Section 7.

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 must 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 possess 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. Since 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.

Essential Nutrients

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

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 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, it might be used more in the future.

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 into microbial protein, which is digested by the cow.

Lightweight, growing cattle, such as young calves, cannot adequately use NPN and can benefit from natural protein sources (such as soybean meal). NPN is generally cheaper than natural protein supplements and is best used to reduce feed costs for older cattle on higher energy diets. Low quality roughages do not contain enough energy to permit rumen microorganisms to use NPN. Use supplements high in natural protein with low quality roughages, even for older cattle.

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.

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

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 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.

Lack of calcium is generally not a problem. 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 5-to-1. Low calcium is most often found in cattle fed high grain diets with little roughage.

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 supplying adequate levels of magnesium (about 20 to 22 grams) in the mineral mix.

Salt (sodium and chlorine) is deficient in the forage diet and generally makes up a large part of the mineral supplement. Trace minerals (microminerals), such as selenium, copper, zinc, cobalt, iron, iodine, and manganese, also should be in the mineral mix.

Chelated 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. 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. (Some chelates may affect performance in other ways. Research in this area is continuing.)

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 7-1 illustrates the nutrient specifications of mineral supplements fed for the past few years to the UK-Princeton beef herd.

Table 7-1. Example of Mineral Supplements Fed to the UK-Princeton Beef Cow Herd

	Month of the year		
Level	**Sept-Jan[1]**	**Feb-April[2]**	**May-Aug[1]**
Salt, %	25-28	15	25-31
Mg, % (from MgO)	2	15	2
Ca, %	12	12	12
P, %	6	5	6
K, %	1	1	1
Cu (no CuO), ppm	800	800	800
Zn, ppm	2,000	2,000	2,000
Se, ppm	53	26	48
I, ppm	48	48	48
Co, ppm	10	10	10
Vit A, IU/lb	200,000	150,000	200,000
Vit E, U/lb	400	300	400
CTC, mg/lb	--	--	800[b]

[1] Distiller's dried grains (40 lb/ton), wet molasses (20 lb/ton), and mineral oil (20 lb/ton).

[2] Distiller's dried grains (100 lb/ton), wet molasses (20 lb/ton), and mineral oil (20 lb/ton).

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.

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.

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.

Water is an essential nutrient for animal life; although, because of its abundance, it is often overlooked. Clean water is most important for young, growing calves. Stagnant, dirty water can retard performance and be a breeding ground for disease. 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).

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 7-1 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 7-3 shows

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 d.m.)	4.4	4.8	5.5	6.5	7.4	10.6
750-lb preg. heifer (16.6 lb d.m.)	6.1	6.6	7.6	9.0	10.3	14.6
1,100-lb dry preg. cow (20 lb d.m.)	7.4	8.0	9.2	10.8	12.4	17.6
1,100-lb lactating cow (22 lb d.m.)	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.

Table 7-3. Nutrient Concentration and Bulk Density of Selected Feed Ingredients

		Concentration in dry matter									
	Dry matter	TDN	NEm	NEg	Starch-sugars	Fat	Crude protein	Bypass protein	Ca	P	Bulk density
Feed	%	%	mcal/lb	mcal/lb	%	%	%	%CP	%	%	lb/ft³
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

Source: Kunkle, W.E., R.L. Stewart, and W.F. Brown. 1995. Using byproduct feeds in supplementation programs. 44th Annual Fla. Beef Cattle Short Course Proc. p. 89.

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 percent to 34 percent moisture)—and may be processed to different degrees.

