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Substituting Grain for Hay in Winter Rations for Beef Cows

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Rations composed largely of roughages are commonly considered to be most economical for wintering beef cows. Substituting grain for roughage may be economical when roughages are scarce and prices are high relative to grains. Drought tends to shift the economics toward feeding grain as more energy can be transported per ton of feed in this form compared to hay.

Substituting a high energy feed (grain) for a low energy feed (hay) becomes economical when cattle can be wintered to achieve the same level of production but at a lower cost. Since grain usually costs more per pound than hay, a smaller amount of grain must be fed to be economically substituted for hay in such rations. This will require some system of restricted feeding.

Wintering Objectives

Pregnant cows should be wintered to maintain health and vigor and to support normal growth and development of the fetus. To rebreed successfully, cows should be fed to reach a moderate body condition (body condition score of 5) by the time of calving.

In wintering breeding stock, a basic question should be, "How can I provide an **adequate** ration at the **least** possible cost?" To find the answer to this question a producer needs to know:

- The animal's daily nutritive requirements.
- The nutritive value of common feeds.
- The substitution value of available feeds in relation to nutritive properties and cost.

Nutritive Requirements

Meeting the nutrient requirements of the pregnant cow is the basic underlying objective of any type of a wintering program. This can be done in a number of ways, and economics will normally dictate the feed combinations that should be considered. However, another concern is that the nutrient availability matches the nutrient needs for the cow during the various phases of pregnancy and lactation.

Substituting Grain for Hay

Table 1 shows the TDN (total digestible nutrient) value of various grains compared to prairie, sorghum-sudan, alfalfa and grass (bermudagrass, fescue or a mixture of grasses) hay. By using this table, the approximate feeding value of various grains in relation to hay may be determined. For example, on the basis of TDN, corn grain is worth 1.7 times as much as good quality grass hay, or 1 pound of corn will replace 1.7 pounds of grass hay in a beef cow wintering ration.

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Table 1. TDN Value of Various Grains Compared to Prairie, Sorghum-Sudan, Alfalfa and Grass Hay[1]

		Amount of Hay That Can Be Replaced by 1 Pound of Grain			
Grain	TDN	Prairie (47% TDN)	Sorghum-Sudan (56% TDN)	Alfalfa (60% TDN)	Grass[2] (53% TDN)
Corn	90	1.9	1.6	1.5	1.7
Barley	84	1.8	1.5	1.4	1.6
Oats	77	1.6	1.4	1.3	1.5
Sorghum, Milo	83	1.8	1.5	1.4	1.6
Wheat	88	1.9	1.6	1.5	1.7
Ear Corn	83	1.8	1.5	1.4	1.6

[1]TDN content of grains and hays is on a dry-matter basis.
[2]Grass hay is bermudagrass, fescue or a mixture of grasses.

Table 2, which is based on TDN value of feeds, shows the price that could be paid for various grains in relation to the price of grass hay.

For example, if good quality grass hay costs $50 per ton delivered, you could afford to pay up to $4.25 per hundredweight for corn grain or $3.75 per hundredweight for oats delivered. If grain can be bought for less than the value indicated in Table 2, the substitution of grain for part of the roughage in the winter ration of beef cows would be economical.

Table 2. Comparative Value of Grass Hay* and Grain for Wintering Cows

	Value of Grain per cwt					
Hay $/ton	Corn	Barley	Oats	Sorghum	Wheat	Ear Corn
30	$2.55	$2.40	$2.25	$2.40	$2.55	$2.40
40	3.40	3.20	3.00	3.20	3.40	3.20
50	4.25	4.00	3.75	4.00	4.25	4.00
60	5.10	4.80	4.50	4.80	5.10	4.80
70	5.95	5.60	5.25	5.60	5.95	5.60
80	6.80	6.40	6.00	6.40	6.80	6.40
90	7.65	7.20	6.75	7.20	7.65	7.20
100	8.50	8.00	7.50	8.00	8.50	8.00

*Grass hay is bermudagrass, fescue or a mixture of grasses which contain 53 percent TDN on a dry-matter basis.

The value of the various grains in relation to the price of prairie hay, sorghum-sudan or alfalfa hay can be calculated from the relative energy values shown in Table 1. Multiply the price per ton of the hay by the relative energy value of the grain and then divide by 20 to convert to a hundredweight basis. For example, if prairie hay costs $50 per ton, the amount you could afford to pay for corn would be
$\underline{\$50 \times 1.9}$ = $4.75/cwt.

Substitution Guide

In estimating total winter feed needs, the approximate amount of the various grains required to replace a ton of prairie hay, sorghum-sudan hay, alfalfa hay or grass hay is shown in Table 3.

Table 3. The Amount of Various Grains Required to Replace 1 Ton of Prairie, Sorghum-Sudan, Alfalfa or Grass Hay

	Grain Needed to Replace 1 Ton of Hay			
	Prairie	Sorghum-Sudan	Alfalfa	Grass*
Corn, lb	1052	1250	1333	1176
Barley, lb	1111	1333	1428	1250
Oats, lb	1250	1428	1538	1333
Sorghum, lb	1111	1333	1428	1250
Wheat, lb	1052	1250	1333	1176
Ear Corn, lb	1111	1333	1428	1250

*Grass hay is bermudagrass, fescue or a mixture of grasses which contain 53 percent TDN on a dry-matter basis.

