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Formulating Supplements for Beef Cows

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Although the basic diet of most South Dakota beef cows is primarily forages, the nutritional content of those forages varies greatly. Type, stage of maturity, and whether and how the forage is harvested and stored all make a difference.

The nutritional needs of beef cows differ, as well. Nutritional needs are based on stage of production, age, size, condition, and weather.

Providing for the nutritional needs of beef cows in most South Dakota herds is a matter of supplementing the existing diet to correct specific deficiencies. This is particularly important from late fall to spring when nutritional deficiencies are most common. Supplements are generally not expected to make up a major part of the total diet or to provide a major share of needed nutrients.

Computing supplement needs

You can quickly calculate the daily supplement needs of your beef cows with a pocket or desk calculator. With minimal additional calculation you can then evaluate and compare costs of a variety of prospective supplements.

First you'll need to know:

1. daily nutrient requirements,
2. approximate daily intake of dry matter,
3. approximate nutrient composition of the basic diet,
4. nutrient composition of the supplement(s) to be considered, and
5. cost of the supplement(s) per pound.

You can get most of that information from Tables 1 and 2 in this publication.

With that information and this formula you can figure the amount of a given supplement needed per head per day.

$$\frac{I\,(N-D)}{(S-D)}$$

where:

I = daily dry matter intake
N = percentage of crude protein, digestible protein, total digestible nutrients (TDN), or any nutrient needed in the diet, expressed on a percent composition basis
D = percentage of N in the existing diet
S = percentage of N in the supplement

In this equation the values for N and D indicate how well the existing diet meets the need for the nutrient considered. If N is larger than D the diet is deficient. If N and D are equal the diet is balanced for that nutrient. And, if D is larger than N the existing diet contains excessive amounts of the nutrient.

To find the cost of the supplement per head per day multiply the pounds of supplement needed per head per day times the cost of the supplement per pound.

Dry matter intake

Dry matter intake varies considerably among cows, depending on size, level of production, and quality of feed, particularly roughages. Greatest dry matter intake can be expected with high quality forages. For dry pregnant cows, intake may range from 1.0-2.5% of body weight with an average of about 1.75%. Dry matter intake of lactating beef cows might vary from 1.5-3.5% of body weight. You can expect about a 2.25% dry matter intake for average milking cows and a 2.75% intake for superior milking cows.

Sample problem

Say a cattleman has a herd of mature 1100-lb beef cows with superior milking ability in early lactation being fed average quality prairie hay. He wishes to know how much 32% commercial supplement will be needed per head per day to balance for protein.

According to Table 1, mature 1100-lb beef cows of superior milking ability in early lactation need a minimum of 26.0 lb forage dry matter per day that contains 10.9% (.109) total protein. From Table 2 he can see average quality prairie hay contains 6.5% (.065) total protein on a dry matter basis. Note also in Table 2 that the protein content of a 32% commercial supplement will probably average about 34% (.34). The 32% is considered a minimum.

The amount of supplement needed per head per day can be calculated as follows:

$$\frac{26.0\,(.109-.065)}{(.34-.065)} = \frac{26.0\times.044}{.275} = \frac{1.144}{.275} = 4.16\text{ lb}$$

The daily diet, on a dry matter basis, then becomes 21.84 lb prairie hay plus 4.16 lb of 32% supplement (21.84 + 4.16 = 26.0).

Checking your calculations

Will 21.84 lb of prairie hay dry matter (d.m.) plus 4.16 lb of 32% supplement (d.m.) really meet his beef cows' needs?

You can check the calculations as follows:

21.84 lb prairie hay d.m. × .065 = 1.42 lb protein
4.16 lb supplement d.m. × .34 = + 1.41 lb protein
2.83 lb ÷ 26.0
= .109 or 10.9% protein

In the same manner, using appropriate values from Table 2, the ration can be checked for TDN:

21.84 lb prairie hay d.m. × .51 = 11.14 lb TDN
4.16 lb supplement d.m. × .81 = + 3.37 lb TDN
14.51 lb ÷ 26.0
= .558 or 55.8% TDN

Checking Table 1 again you can see that this diet is balanced for TDN, as well as for total protein.