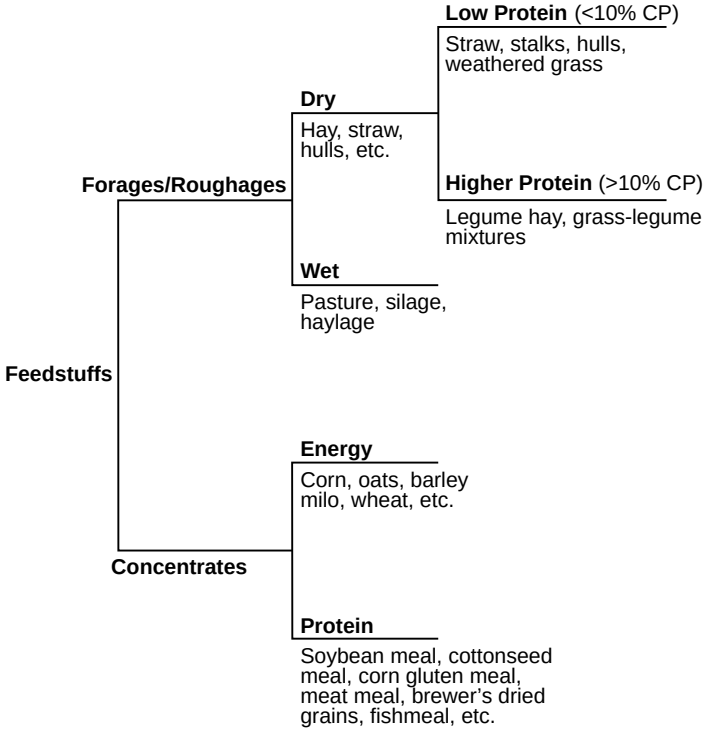
Wheat is about 105 percent the feeding value of corn when it makes up no more than 50 percent of the beef ration. It is a good feed but can pack in the stomach, especially when it is finely ground.

Sorghum grain (milo) is about 85 percent to 90 percent 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 percent 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

Figure 7-1. Classification of feed for beef cattle.



cause digestive disturbances if ground too finely. Rye also can be contaminated with ergot.

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 percent of the total diet or 3 percent 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. While 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 byproduct ingredients that contain natural protein, such as corn steep liquor, brewer's solubles, or fish solubles.

Dried distiller's grains with solubles are a byproduct 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 grain. 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 byproduct of alcohol for "gasohol" production and contain about 65 percent to 75 percent moisture. The moisture content limits their use to areas near the place of production.

Corn gluten feed is a byproduct obtained when high fructose corn syrup is made. It contains about 25 percent crude protein. **Corn gluten meal** is higher in protein—about 65 percent.

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 don't 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.

Broiler litter is readily available in areas where broilers are produced. Broiler litter contains poultry excreta, bedding, and feed waste. Much of the crude protein in broiler litter is in the form of nonprotein nitrogen, which is utilized better when combined with moderate to high energy feeds. Deep-stack litter, and allow it to go through a heat to destroy pathogens and weed seeds and to eliminate some ammonia, which improves palatability. Broiler litter is usually mixed with grain in a 50-50 mix and fed to stocker cattle as a supplement to forages. It can be fed to beef cows at levels up to 80 percent litter. Broiler litter has a high concentration of minerals, notably calcium and potassium. Feeding high levels to pregnant cows near calving can cause milk fever.

Nutritional Requirements

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 7-2 divides the beef cow's productive year into periods of differing nutritional requirements according to her stage of production.

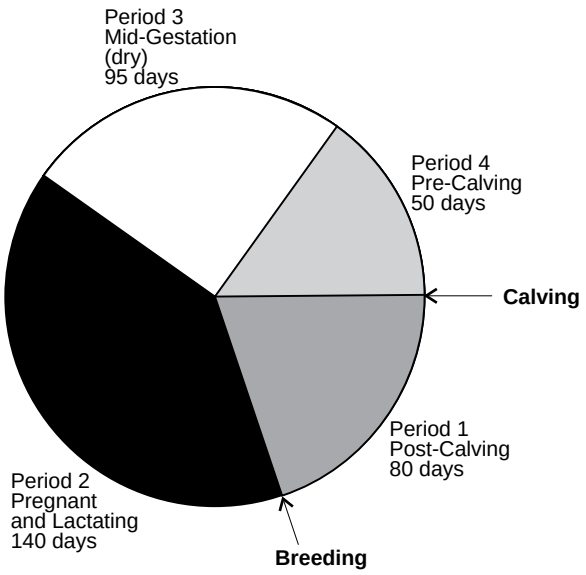
Table 7-4 shows the nutritional requirements of an 1,100-pound beef cow for each of the production periods. Period 1 (the time between calving and rebreeding) is the time of greatest nutrient need. Nutritional "stress" is likely to occur around this time. Probably the greatest stress point occurs when first calf heifers are being prepared to rebreed