Adapting to High Grain Rations

Acidosis, bloat and founder are always a risk when high grain rations are fed to ruminants. Grain should be substituted for only a part of the hay or other roughages. Be aware of the increased risk of digestive problems that may occur with high levels of grain. Adding Rumensin to the diet may help reduce the chances of digestive problems occurring.

To avoid digestive problems, start cattle on grain gradually. It usually takes two to three weeks to adapt to a high grain diet. A minimum roughage level of 0.75 percent of the body weight per day is suggested. If hay is extremely expensive, the daily hay allowance may be reduced to 0.5 percent, but there is an increased risk of digestive problems. Table 4 shows the minimum hay allowance for cows of various sizes.

Table 4. Minimum Daily Hay Allowance for Various Sizes of Cows Fed at a Rate of 0.75 Percent of Body Weight Daily

Body Weight Lb	100% Dry Matter	As-fed (88% Dry Matter)
	lb hay/cow/day	
900	6.75	7.7
1000	7.50	8.5
1100	8.25	9.4
1200	9.00	10.2
1300	9.75	11.1
1400	10.50	11.9

Table 5 presents TDN requirements during late pregnancy (11 months since calving), the amount of TDN supplied by hay allowances in Table 4 and the amount of corn needed to make up the deficit. As shown in Table 5, the amount of corn required would range from 8.2 to 10.9 pounds per head per day.

Table 6 lists TDN requirements for mature cows two months after calving and producing 10 pounds milk/day, the amount of TDN supplied by the hay allowance in Table 4 and the amount of corn required to make up the deficit.

Table 7 shows the amount of corn required to make up the deficit for cows two months after calving and producing 30 pounds milk/day.

The amount of other grains such as milo, wheat, etc., required to meet TDN needs of cows on forage at 0.75 percent of body weight could be calculated using the same procedure above. For example, for an 1,100 pound cow (Table 7), divide the TDN deficit 14.3 by the TDN of milo (74 percent, as-fed basis) to obtain 19.3 pounds milo per day, instead of 18.1 pounds of corn.

Because of possible digestive problems, it is suggested that wheat make up not more than one-half to two-thirds of the grain fed. If wheat is to be used, it might be mixed with oats, barley or ground ear corn. Unless the price of the grain dictates otherwise, the use of grains with “built-in roughage” such as barley, oats, and ear corn is advisable. These grains will likely perform most satisfactorily over a longer period of time and be less apt to cause feeding problems. Cattle being limit fed will often continue to

Table 5. Amount of Corn Required to Meet the TDN Deficit When Hay DM Is Fed at 0.75 Percent of Body Weight Daily to Mature, Gestating Cows (11 Months Since Calving)

Body Wt. Lb	TDN Requirement Lb/Day[1]	TDN Supplied by Hay DM @ 0.75 Percent of BW[2]	TDN Deficit Lb/Day	Corn Required Lb/Day[3]	Crude Protein Required Lb/Day[1]
900	10.1	3.6	6.5	8.2	1.5
1000	10.9	4.0	6.9	8.7	1.6
1100	11.7	4.4	7.3	9.2	1.7
1200	12.6	4.8	7.8	9.8	1.9
1300	13.4	5.2	8.2	10.4	2.0
1400	14.2	5.6	8.6	10.9	2.1

[1]Based on NRC (1996) requirements.
[2]Based on hay containing 53 percent TDN, dry-matter basis.
[3]Based on corn containing 88 percent dry matter.

Table 6. Amount of Corn Required to Meet the TDN Deficit When Hay DM Is Fed at 0.75 Percent of Body Weight to Mature Cows Two Months After Calving (10 Lbs Peak Milk)

Body Wt. Lb	TDN Requirement Lb/Day[1]	TDN Supplied by Hay DM @ 0.75 Percent of BW[2]	TDN Deficit Lb/Day	Corn Required Lb/Day[3]	Crude Protein Required Lb/Day[1]
900	11.7	3.6	8.1	10.2	1.9
1000	12.5	4.0	8.5	10.7	2.0
1100	13.2	4.4	8.8	11.1	2.1
1200	13.9	4.8	9.1	11.5	2.2
1300	14.7	5.2	9.5	12.0	2.3
1400	15.3	5.6	9.7	12.2	2.4

[1]Based on NRC (1996) requirements.
[2]Based on hay containing 53 percent TDN, dry-matter basis.
[3]Based on corn containing 88 percent dry matter.

