

GENERAL PRINCIPLES OF COW NUTRITION

An effective cow herd nutrition program not only meets the animal's nutrient requirements, but it also does this at a minimum cost to the producer. This is extremely important because information from Kansas State University indicates that feed costs typically represent approximately 50% of total costs. Feed not only is a major cost for the producer, it is also the most important factor influencing reproductive performance. Therefore, the goal in the cow herd nutrition program should be to maintain an optimal reproductive rate. A very important concept for producers to keep in mind when planning their nutrition program is the biological priority for nutrients (Table 1). The main concept is that a cow will not reproduce unless all other requirements, such as maintenance, growth and milk production, are met.

Table 1. Biological Priority for Nutrients by Beef Cows

Priority	Function
1	Maintenance
2	Growth
3	Milk Production
4	Reproduction

FACTORS INFLUENCING NUTRITIONAL REQUIREMENTS

There are nine main factors influencing the nutritional requirements of beef cows. Each are discussed below.

1. Stage of Production

One of the most challenging aspects of beef cow nutrition is that their requirements change during the course of a year based on stage of pregnancy and lactation. A typical beef cow year may be divided into four different periods.

- **Period 1: Post-calving**

This is perhaps the most crucial period in the beef cow year in terms of production and reproductive efficiency. The cow must nurse a newborn calf and prepare her body for rebreeding within 80 to 85 days in order to calve at the same time next year. Therefore, inadequate herd nutrition during this period will result in lower milk production and calf weaning weights and a lower percentage of animals breeding back during the desired time period.

- **Period 2: Pregnancy and Late Lactation**

Because the nutritional requirements of early pregnancy is relatively small and high quality forages are normally available, Period 2 is not considered a crucial nutritional period. During this time, a high quality free-choice mineral will be all the supplementation necessary.

- **Period 3: Post-weaning and Mid-gestation**

During this period the cow is not nursing a calf and the requirements for the developing fetus are still relatively low. Therefore, the cow's nutrient requirements are low. Period 3 is a good time to maximize the use of crop residues and other low quality forages. However, it is important to not let cows lose body condition.

- **Period 4: Pre-calving**

This period, which begins approximately 60 days prior to calving, is another crucial reproductive period. During this time, fetal growth is at its maximum. Approximately 75% of the fetal growth occurs during the last 2 to 3 months. Inadequate nutrition during this period may result in:

- Lighter calf birth weights. However, calving difficulty will not be reduced
- Lower calf survival
- Lower milk production and calf growth
- Delayed estrus

2. Weather

Cold weather greatly increases the nutritional requirements. Therefore, during cold weather the cow's diet may need to be supplemented to allow for the additional requirement. Cattle perform optimally in their "thermoneutral zone", where temperatures are neither too hot or too cold. When the ambient temperature, which includes wind, humidity, solar radiation and air temperature, is outside of that zone, cattle performance is depressed. The most common situation cattlemen face is an ambient temperature below the lower critical temperature or the lower range of the thermoneutral zone. In addition to the weather conditions, the animal's insulation influences the critical temperature (Table 2).

Table 2. Estimated Lower Critical Temperatures for Beef Cattle

Coat Description	Critical Temperature
Wet or summer coat	59°F
Dry fall coat	45°F
Dry winter coat	32°F
Dry heavy winter coat	18°F

Table 3 gives examples of the amount of specific feedstuffs, such as grain or hay, needed to meet the additional energy requirements incurred by weather stress. It should be pointed out that in some cases simply feeding more of a low quality feedstuff will not meet these additional requirements, in which case the energy density of the diet must be increased by either feeding a high quality forage or by adding a high energy supplement. The general rule of thumb is to increase the energy density of the winter ration by 1% for each degree (F) below the lower critical temperature.

Table 3. Effect of Temperature On Energy Needs (Assuming A Dry Winter Coat)

Effective Temperature	Increase % in Energy Required	Amount of Extra Hay Needed or	Extra Energy Supplement Needed
50°F	0	0	0
30°F	0	0	0
10°F	20	3½-4 lbs/cow	2-2½ lbs/cow
-10°F	40	7-8 lbs/cow	4-5 lbs/cow

3. Size

As cow size increases the nutritional requirements for energy and protein increases. This would be expected because the larger a cow is, the more energy and protein it takes to maintain normal body functions. As a general rule, each 100 pound change in weight changes the Net Energy for Maintenance requirement by 0.57 Mcal and the crude protein requirement by 0.1%.

4. Cow Body Condition Score

Body condition scores are used to suggest the relative fatness or body condition of the beef cow. The most commonly used system is one that ranges from 1 to 9, with a score of 1 representing very thin body condition and 9, extreme fatness. A cow in a body condition score of 5 should be in average flesh condition and represents a target that many cattlemen strive for.

