Feeding the Cow Herd

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Feed is the biggest single cost of maintaining the beef herd. You must meet the nutrient needs of the beef cow if you want to obtain a high percent calf crop with heavy weaning weights in a short period of time. However, you should meet these nutrient needs in a cost-effective manner to achieve profitability in your operation.

Cattle belong to a group of animals known as ruminants; that is, they have a four-compartment stomach, the major part of which is the rumen. The rumen is a large fermentation vat with a population of microorganisms (bacteria and protozoa) that allows digestion of large amounts of roughage. The cow uses the end products of this microbial fermentation. To work properly, the digestive system of the cow needs a balance of essential nutrients. Because ruminants have the unique ability to digest large amounts of roughage, base the feeding program for your cow herd on forages adapted to your area. Use supplements wisely and according to cattle's nutritional needs for desired performance.

Essential Nutrients

Nutrients are essential for animal maintenance, growth, reproduction, milk production, and fattening. Nutrients fall into the following classes: water, energy, protein, minerals, and vitamins.

Water

Water is an essential nutrient for animal life although, because of its abundance, it is often overlooked. Water intake is vital to feed intake and therefore greatly influences performance.

The effect that small changes in water intake can have on feed intake is shown in Table 7-1. For backgrounding cattle on rations allowing average daily gains (ADG) of 2 pounds, a 4.5% decrease in feed would reduce gain by approximately 0.15 pounds daily. A 22% decrease in feed intake would result in a decrease of 0.75 pounds daily.

Stagnant, dirty water can retard performance and be a breeding ground for disease. Water intake in winter is especially critical for maintaining intake and performance of cattle on rations with dry hay. Clean water should be available at all times. Cattle generally drink about a half gallon of water per pound of dry matter intake, but this varies considerably with temperature. Water requirements increase as the temperature rises and as dry matter intake increases (Table 7-2).

Table 7-1. Water intake and feed intake of growing steers.

Water Intake	Optimal	20% Decrease	40% Decrease
Feed intake, lb.	13.6	13.0	10.6
% change	-----	-4.5	-22.0

Table 7-2. Total daily water intake (gallons) as affected by temperature and feed intake.[1]

Temperature	40˚F	50˚F	60˚F	70˚F	80˚F	90˚F
Gallons of water/lb. dry matter	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

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

Energy

Energy is the major nutrient requirement for beef cattle. It is commonly expressed as TDN (total digestible nutrients), NE (net energy), or ME (metabolizable energy). Both carbohydrates and fats are in the energy group. Think of energy as the fuel a cow uses for grazing, producing milk, maintaining temperature, growing, reproducing, digesting, and voiding body wastes. Most of this fuel comes from forages and roughage products. With proper amounts of protein and minerals, the rumen can obtain energy from some feeds that are useless to nonruminants.

TDN is the measure of energy commonly used for grazing beef cattle. TDN values are readily available for most forages. Net energy (NE) is most widely used for drylot growing and finishing of cattle. NE is a more precise measurement because it is divided into maintenance and gain; also, NE will be used more in the future in ration-balancing programs.

The efficiency of energy utilization should also be considered. Cattle differ significantly in the efficiency with which they use energy. Because energy is the nutrient that represents the greatest cost in feeding cattle, improving efficiency of utilization is very important. Factors influencing utilization efficiency include breed, genetic ability to milk, actual level of milk production, and body composition, among others.

It should be obvious that a positive relationship exists between production (growth, milk) and maintenance energy needs. Larger cattle with more ability to grow have greater maintenance energy needs. Research has shown that metabolizable energy used for maintenance varies between cows within a breed by as much as 35%. This means that efficiency of maintenance energy utilization can be selected for. Cows with greater internal fat content have decreased maintenance energy requirements, while those with greater protein mass have increased needs. Increased body protein is associated with increased internal organ weight and increased metabolic rate. The energy-efficient cow will spend fewer nutrients on body protein maintenance and have more for calf growth.

The Costs of Energy Deficiency

Energy deficiencies affect cow rebreeding, calf health, and survival as well as growth rate of those calves that do survive. Table 7-3 illustrates the effect of an energy deficiency on beef cow reproduction. Energy deficiencies that occur prior to calving increase the days of postpartum interval. Increasing this time period means later-breeding cows and younger calves at weaning next year. Weaning weight of calves can be expected to decrease 35 to 40 pounds for each heat cycle missed, so any factor resulting in increased postpartum interval has significant economic implications to beef producers. Energy deficiencies that occur after calving result in fewer cows conceiving during a confined breeding season. Depending on when an energy deficiency occurs, producers will have either fewer calves or lighter-weight calves to sell the next year.

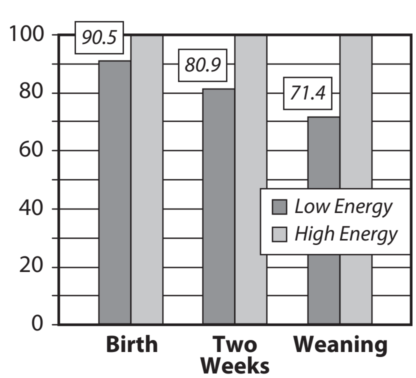
Table 7-3. Energy levels and reproduction.

Precalving	NRC[1]	NRC	Low
Postcalving	NRC	Low	NRC
Postpartum interval	48	43	65
% conception, 1st service	67	42	65
% pregnant	95	77	95

[1] Based on National Research Council (NRC) recommendations.

The effect of an energy deficiency in the precalving cow on calf survivability is shown in Figure 7-1. All cows used in this experiment were bred through artificial insemination (AI) so that an expected calving date could be calculated. During the last trimester of gestation, all cows were placed on energy-deficient rations in order to lose body condition. As each cow reached 30 days from expected calving date, they were either left on the energy-deficient ration or were placed on a ration that allowed them to regain all of the body weight previously lost. After calving, the energy-deficient cows were placed on the high-energy ration. Ten percent of calves born to the energy-deficient cows died at or within 48 hours of birth. An additional 10% died from this period to 14 days of age, with an additional 9% death loss occurring from 14 days of age to weaning. A total death loss of 29% of the calf crop resulted due to late-gestation energy deficiencies in the brood cow.

Figure 7-1. Energy deficiency and calf survival.



The death losses occur due to lowered transfer of immunoglobulins to the newborn calf. Calves born to thin cows will have a lower concentration of blood immunoglobins. They have a decreased ability to withstand disease. In those that do survive, sickness rate will be increased and growth or weaning weight will be decreased (Table 7-4).

Table 7-4. Passive transfer of immunity in the calf, health, and growth.

IgG Level	Inadequate	Adequate
Calves, number	60	183
% sick	25	4.9
Weaning wt., lb.	471	495

Source: American J. Vet. Res. 56:1149.

Underfeeding energy will have a marked negative effect on cow herd performance.

Protein

Protein is made up of many amino acids, which are used in the body as "building blocks" for muscle and other body tissue. These amino acids contain nitrogen, along with other elements. Because cattle have rumen microorganisms, they can use either natural protein or nonprotein nitrogen (NPN) compounds (such as urea and biuret) in their diets to meet their protein requirements. The microorganisms break down much of the dietary protein and synthesize it into microbial protein, which the cow digests.

Protein is generally expressed as crude protein on feed tags and in feed analyses. Crude protein is calculated as nitrogen (N) x 6.25 to make it "equivalent" to true protein. However, not all nitrogen can be converted to true protein. Protein needs are more precisely expressed as metabolizable protein. The use of metabolizable protein recognizes that rations must meet the nitrogen needs of the rumen microbes for optimal fermentation as well as the protein needs of the animal. Metabolizable protein can be further divided into degradable (DIP—degradable intake protein) and undegradable (UIP—undegradable intake protein) in the rumen.

Cattle with functioning rumens actually have two protein requirements. First, the nitrogen needs of the rumen bacteria must be met, and then the amino acid needs of the animal must be met. Microbial nitrogen needs may be met by any compound supplying nitrogen to the rumen. If these compounds are in the feed, they are called degradable intake proteins (DIP). They may be true proteins or nitrogen sources such as NPN. True proteins that escape rumen breakdown but are available for digestion and absorption in the small intestine are known as undegradable intake proteins (UIP). The total amino acids available for absorption in the small intestine are composed of UIP and microbial protein passed from the rumen.

