Response of Weaner Calves to Various Levels of Protein and Energy[1]

R. J. Raleigh and Joe D. Wallace
Squaw Butte Experiment Station[2]
Burns, Oregon

The majority of the livestock in eastern Oregon and many areas of the west are wintered on native meadow hay. This hay is high in bulk in relation to nutrient quality. Calves wintered solely on meadow hay gain little, if any, weight during the winter. This represents a very inefficient use of hay and results in a high cost per unit of gain. Feeding small amounts of the proper supplements with meadow hay will produce satisfactory calf gains as well as substantially reduce the cost of winter gains (Hubbert et al., 1959; Wallace et al., 1961; and Raleigh and Wallace, 1961).

One of the major feeding problems with this hay is to get animals to eat it in sufficient quantity to more than meet their maintenance requirement. Protein is the primary limiting nutrient and probably should receive first consideration with regard to supplementation. There is considerable research to show that increasing protein content of a low protein diet will increase feed intake and gains (Bush et al., 1955; Ross et al., 1954; Woods et al., 1956). Work by Raleigh and Wallace (1961) at this station showed that when steer calves on a 5.5% crude protein hay diet received protein supplements to raise the total crude protein content of the diet to 9% they made satisfactory gains and gained significantly more than those on the hay alone. Increasing the protein content of the diet to 12% did not significantly increase gains.

The objective of the work reported here was to determine whether additional dietary energy would improve gains and to determine what combination of protein and energy would result in the most practical gain.

EXPERIMENTAL PROCEDURE

Twenty-four uniform steer calves were stratified by weight and randomly assigned to four replications of six animals each. The six steers in each replication were randomly allotted to the experimental treatments shown in table 1. The experimental treatments were three levels of energy in combination with two levels of protein. Barley was used as the energy source with treatments containing zero, one and two pounds of barley. The protein levels represent the level of protein in the hay and a second level in which the crude protein content of the ration was increased 3 percent with cottonseed meal.

The percent of crude protein intake was maintained at a constant rate with all levels of energy fed at each protein level. It was necessary to add a small amount of cottonseed meal to the low energy

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1/ Technical Paper No. 1557, Oregon Agricultural Experiment Station.

2/ Jointly operated by the Oregon Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, USDA.

diets to offset the increased protein contained in barley fed on higher energy rations. No attempt was made to compensate for the additional energy supplied in cottonseed meal in order to make the diets within each energy level isocaloric.

The steers were tied to individual feed mangers from 7:00 a.m. to 3:00 p.m. each day and ranged in a common lot the remainder of the time. All calves received chopped meadow hay ad libitum. Fresh hay was weighed in each day and at the end of each week the orts were weighed and average daily hay intake computed. The amount of protein supplement that each animal received during the week was based on the hay consumed the previous week. The grain portion of the ration was mixed according to treatment and fed in feed boxes separate from the hay. Water was available at all times and salt and a salt:bonemeal mixture were available in the lot.

The trial was conducted for 140 days and the calves were individually weighed initially and at 28-day intervals throughout the trial period. All weights were taken following an overnight restriction from feed and water.

RESULTS AND DISCUSSION

Weight gains of all calves used in this study were quite limited during the first month of the trial; consequently, the average gains over the entire trial were somewhat lower than is generally expected. The general health of the steers throughout the trial was good. The majority of the animals became adjusted to being tied and hand fed quite readily and in about a week all but a few were behaving normally.

The steers receiving the lowest level of protein with no additional energy gained at a significantly ($P < 0.01$) lower rate than those on any of the other experimental treatments. These steers gained 0.32 pound per day and the average of all the steers in the trial was 0.70 pound (table 1). The low gaining steers were primarily receiving native meadow hay, and their performance was similar to earlier results reported at this Station from feeding meadow hay alone (Wallace and Raleigh, 1960; Hubbert, et al., 1958 and 1959; Raleigh and Wallace, 1961). However, the hay fed in this trial should have been a higher quality than that used in the above cited work. The hay used in this trial was harvested in late June and contained 10.5 percent crude protein on a dry basis. Considering the quality of this hay, the gains were lower than expected and this poses the question of whether crude protein alone can be used for determining meadow hay quality. Work reported on pelleting or wafering this type of hay indicates that possibly bulk, and not necessarily low nutrient content, is the major limiting factor in animal performance from this hay (Wallace, et al., 1961; Reynolds and Lindahl, 1960; Webb, et al., 1957; Blaxter and Graham, 1956).