5. Milk Production

Milk production places tremendous demands for nutrients on beef cows. Not only does milk production put tremendous nutritional stress on beef cows, but peak lactation usually occurs at 60 - 80 days postpartum, which just precedes the start of the breeding season. Also it is important to remember that, as discussed earlier, milk production has a higher biological priority than does reproduction.

6. Age

Age influences the nutritional requirements because a young animal is still growing and growth has the second highest priority for nutrients. Many producers routinely indicate that most of their "open" cows are 2 and 3 years old. The failure of these females to rebreed means that nutrition was inadequate to meet maintenance, growth and milk production and still allow for reproduction. If possible, young females, along with old or thin cows, should be fed separately from the mature cows during the winter so that their additional nutritional requirements for growth and/or condition can be met.

7. Physical Activity

The maintenance requirement of beef cows is increased by activity. A cow being wintered in a drylot will require less Net Energy for Maintenance than grazing animals. Those cows having to graze over wide areas to find feed will expend much more energy searching for food.

ENERGY NUTRITION OF THE COW HERD

Although corn or other grains can be utilized to increase energy intake in cows, the starch contained in grains can also have a negative impact on forage intake and fiber digestibility. Under pasture or forage feeding conditions, the rumen is host to bacteria and other microorganisms designed to break-down fiber. When starch from a grain source is fed, these bacteria begin to break down the starch because it is a more easily accessible energy source for the bacteria. The pH of the rumen may also decline with the addition of grain to the diet and may inhibit optimal fiber digestibility. Therefore, caution should be exercised when feeding grain to cattle consuming low quality forages if the goal is to maximize utilization of homegrown forages and pastures. Feeding a high grain-based supplement in excess of 4 pounds per head daily can reduce forage consumption, as well as decrease the amount of energy derived from the forage.

An alternative to using grain as an energy source for cows needing additional condition is to utilize digestible fiber-based supplements or ingredients that are high in digestible fiber. These supplements will substitute for the forage the cows are consuming as can grains, but do not have the negative affect on fiber digestibility that grains do. High quantities of the digestible fiber-based supplements can be fed under conditions where homegrown forages and pasture resources are limited.

In the event that forage resources become limiting, a minimum of 0.5 pounds of hay per 100 pounds of body weight should still be fed to minimize digestive problems. The remainder of the cow's energy requirement could then be met with a digestible fiber-based supplement. In some cases, grain will be needed to meet her energy needs. Keep in mind that there is no place where it says that cows have to be full fed. A minimum of forage can be fed without having to fill her up with a high energy supplement. In other words, feed to her requirements. A disadvantage of limit feeding the cow herd is that cows will become more aggressive and linger around the feeding area longer. To help alleviate this problem, a poor quality roughage source could be used to fill her up after she has been fed her minimum amount of forage and energy supplement. More labor is required under these conditions and it is important that all cattle have access to forage and supplement at the same time.

UTILIZING NONPROTEIN NITROGEN WITH THE BREEDING HERD

Much of the research would suggest that as the level of urea in a range supplement increases, fiber digestibility decreases, forage intake decreases and cow body weight loss increases.

It is well known that ruminal microbes can utilize nonprotein nitrogen (NPN) to form microbial protein. However, because a NPN source like urea is broken down rapidly in the rumen, there needs to be a readily available carbohydrate source for ruminal microbes to be able to assimilate the nitrogen and carbohydrate into microbial protein.

Under range and pasture conditions, specifically dormant conditions, there is often plenty of carbohydrate available in the form of fiber, however, it is broken down much more slowly than the urea, resulting in an unsynchronized release of nitrogen and carbohydrate. With grain feeding, as is typical in a feedlot situation, the carbohydrate source is starch, which is broken down at a rate more similar to that of urea; thus, we are able to utilize higher levels of urea. Liquid supplements are a little different situation. Many of the liquid supplements contain high levels of urea, but also contain high levels of molasses compared to dry supplements. With liquid protein supplements, the carbohydrate (molasses) and NPN are broken down at a more similar rate, allowing for better utilization of the NPN.

The use of NPN under range and forage conditions has been studied by various universities. Oklahoma State University conducted earlier work in the 1980's, while more recently (1994 and 1995), urea utilization in range cattle has been studied at Kansas State University. Both sets of research data, as well as others, suggest that not more than 15 to 30% of the total crude protein should come from NPN sources in dry supplements.

Additional concerns have been expressed with regard to excess urea feeding and subsequent reproductive performance. Some of the reduced reproductive efficiency seen in research studies could be due to higher magnitudes of body weight and condition loss seen with the high urea supplementation levels used in some of these studies. Another possible theory has been altered uterine pH with urea feeding.

