

Nutrition and Feeding of the Cow-Calf Herd: Essential Nutrients, Feed Classification and Nutrient Content of Feeds

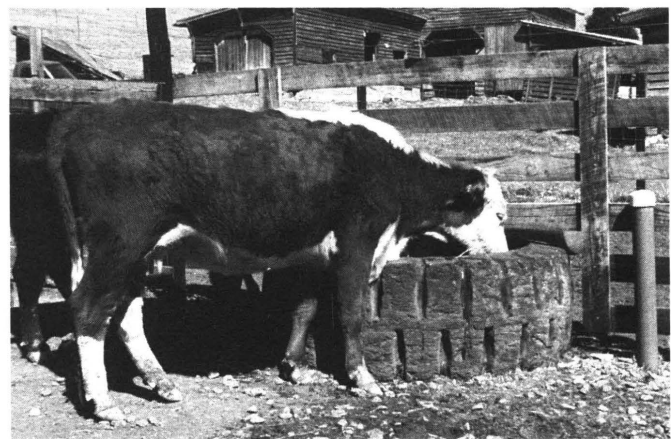
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Essential Nutrients

Essential nutrients are nutrients that are needed by all living things. These nutrients must either be fed or made by the animals from building blocks obtained through eating, drinking, or breathing.

Water

Water is the most essential nutrient for life. Cattle can live for many days or a few weeks without food but will die within a few days without water. Water needs to be fresh, clean, and plentiful to ensure maximum intake. The temperature of the water does not seem to affect cattle very much. Research indicates that cattle readily drink water that is 40 – 90° F. Water intake will vary with environmental temperature and dryness of the feed. Cows eating lush grass on a cool spring day will drink much less water than cows grazing the same field in the middle of summer or cows eating hay. Water requirements for cattle are given in Table 1. A good rule of thumb is cattle need 1.5 gallon for every 100 lbs of body weight.



Clean drinking water - the most essential nutrient.

Energy

Energy is the fuel for all bodily processes – breathing, walking, eating, growth, lactation, and reproduction. Starches, sugars, and fats are all sources of energy. **Maintenance** energy is the fuel used to keep the animal alive without losing or gaining weight or giving milk. Cold weather, mud, increased walking, and a larger body size increase energy needed for maintenance.

Table 1. Total Daily Water Intake (gallons) as Affected by Air Temperature and Feed Intake¹

Temperature:	40°F	50°F	60°F	70°F	80°F	90°F
Gallons of water/lb drymatter (DM):	0.37	0.40	0.46	0.54	0.62	0.88
500-lb calf (12 lb DM)	4.4	4.8	5.5	6.5	7.4	10.6
750-lb preg. heifer (16.6 lb DM)	6.1	6.6	7.6	9.0	10.3	14.6
1,100-lb dry preg. cow (20 lb DM)	7.4	8.0	9.2	10.8	12.4	17.6
1,100-lb lactating cow (22 lb DM)	8.1	8.8	10.1	11.9	13.6	19.4

¹Adapted from Winchester and Morris, 1956. Water intake rates of cattle. Journal of Animal Science 15:722

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Energy above that used for maintenance is available for reproduction, lactation, and growth.

Energy is the nutrient that most often needs to be supplemented in diets for Virginia cows. Energy requirements for cattle and energy content of feeds are expressed in several different ways - **Total digestible nutrients (TDN), metabolizable energy (ME), and net energy (NE)**. For beef cows, TDN is the most commonly used system. Net energy is more accurate than TDN because it accounts for some losses due to metabolism, and it is sub-divided into maintenance energy and energy used for growth and lactation. Net energy is usually used for growing cattle and some special cow rations.

Protein

Protein is the basic structure used to make all tissue – muscle, bone, skin, hair, organs and milk. It is important not only for growth and milk production, but protein is needed daily as the body is constantly repairing itself and replacing lost cells and tissue. Protein is made up of amino acids. Animals use the amino acids from digested protein to build and replace tissue. Because of the rumen microbes, cattle can make all the amino acids they need as long as there is enough protein in the diet.