For optimal gain, cattle must be fed a balance of UIP and DIP as shown in Table 7-5. Corn silage is a low protein feed, and the vast majority of its protein would be DIP. In an experiment at the University of Kentucky, cattle were given either no supplement or a supplement consisting of a DIP source only (urea) or a source balanced in DIP and UIP (soybean meal). Both supplements were equal in crude protein. Cattle fed the balanced supplement gained

Table 7-5. DIP and UIP must be met for optimal gain of cattle.

	Corn Silage (CS)	CS + Urea (DIP)	CS + SBM (DIP and UIP)
Initial wt., lb.	402	402	397
CS intake, lb.	24	25	27
ADG, lb.	0.53	0.97	1.39

significantly more than both the unsupplemented cattle or those supplemented only with DIP.

Mature, low-quality hay is often deficient in DIP. Supplementing energy in the form of grain that is also low in DIP (such as corn) will not improve performance of cattle. Rumen microbes must have enough N or DIP to maximize rumen fermentation before other nutrient deficiencies can be met.

Minerals

Minerals are an essential part of the beef cow's nutritional needs. At least 17 minerals are known to be required for beef cattle. The normal diet in Kentucky provides most of them. However, a good mineral supplement should be available to cows at all times.

Calcium (Ca)

Lack of calcium is generally not a problem, although it is the most abundant mineral in the body. Most forages, especially legumes, are high in calcium, and mineral supplements generally contain considerable amounts of calcium. Keep the calcium-phosphorus ratio in the total diet from becoming too wide. A ratio of about 2 to 1 is ideal; the ratio should not be wider than about 7 to 1. Low calcium is most often found in cattle fed high grain diets with little roughage. Excessive dietary calcium will decrease the absorption of phosphorus, magnesium, and certain trace minerals.

Phosphorus (P)

Phosphorus is the mineral most likely to be deficient for cattle in Kentucky. The need for phosphorus increases during lactation (milk production) and growth. Generally, forages are low in phosphorus (especially as forage maturity increases), and grains are high in phosphorus. Phosphorus is stored in the bones and has several functions in the body. Phosphorus deficiencies can cause poor growth, reduced appetite, poor digestibility of feedstuff, and poor reproduction. Oversupplementation of dietary phosphorus is undesirable since it may reduce magnesium absorption and increase urinary calculi as well as increase costs.

Magnesium (Mg)

Cattle might need supplemental magnesium under certain conditions. Grass tetany (low blood magnesium) can be a severe problem for lactating brood cows grazing cool-season pasture, such as fescue, during early spring. Prevent grass tetany by including adequate levels of magnesium (about 20 to 22 grams) in the mineral mix from midwinter until soil temperatures warm up in the spring; i.e., a free-choice mineral supplement that contains about 15% Mg and is consumed at a minimum of 5 ounces per head daily should be adequate.

Potassium (K)

Forages are excellent sources of potassium; thus, a deficiency in grazing beef cattle is unlikely under most conditions. Excessive intake of potassium should be avoided to prevent reduction of magnesium absorption. Cereal grains are low in the mineral, and cattle consuming high-energy diets must be supplemented with potassium. Newly weaned or received calves will also benefit from short-term supplementation of potassium with an improved health response. Stress increases excretion of potassium by the kidney.

Sulfur (S)

Sulfur is a component of certain amino acids, as well as some B-vitamins. Rations with high levels of nonprotein nitrogen are likely to require supplementation. Deficiencies could occur, but excessive intake should be of greater concern. A total sulfur intake exceeding 0.25% of daily dry matter intake will greatly reduce copper availability to the animal. High dietary sulfur will also interfere with selenium absorption. When determining total sulfur intake, water must also be considered as a source.

Copper (Cu)

Copper deficiency is widespread for grazing cattle throughout the world. Copper is necessary for growth, reproduction, and immunity. Forages vary widely in their copper content and availability. The absorption of copper from fescue by cattle is low, ranging from 5 to 15%. Several other minerals may interfere with copper absorption. Research has shown that molybdenum levels greater than 2 to 3 ppm, iron greater than 250 to 500 ppm, and sulfur greater than 0.25% of dry matter intake increase the dietary copper requirement. Intake of several other minerals must be considered when supplementing copper to the diet. Breed of cattle also affects the copper requirement. Simmental and Charolais cattle require higher levels of copper than Angus due to increased excretion and/or decreased absorption.

Zinc (Zn)

Zinc may be the most deficient of the trace minerals in forages that cattle graze. The mineral is essential for normal growth, fertility, and immune function. Very little zinc is stored in the body, so deficiencies occur rapidly when dietary intake becomes inadequate. Excessive levels of iron and/or calcium in the body reduce zinc absorption. Zinc should be supplemented for all grazing cattle.

Selenium (Se)

Selenium content in forages commonly grazed is generally marginal to deficient. Low levels of vitamin E will increase the selenium requirement, but this is generally not a problem with grazing cattle. Excessive sulfur from forage or water will increase the selenium requirement. Because of the highly toxic nature of the mineral, supplementation cannot legally exceed 3 milligrams per head daily for beef cattle.

Manganese (Mn)

Manganese is involved in several enzyme systems and is necessary for adequate reproduction in both the male and female. Forage manganese content can be quite variable depending on the soil type and other factors. Forage content is not generally meaningful as adult cattle absorb only 3 to 4% of the manganese in forages. Thus, it should be included in the mineral mix.

Iron (Fe)

Iron is an essential component of several proteins involved in oxygen transport in the body. Most commonly grazed forages contain more than adequate iron to meet cattle requirements; thus, true iron deficiency is rare in cattle consuming pasture. Excessive intake of iron is more likely a problem for grazing cattle.

Many water sources also contribute to iron intake of cattle. Many of the calcium and phosphorus sources used in mineral supplements contain significant amounts of iron as a contaminant. Many commercial mineral supplements contain ferric oxide as a coloring agent. The iron from ferric oxide is unavailable but will interfere with absorption of copper. Generally, there is little reason to add iron to mineral supplements for grazing cattle.

Molybdenum (Mo)

Molybdenum is a component of some enzymes, but a true dietary requirement for grazing cattle has not been established. Molybdenum is of concern because of its antagonistic effect on copper. A molybdenum content in a ration greater than 2 or 3 ppm is sufficient to increase copper requirements.

Salt (NaCl)

Salt (sodium and chlorine) is deficient in the forage diet and generally makes up a large part of the mineral supplement. Animals normally consume the mineral mix because of their "craving" for salt.

Chelated Minerals

Chelated (organic) minerals also are available in many commercial mixes. Chelation can alter the availability of minerals. If the bioavailability of a mineral is increased, lower dietary concentrations can be used. This form of mineral can be used in the presence of antagonists. The "organic" minerals are also better at immune system stimulation. Compare the costs of chelated mineral sources to inorganic mineral sources; it might be more cost effective to simply increase the amount of inorganic minerals used.

Many good commercial mineral supplements are available. The mineral supplement needed varies depending on the time of year, the cow's stage of production, other ingredients in the diet, and, perhaps, breed and the geographic area of the state (some regions might be marginal or deficient in certain microminerals). Table 7-6 illustrates the nutrient specifications of mineral supplements fed for the past 10 years to the herd at the University of Kentucky Research Center in Princeton, Kentucky.

Vitamins

Vitamins belong to two groups: fat-soluble (A, D, E, and K) and water-soluble (B vitamins and vitamin C). Bacteria in the rumen and intestines make the necessary water-soluble vitamins and vitamin K. Vitamin D is synthesized in the skin when animals are exposed to sunlight. Vitamin E is found in most feeds. This leaves vitamin A as the only mineral that is deficient under normal situations.

Vitamin A can be synthesized in the body from carotene, which is found in plants. Vitamin A deficiency is rare when good-quality roughages are fed to beef cattle. Vitamin A deficiencies can occur when the ration consists of weathered or low-quality hay and concentrates low in carotene content, such as old corn, small grains, or grain sorghums. Cattle that are fed or that graze highly nitrated forages can have a vitamin A deficiency due to poor use of carotene.

Table 7-6. Example of mineral supplements fed to the UK-Princeton[1] beef cow herd.

Level	Basic[2]	High Magnesium[3]
Salt, %	22-25	15
Mg, % (from MgO)	1	15
Ca, %	12	12
P, %	6	5
K, %	1	0.5
S, % (maximum)	0.8	0.8
Cu, ppm	1,600	1,400
Zn, ppm	3,200	3,000
Se, ppm	35	26
I, ppm	60	48
Co, ppm	15	10
Mn, ppm	3,000	2,000
Fe (iron)	None added	None added
Vit. A, IU/lb.	250,000	200,000
Vit. E, U/lb.	250	200

1 University of Kentucky Research Center in Princeton, Kentucky.
2 Distiller's dried grains (40 lb./ton), wet molasses (20 lb./ton), and mineral oil (20 lb./ton).
3 Distiller's dried grains (100 lb./ton), wet molasses (20 lb./ton), and mineral oil (20 lb./ton).