AFFECT OF ENERGY AND PROTEIN LEVEL PREPARTUM ON CALVING DIFFICULTY & REPRODUCTIVE PERFORMANCE

A summary article by Houghton et al. (1990) showed that energy and/or protein supplementation does not increase calving problems in cows. Supplementation of these nutrients above NRC recommendations for the last 100 days prior to calving can increase calf birth weight without affecting calving difficulties. Meeting or exceeding the NRC energy and protein requirements can also increase calf weaning weight and pregnancy rate while also decreasing the postpartum interval. Energy and protein levels below requirements can decrease calf vigor, calf survival and calf birth weight, possibly by decreasing the calf's ability to maintain adequate heat production or resulting in a calf that is slower to nurse after calving. There is a strong correlation between protein status of the cow and weak calf syndrome in the newborn calf.

PROFITABILITY

Table 4 lists some key factors that can influence the profitability of the cow herd and what a 10% change in any one of those factors can do to the calf break-even price and dollar return to the cow.

TABLE 4. FACTORS THAT ALTER PROFITABILITY IN THE COW HERD

Factor	Change	Decrease in Break-Even Price (\$/cwt.)	Increase in Return (\$/cow)
Weaned Calf Crop	+10%	9.15	36.87
Weaning Weight	+10%	7.69	30.75
Calf Price	+10%	0.00	30.75
Total Feed Cost	+10%	5.83	18.60
Interest Cost	+10%	1.64	5.25
Cull Cow Weight	+10%	2.08	6.65
Cull Cow Price	+10%	2.08	6.65
All Combined	+10%	\$24.70	\$143.41

(Adapted from Larry Corah, 1995)

Notice that the greatest return was obtained when the weaned calf crop was increased 10%, followed by increasing weaning weight and calf price 10%. The cow/calf producer should strive for at least a 95% calf crop weaned, a 205 day adjusted weaning weight of 550 pounds and a calving interval close to 365 days. In order for a 365 day calving interval to be achieved, the postpartum interval must be no longer than 80 to 85 days based on a 285 day gestation period. Total feed cost per cow is an important factor influencing profitability in the cow herd. Typically, the cost of keeping a cow should be less than \$350 per year. This means more than the cost of supplement and mineral. Short changing a cow protein, energy, minerals and vitamins can have a negative impact on many of the other factors listed in the above table. Total feed costs can be reduced by closely matching available forage resources with the needs of the cow based on her stage of production. Cows during the gestation period typically do not need high quality forage such as alfalfa hay to meet their requirements. In many cases, it may be more economical to sell off a portion of the high quality forage and buy back a forage that more closely meets the cow herd's nutrient requirement. Minimizing the use of harvested forages and maximizing the use of crop residues are a couple other ways that total feed costs can be reduced.

FACTORS AFFECTING DRY MATTER INTAKE

Several factors influence the dry matter intake of a beef cow. A few of the most important are:

- 1. Quality of available forage**
- 2. Protein content of the diet**
- 3. Environment**
- 4. Water intake**

The quality of forage probably has the largest impact on dry matter intake. Generally higher quality forages result in higher levels of forage intake. Indigestible or slowly digestible components decrease forage intake. Since protein is required by the rumen microorganisms to digest forages, it is very important that the cow's protein requirement be met. If protein intake is inadequate, voluntary intake of forages will be substantially reduced. The data shown in Table 5 from Oklahoma State University illustrates the relationship between forage quality and protein on forage intake.

Table 5. Expected Intake Levels Of Forage Varying in Quality With and Without Supplementation Forage Intake (% Body Weight, DM Basis) of Beef Cows

Roughage Type	Dry, Bred Cow	Lactating Cow
Low quality roughages:		
Unsupplemented	1.5	2.0
With protein supplement	1.8	2.2
With energy supplement	1.5	2.0
Average Quality Roughages:		
Unsupplemented	2.0	2.3
With protein supplement	2.2	2.5
With energy supplement	2.0	2.3
High Quality Roughages:		
Unsupplemented	2.5	2.7
With protein supplement	2.5	2.7
With energy supplement	2.5	2.7

(C.A. Hibbard and T.A. Thrift, Oklahoma. Presented at 1992 National Meeting of ASAS.)

Weather conditions can also influence forage intake by disrupting grazing patterns. Cold weather generally increases forage intake, while windy or wet weather reduces grazing time and intake (Table 6). Water is important because if adequate water is not available, dry matter intake will be reduced resulting in less than optimum performance.

Table 6. Affect of Temperature on Dry Matter Intake

Temperature, °F	Dry Matter Intake Adjustment
>95°	-35%
77°-95°	-10%
59°-77°	No Adj.
41°-59°	+3%
23°-41°	+5%
5°-23°	+7%
<5°	+16%

(Adapted from Fox et al., 1988)

COW BODY CONDITION AND DIET FORMULATION

As previously mentioned, the nutrition of the cow has a drastic impact upon reproductive efficiency. Keep in mind that most of the problems relating to poor reproductive performance and low weaning weight, can be directly attributed to inadequate energy and/or protein intake, not to a trace mineral or vitamin deficiency. Only after the protein and energy requirements have been met should the focus turn to mineral and vitamin nutrition.