Plant protein is the primary source of protein in cattle diets. Mature cattle and heavy stockers (>450-500 lbs) can use **non-protein nitrogen (NPN)**, such as urea, as a source for part of their protein. Microbes in the rumen use NPN to make amino acids; cattle can then use the amino acids made by the microbes. Young cattle (<450-500 lbs) cannot use NPN because their rumen is not fully developed. NPN is toxic to young cattle and non-ruminants, so they should only be fed "natural" proteins, such as soybean meal, that already have chains of amino acids.

Protein requirements of cattle and feed content of protein is usually expressed as **crude protein (CP)**. Crude protein = nitrogen x 6.25 to estimate the protein value of the feed. Some of CP is not available to the cow, and CP from different feeds may not be used at the same efficiency so nutritionists often use **metabolizable protein (MP)** instead. Most protein is digested by rumen microbes and is known as **degraded intake protein (DIP)**. Protein not degraded in the rumen passes to the small intestine and is known as **undegraded intake protein (UIP)**. UIP is often referred to as **by-pass protein**. Most protein entering the small intestine will be digested and absorbed for various body functions.

For most cow-calf rations, CP will be the protein requirement and feed analysis used. However, cattlemen should understand the difference between DIP and UIP.

Minerals

Minerals are important for a variety of functions in the animal. Some minerals along with proteins form structures like bone and teeth. Other minerals help transmit nerve impulses, while certain minerals are important to enzymes or carrying oxygen.

Minerals can be divided into two types – Macro and Micro. The different macro and micro minerals important to cattle are listed in Table 2. Macro minerals are needed in ounces or grams per day. Micro minerals, on the other hand, are needed in milligrams or parts per million (PPM). Micro minerals are often called trace minerals.

Table 2.

**Macro Minerals
(need in gram amounts)**

Calcium	Potassium
Phosphorus	Sodium
Sulfur	Chloride
Magnesium	

**Micro Minerals
(needed in milligram amounts)**

Copper	Chromium
Iron	Cobalt
Iodine	Manganese
Selenium	Molybdenum
Zinc	Nickel

Well managed forages in Virginia provide most of the mineral needs for the cow-calf operation. Soil fertility, soil pH, forage species, and forage quality all affect mineral content of forages. Since Virginia has a wide variety of soil types, mineral deficiencies in the forage will vary across the state. However, there are several minerals that are deficient or marginal in Virginia (Table 3). Special attention should be paid to supplementing these minerals.

Table 3. Deficient Minerals in Virginia

Deficient	Marginal
Copper	Calcium
Selenium	Phosphorus
Sodium	Magnesium
Zinc	Iodine
Vitamins	

Vitamins are compounds that are involved in the regulation of metabolism. These vitamins impact reproduction, skin and coat quality, and immune function. They are needed in minute quantities. Vitamins A, D, E and K are fat soluble vitamins that can be stored in the cow's body. Vitamin C and the B complex vitamins are water soluble and are needed daily.

The rumen microbes produce all or nearly all of the B vitamins needed by cattle. Grazing cattle usually get enough vitamin A and E from lush green forage, and they produce vitamin D in response to sunlight. Vitamin C and K requirements are low and provided by the diet, so deficiencies are not a problem in cattle.

When grazable forage is not available such as in the winter-time, vitamin A, D and E supplementation is needed. These vitamins can be fed in the mineral mix or given as an injection every 2 to 3 months.

Classifications of Feeds

All feeds can be classified into specific categories based on their primary function in the diet, whether the feed is a protein or energy feed, for example. A basic understanding of the classification of feed and the nutrient content of common feeds will make it easier for producers to make feeding decisions.

Feeds fall into two main groups: roughage/forage or concentrates. Feeds can be further sub-classified as shown in Figure 1.

