University of Idaho
College of Agriculture

Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 499

September 1979

A Feed-Pricing Guide For Wintering Beef Cattle

J. J. Ney, V. M. Thomas, G. W. Gibson

This publication outlines some basic principles that will help you plan a least-cost winter feeding program for beef cattle.

A feed-pricing guideline must: (1) determine the amount of roughage that can be fed to a particular weight and class of beef cattle; (2) determine the relative feeding value of hay in comparison to cereal grains; (3) calculate or determine the relative price of hay compared to cereal grains on an energy basis; (4) apply principles of substitution to determine the monetary advantage of one feed combination over another, and (5) price mineral and protein supplements at least cost.

Substituting Grain for Hay

Table 1 lists the normal and minimum daily roughage requirements for beef cattle. Table 2 shows the amount of grain to add for each pound of hay removed from the ration. For example, .55 pound of corn or .61 pound barley can be substituted for a pound of alfalfa to maintain the energy intake of the beef animal. (Keep in mind that not more than 50% of the normal roughage requirements of beef cows should be replaced with grain.)

Before replacing hay with grain, you should consider (1) feeding facilities; (2) relative price of hay compared to cereal grains; (3) cost and amount of labor required to feed grain, and (4) cost of grain processing — dry or steam rolling or pelleting.

Relative Prices of Hay and Grains

Table 3 shows the relative prices of hay, corn, barley and oats compared on an energy-equivalent basis. The table tells you that if hay costs $40 per ton, barley would be an economical buy at $65.60 per ton or less. The relative feed prices in Table 3 were calculated this way:

A ton of barley that contains 90% DM and 82% total digestible nutrients (TDN) has 1,476 pounds of TDN —

2,000 lb. barley x 90% DM = 1,800 lb. DM
1,800 lb. barley x 82% TDN = 1,476 lb. TDN

A ton of alfalfa that contains 90% DM and 50% TDN has 900 pounds of TDN —

2,000 lb. alfalfa hay x 90% DM = 1,800 lb. DM
1,800 lb. alfalfa hay x 50% TDN = 900 lb. TDN

The Relative Energy Value Constant (REVC) of grain compared to hay is:

$$\text{REVC} = \frac{\text{TDN (lb.) in 1 ton grain}}{\text{TDN (lb.) in 1 ton hay}}$$

$$= \frac{\text{1,476 lb. TDN barley}}{\text{900 lb. TDN alfalfa hay}}$$

= 1.64 times more TDN in barley than alfalfa (DM basis)

Then, to calculate the relative price of barley in comparison to hay,

REVC x cost hay per ton = relative price barley
1.64 x $40 = $65.60

Thus, you would be justified to substitute some barley for hay if you could buy the barley for $65.60 per ton or less.

Principles of Substitution

Let's assume you are feeding 1,000-pound pregnant, mature cows and that alfalfa hay is priced at $60 per ton, barley at $80 per ton. How can you

Table 1. Normal and minimum daily roughage requirements of beef cattle.*

Class of cattle	Normal roughage** intake per day	Minimum roughage** intake per day
	(lb.)	(lb.)
Growing steer calves (450 lb.)	14	7
Yearling steer calves (750 lb.)	9	4.5
Wintering pregnant mature cow (1,000 lb.)	20	10
Nursing mature cow (1,000 lb.)	25	12.5
Mature bull (2,000 lb.)	31	15.5

*Feed requirements assume 90% dry matter (DM), 10% loss during feeding and 50% total digestible nutrients (TDN).

**As-fed basis.

Table 2. Replacing hay with grain.

Grain or concentrate	TDN	Grain required to replace 1 lb. of	
		Alfalfa	Native hay
	%	(lb.)	(lb.)
Corn	91	.55	.51
Barley	82	.61	.56
Oats	77	.65	.60
Milo	80	.63	.58
Dried beet pulp	72	.69	.64
Hard red winter wheat	88	.57	.52
Soft white winter wheat	88	.57	.52

Table 3. Relative feed price per ton of alfalfa and selected grains.*

Alfalfa hay	Corn	Barley	Oats
$30	$54.60	$49.20	$46.20
35	63.70	57.40	53.90
40	72.80	65.60	61.60
45	81.90	73.80	69.30
50	91.00	82.00	77.00
55	100.10	90.20	84.70
60	109.20	98.40	92.40
65	118.30	106.60	100.10
70	127.40	114.80	107.80
75	136.50	123.00	115.50
80	145.60	131.20	123.20
85	154.70	139.40	130.90
90	163.80	147.60	138.60

*These prices are based on National Research Council (NRC) values of 90% DM and TDN as follows: alfalfa hay, 50%; corn, 91%; barley, 82%; oats, 77%.

combine these two feeds to provide the most economical ration?