On an "as fed" basis, the daily ration would be:

prairie hay—21.84 lb ÷ .90 (% d.m.)	=	24.3 lb
supplement— 4.16 lb ÷ .90 (% d.m.)	= +	4.6 lb
Total as fed		28.9 lb

Evaluating potential supplements

In the equation used to solve the sample problem the numerator (1.144) indicates the protein deficiency of the existing diet in pounds per day. The denominator (.275) indicates the net increase in dietary protein for each pound of supplement added to the diet. To compare different supplements all you need to do is substitute different denominators derived from the nutrient values of those different supplements. See the sample calculations that follow. Table 2 has the nutrient values you'll need.

Supplement considered	Denominator (S-D)	Calculation	Pounds d.m. needed per head daily
Alfalfa hay, early cut	.184-.065 = .119	1.144 ÷ .119 =	9.61
Brewers grains	.281-.065 = .216	1.144 ÷ .216 =	5.30
44% soybean meal	.48 -.065 = .415	1.144 ÷ .415 =	2.76

Any feed or combination of feeds can be considered. For example, you might want to feed your beef cows half alfalfa hay and half 44% soybean meal. The nutrient value of the combination would be the average of the feeds. If you did decide to supplement your beef cows' diet with a combination of feeds, you wouldn't have to mix them together. The feeds could be fed individually on an alternating basis.

Optional calculations

If for some reason you wanted to feed a predetermined quantity of a supplement per head per day you would need to know what the protein level in the supplement should be. You can figure that with the following equation. Use the same code letters indicated previously.

$$\frac{I(N-D)}{\text{lb of supplement}} + D$$

Considering the same herd of mature 1100-lb beef cows as in the earlier problem and feeding a predetermined 3.0 lb of supplement dry matter per head per day, you would find you needed a supplement with a 45% protein level.

$$\left[\frac{26.0\ (.109 - .065)}{3.0}\right] + .065 = \left[\frac{1.144}{3.0}\right] + .065 = .45 \text{ or } 45\%$$

Mineral and vitamin supplementation

Minerals and vitamins are not considered in these calculations. Free choice feeding of mineral supplements appears adequate under most conditions. As a rule, complex mineral mixtures are not necessary. Mineral supplements may be commercial or home-mixed, and in either case, the phosphorus content should be about 10%. Salt should be offered in addition to the mineral mix; in some areas the use of trace mineral salt may be suggested. Supplemental vitamins, especially vitamin A, may be included in the supplement or they can be provided by injection or periodically feeding a special vitamin supplement.

Table 1. Nutrient requirements of beef cows and heifers (Nutrient concentration in ration dry matter).

Weight	Daily gain	Minimum daily dry matter	TDN	Total protein	Digestible protein	Calcium	Phosphorus
lb	lb	lb	%	%	%	%	%
Dry pregnant mature cow—middle third of pregnancy							
900		13.5	52	5.9	2.8	.18	.18
1000		15.0					
1100		16.0					
1200		17.0					
Dry pregnant mature cow—last third of pregnancy							
900		15.5	52	5.9	2.8	.18	.18
1000		16.5					
1100		18.0					
1200		19.0					
Early lactation—average milking ability							
900		19.5	52	9.2	5.4	.28	.28
1000		20.5					
1100		21.5					
1200		23.0					

Table 1. (Cont.)

Weight	Daily gain	Minimum daily dry matter	TDN	Total protein	Digestible protein	Calcium	Phosphorus
lb	lb	lb	%	%	%	%	%
Early lactation—superior milking ability							
900		24.0	55	10.9	6.4	.39	.37
1000		25.0					
1100		26.0					
1200		27.5					
Pregnant yearling heifers—last third of pregnancy							
700	0.9	14.3	52	8.8	5.2	.22	.22
	1.3	18.5	52				
	1.8	20.8	57				
800	0.9	15.6	52	8.7	5.0	.20	.20
	1.3	20.1	52				
	1.8	23.7	55				
900	0.9	16.8	52	8.7	5.0	.19	.19
	1.3	21.8					

Table 2. Nutrient composition of common feedstuffs on a 100% dry matter basis.

