Supplements and Supplementation Strategies

Used to Keep Livestock Productive During the Winter Feeding Period

6

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Having learned about nutrient requirements, feed value, and forage evaluation in previous chapters, you probably have discovered that the winter feed resources available on your operation don't always meet the requirements of your cows and heifers at every physiological state. Late-gestation and early-lactation cows have increased nutritional requirements. Bred heifers have these same requirements plus the elevated nutritional demands of body growth. These increased demands, combined with the lower quality feed that often is fed during the winter, commonly create a need for nutrient supplementation.

Determining how much and what kind of supplementation you need

There are three nutritional components that may need to be supplemented: protein, energy, and minerals. Supplements are feedstuffs that are added to the base forage to provide the nutrients required to support the desired level of production. The goal of supplementation is to supply the difference between the animal's requirements and the nutrients available through forage. Supplementation of protein and energy is discussed in this chapter. Chapter 4 discusses supplementation of minerals.

To develop a supplementation plan, begin by answering the following questions.

1. What is the physiological state of the animal?
2. What nutrients (and amounts of those nutrients) are required for the desired level of production? Keep in mind that cattle require quantities of nutrients, not percentages of nutrients. Percentages apply only when the animal's intake is the same as the predicted intake. It is best to break percentages down into quantities when evaluating rations and feeds (see Chapter 1).
3. What is the nutrient content of the forage available to you?
4. How much forage is available?

After you answer these questions, you should have a pretty clear idea of what you need to supplement. A common mistake is to "blanket supplement," or to buy a supplement that includes protein, minerals, and a little energy. These supplements are fine if they provide what you need, but often they cause producers to waste money supplementing something that isn't deficient.

A worksheet to help you determine what supplement is best for you is included at the end of this chapter (Worksheet 6.1).

Protein supplementation

Protein is a crucial part of the diet that often is deficient in winter-feeding situations. Both the animal itself and ruminal microorganisms need protein; hence, protein deficiency can severely depress animal performance. Research shows that protein deficiency also can suppress appetite and limit intake. Limited intake leads to an increased potential for other deficiencies.

If you determine that your forage is deficient in protein, you will want to consider: (1) what kind of protein supplementation is available, (2) the nutritional value of those supplements, and (3) the costs associated with using them.

Nonprotein nitrogen vs. natural protein

An important consideration in choosing a protein supplement is whether the supplement is nonprotein nitrogen (NPN) or natural protein. Nonprotein nitrogen is a good source of nitrogen, but it does not contain preformed amino acids. Natural proteins, on the other hand, are made up of amino acids.

Ruminal microorganisms can use NPN effectively as a nitrogen source in the production of microbial protein; however, NPN is not utilized as efficiently as natural protein. While utilization of NPN varies greatly (Table 6.1), you might expect 50 to 60 percent efficiency when feeding NPN with high-forage diets. The actual utilization depends on the source and the base diet of the animal.

Table 6.1. Comparison of the utilization rate of nonprotein nitrogen (NPN) in liquid and dry forms when supplementing various feeds.

Study	NPN efficiency (as a % of natural protein)
Oklahoma—dry range	
Dry urea (6 studies)	92
Liquid urea (3 studies)	84
Maryland—corn stalks	
Liquid supplement	55
Southern Illinois—corn stalks	
Liquid supplement	14
Oklahoma—dry range	
Dry urea	37
Nebraska—dry range	
50% NPN/50% natural protein	74

Source: National Research Council. 1976. *Urea and Other Nonprotein Nitrogen Compounds in Animal Nutrition*. National Academies Press, Washington, DC.

Consider the above factors when pricing and purchasing a protein supplement. In addition, be aware that an NPN protein source should not exceed one-third of the animal's total protein requirements.

Supplement options

Oilseed by-products such as cottonseed meal and soybean meal are common sources of protein supplements. These sources of natural protein contain more than 40 percent crude protein (CP) and a high density of energy. They work especially well when energy supplementation also is needed. The drawback to oilseed by-products is that they are relatively expensive.