Table 7-4. Daily Nutrient Requirement for 1,100-lb Beef Cow with Average Milk Production (15 lb/day)[1]

	Period			
Nutrient	**1**	**2**	**3**	**4**
TDN, lb	13.3	11.5	9.5	11.2
NE, Mcal/day	13.5	12.2	9.2	10.3
Protein, lb	2.3	1.9	1.4	1.6
Calcium, g	33	27	17	25
Phosphorus, g	25	22	17	20
Vitamin A, IU	39,000	36,000	25,000	27,000

[1] *Adapted from Nutrient Requirements of Beef Cattle. Revised edition, 1984. Washington, DC: National Academy Press.*

Figure 7-2. Beef cow year by productive periods (calf weaned at 220 days of age).



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.

Table 7-5 gives examples of rations for various classes of cattle. You can use these rations as a guide to planning the feeding program for your beef herd or when a forage analysis is not available.

Winter Feeding the Cow Herd

The cost of winter feeding the cow herd makes up 40 percent to 50 percent 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.

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 discussions 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.

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 calving later in the season.

Feed **first and second calf heifers** differently than the mature lactating cow. Unlike the mature cow, their nutrient

Table 7-5. 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 2 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 2 yr 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.

needs are increased by the need to continue growing. *Provide young cows nursing calves the highest quality feed.*

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 to 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.

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

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.

Evaluating Nutritional Status with Body Condition Scores

Adequate nutrition from about 50 days before to 80 days after calving is critical to the cow's ability to rebreed and maintain a 365-day calving interval. If the cow gets inadequate nutrition or is in poor body condition at calving and breeding, she will take longer to come into heat and may require more services per conception.

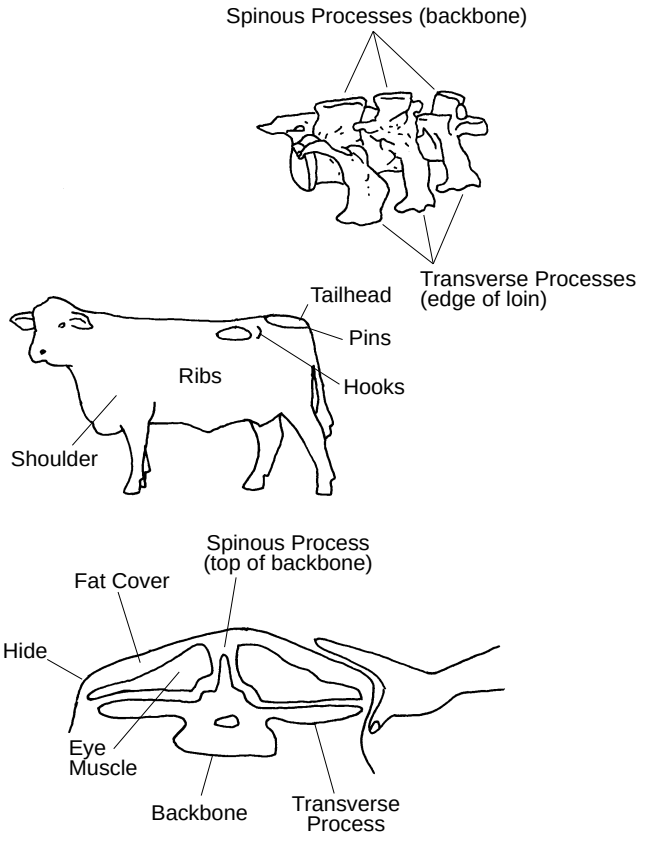
It is not economical to maintain cows that are too thin to rebreed properly or those that are too fat. Cows need appropriate fat reserves for the increase in production during calving and rebreeding to help ensure satisfactory breeding performance.

Body Condition Scoring (BCS) allows you to judge the adequacy of your feeding program based on the condition of your cows. This evaluation can help you plan supplemental feeding programs to maintain adequate productivity.

