K-STATE Kansas State University Research and Extension

FORAGE FACTS

Publication Series

NUTRITIONAL REQUIREMENTS FOR BEEF COWS

INTRODUCTION

Cow nutrition is dynamic. Factors that affect cow nutritional requirements are cow size, stage of production, "work load," and environment (weather, ambient temperature, humidity). Because these factors can change daily, a beef cow's nutrient requirements are constantly in flux. Fortunately, most changes in nutrient requirements are subtle in nature and long-term nutritional programs can be planned. Requirement levels for energy are the most variable, followed by the protein, minerals and vitamins. Keep in mind, each cow has her own required amount of a particular nutrient to perform at a specified level; however, with tabular values, producers can still have confidence in their management programs. It has been and will continue to be common to report requirements as a percentage of the diet. In doing so, practitioners must know the nutrient requirement of the animal and the daily dry matter intake.

Energy drives every biological system in nature. Beef cows use energy to maintain body weight, gain weight, reproduce and to produce milk. Biological units of energy are measured in terms of calories making it unique to other nutrients. To convert calories, to pounds or a percentage of the diet, TDN (total digestible nutrients) was conceived. The drawback from using TDN in energy calculations is that TDN overestimates the energy value of forages and underestimates the energy value of grains. The energy requirement necessary to maintain body weight is closely related to the surface area of the animal. Body weight raised to the .75 power is a good estimate of surface area. Therefore, if the weight of the animal is known, the amount of energy that is required for maintenance can be calculated. The formula for maintenance is equal to 0.77 Mcal per kilogram of body weight raised to the .75 power. The environment, breed and body condition can affect the energy requirement to maintain body weight. Energy is also needed for animals to grow, produce edible products and to exercise or work. This energy is often called net energy for gain (or performance). Net energy for gain (NEg) is only available for the animal after the energy demands for maintenance are met. Net energy for gain requirements are not a function of body weight or surface area but are dictated by the nature of the work or the composition of the growth. Therefore, the animal's total energy demand is additive between maintenance and gain. And to complicate management decisions, producers should also remember that both dry matter intake and energy density of the diet affect animal performance simultaneously.

Proteins play many important roles in the ruminant body. Functions include enzyme systems, muscles, nerves and soft tissues. What makes ruminants unique is that dietary proteins (and other nitrogen sources) are first made available to microflora inhabiting the rumen. Those nitrogen sources used by rumen microorganisms have been called DIP (Degradable Intake Protein) and are used by the "bugs" to reproduce and to digest carbohydrates (cellulose, starch and sugar). Rumen microflora not only supply energy to the animal by breaking down cellulose and starches, but they are also one of the most balanced protein sources available to the animal. Dietary protein that is not utilized by the microflora is not necessarily wasted. Dietary protein that enters the small intestine unaltered is called UIP

(Undegradable Intake Protein) and can play an important role in meeting the requirements of the host animal. Like energy, as cow weight increases, the requirement for protein increases. Forages are richest in protein when they are vigorously growing, and often meet or exceed the ruminant's protein requirement. As forages mature, quite often the protein content decreases to the point that cattle cannot consume sufficient DIP to maintain desired performance levels. Limiting protein adversely affects dry matter intake to the point that energy intake is compromised. Supplemental DIP has been shown to greatly stimulate low-quality forage intake and enhance animal performance more than starchy (high energy) supplementation. This is true only when dietary protein is the first limiting nutrient.

Major and trace minerals have important functions in the body. Bones are composed mostly of calcium and phosphorus. Many of the enzyme systems utilize minerals—enzyme systems that control such economic traits as immunity, reproduction, digestion and milk production. Dietary requirements for minerals make up a small percentage of the diet. Major minerals (calcium, phosphorus, salt) are commonly reported in grams per day or percentages, while trace minerals (copper, manganese, zinc) are usually reported in parts per million. Forages are good suppliers of most minerals, and their mineral content is a reflection of the native soil and weather. Many interactions exist between minerals and other nutrients making mineral nutrition fairly complicated. Subtle changes in mineral proportions can cause deficiencies. Producers sometimes look to supplementation of minerals as a cure all, however, quite often more fundamental concerns to energy and protein deserve greater scrutiny.