Alfalfa or alfalfa cubes are another common protein supplement, especially in areas where they are readily available. Alfalfa is a good source of natural protein that provides the same benefits as other protein supplements when fed on an equal crude protein basis.

One potential drawback to alfalfa is that it doesn't have the high caloric density that some oilseed meals do. Thus, it may not be as effective if an energy source is also needed. One advantage is that it does not require special equipment or facilities to deliver it to the herd.

Commonly used sources of nonprotein nitrogen are urea and biuret. These products may be available as a liquid (typically with molasses as the carrier) or in a dry form (usually with a grain as the carrier). While these supplements may seem to be the most economical, keep in mind that NPN is not used as efficiently as natural protein.

Finally, high-quality grass hays may be a potential supplement for low-quality forages. They typically have a lower crude protein content

Table 6.2. Chemical composition of some potential feed ingredients used as sources of supplemental protein for low-quality forages.[a]

Protein source	CP (%)	% of CP DIP	% of CP UIP	TDN (%)	ME (Mcal/kg)
Brewers grain	26	41	49	7	2.53
Canola meal	41	68	32	69	2.49
Coconut meal	22	62	38	64	2.31
Corn gluten meal	47	38	62	84	3.04
Cottonseed meal					
Mech	44	57	43	78	2.82
Sol-41% CP	46	57	43	75	2.71
Sol-43% CP	49	57	43	75	2.71
Distillers grain	30	45	55	90	3.25
Soybean meal-44	53	80	20	84	3.04
Soybean meal-49	50	65	35	87	3.15
Soybean, whole	40	65	35	94	3.40
Sunflower meal	26	38	62	65	2.35
Urea	291	100	0	0	0
Alfalfa hay					
Vegetative	22	86	14	64	2.31
Early bloom	20	84	16	62	2.24
Midbloom	17	82	18	60	2.17
Full bloom	13	77	23	56	2.02
Wheat middlings	18	77	23	83	3.00
Tall fescue hay	9	67	33	56	2.02
Meadow hay	13	77	23	60	2.17

[a]CP = crude protein; DIP = degradable intake protein; UIP = undegradable intake protein; TDN = total digestible nutrients; ME = metabolizable energy

Source: Torell, R. and J. Balliette. 1994. Pricing Protein and Energy Supplements. CL313 in *Cow–Calf Management Guide and Producer's Library*. Agricultural Communications, College of Agricultural and Life Sciences, University of Idaho, Moscow, ID.

than do protein supplements, but, depending on the base diet and their availability, they might be a viable option.

Cost analysis

Once you have determined how much protein you need to supplement, and what supplements are available, you need to do a cost analysis. It is essential that you compare the cost per ton of utilizable protein, not the cost per ton of supplement. Looking at the cost per ton of supplement can be very misleading.

Keep in mind that you are buying a specific nutrient, either protein or energy. Mineral requirements typically can be met with a less expensive free choice salt/mineral program. You do not want to pay for something you don't need!

The following steps will guide you through the cost analysis process.

1. Determine the total pounds of nutrients in 1 ton of supplement. To do so, multiply 2,000 pounds by the percentage of the nutrient in the supplement.

   Example:

   2,000 lb x 0.17 (17% CP alfalfa hay) = 340 lb of actual protein

2. Determine the cost per pound of nutrients. Divide the per-ton price of feed by the pounds of actual nutrient contained in a ton.

   Example:
   $100/ton ÷ 340 lb CP = $0.29/lb of protein

Therefore, the cost of protein in the alfalfa hay listed above is $0.29/pound ($580/ton). Use this value in your cost comparison.

If a protein supplement consists partially of NPN, you need to account for the lower utilization of NPN when figuring the cost per ton of protein. You want to figure the cost per ton of utilizable protein. Following is an example of how to make this adjustment.