Body Condition Scores are numbers used to evaluate body energy reserves of the cow. Most reports suggest a scale from 1 to 9, with 1 being extremely thin and 9 being extremely fat. You should at least be able to recognize the differences in thin (3), marginal (4), and optimum (5, 6, 7) condition in order to plan the feeding program. Table 7-6 provides a description of condition scores.

How do you determine body condition? Figure 7-3 shows the areas of the body that are best for scoring body condition.

Figure 7-3. Anatomical areas which are useful in scoring body condition.



Research and field observations indicate the importance of adequate body condition for cows from calving through rebreeding. Table 7-7, which shows the results of five Texas trials involving more than 1,700 cows, illustrates the effect of body condition at calving on subsequent reproductive performance. In all instances, cows scoring less than 5 at calving time had the lowest pregnancy rates, indicating that their condition at calving time is undesirable. Scores of less than 5 at calving impede reproduction. The body condition score should be at least 5 or possibly 6. Anything higher than 6 may not be helpful.

The best way to use condition scoring is to sort cows according to condition at 90 to 100 days before calving. Grouping cows according to body condition and nutrient needs can optimize reproductive performance. The goal should be to have a BCS of 5 or 6 for the herd. Table 7-8 gives guidelines for maintaining the 5 or 6 optimum condition in a 1,000-pound cow.

Winter 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

Table 7-6. 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.

Optimum 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.

Table 7-7. 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 7-8. Body Condition Score 90 to 100 Days Prior to Calving

Score	Desired score at calving	Recommendation
3	5	Needs to gain 200 to 300 lb
4	5	Needs to gain 150 to 200 lb
5	5-6	Needs to gain weight of fetus (100 lb)
6	5-6	Needs to gain weight of fetus (100 lb)
7	5-7	No weight gain needed
8	5-7	Can probably lose 50 to 150 lb

Adapted from Beverly, 1985. Reproduction in beef cattle as related to nutrition and body condition. Proceedings, Kentucky Beef Cattle Roundup, pages 1-12. Lexington: University of Kentucky.

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, don't 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 7-5 shows sample rations for various classes of beef cattle. Multiply the appropriate ration by 120 (approximate number of days in winter) and the number of cattle you have to estimate the amount of winter feed you will need.

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.

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

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 only supplies about 50 percent of the nutrients it 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 weaning weight. Expect increases in gain of .10 to .25 pounds/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 rule of thumb. Table7-9 gives the cost of additional gain at various conversion rates and feed costs.

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.

Table 7-9. 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

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 don't eat it, they won't gain more. You can use wet molasses or distiller's dried grains to enhance consumption. For example, a creep ration that is 12 percent crude protein could be 67.5 percent shelled corn, 22.5 percent oats, 5 percent soybean meal, and 5 percent distiller's dried grains. If consumption is not adequate, substitute wet molasses for 3 percent to 5 percent 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 non-nutritive 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 (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 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.

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 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 Service 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: early-weaning calves, 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 3 to 5 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/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 percent to 15 percent) and energy (70 percent to 75 percent 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 isn't 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 an 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 percent TDN; 10 percent 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 percent to 60 percent 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.

Before you begin ration balancing, you'll need 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. Table 7-11 shows the amounts of nutrients required for beef cattle.

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 7-12). These tables contain only average values; your feed will be represented only if it is average. For accurate information, you'll 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.

Table 7-10. Nutrient Composition of Various Feedstuffs, Dry Matter Basis*

Feed	% Dry matter	% TDN	% Protein	% Ca	% P
Fescue hay	92	48	9.5	.3	.26
Shelled corn	88	90	10.1	.02	.35
Soybean meal	89	84	49.9	.33	.71