1. Check minimum ration requirements. Table 1 tells you that an animal in this class requires the energy equivalent of 20 pounds of hay per day. At least 10 pounds of the ration must be fed as hay; the rest can be provided by substitute feeds.

2. Compare prices. Table 3 shows that when alfalfa hay is priced at $60 per ton, you can afford to pay as much as $98.40 per ton for barley. So barley at $80 per ton is a more economical buy than the alfalfa hay on an energy basis.

3. Calculate energy needs. Note in Table 2 that .61 pound of barley provides the same energy as 1 pound of alfalfa hay. So replacing 10 pounds of hay would require:

10 lb. hay x . 61 = 6.1 lb. barley

What are the savings? If you feed alfalfa only at a cost of $60 per ton, or 3¢ per pound, daily feed cost would be:

20 lb. alfalfa x 3¢ = 60¢ per day

By substituting the less expensive grain for part of the hay, you reduce the cost to:

10.0 lb. alfalfa x 3¢ = 30.0¢
6.1 lb. barley x 4 ¢ = 24.4¢
54.4¢ per day.

The savings is 5.6¢ per head per day. For 100 cows, that means a savings of $5.60 per day or a total of $672 over a 120-day feeding period.

Pricing Mineral Supplements

No single plan can be proposed as best for mineral supplementation. Rather, you should adjust your supplement program according to: (1) needs of a particular animal (age, sex, weight and production); (2) types of feed fed; (3) facilities (will the mineral supplement be mixed in the feed or offered free choice?); (4) convenience, and (5) cost.

Table 4 lists some common sources of calcium and phosphorus and the calcium:phosphorus ratio in each product. If you need a phosphorus

Table 4. Common sources of calcium and phosphorus.

Mineral source	Calcium (Ca) %	Phosphorus (P) %	Ratio of Ca:P
Limestone	38	0	---
Calcite flour	34	0	---
Steamed bone meal	30	13	2.2:1
Dicalcium phosphate	24	20	1.2:1
Monoammonium phosphate	---	24	---
Monocalcium phosphate	18	22	.8:1
Sodium tripolyphosphate	---	26	---

supplement, buy a mineral supplement that is high in phosphorus. Don't buy a mineral that is high in calcium and low in phosphorus, because that will make the Ca:P ratio of the total ration more out of balance.

Compare prices of mineral supplements by calculating the cost per pound of the mineral:

$$\text{Mineral cost per pound} = \frac{\text{Cost per ton}}{\text{\% mineral in supplement} \times 2{,}000 \text{ lb.}}$$

Example: If monoammonium phosphate (24% phosphate) is selling for $380 per ton and sodium tripolyphosphate (26%) sells for $480 per ton, which is the better buy?

Monoammonium phosphate =

$$\frac{\$380}{24\% \times 2{,}000} = 79.1¢ \text{ per pound of phosphorus}$$

Sodium tripolyphosphate =

$$\frac{\$480}{26\% \times 2{,}000} = 92.3¢ \text{ per pound of phosphorus}$$

At these prices, then, monoammonium phosphate is the better buy.

Pricing Protein Supplements

Feeding programs for wintering cattle are generally designed to make maximum use of low-cost forages. This means supplemental nutrients must be provided at levels necessary to maintain satisfactory gains and conditions. Protein is often the most limiting nutrient, and the most costly as well.

Select a protein supplement for its: (1) efficiency of use when fed with low-energy, high-roughage rations; (2) safety of use under the extremes of winter feeding; (3) convenience of feeding, and (4) economy of use.

