cottonseed Meal	0.7	0.8	0.32	0.5	0.001	0.008
Total	26.4	29.3	2.89	16.0	0.084	0.057

The total feed (as-fed) is determined by dividing the pounds of feed (dry matter basis) by the percent dry matter in the feed (for grass hay with 90 percent dry matter, 23.8 divided by 0.90 = 26.4).

Grass hay fed alone was deficient in phosphorus, but supplemental corn and cottonseed meal eliminated the phosphorus deficiency. If phosphorus deficiency was a problem, dicalcium phosphate or another feed with a high phosphorus level could be used to meet the animal's requirement. If only calcium was deficient, limestone could be used. The same procedure used to determine protein and TDN needs would be used to determine calcium or phosphorus needs.

A mineral-vitamin supplement should be provided with the ration above to supply adequate amounts of all required minerals, including salt, trace minerals and also vitamin A.

When purchasing nutrients to balance a ration, always purchase the feed that provides the least cost per pound of nutrient needed. For example, if energy is a limiting factor in your ration, then supplement the ration with a high-energy feed. Refer to Table 6-3 (Composition of Feeds) for the TDN level of various feeds and calculate what each unit of TDN costs by using the following formula:

$$\text{Cost/cwt of TDN} = \frac{\text{Cost of feed/cwt}}{\text{Lbs of TDN/cwt (as-fed basis)}} \times 100$$

To convert TDN value of corn on a dry matter basis to an as-fed basis, multiply the TDN value of corn on a dry matter basis (90 percent) by percent dry matter for corn (90 percent).

$$\begin{array}{l} 90\% \\ \text{(TDN)} \end{array} \times \begin{array}{l} 0.90 \\ \text{(DM)} \end{array} = \begin{array}{l} 81\% \text{ TDN} \\ \text{As-fed} \end{array}$$

$$\text{Corn} \quad \frac{\$6/\text{cwt}}{81 \text{ lbs of TDN/cwt}} \times 100 = \$7.40/\text{cwt TDN}$$

To calculate the cost of a protein supplement:

$$\text{Cost/cwt of total protein} = \frac{\text{Cost of feed/cwt}}{\text{Lbs of protein/cwt}} \times 100$$

A computer is often used to calculate beef cattle rations. Several ration formulation programs are available for public use. Contact the county Extension office to help plan feeding programs for individual farms.