The two major classifications of vitamins are fat-soluble and water-soluble. Water-soluble vitamins, commonly called the B vitamins, are produced in sufficient quantities within healthy rumens so that dietary fortification is unnecessary. On the other hand, fat-soluble vitamins (Vitamins A, D, E) must be a part of the cattle diets. Fortunately, most green forages are high in these vitamins and only when they have been improperly harvested or stored will supplemental vitamins be advantageous. Vitamin A is commonly supplemented to cows during the winter months, particularly during the last trimester of pregnancy.

BEEF COWS' NUTRIENT REQUIREMENTS

A few of the basic nutrient requirements are listed in the following table. These values may be used as a baseline and adjustments for variations in animal and environmental factors may be used to calculate a specific animal's requirements.

Several assumptions have been made to determine the tabular values that are listed below. The table is based on cows weighing 1,100 pounds (in moderate body condition), who is average in milk production (15 pounds per day), and will be grazing within her thermal neutral zone. The following sections have been included to adjust tabular values to more correctly predict cow requirements.

ANIMAL ADJUSTMENTS

As a general rule, each 100-pound change in body weight directly changes the requirement for TDN by about .65 pound, NEm .57 Mcal, and crude protein about .1 pound daily. Milk production has a major affect on nutrient demand. Every 5-pound variation in milk production per day requires 1.2 pounds of TDN or 1.7 Mcal of NEm, .3 pounds of crude protein, 5.5 grams of calcium an 2.75 grams of phosphorus. Since energy used for exercise must be included in the animal's daily requirement, it has been determined that cows in grazing situations expand about .9 Mcal per day more than when kept in drylots.

Table 1. *NRC Requirements for an 1,100 pound beef cow producing 15 pounds of milk.*

	Nutritional Periods			
Lactation	Yes	Yes	No	No
Days post calving	82	123	70	90
	post-calving	pregnant & lactating	mid-gestation	pre-calving
TDN (lb / day)	14.5	11.5	9.5	11.2
NEm (Mcal / day)	14.9	12.2	9.2	10.3
Protein (lb / day)	2.3	1.9	1.4	1.6
Calcium (grams / day)	33	27	17	20
Phosphorus (gram / day)	25	22	17	20
Vitamin A (IU / day)	39,000	36,000	25,000	27,000

Nutrient Requirements of Beef Cows, NRC, 1984.

ENVIRONMENTAL ADJUSTMENTS

Energy is the only nutrient that is influenced by changes in the ambient temperature. Ambient temperature is defined as the temperature that is experienced by the animal. Wind speed and moisture are two factors that affect ambient temperature besides the temperature measured by a common thermometer. Haircoat condition is the major factor in determining lower critical temperature. Table 2 lists the lower critical (ambient) temperature of different haircoats. For each degree (F) below the lower critical temperature, energy consumption must increase 1 percent to prevent weight loss.

Table 2. *Estimated lower critical temperature for beef cattle.*

Coat Description	Critical temperature (˚F)
Wet or summer coat	59
Dry fall coat	43
Dry winter coat	32
Dry heavy winter coat	19

SUMMARY

Advancements in beef cow nutrition have progressed to where tabular nutrient requirements can be insufficient in predicting animal performance. However, tabular data along with "cow sense" can be used to make good management decisions. Readers should remember that intake (nutrient concentration equals the amount of nutrient consumed, which is the true measure of nutrient requirements. When cattle are grazing, their daily dry matter intakes are difficult to measure. Also, the nutrient levels of forages (plant parts) that are actually consumed are difficult to obtain. Samples of harvested forages can be sent to commercial testing laboratories to approximate their nutritive values. Visual observation of animals allows for body condition scoring to accurately assess most nutritional programs for energy and protein. Finally, cattle producers should keep cowherd production records documenting individual reproductive and growth performance and use those records to assess past and predict future nutritional programs.

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