Table 7. Amount of Corn Required to Meet the TDN Deficit When Hay DM Is Fed at 0.75 Percent of Body Weight to Mature Cows Two Months After Calving (30 Lbs Peak Milk)

Body Wt. Lb	TDN Requirement Lb/Day[1]	TDN Supplied by Hay DM @ 0.75 Percent of BW[2]	TDN Deficit Lb/Day	Corn Required Lb/Day[3]	Crude Protein Required Lb/Day[1]
900	17.2	3.6	13.6	17.2	3.5
1000	17.9	4.0	13.9	17.6	3.6
1100	18.7	4.4	14.3	18.1	3.7
1200	19.3	4.8	14.5	18.3	3.8
1300	20.1	5.2	14.9	18.8	3.8
1400	20.7	5.6	15.1	19.1	3.9

[1]Based on NRC (1996) requirements.
[2]Based on hay containing 53 percent TDN, dry-matter basis.
[3]Based on corn containing 88 percent dry matter.

act hungry despite their nutrient requirements being met. Always monitor body condition and adjust feeding rate as needed to maintain cows in moderate body condition.

Protein Not Considered

The comparative values of the various grains as shown in Tables 1 to 3 are based on estimated TDN values alone. Differences in protein content of feeds have not been considered. The higher protein grains (barley, oats and wheat) would be worth slightly more than is indicated in Table 2 especially if they are fed to younger stock which require more protein in the diet.

In many cases, especially with nursing cows, protein requirements are greater than the amount supplied by the grain and hay. Therefore, the hay should be analyzed for crude protein content and the amount of protein in the hay and grain should be determined. If the grain and hay fail to meet the protein requirement, a protein source such as cottonseed meal or soybean meal should be substituted for a portion of the grain to meet the protein needs of the animals.

How to Feed Grain

Preparation for feeding grain during the winter is something that should be considered. A producer has the alternative of using bunks or having the grain pelleted so feeding on the ground would be feasible. The choice should depend on labor, facilities, cost of bunks and cost of pelleting.

A little pencil work will determine the most economical method. If bunk feeding is selected, grains could be fed whole, except sorghum (milo) which must be rolled or ground. If vitamins, minerals and high protein feedstuffs are added to the grain portion, grains will need to be processed, such as coarsely grinding, to allow a uniform mix and prevent separation during storage and handling. Feed in a manner so each animal has an equal opportunity to eat. Provide at least 30 inches of feed bunk space per cow and try to feed at the same time each day. Sorting the herd into nutritional groups will aid in limiting the amount of grain fed. Timid mature cows can be wintered with heifers so they can get their daily allotment of feed.

Some producers may wish to try a self-fed salt-grain mixture. Such a system of feeding grain to breeding stock should be attempted with great caution and with special care to ensure the desired intake. It should be remembered that the proportion of salt to grain required to control grain consumption varies according to (1) daily grain consumption desired, (2) age and weight of the animal, (3) fineness of the salt, (4) salinity of the water, (5) severity of weather, (6) quality and quantity of hay or forage available and (7) length of the feeding period.

If this method is used, some trial and error is necessary to determine the proper ratio of salt to grain (and this will probably change during the winter). One might start by mixing one part salt to four or five parts of grain and subsequently change the proportion of salt as needed to control intake.

Warning: Forced salt consumption increases water intake. Be sure that clean, ice-free water is available at all times.

Don't Forget Vitamin A and Minerals

There is a good possibility that before spring green up beef cows may become deficient in vitamin A. Pregnant beef cows (900 to 1,300 pounds) need 25,000 to 35,000 I.U.'s of vitamin A per day before calving and 36,000 to 60,000 I.U.'s per day during lactation. Vitamin A may be included in the protein or energy supplement. A practical way to supplement vitamin A is to include it in the mineral mixture. This method works well if mineral and highly stable vitamin A are mixed weekly. Mineral consumption will vary, thus more vitamin A than is actually needed should be mixed with the mineral supplement.

Subcutaneous injections of vitamin A will bring liver stores up to normal. However, it is advisable to include vitamin A in the mineral or in the feed to ensure adequate amounts for cattle consuming poor quality hay or high amounts of grain.

Minerals most likely to be deficient in Arkansas forages are salt, phosphorus and magnesium. The trace minerals zinc, copper, selenium, iodine and cobalt may also be in short supply. When animals are maintained on a limited feed of a high concentrate ration, they may also be deficient in calcium and potassium.

Some Suggestions on Substituting Grain for Hay

- It is generally best to replace only part rather than all of the roughage. A minimum roughage level of 0.75 percent of the animal's body weight per day is suggested (see Table 4).
- The cattle should receive a balanced ration. It should provide adequate amounts of vitamins and minerals as well as protein and energy.
- Be sure you are equipped to feed grain. Grain should be fed in a manner so each animal has an equal opportunity to eat.
- Figure feed, equipment and labor costs carefully. Be sure there is a cost advantage to the specific program you choose.
- If wheat is used, it should make up not more than one-half to two-thirds of the grain portion of the ration.
- Grain sorghum (milo) should be rolled or ground before feeding.
- If practical, use those grains with "built-in roughage" such as barley, oats or ear corn.

Portions of this information were assembled and adapted for Arkansas conditions from a publication of the same title by David Whittington and Joe Minyard, South Dakota State University, and Dr. George Davis, former Extension livestock specialist.

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