The steers on the high level of protein with low energy and those on the second level of energy with low protein made comparable gains. This was probably due to the relatively high crude protein content of the meadow hay indicating that with hay of this protein content, energy

was probably the first limiting factor. Increasing the level of energy to 2 pounds of barley per day did not significantly increase gains over those on the one pound barley level at either level of protein. The steers receiving one and two pounds of barley with the high level of protein gained significantly ($P < 0.01$) more than all of the others but not significantly different from each other.

Table 1. Experimental design with average daily gain of calves on each treatment.[1/]

Crude Protein	Energy (lb. barley/day) 0	1.0	2.0	Average
%	(lb.)	(lb.)	(lb.)	(lb.)
10.5	.32[a]	.67[b]	.68[b]	.56
13.5	.62[b]	.91[c]	1.01[c]	.85
Average	.47	.79	.84	.70

LSD P.05 = .151, P.01 = .215.

1/ Means with the same superscript are not significantly different ($P < 0.01$).

The average daily feed intake and calculated digestible energy intake appear in tables 2 and 3, respectively. Total intake followed the same pattern as gains. In general, as more supplement, either barley or cottonseed meal, was fed hay consumption decreased so total digestible energy intake was not additive with each treatment. It is of interest to note that even though gains were significantly ($P < 0.01$) increased by the addition of one or two pounds of barley at the low level of protein, there was no significant increase in digestible energy intake.

Table 2. Average daily feed intake on each treatment.

Protein	Energy (lb. barley/day) 0	1.0	2.0
%	(lb.)	(lb.)	(lb.)
10.5	8.83	9.86	10.01
13.5	9.37	10.32	11.11

Feed efficiency and cost per pound of gain were more favorable when one pound of barley was fed with high level of protein than with any other combination (tables 4 and 5).

Table 3. Average daily calculated digestible energy intake of steers on each treatment.1/

Crude Protein	Energy (lb. barley/day) 0	1.0	2.0
%	Kcal	Kcal	Kcal
10.5	9,991[a]	11,253[ab]	11,785[abc]
13.5	10,530[a]	12,069[bc]	13,147[c]

LSD P.05 = 1851, P.01 = 2617.

1/ Means with the same superscript are not significantly different (P 0.05).

Results of this trial indicate that the greatest return can be expected with a balanced supplementation program. Feeding an excess of one supplement can create a deficiency of another and, therefore, it would be more practical to feed them in a balanced combination. If the hay used in this trial had been of lower crude protein content, the results might well have been different with less response being made from additional energy alone. This brings out the need for a proper evaluation of feed, especially roughage, before establishing a supplementation program.

Table 4. Average feed required per pound of gain on each treatment.

Protein	Energy (lb. barley/day) 0	1.0	2.0
%	(lb.)	(lb.)	(lb.)
10.5	32.70	16.16	14.72
13.5	15.11	12.28	12.34

SUMMARY

Twenty-four weaner steers were used in four replications of a factorial design with three levels of energy supplementation and two levels of crude protein. Barley was used as the energy source with

treatments containing zero, one and two pounds of barley with native meadow hay fed ad libitum. The protein levels were 10.5 and 13.5 percent of the total ration.

Table 5. Average cost per pound of gain on each treatment.1/

Protein	Energy (lb. barley/day)		
	0	1.0	2.0
%	(¢)	(¢)	(¢)
10.5	34.4	19.2	19.1
13.5	19.2	17.5	18.7

1/ Feed charges used: meadow hay $20 per ton, barley $50 per ton and cottonseed meal $70 per ton.

The steers on the low energy-low protein diet gained significantly ($P < 0.01$) less than all others. This was essentially an all hay diet and gains were comparable to those generally made from meadow hay alone.

Animals on the high protein level with the intermediate or high level of energy gained significantly ($P < 0.01$) more than all others but differences between their gains were not significant.

Gains were comparable for steers on the low energy-high protein treatment and for those on the intermediate and high energy levels with low protein. There was no advantage to feeding two pounds of barley with either level of protein fed in this trial.

Digestible energy intake did not increase by increments as the design suggests. This was due to a decrease in hay intake as level of supplement increased.

The most efficient and economical gains were made by the steers on the high protein and intermediate energy levels.

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