You can add supplemental vitamin A to the ration or mineral supplement as a dry, stabilized vitamin A premix, or give it as an injection. An injection of 1 million IUs prevents deficiency symptoms for two to four months in cattle. The most common method is to provide a mineral/vitamin supplement with approximately 150,000 to 200,000 IUs of vitamin A per pound.

Vitamin E and the B-complex vitamins should be available in higher than normal levels in the diets of stressed calves to decrease the percent morbidity and mortality.

Classification of Feeds

Feedstuffs are generally divided into two broad categories: roughages/forages and concentrates. Roughages/forages are usually high in fiber and somewhat low in energy. Concentrates, on the other hand, are low in fiber and high in energy. Both broad categories are sometimes further divided into energy and protein feeds. These feedstuffs may require mineral and vitamin supplementation or feed additives. Figure 7-2 shows various feeds classified according to their use.

Various feedstuffs are available for use in beef cattle diets. Brief descriptions of several ingredients you can use to supplement forage-based diets follows. Table 7-7 shows nutrient concentration and feed density of several types of feeds.

Corn is the most widely fed grain. It is used as an energy source and is low in crude protein, fair in phosphorus, and low in calcium. Corn is fed in different forms—shelled corn, whole ear corn, and high-moisture corn (20 to 34% moisture)—and may be processed to different degrees.

Wheat is about 105% the feeding value of corn when it makes up no more than 50% of the beef ration. It is a good feed but can pack in the stomach, especially when it is finely ground.

Figure 7-2. Classification of feed for beef cattle.

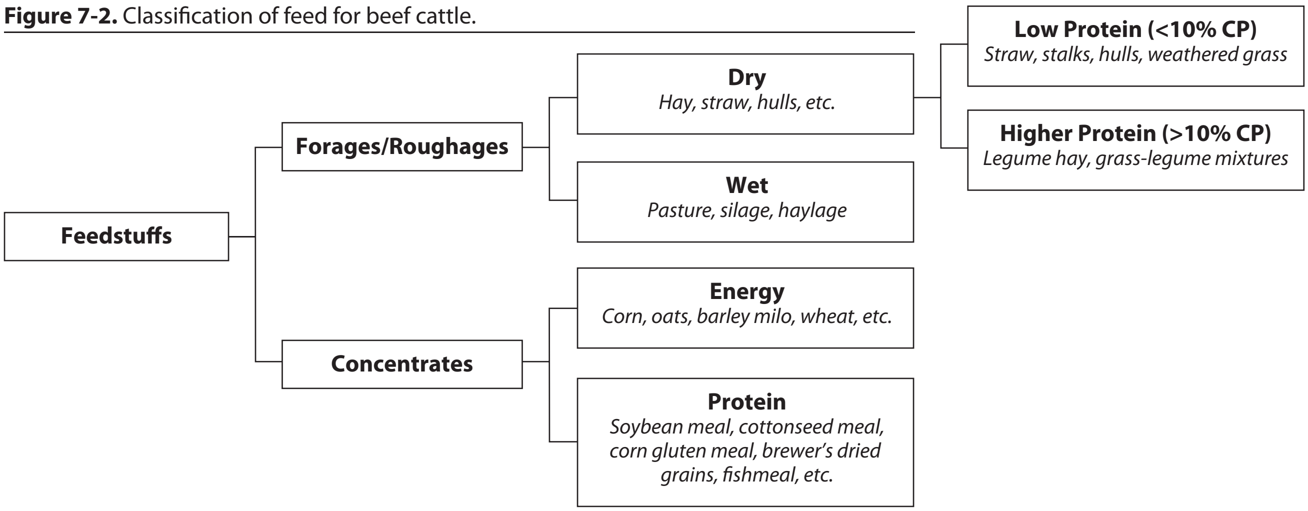


Table 7-7. Nutrient concentration and bulk density of selected feed ingredients.

Feed	Dry Matter %	TDN %	NEm[1] mcal/lb.	NEg[2] mcal/lb.	Starch-Sugars %	Fat %	Crude Protein %	Bypass Protein % CP	Ca %	P %	Bulk Density lb./cu. ft.
		Concentration in Dry Matter									
Grains											
Corn	88	87	0.96	0.64	75	4.2	10	65	0.02	0.30	48
Oats	89	76	0.81	0.52	47	4.6	13	21	0.09	0.40	25
Rye	89	81	0.88	0.58	---	1.7	12	20	0.07	0.39	45
Wheat	89	88	0.98	0.65	69	2.0	12	---	0.06	0.40	48
High-Energy Feeds											
Hominy	90	92	1.03	0.70	52	5.3	11	44	0.04	0.45	28
Molasses, heavy	78	78	0.79	0.50	60	0.0	9	0	1.10	0.10	78
Rice bran	91	66	0.68	0.38	27	15.8	14	34	0.08	1.68	20
Soybean hulls, grd.	91	77	0.82	0.53	14	2.5	14	30	0.63	0.22	20
Wheat middlings	89	82	0.89	0.59	35	4.6	18	24	0.14	1.04	20
Medium-Protein Feeds											
Brewer's grains	92	84	0.92	0.61	14	7.4	30	56	0.30	0.60	15
Broiler litter	78	53	0.52	0.16	---	2.0	25	---	2.10	1.80	35
Cottonseed, whole	90	94	1.06	0.72	8	18.0	23	39	0.16	0.62	25
Corn gluten feed	90	82	0.89	0.59	30	3.3	24	25	0.20	0.85	30
Distiller's grains	92	87	0.96	0.64	12	9.0	27	47	0.30	0.75	15
High-Protein Feeds											
Blood meal	91	66	0.66	0.37	---	1.3	92	82	0.29	0.23	38
Corn gluten meal	91	89	0.99	0.67	19	2.4	67	60	0.05	0.51	42
Cottonseed meal	91	76	0.81	0.52	12	2.0	47	41	0.21	1.18	42
Feather meal	92	69	0.71	0.43	7	5.0	88	72	0.40	0.60	15
Fish meal	90	72	0.75	0.47	2	8.0	66	63	6.40	3.60	40
Meat and bone meal	93	71	0.74	0.46	---	10.4	55	53	9.95	5.00	37
Soybean meal	91	87	0.96	0.64	10	1.2	55	30	0.28	0.70	42
Soybeans, whole	88	93	1.04	0.71	10	18.5	40	30	0.27	0.64	48

[1] NEm = Net energy for maintenance.
[2] NEg = Net energy for gain.
Source: W. E. Kunkle, R. L. Stewart, and W. F. Brown. 1995. Using by-product feeds in supplementation programs. 44th Annual Fla. Beef Cattle Short Course Proc., p. 89.

Sorghum grain (milo) is about 85 to 90% the value of corn for beef cattle. It is lower in energy than corn and more variable in its protein content. Sorghum grain must be processed for maximum digestibility. Milo is generally grown as a crop when it is too late to plant corn or in areas that are susceptible to drought.

Oats are about 85% the feeding value of corn because of their high fiber level. Oats are very palatable and excellent for starting young calves on feed. You can use oats as a creep feed for calves in a 50-50 mixture with corn.

Rye is the least palatable of all the grains and should not make up more than one-third of the ration. It tends to cause digestive disturbances if ground too finely. Rye also can be contaminated with ergot, which can cause problems due to the presence of mycotoxins.

Corn-and-cob meal consists of whole ears of corn (cob and grain), ground to varying degrees of fineness. The mixture is usually about one-fourth cobs and three-fourths corn grain. It is a good feed for growing calves because of its increased fiber content.

Many commercial protein supplements are available, and most contain some of the following ingredients (which also may be fed as the sole protein supplement).

Soybean meal (SBM) is the most popular of all the natural protein supplements for cattle. It is the most widely used of all the oilseed meals and is the standard to which other protein supplements are compared. The amino acid composition of soybean meal makes it an excellent supplement with corn, which is deficient in lysine. This amino acid composition is beneficial to young, growing calves.

Cottonseed meal is not as readily available in Kentucky as SBM and is lower in its protein content. It is a satisfactory protein supplement for beef cattle.