Feedstuff	Dry matter %	Total protein %	Digestible protein %	TDN %	Calcium %	Phosphorus %
Grazing						
Mixed native plants						
Late spring and early summer		11.0	6.0	56	.38	.22
Late summer		7.5	3.5	53	.38	.18
Early fall		6.5	2.8	52	.38	.15
Late fall		5.5	2.3	50	.35	.14
Winter, good range condition		4.5	1.5	48	.35	.09
Winter, poor range condition		4.0	0.7	43	.35	.06
Crop residue (corn and sorghum), first 30 days		6.5	3.0	50	.30	.11
Crop residue (corn and sorghum), after 30 days		4.5	1.5	46	.30	.08
Wheatgrass pasture, early spring and fall		13.0	8.0	58	.40	.30
Roughages						
Alfalfa hay, early cut	90	18.4	12.7	59	1.25	.23
Alfalfa hay, midseason	90	15.9	11.4	56	1.25	.20
Alfalfa hay, late cut	90	13.6	9.5	53	.50	.15
Alfalfa-brome hay	90	16.0	12.0	54	1.30	.26
Barley straw	88	4.1	0.5	43	.34	.09
Brome hay	90	11.8	5.0	52	.40	.30
Corn cobs	90	2.8	0.0	47	.12	.04
Corn husklage	85	5.0	1.8	52	.30	.10
Corn silage	33	8.4	4.9	70	.28	.21
Oats hay	90	9.2	4.4	61	.26	.24
Oats straw	92	4.4	1.4	50	.33	.10
Prairie hay, early cut	90	8.5	4.1	53	.57	.19
Prairie hay, average	90	6.5	2.8	51	.35	.21
Prairie hay, late cut	90	4.5	1.5	47	.35	.10
Rye straw	90	3.0	0.0	40	.28	.10
Small grain chaff	89	6.5	2.0	56	.35	.10
Sorghum hay	88	7.0	3.5	58	.35	.20
Sorghum silage	30	6.3	1.7	58	.35	.20
Sudangrass hay	90	11.0	5.7	56	.56	.31
Stalklage, corn and sorghum	88	5.2	2.0	50	.30	.10
Wheatgrass hay, early cut	90	12.0	7.5	57	.35	.30
Wheatgrass hay, late cut	90	6.5	3.5	50	.35	.15
Wheat straw	89	3.6	0.4	48	.17	.08
Concentrates						
Barley	88	13.0	9.8	82	.09	.47
Beet molasses	78	8.7	5.0	75	.21	.04
Brewers grains	92	28.1	20.8	66	.29	.54
Ground ear corn	87	9.3	4.6	83	.05	.31
Milo	89	12.4	7.1	80	.04	.33

Table 2. (Cont.)

Feedstuff	Dry matter %	Total protein %	Digestible protein %	TDN %	Calcium %	Phosphorus %
Oats	89	12.4	9.3	75	.10	.43
Shelled corn	89	10.0	7.5	91	.02	.35
Soybean meal, 44%	90	48.0	41.0	81	.36	.75
32% commercial supplement	90	34.0	27.0	81	.22	.57
20% grain-base supplement	90	22.0	17.0	80	.15	.46
Wheat	89	14.6	11.4	88	.06	.47
Wheat screenings	89	16.9	12.2	77	.09	.40
Minerals						
Bonemeal, steamed	95				30.5	14.3
Dicalcium phosphate	96				23	18.6
Ground limestone	100				34	
Monosodium phosphate	97					22.5
Rock phosphate defluorinated	100				32	18
Sodium tripolyphosphate	96					26

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