Table 7-11. Nutrient Requirements of Beef Cattle

Body wt.,lb	Daily gain, lb	Dry matter intake, lb	Crude protein lb/day	Crude protein % of D.M.	TDN lb/day	TDN % of D.M.	Ca,%	P,%
Steer calves (medium-frame)								
400	1.5	10.8	1.24	11.5	6.8	63.0	.47	.25
400	2.0	11.0	1.41	12.7	7.5	67.5	.56	.26
400	2.5	11.0	1.56	14.2	8.1	73.5	.68	.30
500	1.5	12.8	1.33	10.5	8.1	63.0	.40	.22
500	2.0	13.1	1.49	11.4	8.9	67.5	.47	.24
500	2.5	13.0	1.63	12.5	9.6	73.5	.56	.27
600	1.5	14.7	1.42	9.8	9.3	63.0	.35	.21
600	2.0	15.0	1.57	10.5	10.2	67.5	.40	.22
600	2.5	14.0	1.69	11.4	11.0	73.5	.46	.24
Heifer calves								
400	1.5	10.2	1.17	11.4	7.0	68.5	.45	.24
500	1.5	12.1	1.25	10.3	8.3	68.5	.38	.22
600	1.5	13.8	1.32	9.5	9.4	68.5	.32	.21
Pregnant yearling heifers—last third of pregnancy								
750	1.4	16.6	1.5	8.9	10.0	59.9	.32	.21
850	0.9	17.6	1.4	8.2	9.6	54.5	.26	.20
950	0.9	19.0	1.5	8.0	10.3	54.1	.27	.20
Dry pregnant mature cows—middle third of pregnancy								
1,000	- - -	18.1	1.3	7.0	8.8	48.8	.18	.18
1,100	- - -	19.5	1.4	7.0	9.5	48.8	.19	.19
1,200	- - -	20.8	1.4	6.9	10.1	48.8	.19	.19
Dry pregnant mature cows—last third of pregnancy								
1,000	0.9	19.6	1.6	7.9	10.5	53.6	.26	.21
1,100	0.9	21.0	1.6	7.8	11.2	53.2	.26	.21
1,200	0.9	22.3	1.7	7.8	11.8	52.9	.26	.21
Two-year-old heifers nursing calves—first 3-4 months postpartum—10 lb milk/day								
800	0.5	17.6	1.9	10.8	11.2	63.8	.34	.24
900	0.5	19.2	2.0	10.4	12.0	62.7	.32	.23
1,000	0.5	20.8	2.1	10.0	12.9	61.9	.31	.23
Cows nursing calves—first 3-4 months postpartum—average milking (10 lb/day)								
1,000	- - -	20.2	2.0	9.6	11.5	56.6	.28	.22
1,100	- - -	21.6	2.0	9.4	12.1	56.0	.27	.22
1,200	- - -	23.0	2.1	9.3	12.8	55.5	.27	.22
Cows nursing calves—first 3-4 months postpartum—superior milking (20 lb/day)								
1,000	- - -	20.6	2.5	12.3	13.8	67.0	.39	.27
1,100	- - -	22.3	2.6	11.9	14.5	65.2	.83	.27
1,200	- - -	23.8	2.7	11.5	15.2	63.7	.36	.26
Bulls—maintenance and slow rate of growth (regain condition)								
1,400	2.0	27.7	2.2	8.0	17.8	64.0	.25	.20
1,600	1.0	29.7	2.2	7.3	16.6	55.8	.22	.19
1,800	0.5	30.9	2.2	7.0	16.1	52.0	.20	.20

Note: Vitamin A for:
(1) pregnant heifers and cows—1,270 IU per lb dry feed
(2) lactating cows and breeding bulls—1,770 IU per lb dry feed
Source: Reprinted with permission from "Nutrition Requirements of Beef Cattle," 6th revised edition, c. 1984 by the National Academy of Sciences. Published by National Academy Press, Washington, D.C.

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. Then look up the requirements in Table 7-11. Next, determine the feeds available for use. List their composition on a dry matter basis from a composition table (such as Table 7-12) or a chemical analysis. Now you are ready to determine the amounts of the feeds necessary to balance the ration.