1. Determine the amount of utilizable protein in the supplement.
   % NPN x utilization rate = % utilizable protein (from NPN)

   Example—liquid supplement:
   Crude protein, not less than 25%
   Includes not more than 18.5% equivalent protein from nonprotein nitrogen
   25% – 18.5% = 6.5% natural protein
   18.5% x 0.6 utilization = 11.1% utilizable protein (from NPN)
   6.5% natural protein + 11.1% utilizable NPN = 17.6% total utilizable protein

When calculating the cost per pound of protein in this supplement, you would use 17.6 percent as the protein content.

Energy supplementation

Energy is another nutrient that is commonly supplemented into low-quality forage diets during critical periods of the biological cycle. Energy supplementation leads to problems not encountered when supplementing for protein. High-energy feeds have been shown to decrease forage utilization. In other words, cattle tend to use energy supplements as a replacement or substitute for lower-quality forage instead of as a

supplement. The degree to which they use energy as a replacement depends on the forage quality, the amount of energy in the supplement, the protein in the diet, and the energy source.

Supplement options

There are two general types of energy supplements: starch-based supplements and fermentable fiber sources. Starch-based supplements include grains such as corn, sorghum-grain, barley, oats, and wheat. Sources of fermentable fiber include soybean hulls, wheat middlings, beet pulp, and corn gluten feed.

Starch-based supplements can depress forage intake and digestibility by increasing the proportion of starch-digesting bacteria and decreasing the number of fiber-digesting bacteria within the rumen. While results vary, supplementation of grain at 0.4 percent of body weight or less typically does not depress the intake and digestibility of low-quality forage by beef cattle. At supplementation levels greater than 0.8 percent of body weight, forage intake and digestibility can be greatly depressed.

Supplementation with fermentable fiber sources generally does not decrease forage intake and/or digestibility as much as grain-based supplements. Fermentable fiber supplemented at rates of 0.2 to 0.8 percent of body weight has yielded favorable results.

Cost analysis

As in the case of protein, cost analysis of energy is an important step in determining which energy source is best for your operation. A number of different measures of energy are used in evaluating feedstuffs (see Chapter 3, page 30). Regardless of the measure you use, it is important that you be consistent. Cost analysis of energy follows the same steps as cost analysis of protein.

Frequency of supplementation

The frequency with which you supplement depends on whether you are supplementing protein or energy. Energy should be supplemented on a daily basis, as infrequent and irregular supplementation of energy can cause digestive problems.

Frequency of protein supplementation is more flexible. Ruminants have the ability to recycle absorbed nitrogen back to the rumen. Therefore, research has shown that infrequent protein supplementation is acceptable and safe as long as it results in the same total amount of supplement. Thus, you can save labor and time by supplementing every 2 to 7 days rather than every day.

Additionally, studies show less variation in weight change and supplement intake within a herd when supplementation is less frequent. There probably is less competition for the supplement when greater quantities are provided in a single feeding.

When practicing infrequent supplementation, be aware that you still must provide the same total amount of supplement, just in a larger quantity less frequently. Infrequent supplementation works best with natural protein supplements.

In the case of either protein or energy supplementation, be sure to provide adequate space for cattle to access the supplement. This will help prevent excessive variation in consumption within the herd.

Supplement placement

In many parts of the Northwest, stockpiled dormant forages are used as a winter feed resource. In this case, it is advantageous to feed supplements in a location that encourages more efficient use of the stockpiled forage. You might move the supplement site to increase use of the forage in specific areas and discourage the tendency of animals to remain at a supplement site where feed is not available. While the supplement may be necessary to meet the animals' nutrient requirements, it also is a potential tool for achieving management goals.

Other considerations

As in any management situation, the selection of protein and energy supplements is not always straightforward. Factors beyond price must be considered. The convenience, or feedability, of the product is important. Labor and time are valuable. It might be worth extra cost to drop off a feed tub or block once a week instead of having to load and feed one or several loads of alfalfa once or twice a week. Product availability also is critical.