Urea and biuret are not proteins but are nitrogen supplements that can be converted to protein by rumen microorganisms. The diet should contain a source of readily fermentable energy (carbon skeletons) to be combined with ammonia (nitrogen) by the rumen microbes to form protein. Generally, NPN should not make up more than 1% of the total diet or 3% of the concentrate mix.

Liquid urea-containing supplements are popular with some producers because they can be self-fed from "lick tanks." This makes supplements from "lick tanks" convenient for producers, but they are generally expensive in terms of nutrients provided and performance obtained. Some liquid supplements contain molasses as a palatable carrier for the urea. Although molasses would seem to provide a source of readily fermentable energy for bacteria to use for protein synthesis, it might reduce forage intake and/or digestion, which would offset its energy value. Some liquid supplements now contain by-product ingredients that contain natural protein, such as corn steep liquor, brewer's solubles, or fish solubles.

Dried distiller's grains with solubles are a by-product of the production of ethyl alcohol. Solubles left over from the fermentation are added to the grains before they are dried. Corn, the predominant grain, is used with varying amounts of other grains. Dried distiller's grains with solubles, if dried properly, are a good source of bypass (undegraded in the rumen) protein.

Wet distiller's grains are a by-product of alcohol for "gasohol" production and contain about 65 to 75% moisture. The moisture content limits their use to areas near the place of production.

Corn gluten feed is a by-product obtained when high fructose corn syrup is made. It contains about 25% crude protein. When a corn gluten product is referred to as "meal," it will contain about 65% crude protein.

You can feed whole soybeans to beef cattle as a protein supplement. Do not feed them at high levels, however, because of their fat content. Limit them in the diet to replacing the usual protein supplement of calves (usually 2 to 3 pounds), and do not feed in diets with urea.

Soyhulls, the seed coats of soybeans, are removed during oil extraction. The hulls are high in fiber, which is highly digestible by ruminants. They also have a lower starch level, resulting in a lower rate of fermentation and reducing the chance of acidosis. They are very palatable, making them a good feed for newly weaned calves and for supplementing bulls because of the reduced chance of founder.

Factors That Affect Nutrient Requirements of Cattle

Low-cost beef producers feed to meet the nutritional requirements of cattle as economically as possible. They can produce more with less. These nutritional requirements are influenced by body size, production status, level of milk production, growth rate, and the environment.

Body size can have a dramatic effect on nutrient needs. Energy and protein needs increase markedly as weight increases. Feeding cows of varying sizes together cannot be done correctly.

Production status of the cows influences nutrient demand. Daily nutrient demands increase as the cow progresses in gestation and into peak lactation. This should illustrate why short calving seasons are highly desirable. Calving over a three- to four-month period ensures that some cows will not be fed correctly. Cows with calves should be separated from the uncalved portion of the herd during calving season and fed differently. In the growing calf, rate of gain represents production status. Obviously, as rate of gain increases, daily nutrient requirements also increase.

As we select cows for greater milk production, their energy and protein needs are increased. Producers who are constantly selecting sires with high milk EPDs must be careful not to allow the nutrient needs of the cow to outstrip the feed resources of the farm.

Environmental stresses can also influence nutrient needs. Cattle require more energy to generate heat in periods of cold stress and energy to dissipate heat in hot weather. Giving extra feed during periods of extreme cold and providing shade and cool water during heat stress are beneficial practices.

When you build a nutrition program for your cow herd, keep three issues in mind: fulfilling the nutrient requirements of the cow, responding to "stress points" that can cause nutrient deficiencies, and making maximum use of forage supplies while filling gaps with supplemental feed.

Nutrient requirements of the cow vary according to the cow's size, whether the cow is lactating or dry, the level of milk production, and the stage of production. Figure 7-3 divides the beef cow's productive year into periods of differing nutritional requirements according to her stage of production.

Table 7-8 shows the nutritional requirements of a 1,100-pound beef cow for each of the production periods. Period 1 (the time between calving and rebreeding) is the time of greatest nutrient need. Nutritional "stress" is likely to occur around this time. Probably the greatest stress point occurs when first-calf heifers are being prepared to rebreed after their first calf. The critical period for the cow herd is from 50 days before to 80 days after calving. Another problem period is when you are trying to get yearling heifers to gain adequate amounts so they can breed soon enough to calve at 24 months of age.

Winter Feeding the Cow Herd

The cost of winter feeding the cow herd makes up 40 to 50% of the total variable costs of producing a weaned calf. Because winter nutrition is vital to calf health and cow reproduction, you must supply adequate nutrition while avoiding feed waste.

The goals of a winter feeding program may vary by calving season. Most beef herds calve in the spring or fall. In either case, we want to provide an economical ration that meets the cattle's nutritional needs. Calves must be vigorous at birth since many are born during periods of cold stress, and the cows need to have an adequate milk supply. After calving in the spring, cows need to cycle early and be in good condition so that pregnancy occurs before periods of extreme heat (in July).

The goals for fall calving herds are similar, but cows need to rebreed in December/January (accumulated fescue can work well for this). Calves also need supplemental feed from Feb. 15 to Apr. 15 when pastures are not normally available. Creep grazing wheat can work well.

As shown earlier, cattle in different developmental stages have different nutrient needs. You can meet these needs by separating the herd into groups with similar nutrient needs. You also make the most efficient use of feed resources this way.

The following brief discussion of the production groups will help you understand their needs. Not all groups are present in all herds, and your facilities may limit the amount of grouping you can do. If you can only do limited grouping, separate the animals having the greatest differences in nutrient needs and feed accordingly.

Stored forage, such as large round bales, is relied upon for wintering beef herds in Kentucky.

Figure 7-3. Beef cow year by productive periods (calf weaned at 220 days of age).

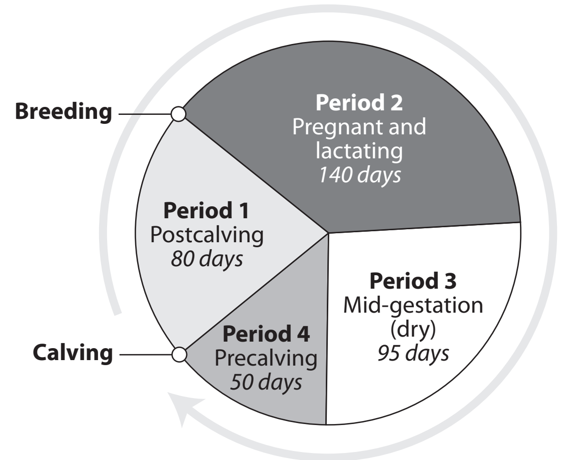


Table 7-8. Daily nutrient requirement for a 1,100-lb. beef cow with 20 lb. peak production.[1]

	Period			
Nutrient	**1**	**2**	**3**	**4**
TDN, lb.	15.9	13.0	10.6	12.9
NE, Mcal/day	16.3	12.4	9.1	12.6
Protein, lb.	2.88	1.95	1.45	2.00
Calcium, lb.	0.084	0.053	0.033	0.055
Phosphorus, lb.	0.055	0.37	0.026	0.035
Vitamin A, IU	48,000	43,000	29,000	29,000

[1] Adapted from Nutrient Requirements of Beef Cattle. 7th Revised edition, 1996. National Academy Press, Washington, D.C.

Production Groups of Cattle

Mature, Dry, Pregnant Cow

The mature, dry, pregnant cow in medium flesh has the lowest nutrient needs: she can use lower-quality feed than other groups in the herd. Treat this as an opportunity to cut feed costs by using such feeds as crop residue, mature standing grass, or mature hay. Recognize that body condition score or the amount of flesh the cow is carrying must be adequate if you use lower-quality feeds. However, lower-quality feeds are not suitable even for the mature, dry, pregnant cow if she is thin initially.

Nutrient needs begin to increase in the last third of pregnancy and increase dramatically after calving when the cow is nursing a calf. Thus, you should move cows dropping calves to a separate pasture and increase the quantity and/or quality of feed. This ensures the best feed to those cattle needing it most and prevents overfeeding cows that are calving later in the season.

First-/Second-Calf Heifers

Feed first- and second-calf heifers differently from the mature lactating cow. Unlike the mature cow, their nutrient needs are increased by the need to continue growing. Provide young cows nursing calves the highest-quality feed.

Replacement Heifers

Replacement heifers, both bred and open, comprise another group in the herd. Heifers going into their first winter are at the lowest level of social order in the herd and would certainly be "bossed" by older cows. In addition, their nutrient requirements for growth demand a much higher-quality feed than that needed by the mature cow.