A wide variety of forages, grains, oilseeds, by-products, and crop residues can be used to feed cattle. Some of the more common feeds are described briefly in the following paragraphs. Table 4 lists the nutrient content of some feeds common to Virginia. Feed values are normally listed on a dry matter (DM) basis because dry

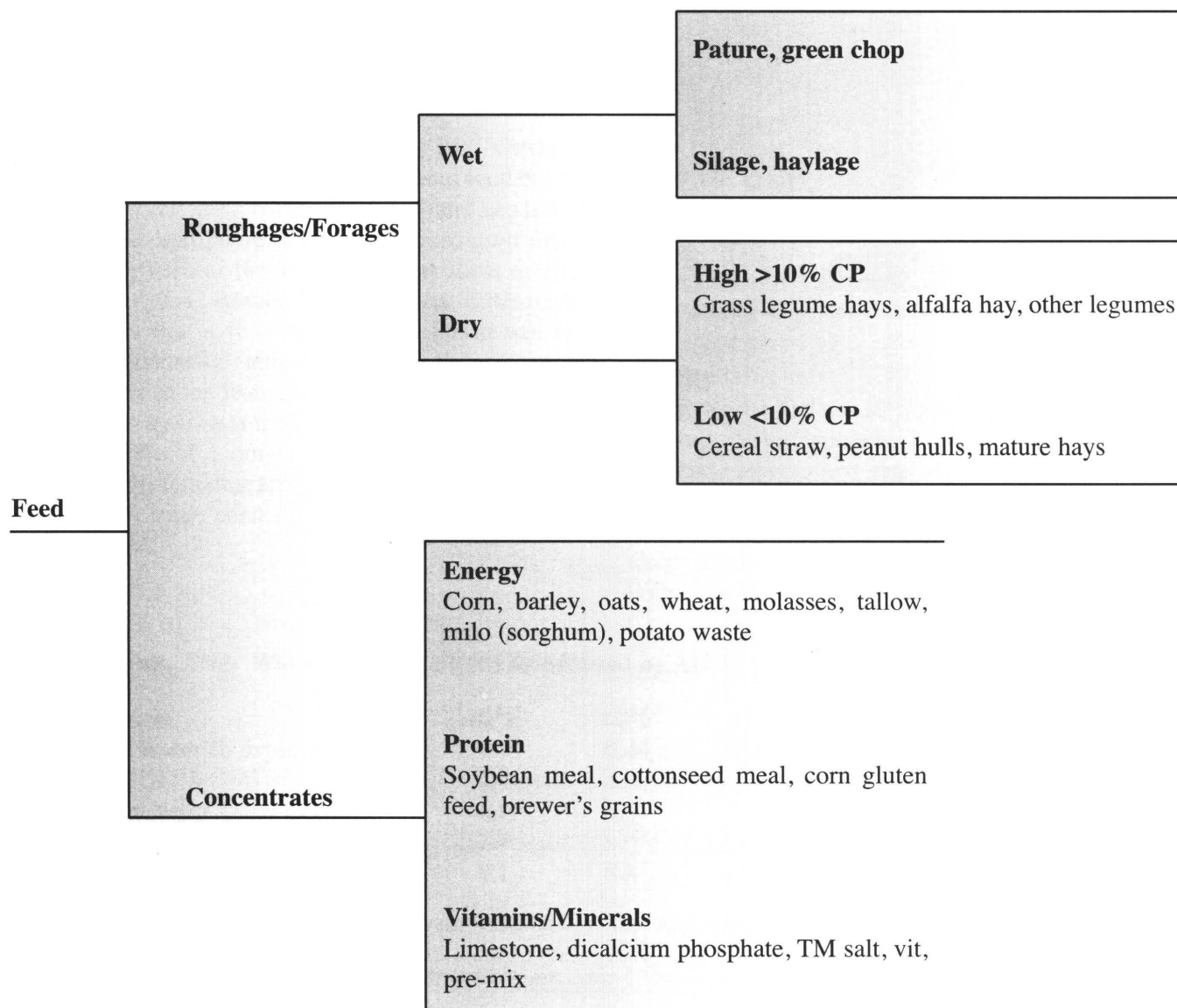


Figure 1. Classification of feeds for beef cattle.

matter contains all of the important nutrients. This is the nutrient content of the feed if all water was removed. This makes it easy to compare feeds and evaluate their nutrient composition. For example, a feed with 90% DM is a dry feed in its everyday form (i.e. corn), whereas a 35% DM feed is a wet feed as it is normally fed (i.e. silage). It would be difficult to compare these two feeds unless we look at the nutrient content on a DM basis.