Finally, consider what other nutrients you must supplement to balance the ration. If your ration is deficient in protein, energy, and minerals, and you can find one product that satisfies all of the deficiencies, it might be worth the extra cost. While vitamins and minerals can be supplemented in a free-choice salt/mineral supplement, the convenience of an all-in-one product may be worth the extra dollars. In this respect, each operation differs. It is up to you as the manager to use cost analysis and consider other factors to make the best choice for your operation.

References

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Worksheet 6.1
Determining Which Supplement Is Best for You

1. What supplements are available and what is their cost?
(Figure cost based on ton of nutrient, not on ton of supplement. Examples are included below to help you work through the cost comparison.)

Example supplements—nutrient content and cost[a]

Supplement	Energy content (% TDN)	Protein content (% CP)	NPN (%)	Cost/ton of supplement	Cost/ ton of nutrient
Alfalfa	60	19	0	$100	$526 (CP)
Liquid		25	18	$280	$1,573 (CP)
Barley	73	11	0	$200	$273 (TDN)
Tub		18	18	$250	$1,389 (CP)

[a]TDN = total digestible nutrients; CP = crude protein; NPN = nonprotein nitrogen

Alfalfa
0.19 (% crude protein) x 2,000 lb = 380 lb of protein/ton of alfalfa
$100/ton of alfalfa ÷ 380 lb of protein = $0.26/lb of protein x 2,000 lb/ton = $526.32/ton of protein

Liquid
25% – 18% = 7% natural protein
18% x 0.60 (NPN utilization) = 10.8% utilizable protein from NPN
7% natural protein + 10.8% utilizable NPN = 17.8% total utilizable protein
0.178 (% crude protein) x 2,000 lb = 356 lb of protein/ton of liquid
$280/ton of liquid ÷ 356 lb of protein = $0.79/lb of protein x 2,000 lb/ton = $1,573/ton of protein

Barley
0.73 (% TDN) x 2,000 lb = 1,460 lb of protein/ton of barley
$200/ton of barley ÷ 1,460 lb of TDN = $0.14/lb of TDN x 2,000 lb/ton = $273/ton of TDN

Protein tub
0.18 (% CP) x 2,000 lb = 360 lb of protein/ton of tub
$250/ton of tub ÷ 360 lb of protein = $0.69/lb of protein x 2,000 lb/ton = $1,389/ton of protein

continued on next page

Worksheet 6.1 (continued)
Determining Which Supplement Is Best for You

2. Other factors that are very important when choosing a supplement are: (1) how much of the supplement cows will need to eat to balance the ration, and (2) whether it is physically realistic for them to eat that amount of that particular supplement.

Review the amount of protein (pounds) needed to supplement the forage you are feeding (see Chapter 5) and enter below:

Pounds of supplemental protein required to meet the cows' protein requirement _____lb

What type of protein supplement do you prefer to use (based on convenience and price/nutrient needed—see above)? _____

What is the percentage of protein in the supplement? _____

How much will each animal need to consume to meet its requirement?_____

Example
Your mature cows are grazing on dry winter range. The grass they are eating is about 4.5% CP. Daily consumption is about 21 lb DM, and their protein requirement is 7.8%, or 1.6 lb of CP. You are planning to supplement with a baked protein tub containing 18% CP (all natural).

Pounds of supplemental protein required to meet the cows' protein requirement: 0.655 lb
(21 lb DM x 4.5% CP = 0.945 and 1.6 lb CP – 0.945 = 0.655 lb)

What type of protein supplement do you prefer to use (based on convenience and price/nutrient needed—see above)? Protein tub

What is the percentage of protein in the supplement? 18%

How much will each animal need to consume to meet its requirement? 3.64 lb
(See below for calculations.)

Calculations
0.18 (protein content of baked tub) x _____(amount of tub consumed) = 0.655 lb (protein needed to balance ration)

0.655 ÷ 0.18 = 3.64 lb of supplement consumed to balance ration

Many of the protein tubs suggest consumption levels of 1.5 to 2 pounds/animal. If each cow needs to eat 3.5 pounds of supplement from the tub, you might look for a different source of protein, where consumption likely would be greater.