The bred heifer entering her second winter must be fed sufficiently to grow and develop the fetus. A higher-quality feed than so-called "dry cow hay" is necessary. Do not get her too fat, or calving difficulties can occur. If forage quality is high and enough feeding space is available so that competition does not occur, you do not have to feed bred heifers separately from mature, dry, pregnant cows.

Bulls

The bull is often the forgotten animal in winter feeding, but he should not be. If the bull is mature and in adequate condition, nutrient needs are not high. Feed so that the bull maintains body condition. Fattening the mature bull is a waste of feed and money.

Young bulls are still growing and must be fed accordingly. A high-quality forage, and possibly some concentrate, is necessary for these animals. If possible, maintain younger bulls in separate lots from mature bulls for feeding and safety reasons.

Dealing with Cold Weather

You also must consider the special problems of cold winter weather. Cold increases the rate at which feed passes through the digestive tract. Less time in the digestive tract means less digestion of nutrients. In other words, a high-fiber, lower-digestible feed provides even fewer nutrients in cold winter weather.

Cold weather also increases the cattle's nutrient requirements, especially for energy. As wind chill drops below the low critical temperature for the animal, the amount of energy required for maintenance increases. Thus, prolonged cold periods decrease the digestion of nutrients from feed and increase the animal's energy requirements. Producers can cope with long periods of cold by increasing the quality of the forage being fed or by substituting concentrates for a portion of the forage.

Certain nutrients, such as water, require specific attention in winter. If water intake is limited by freezing or cold weather, feed intake, especially of hay, decreases. Producers must keep water sources open in the winter and, if possible, above 40°F for maximum feed intake.

We earlier described vitamin A as critical. This is especially true in winter. Cows consuming high-fiber, low-quality hay and coming out of a hard winter will have used most of the vitamin A in their bodies. Supplement the vitamin in the winter by either feeding or injecting.

The greatest out-of-pocket expense for winter feeding is generally protein supplementation. Test your forage for protein content before you add a protein supplement. If a supplement is needed, do not purchase on price alone. Instead, purchase a supplement that is useful; that is, one high in natural protein. High NPN supplements have limited usefulness for cows being wintered on low-quality hays.

Before winter, give yourself time to make decisions by estimating whether an adequate quantity of feed is available to meet animal needs. Table 7-9 shows sample rations for various classes of beef cattle. To estimate the amount of winter feed you will need, multiply the appropriate ration by 120 (approximate number of days in winter) and the number of cattle you have.

If forage supply is inadequate for the entire feeding period, you can substitute concentrates for forages. One pound of corn contains the same amount of energy (TDN) as 1.5 pounds of good hay or 2 pounds of medium-quality hay. When hay is in short supply, grains might be a cheaper source of nutrients. Use ground corn as a carrier for magnesium or vitamin A when needed.

Table 7-9. Sample rations for various classes of beef cattle.

Weaned Heifer Calves *(500 lb.—1½ lb. ADG)*	
1.	High-quality pasture + 5 lb. corn
2.	5-10 lb. grass-legume hay + 5 lb. corn
3.	5-10 lb. grass hay + 5 lb. corn + ¼ lb. protein supplement
4.	35 lb. corn silage + 1 lb. protein supplement
5.	30 lb. corn silage + 5 lb. alfalfa hay
Bred Yearling Heifers *(850 lb.—1 to 1½ lb. ADG)*	
1.	High-quality pasture
2.	20 lb. good grass hay
3.	45 lb. corn silage + 1 lb. protein supplement
4.	25 lb. corn silage + 10 lb. hay + ½ lb. protein supplement
Dry, Pregnant Cows	
1.	Low- to medium-quality pasture
2.	20 lb. grass hay
3.	20 lb. stalks or straw + 8 lb. good hay
4.	20 lb. stalks or straw + 2½ lb. corn + 1 lb. protein supplement
Dry, Pregnant Cows *(last two months before calving)*	
1.	Medium- to high-quality pasture
2.	22 lb. of good hay
3.	25-30 lb. corn silage + 10 lb. legume hay
4.	25-30 lb. corn silage + 10 lb. grass hay + ½ lb. protein supplement
Lactating Cows *(average milk)*	
1.	High-quality pasture
2.	25 lb. hay
3.	65 lb. corn silage + 1 lb. protein supplement
4.	55 lb. corn silage + 5 lb. alfalfa hay
Lactating Cows *(heavy milk)*	
1.	High-quality pasture + grain if needed for condition
2.	30 lb. grass-legume hay + grain if needed for condition
3.	60 lb. corn silage + 2½ lb. protein supplement
4.	50 lb. corn silage + 10 lb. alfalfa hay
Young Herd Bulls *(yearlings or two years old)*	
1.	High-quality pasture + 12 lb. corn
2.	20 lb. grass-legume hay + 12 lb. corn
3.	80 lb. corn silage + 2 lb. protein supplement
Mature Herd Bulls	
1.	High-quality pasture + grain, if needed for condition
2.	30 lb. hay + grain, if needed for condition
3.	70 lb. corn silage + 1½ lb. protein supplement

Notes: Actual amounts vary depending on quality of forage used. A forage analysis should be obtained so that rations can be balanced more accurately. Mineral and vitamin supplementation should be included.

Feed costs represent the greatest single expense in calf production. Managing to keep feed costs low and production levels high will improve your profitability.

Since winter feeding is a major expense, ways of lowering costs without compromising performance should be considered. Some things to consider are:

- shortening the winter feeding period
- reducing dependence on stored feed
- making planned, volume purchases
- considering alternative feed
- forage testing and supplementing according to needs
- minimizing equipment costs
- culling open or poor-producing cows prior to winter
- not wasting feed
- harvesting hay at the proper stage of maturity.

Nontraditional Winter Feeding

Forages that are grazed or harvested and later fed form the basis of the nutrition for beef cattle. They are grown on the farm, require little out-of-pocket expense, and generally are the most economical source of nutrients for beef cattle. Situations do occur in which producers should consider alternative feed sources, however. Drought may limit forage production or, in some situations, excessive moisture may delay harvest such that quality of forage is severely limiting. In some cases, prices of certain commodities may be so low that it is more economical to use them in place of home-harvested forage. Regardless of the situation, the most important factor is to meet the nutrient needs of cattle. Which feeds are used to meet these needs is of less importance than the fact that they are met.

Alternative feeds are not always purchased feeds. Producers should first ask themselves whether there are other potential feeds available on the farm. For example, is there a corn or soybean crop on the farm that will make too little yield to justify harvesting as a grain? If so, chopping the corn as silage or rolling the soybeans as hay can be helpful for salvaging a drought-damaged crop. Some special considerations are necessary, however. Compared to normal corn silage, drought corn silage contains less energy and equal or greater levels of crude protein. The crude protein is mostly all in the NPN form, and supplementation with urea-containing supplements will not produce normal levels of gain.

When alternatives are not available on the farm, purchased feeds must be considered. Hay can be purchased, but feeds that are high in energy content such as grains or certain commodity feeds are generally cheaper per unit of nutrient than hay.

Table 7-10. Limit-fed corn versus hay rations for cows (three-year summary).

Ration	Corn	Hay
Wt. loss lb.	-53	-72
Calf birth wt. lb.	102	96
Wean wt. lb.	634	613
Conception %	91	84
Average Daily Feed Intake (lb.)		
Hay	2.1	30
S. corn	11.3	-----
Supplement	2.5	-----

Source: Journal of Animal Science 74:1211.

Cattle can be wintered safely if rations are limit fed as shown in Table 7-10. In an experiment at Ohio State University, large-framed Simmental cows were divided into two groups at the beginning of the winter feeding season. One group was provided free-choice access to round bales of hay, primarily orchardgrass and alfalfa. The second group was fed whole shelled corn and a pelleted protein supplement to meet NRC nutrient requirements. In all trials, cows in the second group (fed whole shelled corn) also received less than 3 pounds of long hay daily to ensure rumen wall health. For the grazing season, both groups were combined and grazed together for the remainder of the season.

Based on daily costs, limit feeding high-energy rations to wintering cows was slightly more economical than free-choice hay feeding. When considering differences in weaning weight and conception rate, limit feeding high-energy rations for wintering cows can be an alternative to winter cattle with free-choice hay feeding.

Table 7-11. Limit feeding high-energy rations for growing cattle.

Ration	C.S. + Supplement	H.M. Corn
Head	40	40
ADG, lb.	1.94	1.94
DMI, lb.	13	9
F/G, lb. DM	6.69	4.65
DM digest %	65	88.6

Source: Journal of Animal Science 68:3086.