Research and economic studies in various states show that well-formulated diets and efficient use of forage resources tend to reduce the feed costs. Body condition scoring puts a quantitative score on a procedure many cow-calf producers have followed for years to formulate sound nutrition programs. Body condition scores (BCS) allow producers to sort cattle according to their nutritional needs. Identifying animal needs and feeding them appropriately can have a great impact on reproductive efficiency. A 1988 South Dakota State University study by Pruitt and Momont, illustrates the relationship between BCS and percentage of cows cycling (Table 7).

Table 7. Effect of Body Condition Score on Percentage of Cows Cycling

Body Condition Score	No. of Cows	% of Cows Cycling		
		May	June	July
Early Calving Cows				
March condition score (prior to calving)				
≤4	45	10.0	28.2	70.5
5	84	17.8	43.5	85.6
6	43	41.9	77.5	97.5
≥7	25	45.9	76.6	94.7
Late Calving Cows				
March condition score (prior to calving)				
≤4	14	0.0	0.0	44.7
5	41	7.5	26.0	74.4
6	22	0.0	35.3	98.5
≥7	6	0.0	65.8	99.1

(Pruitt and Momont, South Dakota State University, 1988)

The most commonly used means to body condition score animals is the nine point system described below:

- BCS 1** Bone structure of shoulder, ribs, back, hooks and pins is sharp to the touch and easily visible. Little evidence of fat deposits or muscling.
- BCS 2** Little evidence of fat deposition but some muscling in the hindquarters. The spinous processes feel sharp to the touch and are easily seen with space between them.
- BCS 3** Beginning of fat cover over the loin, back and foreribs. The backbone is still highly visible. Processes of the spine can be identified by touch and may still be visible. Spaces between the processes are less pronounced.
- BCS 4** Foreribs are not noticeable but the 12th and 13th ribs are still noticeable to the eye, particularly in cattle with a big spring of rib and width between ribs. The transverse spinous processes can be identified only by palpation (with slight pressure) and feel rounded rather than sharp. Full but straight muscling in the hindquarters.
- BCS 5** The 12th and 13th ribs are not visible to the eye unless the animal has been shrunk. The transverse spinous processes can only be felt with firm pressure and feel rounded but are not noticeable to the eye. Spaces between the processes are not visible and are only distinguishable with firm pressure. Areas on each side of the tail head are well filled but not mounded.
- BCS 6** Ribs are fully covered and are not noticeable to the eye. Hindquarters are plump and full. Noticeable sponginess over the foreribs and on each side of the tail head. Firm pressure is now required to feel the transverse processes.

- BCS 7** End of the spinous processes can only be felt with firm pressure. Spaces between processes can barely be distinguished. Abundant fat cover on either side of the tail head with evident patchiness.
- BCS 8** Animal takes on a smooth, blocky appearance. Bone structure disappears from sight. Fat cover is thick and spongy and patchiness is likely.
- BCS 9** Bone structure is not seen or easily felt. The tail head is buried in fat. The animal's mobility may actually be impaired by excessive fat.

When using the BCS system, remember that the goal is to strive for a BCS at calving, which will allow the cows in a given operation to be both reproductively and economically efficient. Data indicates that on the average, producers should strive for a BCS of 5 at calving for mature beef cows. Two-year old, first calf heifers, however, may need to have a BCS of 5.5 to 6 when they calve. This slight increase in condition in young cows can help compensate for the additional nutrient demands for growth and help these cows resume cycling activity in a timely manner. Ideally producers would sort two-year old young cows and thin mature cows into a separate group, allowing these animals to be fed a more nutrient dense ration.

There are some key times during the year that cows should be body condition scored to maintain optimal reproductive performance in the herd.

- Spring Calving Operation
- Mid Summer
- Weaning in the Fall
- 60 Days Prior to Calving
- Calving Time
- Beginning of the Breeding Season

Evaluating body condition at mid-summer can provide an indication of pasture conditions and stocking density. If by mid-summer, cows have not regained weight lost since calving, it could be an indication that stocking density may be too high for the pasture conditions. Evaluating cow body condition at weaning time can help decide the type of supplementation program needed for the coming winter. If cows are in poor condition 60 days prior to calving, it will be more economical to put condition on them, than to wait until after calving. Monitoring cow body condition at calving time can help decide how long the supplementation program should be extended. If cows are in thin condition at the beginning of the breeding season, it may warrant extending the breeding season in an attempt to increase the number of cows cycling.