Table 5 lists some of the common plant protein supplements and their protein, calcium and phosphorus content. A number of commercial protein supplements are also available. You can calculate the cost per pound of protein with this formula:

$$\text{Protein cost per pound} = \frac{\text{Price per ton}}{\text{\% protein in supplement} \times 2{,}000 \text{ lb.}}$$

Table 5. Sources of natural protein supplement.[1]

Plant sources	% crude protein	Ca %	P %
Cottonseed meal	41.9	.16	1.06
Safflower oil meal	21.6	.24	.61
Soybean oil meal	44.0	.28	.59
Linseed meal	35.9	.39	.87
Pea meal	17.7	.17	.32
Bean meal	21.9	.11	.40
Alfalfa hay[2]	16 or better (green leafy)		

[1]Nutrient content of alfalfa will vary greatly. Alfalfa should be analyzed for crude protein, Ca and P before you use it as a protein source.

[2]Commercial protein supplements are available. (Relative price comparisons can be made with them using the same procedure described in the example below.)

Example: If soybean meal (44% protein) is selling for $200 per ton and a 32% protein supplement sells for $165 per ton, which is the better buy?

Soybean meal =

$$\frac{\$200}{44\% \times 2{,}000} = \frac{\$200}{800} = 22.73¢ \text{ per pound protein}$$

32% protein supplement =

$$\frac{\$165}{32\% \times 2{,}000} = \frac{\$165}{640} = 25.78¢ \text{ per pound protein}$$

At these prices, soybean meal is the better buy because the cost per pound of actual protein is less and also because fewer pounds of soybean meal are needed to meet the protein requirements of the ration. For example, approximately 6.5 pounds of the 32% supplement would be needed to provide 2 pounds of protein; but only 4.75 pounds of the soybean meal would supply the same 2 pounds of protein.

One word of caution: When selecting a protein supplement, cost per pound is important but so is the use of the nitrogen or protein in the supplement. Before buying a protein supplement, be sure you consider how well it will be used by your cattle when fed with forage.

Other publications that will be helpful in planning a winter feeding program are CIS 348, Buying and Selling Alfalfa Hay, Corn Silage and Barley, and CIS 498, A Feed-Planning Guide for Wintering Beef Cattle. Both of these publications are available from University of Idaho Cooperative Extension Service offices.

The Authors

J. J. Ney is extension agricultural agent and associate extension professor at the Nez Perce County Extension Office, Lewiston, and V. M. Thomas is assistant professor of animal sciences and ruminant nutritionist in the Department of Animal Sciences, University of Idaho, Moscow. G. W. Gibson formerly was extension animal scientist headquartered at the District 3 Extension Office, Twin Falls.

The State is truly our campus. We desire to work for all citizens of the State striving to provide the best possible educational and research information and its application through Cooperative Extension in order to provide a high quality food supply, a strong economy for the State and a quality of life desired by all.

Auttis M. Mullins
Dean, College of Agriculture
University of Idaho

SERVING THE STATE

Teaching . . . Research . . . Service . . . this is the three-fold charge of the College of Agriculture at your state Land-Grant institution, the University of Idaho. To fulfill this charge, the College extends its faculty and resources to all parts of the state.

Service . . . The Cooperative Extension Service has offices in 42 of Idaho's 44 counties under the leadership of men and women specially trained to work with agriculture, home economics and youth. The educational programs of these College of Agriculture faculty members are supported cooperatively by county, state and federal funding.

Research . . . Agricultural Research scientists are located at the campus in Moscow, at Research and Extension Centers near Aberdeen, Caldwell, Parma, Tetonia and Twin Falls and at the U. S. Sheep Experiment Station, Dubois and the USDA/ARS Soil and Water Laboratory at Kimberly. Their work includes research on every major agricultural program in Idaho and on economic activities that apply to the state as a whole.

Teaching . . . Centers of College of Agriculture teaching are the University classrooms and laboratories where agriculture students can earn bachelor of science degrees in any of 20 major fields, or work for master's and Ph.D. degrees in their specialties. And beyond these are the variety of workshops and training sessions developed throughout the state for adults and youth by College of Agriculture faculty.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture, James L. Graves, Director of Cooperative Extension Service, University of Idaho, Moscow, Idaho 83843. We offer our programs and facilities to all people without regard to race, creed, color, sex or national origin.

2M 9-79

10 cents per copy