An additional benefit of limit feeding high-energy rations is shown in Table 7-11. The cattle fed the high-moisture corn consumed only 70% of the amount of dry matter the corn-silage-fed cattle consumed. Gain was equal for both groups of cattle because ration digestibility increased for the high-moisture corn-fed cattle. A principle to understand is that as intake of high-energy rations is decreased, digestibility of that ration increases. The cattle receive more nutrients out of each unit of feed.

Some producers may not be willing or able to manage the elimination of hay feeding with limit-fed high-energy rations. They may simply want to supplement some additional energy when hay quality is low or when there is some supply but not enough to last through the winter. In these cases, producers will commonly feed a few pounds of corn per day to the cows. This may not be the best decision due to a phenomenon known as associative effects of digestion.

Associative Effects of Digestion

The term associative effects of digestion simply means that one feed can affect how another feed is digested when both are fed together. These effects can be negative or positive and must be considered when deciding on a supplementation program for forage. Tables 7-12 and 7-13 illustrate the effect of negative and positive associative effects of digestion on hay-based rations. In an experiment at Oklahoma State University, cows were fed either hay alone or hay with increasing amounts of corn. As corn intake increased, starch intake increased and DIP intake decreased. This resulted in digestible organic matter intake decreasing to less than the amount consumed from hay alone when corn intake increased. Increasing starch intake lowered rumen pH, resulting in a decrease in fiber digestibility. Hay digestibility was decreased by 50% compared to the unsupplemented group when 6.6 pounds of corn was fed.

When soyhulls were supplemented, digestible organic matter increased with each increasing unit of supplementation, indicating a positive associative effect on hay digestion. This would indicate

Table 7-12. Effect of increasing corn on hay intake and digestibility.

Corn, lb./day	None	2.2	4.4	6.6
Hay DMI, lb.	19.3	18.0	14.1	11.2
Total DMI, lb.	20.9	21.1	18.6	17.2
Starch intake, lb.	None	1.48	2.95	4.74
DOMI, lb.	7.5	8.4	7.1	7.3
Hay OM, digest %	36.5	35.1	23.6	18.9

Source: Journal of Animal Science 65:557.

Table 7-13. Effect of increasing soybean hulls (SBH) on hay intake.

SBH, lb./day	None	2.2	4.4	6.6
Hay, OMI, lb.	21.4	22.3	21.6	19.9
DOMI, lb.	10.6	11.8	12.3	12.7

Source: Journal of Animal Science 68:4319.

that high-energy, low-starch commodity feeds are to be preferred over grains when making limited substitutions for hay. For many of the commodities, energy content is similar to corn, and protein supplementation may not be needed as protein content is generally greater than corn.

Commodities are generally safer to feed than corn. High-corn rations may present the possibility of digestive upset or founder to cattle due to the starch content. Soyhulls and corn gluten contain little starch and are unlikely to founder cows even if an aggressive cow overconsumes. Some commodities such as rice meal or bakery waste contain high fat levels and can upset fiber digestion in the rumen if intake is not limited when hay is consumed free choice. Wheat midds are available and represent an excellent feed source. They are a more variable product depending on the miller. Some samples can contain significant amounts of starch from broken grain particles and, if fed in high levels, may present digestive problems.

Evaluating Nutritional Status with Body Condition Scores

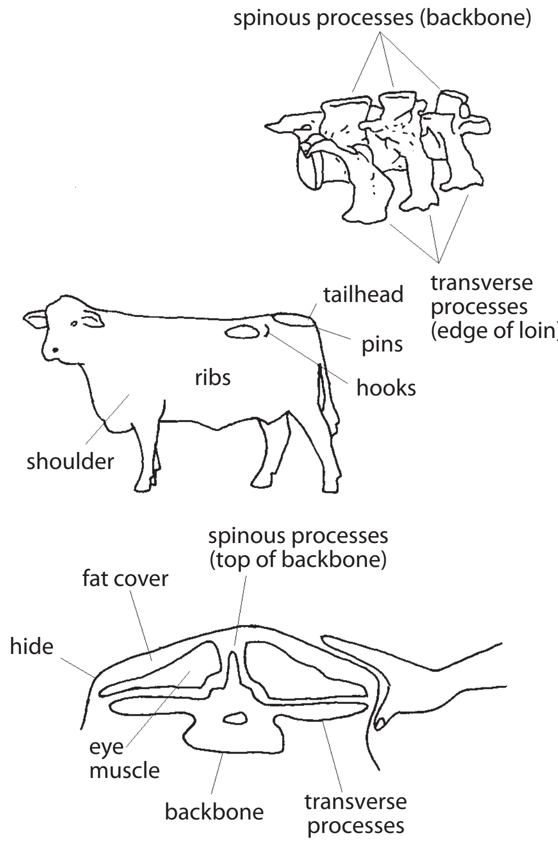
Nutritional status can be most easily evaluated by determining the body condition score (BCS) of cows. Body condition scores allow you to judge the adequacy of your feeding program and plan your program to maintain optimal productivity.

Live weight itself does not adequately reflect nutritional status. Two animals with similar weights may be very different in their body condition. For example, a 1,100-pound cow could be a 1,000-pound cow that has gained 100 pounds of body fat or a 1,200-pound cow that has lost 100 pounds of body fat.

Body condition scores are numbers that are used to evaluate body energy reserves of the cow. A scale of 1 to 9, with 1 being extremely thin and 9 being obese, is generally used. Producers should at least be able to recognize the differences in thin (BCS 3), marginal (BCS 4), and optimal (BCS 5, 6, 7) in order to plan a feeding program.

How do you determine body condition? Figure 7-4 shows the areas of the body that are best for scoring body condition, and Table 7-14 provides a description of the condition scores. Examples of condition scores 1 through 9 are shown on the next page. Adequate nutrition from about two months prior to calving and three months after calving is critical to the cow's ability to rebreed and maintain a 365-day calving interval. If the cow gets inadequate nutrition resulting in poor body condition at calving and breeding, she will take longer to come into heat and may require more services per conception.

Figure 7-4. Anatomical areas that are useful in scoring body condition.



Precalving BCS has a tremendous influence on reproductive efficiency. As precalving BCS decreases, the number of days from one calving to the next increases in beef cows. Cows with lower precalving BCS reproduce less efficiently because their postpartum interval (PPI) is longer. Cows need to conceive early in a spring breeding, before periods of heat stress begin. When cows are wintered on low-quality hay, they generally lose body condition and may not regain it quickly enough to conceive before periods of heat stress occur (usually late June).

Table 7-15 shows the results of several trials in which the effects of BCS at calving were studied. In all instances, cows scoring less than 5 at calving time had the lowest rates of return to estrus and the lowest pregnancy rates.

Maintaining BCS of cows after calving also affects reproductive efficiency. Cows that calve in moderate body condition need to be fed to maintain their body condition in order to obtain a short PPI. Data shown in Table 7-16 illustrate the importance of maintaining condition (feeding more) after calving. Cows that had been maintained at a BCS of 5 were allowed to lose condition or were maintained at that

Table 7-14. Description of body condition scores (BCS).

Thin Condition

1. Emaciated—Emaciated with no detectable fat over backbone, hips, or ribs. All ribs and bone structures easily visible.
2. Still emaciated but tailhead and ribs are less prominent. Backbone still sharp but some tissue on it.
3. Ribs still identifiable but not as sharp to the touch. Backbone still highly visible.

Borderline Condition

4. Borderline—Individual ribs no longer obvious. Foreribs not noticeable. However, 12th and 13th ribs may still be noticeable, particularly in cattle with big spring of rib. The backbone is still prominent but feels rounded rather than sharp.

Optimal Condition

5. Moderate—Good overall appearance. The 12th and 13th ribs are not visible unless the animal has been shrunk. Fat cover over the ribs feels spongy. Area on each side of the tailhead filled but not mounded. The transverse processes (see Figure 7-3) are not noticeable to the eye. Spaces between the processes can only be felt with firm pressure.
6. High moderate—A high amount of fat present over the ribs and around the tailhead. Noticeable sponginess over the foreribs and on each side of the tailhead. Firm pressure now required to feel the spinous processes.
7. Good—Cow appears fleshy and carries some fat. Spongy fat cover over the ribs and around the tailhead. Some "patchiness" evident around the tailhead.

Fat Condition

8. Fat—Fleshy and overconditioned. Bone structure disappearing from sight. Animal taking on a smooth, blocky appearance. Large fat deposits over ribs, around tailhead, below vulva. Patchy fat.
9. Extremely fat—Wasty, patchy, and blocky. Tailhead and hips buried in fat. Bone structure no longer visible. Animal's movement may be impaired.