Roughage/Forage

Pasture, stockpiled forage, hay, silage, crop residues, and straws should make up a majority of the beef cow's

diet. However, these are the most variable of all the feedstuffs in terms of nutrient content. In general, forages and roughages should be tested by a forage analysis laboratory to determine nutrient densities.

Pastures and stockpiled forage can often meet or exceed the protein and energy needs of most cows, even lactating cows. Cool season grasses like fescue and orchardgrass are very nutritious in the vegetative (leafy) stages, but their nutritional value decreases rapidly as these grasses bloom. Supplemental energy may be needed on poor quality pastures. Warm season grasses like switchgrass and caucasian bluestem may need supplemental protein.

Table 4. Nutrient Content of Some Feeds Common to Virginia (Dry Matter Basis)*

Energy Feeds	% Dry Matter	% TDN	NEm Mcal/lb	NEg Mcal/lb	% CP	% Fat	Ca, % DM	P, % DM
Grains								
Corn, 56 lb/bu	87	88	0.91	0.61	9.8	4.3	0.03	0.31
Corn, cracked	88	90	1.02	0.70	9.8	4.1	0.03	0.32
Barley, heavy	88	74	0.94	0.64	13.2	2.2	0.05	0.35
Oats	91	73	0.79	0.50	13.6	4.9	0.07	0.30
Milo	90	85	0.95	0.64	11.3	1.9	0.05	0.34
Wheat	89	76	0.83	0.54	11.6	3.1	0.07	0.33
High energy, others and by-products								
Brewers grains, wet	21	70	0.74	0.47	26.0	6.5	0.29	0.20
Distillers grains, wet	25	90	1.02	0.70	26.0	9.9	0.32	1.40
Corn gluten feed	90	80	0.88	0.60	23.8	3.9	0.07	0.95
Hominy	90	91	1.03	0.71	11.5	7.3	0.05	0.57
Soybean hulls	91	80	0.88	0.59	12.2	2.1	0.53	0.18
Wheat midds	89	83	0.92	0.62	18.4	3.2	0.15	1.00
Molasses	74	72	0.77	0.49	5.8	0.0	1.00	0.10
Protein feeds								
Soybean meal – 44	89	84	0.94	0.64	49.9	1.6	0.40	0.71
Whole soybean, roasted	90	94	1.07	0.75	42.8	18.8	0.27	0.65
Cottonseed meal	92	75	0.81	0.53	46.1	3.2	0.20	1.16
Whole cottonseed	92	95	1.08	0.76	24.4	17.5	0.17	0.62
Poultry litter	78	60	0.99	0.59	28.0	ND	2.30	2.00
Fish meal	90	72	0.75	0.47	66.0	8.0	6.40	3.60
Urea forages								
Spring pasture	21	79	0.87	0.58	26.0	3.7	0.55	0.45
Summer pasture	22	67	0.72	0.43	19.5	3.2	0.40	0.27
Fall pasture	24	53	0.49	0.24	22.0	3.7	0.40	0.25
Stockpiled fescue	49	60	0.59	0.34	11.0	3.5	0.30	0.20
Fescue hay, ave.	91	54	0.56	0.31	10.5	5.3	0.43	0.32
Fescue hay, mature	91	44	0.34	0.10	8.7	4.7	0.41	0.30
Corn silage	35	69	0.73	0.45	8.5	2.6	1.19	0.24
Orchardgrass hay (2nd cut)	89	65	0.67	0.40	12.8	2.9	0.31	0.27
Alfalfa hay, bloom	91	55	0.52	0.26	17.0	3.4	1.19	0.24

* % TDN = % total digestible nutrients; NEm = net energy for maintenance; NEg = net energy for gain; % CP = % crude protein; Ca = calcium; P = phosphorous.