Table 7-12. Composition of Commonly-used Feeds (dry matter basis)

Feedstuff	% Dry matter	% TDN	% CP	% Ca	% P
Alfalfa hay, midbloom	90	58	17.0	1.41	.24
Alfalfa hay, late bloom	90	52	14.0	1.43	.25
Barley grain	88	84	13.5	.05	.38
Bluegrass hay	89	56	13.0	.33	.16
Crimson clover hay	87	57	18.4	1.40	.22
Ladino clover hay	90	60	22.0	1.35	.31
Red clover hay	89	55	16.0	1.53	.25
Corn, yellow	88	90	10.1	.02	.35
Corn, yellow, high-moisture	72	93	10.7	.02	.32
Corn stover	85	50	6.6	.57	.10
Ground ear corn	87	83	9.0	.07	.27
Corn silage (few ears)	29	62	8.4	.34	.19
Corn silage (well-earred)	33	70	8.1	.23	.22
Corn, distiller's grain (dehy.)	94	86	23.0	.11	.43
Fescue hay, early veg.	91	61	12.4	.51	.36
Fescue hay, early bloom	92	48	9.5	.30	.26
Lespedeza hay, midbloom	93	50	14.5	1.20	.25
Molasses (syrup)	78	79	8.5	.17	.03
Oats	89	77	13.3	.07	.38
Orchardgrass hay, early bloom	89	65	15.0	.27	.34
Orchardgrass hay, late bloom	91	54	8.4	.26	.30
Sorghum stover	88	54	5.2	.52	.13
Sorghum grain (milo), 8%-10% CP	87	84	10.1	.04	.34
Sorghum silage	30	60	7.5	.35	.21
Sorghum sudangrass hay	91	56	8.0	.55	.30
Sorghum johnsongrass hay	89	53	9.5	.84	.28
Soybean meal (44%)	89	84	49.9	.33	.71
Timothy hay, midbloom	89	57	9.1	.48	.22
Urea (45% nitrogen)	99	0	287.0	0	0
Wheat	89	88	16.0	.04	.42
Wheat hay	88	58	8.5	.15	.20
Wheat silage, full bloom	25	59	8.1	.15	.20
Wheat straw	89	41	3.6	.18	.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, c. 1984 by the National Academy of Sciences. Published by National Academy Press, Washington, D.C.

Using the Pearson Square

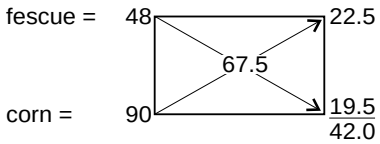
A relatively simple technique of ration balancing involves using the "Pearson Square." This square is used to determine the proportions of two feed materials needed to create a feed of the desired nutrient level. It can only be used for two feed materials; however, one or both of those can be mixtures.

The following example will help explain the Pearson Square method. In this example, a ration will be balanced for a 500-pound steer calf having a desired gain of 2.0 pounds per day. The daily requirements (from Table 7-11) are:

13.1 lb dry matter intake
11.4% crude protein
67.5% TDN

The feeds available in this example and their compositions are shown in Table 7-10. Values for their compositions came from Table 7-12.

The animal requires a 67.5 percent TDN ration. Place 67.5 in the center of a square. Place the TDN values of fescue (48 percent) and corn (90 percent) on the left side of the square and subtract diagonally, smallest from largest. Now, add the two numbers on the right side of the square.



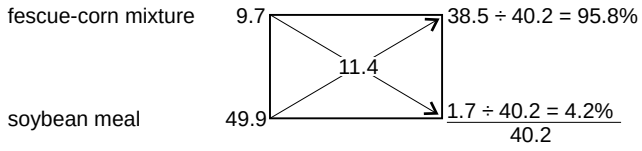
The numbers on the right side show that 22.5 parts of fescue and 19.5 parts of corn would give a 67.5 percent TDN mixture. This would be a total of 42 parts. Divide these two numbers (22.5 and 19.5) by the total (42) to determine the preliminary percentages of fescue and corn in the ration.

fescue 22.5 ÷ 42 = .54 (54%)
corn 19.5 ÷ 42 = .46 (46%)

The next step is to determine the percentage of crude protein in this fescue-corn mixture. Multiply the percentage of each ingredient in the mix by its crude protein content. Fescue is 54 percent of the mix and contains 9.5 percent crude protein. Corn is 46 percent of the mix and contains 10.1 percent crude protein.

fescue .54 × 9.5 = 5.1%
corn .46 × 10.1 = 4.6%
9.7%

The crude protein content of the mix is 9.7 percent. The animal requires 11.4 percent. Therefore, the crude protein content needs to be increased by adding a protein supplement. Use the square method again to balance the fescue-corn mix with soybean meal (SBM) to obtain an 11.4 percent crude protein mixture (see below). Place 11.4 in the center of the square and 9.7 and 49.9 on the left side, and subtract as before. Add the two figures on the right side of the square (38.5 and 1.7) to determine the total parts of the ration (40.2). Divide each of the numbers by the total to determine the percentages of fescue-corn (95.8 percent) and soybean meal (4.2 percent).