Score = 1

Score = 2

Score = 3

Score = 4

Score = 5

Score = 6

Score = 7

Score = 8 or 9

level. Those that lost condition required 60 days to return to estrus compared to only 32 days for those that were maintained at a BCS of 5.

Basically, cows need to be managed so that they maintain a BCS of 5 or greater from the precalving period (usually during the winter) through rebreeding on pasture. Do not move cattle to pasture so early in the spring that they lose body condition.

Table 7-15. Effect of body condition score at calving on reproductive performance.

	Body Condition at Calving		
	4 or less	**5**	**6 or more**
Trial 1			
Percent in heat within 80 days after calving	62	88	98
Trial 2			
Percent pregnant after 60 days	69	80	- - -
Trial 3			
Percent pregnant after 60 days	24	60	87
Trial 4			
Percent pregnant after 180 days	12	50	90
Trial 5			
Percent pregnant after 60 days	70	90	92

Adapted from Herd and Sprott, 1986. Body Condition, Nutrition, and Reproduction of Beef Cows. Texas Agricultural Extension Service B-1526.

Table 7-16. Effect of change in BCS after calving on PPI.

BCS	PPI (days)
Lost	60
Maintained	32
All cows	43

Creep Feeding Beef Calves

Creep feeding is the practice of supplying supplemental feed to the nursing calf without the cow being able to get to the feed. After a calf is 90 to 120 days of age, cow's milk supplies only about 50% of the nutrients the calf needs for maximum growth. The other nutrients have to come from somewhere else if the calf is to realize its genetic potential for growth. High-quality pasture is the best source of nutrients; if this is unavailable or inadequate, you can use creep feeding.

Creep feeding the nursing calf increases its rate of gain and its weaning weight. Expect increases in gain of 0.10 to 0.25 pounds per day. You must determine if the increased rate of gain will be profitable. To do this, consider the conversion rate, or the pounds of creep feed needed to produce a pound of gain. Conversion rates may range from 3 to 1 to 18 to 1. For high-energy creep feeds, use a 10 to 1 conversion rate as a general rule. Table 7-17 gives the cost of additional gain at various conversion rates and feed costs.

Table 7-17. Cost ($/cwt.) of extra gain from creep feeding.

Feed/Pound Extra Gain	Feed Cost ($/cwt.)				
	5	6	7	8	9
6	30	36	42	48	54
8	40	48	56	64	72
10	50	60	70	80	90
12	60	72	84	96	108

You have to base your decision on your own operation, but you will generally find that creep feeding is profitable under the following circumstances: long periods of dry weather or drought, poor milking cows, large numbers of first-calf heifers or very old cows in the herd, late calvers (such as midsummer), fall-born calves, only low-quality pasture available, and periods of low feed costs and high calf prices.

Creep feeding may not be beneficial under these situations: good milking cows; abundant, high-quality pasture; high feed costs and low calf prices; weaned calves kept to yearling weights; and heifers kept as replacement females. Creep feeding can be detrimental to replacement females. Fat can be deposited in the mammary gland, permanently reducing the heifer's ability to produce milk. Creep feeding also can "mask" the presence of poor milking dams and may make performance records difficult to analyze.

Creep rations do not have to be complex, but they should be economical and palatable. No matter how good a ration might be, if calves do not eat it, they will not gain more. You can use wet molasses or distiller's dried grains to enhance consumption. For example, a creep ration that is 12% crude protein could be 67.5% shelled corn, 22.5% oats, 5% soybean meal, and 5% distiller's dried grains. If consumption is not adequate, substitute wet molasses for 3 to 5% of the corn. If possible, process the grains by coarse grinding or cracking. When only grain is being used as the creep ration, it is useful to roll the grain. You may substitute other grains or grain products for the corn and oats. High-quality commercial creep feeds are available, and you might find that purchasing these is your best choice.

Starting calves on creep rations is sometimes difficult. One of the best starting methods is to feed their mothers small amounts of ground feed for a few days prior to beginning creep feeding. The calf learns to eat with its mother and can soon be switched to the creep.

Limit-fed, high-protein creep rations have drawn attention recently. These types of creep rations may be useful with large-framed, rapidly growing calves that have greater than normal protein needs. The benefit can be increased gain without excessive fattening due to excessive energy intake. Monitor daily creep intake to be sure it does not exceed 1.5 pounds. Conversion rates should be no greater than 5 pounds of high protein creep to 1 pound of calf gain for this to be profitable.

Creep grazing is basically the same as creep feeding. The calf has access to higher-quality forage, while the cow does not. Control access with creep gates constructed so that calves can pass through but cows cannot (from 15 to 18 inches wide and 36 to 40 inches high), or raise an electric fence that permits calves to walk under it but restricts cows.

Feed Additives for Beef Cows

Feed additives are either nutritive or nonnutritive compounds that improve performance and/or feed efficiency or act as a disease preventative when consumed in feed. If you properly use feed additives, you can greatly improve the profitability of your beef cattle operation.

You have the responsibility to use feed additives properly. This means:

- using the feed additive for its intended purpose
- following the feeding guidelines and any warning statement on the label
- storing feed properly
- observing any withdrawal time when necessary.

Most feed additives fall into one of six broad categories: rumen fermentation modifiers, antibiotics, hormone or hormone-like products, anthelmintics, buffers, and coccidiostats. Other products that are approved for use in feed but do not fit the broad categories will be discussed as general additives. Additives in each category that apply to the beef cow are discussed below.

Rumen Fermentation Modifiers

Rumen fermentation modifiers (which include the ionophores) alter microbial fermentation in the rumen, thereby allowing cattle to obtain more energy from the feed consumed. Products currently available are Rumensin® (monensin), Bovatec® (lasalocid), Gainpro® (bambermycin), and Cattlyst® (laidlomycin). These products are most commonly used for increased weight gain and improved feed efficiency for cattle fed in confinement or increased rate of weight gain for pasture cattle. Rumensin is also approved for increased feed efficiency in mature reproducing beef cows. All products have various label claims and are available in different forms of feed. Instructions for use of rumen fermentation modifiers are found on feed tags of commercial feeds that contain them.

Antibiotics

Antibiotics are generally added to the feed of growing and finishing cattle, but most may also be used with the beef cow when necessary. They are normally used at continuous low levels for an improvement in rate of gain and feed efficiency. Antibiotics may be used at higher levels for prevention and treatment of diseases such as the bovine respiratory complex, anaplasmosis, and pinkeye.

Use care when feeding antibiotics. Recommended levels give the desired results; too much can interfere with rumen function and actually decrease performance.

Anthelmintics

Many anthelmintics, or dewormers, are available in feed forms. Dewormers are generally administered directly to the animal, but when handling is a problem, feeding can be an acceptable method. Products may be mixed into meal feed, or they are commercially available as cubes or pellets. Some products are also available in block form and as loose minerals. Check with a local feed or animal health dealer to find products available in your area.

Other Additives

Other products are approved as feed additives for specific purposes. These include products to prevent bloat when cattle are grazing lush legume pastures and fly-control products that act as growth regulators or as a larvacide (also available in feed forms).

Remember, feed additives are controlled by the Food and Drug Administration, and you have the responsibility to use these products properly. For more information and a listing of common products, refer to Kentucky Cooperative Extension publication ASC-123, *Feed Additives for Beef Cattle.*

Feeding Management During Drought

The effect that drought and the ensuing pasture shortage have on the beef herd largely depends on when the drought occurs. For example, if drought conditions occur in late spring and early summer (June and July), production is decreased in both the current year and the subsequent one. Producers must deal with decreased weaning weights and understand that the rebreeding of the spring-calving cow herd is in jeopardy. Managing the cows for adequate rebreeding is a primary concern. If the same conditions were to occur in late summer, the cows should already be pregnant and the calves closer to weaning age.

These are options to consider when deciding what to do in a drought situation: weaning calves early, feeding the cow herd, creep feeding calves, "stretching" the forage supply, marketing a portion of the herd, or implementing various combinations of these options.

Early weaning has been successfully used on calves as young as 35 days of age to encourage cows to cycle and rebreed earlier during periods of drought or when body condition is poor. It is a fairly common practice for first-calf heifers, which are more likely to have poor rebreeding performance. Weaning calves at three to five months of age is also a viable alternative when forages are scarce and milk production is low, but this is too late to assist early cycling. Consider early weaning when cows milk poorly, calf growth is below normal, and cows are likely to experience poor reproductive performance.