Hays are usually adequate to marginal in energy and protein. Legume hays are high in protein.

Silage from corn or sorghums are moderate to high in energy and low in protein.

Straw and some crop residues may provide limited amounts of energy, but are very deficient in protein. Peanut hulls may supply little more than fiber to maintain rumen function.



Hays should be tested for nutrient content.

Concentrates-Energy Feeds

Grains are high in energy and low to moderate in protein content. Corn is the standard energy feed to which all others are compared, and is the most widely fed grain. Small grains like barley and oats have 85-95% of the energy value of corn, and they are higher in protein. Wheat is rapidly digested in the rumen and should not be fed at high levels.

Molasses has 80% of the energy of corn and contains 14% more moisture. It is primarily a palatability enhancer or a carrier for other products such as NPN or minerals. It tends to be expensive per unit of energy.

Fats and oils contain 2 to 2.25 times the amount of energy per pound as corn, but they should be used sparingly in cattle diets. Diets containing more than 5% fat can impair rumen function.

High energy by-products include soybean hulls, hominy, distiller's grains, brewer's grains, corn gluten feed and wheat middlings (mids). The availability and cost of these by-products vary considerably depending on your location; however, they can often be a very economical source of energy. Some like corn gluten, brewer's grains, and distiller's grain also are moderate in protein content.

Concentrates-Protein Feeds

Soybean meal is the principal supplementary protein source in many livestock diets. It is a well balanced natural protein with some by-pass properties. Whole soybeans, roasted or raw, can also be fed to cattle, but they have a high fat content. Raw soybeans contain a protein digestion inhibitor so they should be used sparingly. Whole soybeans contain about 15% less protein than soybean meal.

Cottonseed meal is another good source of protein that is becoming more readily available in Virginia. Cottonseed meal is slightly lower in protein content than soybean meal. Whole cottonseed is also high in energy and fiber. Whole cottonseeds may also be fed to cattle, but whole cottonseed contains only half the protein of cottonseed meal and are high in fat. Because of the gossypol content, cottonseed meal or whole cottonseed are not recommended as a protein supplement for young bulls due to detrimental effects on reproduction.

High to moderate protein by-products include distiller's grains, brewer's grains, corn gluten meal, poultry litter, feather meal, and fishmeal.

Poultry litter is potentially the cheapest protein supplement available in the Southeast. It contains moderate levels of protein and marginal to adequate levels of energy. As long as it is properly deep-stacked before feeding, it contains no harmful bacteria or other pathogens. When mixed with a high-energy grain, it is an excellent feedstuff for beef cows and stockers. Because of high levels of calcium, phosphorus, and copper, special mineral mixes are needed when feeding high levels of poultry litter.

Feather meal may be available in some parts of Virginia. It is high in protein, but most of the protein is by-pass protein. Feather meal should not be used as a sole protein source.

Feeding animal proteins to cattle is banned, restricted, or tightly controlled depending on the source of the protein. These restrictions are to prevent the introduction of bovine spongiform encephalomacia or Mad Cow Disease to the US. In general, mammalian derived proteins can not be fed to cattle. Feeding proteins from poultry and fish are permitted.

Urea is the most common of non-protein nitrogen (NPN) fed. NPN must be fed with an energy source that is readily available to the rumen. It should not make up more than 1% of the total diet or 3% of the concentrate mix. Urea is often used in lick tanks or liquid protein supplements to increase the CP value of the product or added to corn silage to boost the CP level.

Summary

The cow-calf herd's primary source of nutrition is forages, but forages are variable in nutrient content. A nutrient analysis or forage test is highly recommended. By knowing the nutrient content of their base forages, producers can then identify the deficient nutrients that need to be supplemented. Your Extension Agent can provide information on sampling forages and sending them to laboratories for analysis. Beef producers can then seek economical supplements from products in their area. A firm understanding of the categories of feeds and their role in feeding cattle will make identifying alternatives easier.