Next, determine the pounds of dry matter each ingredient contributes to the total. Multiply pounds of dry matter required daily by the animal (13.1) by the value obtained for soybean meal (.04).

Dry matter intake, lb x value for SBM = SBM dry matter, lb
(13.1 × .042 = 0.55)

Subtract this amount (0.55) from the dry matter intake (13.1) to determine how much dry matter will come from the fescue-corn mixture.

(13.1 - 0.55 = 12.55)

There should be 12.55 pounds of fescue-corn on a dry matter basis.

To determine the amounts of dry matter each of fescue and corn, multiply 12.55 by the relative amounts of fescue and corn obtained in the first square (.54 fescue and .46 corn).

12.55 × .54 = 6.77 lb dry matter from fescue
12.55 - 6.77 = 5.78 lb dry matter from corn

Next, convert each ingredient from dry matter to an as-fed basis so you know how much to actually feed. To do this, divide the pounds of dry matter from each ingredient by the amount of dry matter in each pound of feed (obtained from Table 7-10).

Fescue 6.77 ÷ .92 = 7.36 pounds as fed
Corn 5.78 ÷ .88 = 6.57 pounds as fed
SBM 0.55 ÷ .89 = 0.62 pounds as fed

Minerals are generally supplied by free-choice supplementation with commercial mineral supplements or "homemade" mixes. Calculate mineral levels by multiplying the dry matter pounds of each feed by that feed's calcium and phosphorus contents and adding the results. Compare the results to the animal's needs.

Supplementing Cows Receiving Free-choice Hay

Again, you must determine the nutrient requirement of the animal. In this example, use an 1,100-pound cow nursing a calf, in the first three to four months postpartum, with average milking ability (from Table 7-11):

Dry matter intake, lb	Crude protein, lb	TDN, lb
21.6	2.0	12.1

If fescue hay is being fed and corn and soybean meal are available, list their compositions next (from Table 7-12):

	Dry Matter	TDN	Protein
Fescue hay (early bloom)	92%	48%	9.5%
Corn	88%	90%	10.1%
Soybean meal	89%	84%	49.9%

Since you are interested in using as much hay as possible, begin by assuming the cow will consume her dry matter requirement (21.6 pounds) from fescue hay. This will be 23.5 pounds of actual hay (21.6 pounds of dry matter divided by .92).

Next, calculate nutrients supplied by 21.6 pounds of hay (dry matter basis):

TDN = 21.6 x .48 = 10.4 lb
Protein = 21.6 x .095 = 2.1 lb

Now, see how 21.6 pounds of hay on a dry matter basis (23.5 pounds as-fed) matches up to the animal's requirements:

	Protein	TDN
Required	2.0	12.1
Furnished	2.1	10.4
	(OK)	minus 1.7 lb TDN

An addition of corn grain for extra energy is needed. If 21.6 pounds of dry matter from fescue is all the cow can consume, corn must be substituted for fescue. One pound of fescue dry matter contains .48 pounds of TDN, while one pound of corn contains .90 pounds of TDN. The net effect of replacing one pound of fescue with one pound of corn is a gain of .42 pounds of TDN (.90 - .48 = .42).

Since a deficiency of 1.7 pounds of TDN exists, divide this by .42 to get the pounds of dry matter to substitute.

$$1.7 \div .42 = 4.0$$

Now, the ration is 17.6 pounds (21.6 - 4.0) of fescue and 4 pounds of corn on a dry basis. Divide each by its dry matter content to convert to an as-fed basis.

$$17.6 \div .92 = 19.1 \text{ lb of fescue}$$
$$4.0 \div .88 = 4.5 \text{ lb of corn}$$

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.