Before you wean calves early, make plans to handle the calves based on their age and the available feed supply. In some situations, you might need to sell early-weaned calves. However, this is not usually a good option since calves are lightweight and the market is depressed during a widespread drought. The long-term considerations might be more important than the present economic situation (that is, high feed prices). Early weaning eliminates the nutrient needs for milk production, thus freeing up more energy for maintenance and reproduction. Removing the suckling calf also causes hormonal changes in the cow that stimulate estrus (heat).

The first two weeks are the most critical time in the early weaning period. Calves must overcome the stress of weaning and learn to eat and drink quickly. The first ration should be very palatable and high in protein and energy, since intake at first is small. Place calves in a small pen with shelter available. The feed bunk and water source should be accessible and easily recognizable to small calves. Place feed bunks perpendicular to fences, and allow water troughs to overflow to attract calves. Vaccinate all calves for blackleg and malignant edema.

Several commercial starter/conditioning feeds are available, or you can have feed mixed locally. The diet should be high in natural protein (13 to 15%) and energy (70 to 75% TDN), with adequate minerals and vitamins. It should also contain an antibiotic or coccidiostat.

Some problems to look for during drylot rearing of calves are respiratory problems, especially seven to 14 days after weaning; sorting of the feed, which can lead to founder; coccidiosis; and scouring. If calves become fleshy or scour, increase the roughage content of the ration or cut back on the amount fed. Remember that early-weaned calves are started on a diet high in energy and protein and should be gradually changed to a grower-type ration as their intake increases.

Early weaning permits high conception rates and rapid rebreeding. Although it is not recommended as a standard practice, it can be useful in times of drought when purchased feed may be more efficiently fed directly to the calf than to the lactating cow.

Kentucky research shows that weights at normal weaning time were 508 pounds for early-weaned and fed calves compared to 463 pounds for calves reared on dams that were fed. If supplemental feed for the cow herd had not been available during drought, early weaning or selling the calves would have been the only choices.

Feeding the cows is an option if early weaning is too drastic, requires too much management, or is not needed because an economical source of feed is available. The amount of feed needed varies with cow size, stage of production, and amount of feed being supplied from pastures. As an example, the nutrient needs of a 1,100-pound cow during the first three to four months of lactation could be met with 20 to 25 pounds of good-quality hay (minimum 55% TDN; 10% protein) with mineral/vitamin supplementation. Heavy-milking cows require another 3 to 5 pounds of grain. If cows are getting some portion of this from pasture, feeding can be reduced.

If the cow herd is still in the breeding season, it is desirable to supplement with good hay instead of "saving it for winter." Protein supplementation can help increase digestion and intake of roughage, but energy is the greatest need. Therefore, some grain or better-quality hay might be needed for high-producing cows. Vitamin A should be supplied in the mineral/vitamin supplement since it is likely to be lacking in "dried" forage (pasture or hay).

When pastures are short and the corn crop has little grain due to drought, producers frequently decide to green chop the damaged corn and feed it directly. This can be extremely dangerous. Drought-stricken corn fed as green chop, whether grazed or baled, carries a high risk of nitrate toxicity. Nitrate level in forage can be checked, but it changes constantly. The safest use of drought-stricken corn is to ensile it and wait six to eight weeks before feeding it. Although this does not help your immediate feed shortage, it will cause the corn stalk to lose 40 to 60% of its nitrate content and provide a safe feed for later use.

Sorghum and sorghum-cross plants used for temporary summer pasture are also potentially dangerous during drought due to their prussic acid contents. These plants should not be grazed during or shortly after drought periods when they are stunted or wilted.

Creep feeding (see earlier discussion in this section) may have extra merit during drought. When pastures are adequate and of good quality and cows are supplying plenty of milk to the calf, benefits may not be great relative to the added cost. However, when pastures are poor during a drought, the increase in gain should be greater.

Balancing Rations

Feed costs are the major component of the total cost of producing a feeder calf. Feeding cattle a balanced ration prevents wasting feed dollars and allows the most efficient level of production.

Ration balancing requires some basic information, including definitions of terms:

- **Ration** is the amount of feed an animal receives in a 24-hour period.
- **Balanced ration** is a ration that supplies the proper amounts and proportions of nutrients needed for an animal's growth, maintenance, lactation, or gestation.
- **Nutrient composition** refers to the amounts of specific nutrients contained in the feed. It is expressed as a percentage of the dry matter and may also be looked up in a feed composition table (see Table 7-18). These tables contain only average values; your feed will be represented only if it is average. For accurate information, you will need a nutrient analysis on stored forages; this can easily be done for a reasonable cost.
- **Dry matter** is the portion of feed left after all water has been removed. It contains the nutrients. Levels of dry matter intake for animals are shown in the requirement tables. These amounts are not all an animal will consume, but they represent an amount that can be consumed under normal circumstances. Different feeds contain different levels of dry matter; therefore, it is desirable to balance the ration on a dry-matter basis and then convert the various feeds back to an as-fed basis.

A systematic approach helps in ration balancing. First, determine the nutrient requirements of the animal. This means you have to know the animal's type, size, and production level. Nutritional requirements are obtained from National Research Council (NRC) recommendations, which are generally available in computerized ration-balancing programs. Next, determine the feeds available for use. List their composition on a dry-matter basis from a composition table (such as Table 7-18) or a chemical analysis. Now you are ready to determine the amounts of the feeds necessary to balance the ration. This can be accomplished by using a computerized ration balancing program or, in some cases, by hand calculations.

Animals will gain more efficiently with a balanced ration. Using the guidelines should enable you to balance rations for your cow-calf operation. The Kentucky Cooperative Extension Service can help you obtain forage analyses and ration balancing.

Table 7-18. Composition of commonly used feeds (dry matter basis).

Feedstuff	% Dry Matter	%TDN	% CP	% Ca	% P
Alfalfa hay, midbloom	90	58	17.0	1.41	0.24
Alfalfa hay, late bloom	90	52	14.0	1.43	0.25
Barley grain	88	84	13.5	0.05	0.38
Bluegrass hay	89	56	13.0	0.33	0.16
Crimson clover hay	87	57	18.4	1.40	0.22
Ladino clover hay	90	60	22.0	1.35	0.31
Red clover hay	89	55	16.0	1.53	0.25
Corn, yellow	88	90	10.1	0.02	0.35
Corn, yellow, high-moisture	72	93	10.7	0.02	0.32
Corn stover	85	50	6.6	0.57	0.10
Ground ear corn	87	83	9.0	0.07	0.27
Corn silage (few ears)	29	62	8.4	0.34	0.19
Corn silage (well-earred)	33	70	8.1	0.23	0.22
Corn, distiller's grain (dehy.)	94	86	23.0	0.11	0.43
Fescue hay, early veg.	91	61	12.4	0.51	0.36
Fescue hay, early bloom	92	48	9.5	0.30	0.26
Lespedeza hay, midbloom	93	50	14.5	1.20	0.25
Molasses (syrup)	78	79	8.5	0.17	0.03
Oats	89	77	13.3	0.07	0.38
Orchardgrass hay, early bloom	89	65	15.0	0.27	0.34
Orchardgrass hay, late bloom	91	54	8.4	0.26	0.30
Sorghum stover	88	54	5.2	0.52	0.13
Sorghum grain (milo), 8%-10% CP	87	84	10.1	0.04	0.34
Sorghum silage	30	60	7.5	0.35	0.21
Sorghum sudangrass hay	91	56	8.0	0.55	0.30
Sorghum johnsongrass hay	89	53	9.5	0.84	0.28
Soybean meal (44%)	89	84	49.9	0.33	0.71
Timothy hay, midbloom	89	57	9.1	0.48	0.22
Urea (45% nitrogen)	99	0	287.0	0	0
Wheat	89	88	16.0	0.04	0.42
Wheat hay	88	58	8.5	0.15	0.20
Wheat silage, full bloom	25	59	8.1	0.15	0.20
Wheat straw	89	41	3.6	0.18	0.05
Mineral Sources					
Dicalcium phosphate	97	- - -	- - -	22.0	19.3
Ground limestone	100	- - -	- - -	39.4	- - -
Steamed bone meal	97	8.4	15	31.5	14.2
Sodium tripolyphosphate	96	- - -	- - -	- - -	25.0

Source: Reprinted with permission from Nutrition Requirements of Beef Cattle, 6th revised edition. National Academy of Sciences. National Academy Press, Washington, D.C. 1984.