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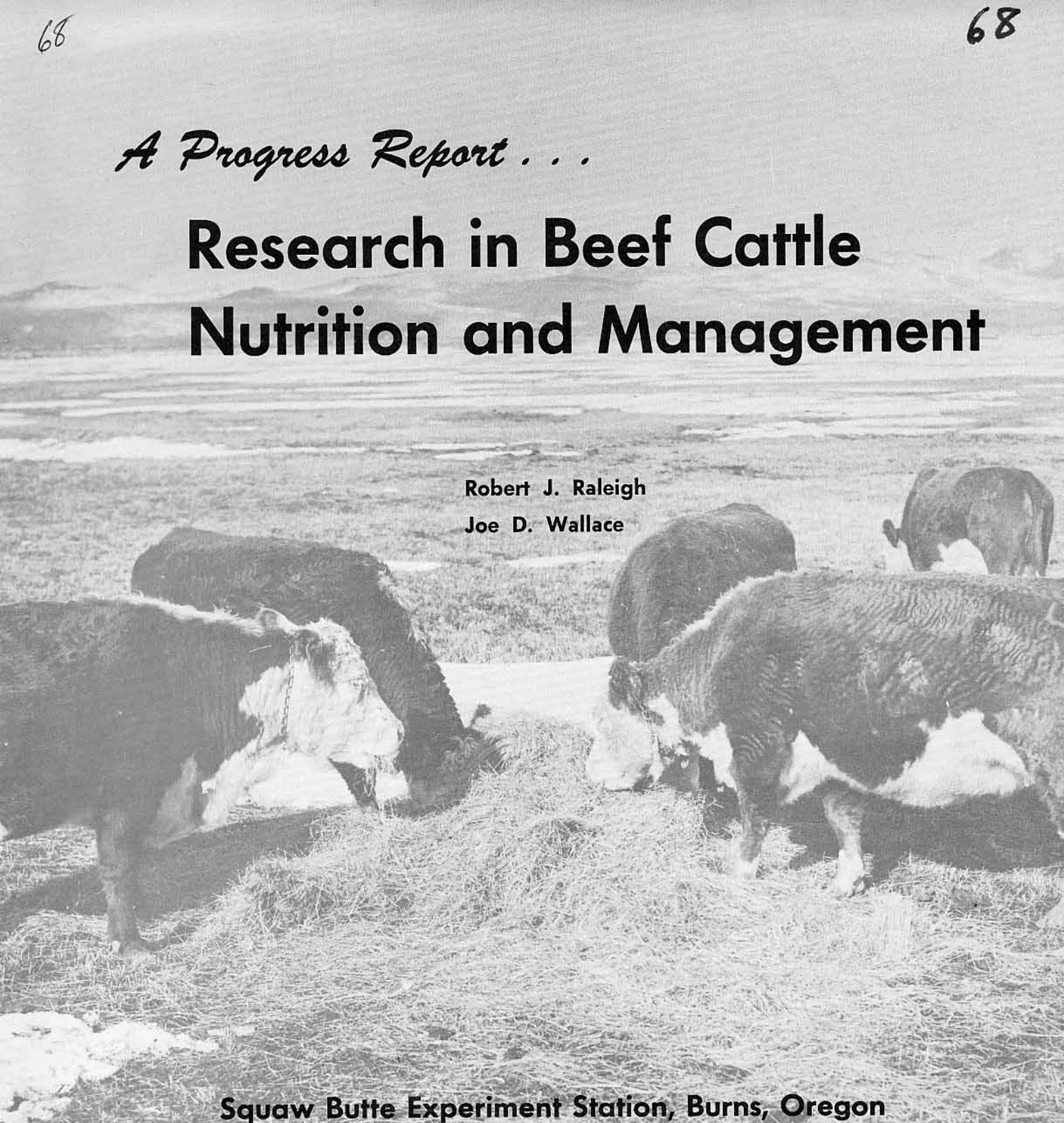
A Progress Report . . .

Research in Beef Cattle Nutrition and Management



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of

Research in Beef Cattle Nutrition and Management

Foreword

The livestock producer of today is both a scientist and an artist. Webster defines a scientist as one who possesses knowledge gained and verified by exact observation and correct thinking. An artist is defined as one who possesses skill or can skillfully use knowledge for the creation of material or abstract things.

Economic pressure, competition from other areas and products, demand for different and higher quality products and the general desire for man to achieve; increases the level of scientific and artistic ability that the rancher must possess.

Research such as is reported on the following pages would serve little useful purpose if you - the livestock producer - did not use the information to increase both your scientific and artistic ability.

If we of this experiment station can be of assistance by supplying you with other information, please contact us. This is submitted as a progress report. As the work moves forward other publications will follow.

W. A. Sawyer,
Superintendent

INFLUENCE OF DIFFERENT LEVELS OF SALT IN A COTTONSEED MEAL SUPPLEMENT FOR YEARLING CATTLE ON CRESTED WHEATGRASS RANGE

The use of salt as a regulator of feed intake for livestock originated in the early 1930's. Today this practice of controlled supplemental feeding is in wide usage by stockmen throughout the western range area.

Numerous investigations have indicated that a relatively high salt intake does not impair health, reproduction or ration digestibility in cattle. However, little work is reported regarding the effect of different levels of salt intake on rate of gain. Previous work at this station has suggested that a beneficial effect on yearling gains may be derived from forced feeding of salt during the earlier part of the grazing season on crested wheatgrass. These studies also pointed out that when salt and protein where fed in combination there was an apparent detrimental effect on gains during the latter part of the grazing season.

A more recent approach to studying the nutrient requirement of ruminant animals has been that of investigating the requirements of the microorganism population present in the rumen. Such studies have indicated that a more suitable media for rumen bacteria is provided when the sodium-potassium ratio of the nutrient intake is approximately 1 to 1. Chemical analyses of crested wheatgrass forage show that potassium is relatively high in relation to sodium during the earlier part of the grazing season. Forcing an animal to consume above normal amounts of salt during this period may help to correct the sodium-potassium ratio.

The objective of this study was to determine the effect of varying and constant levels of salt in a cottonseed meal supplement for yearlings on crested wheatgrass pasture.

Experimental Procedure

Thirty-two uniform yearling cattle were randomly allotted to the four experimental treatments outlined in table 1. The grazing season was divided

Table 1. Outline of Experimental Treatments

Period of grazing season	Cottonseed meal per head daily 1/	Treatment (lb. salt/hd./da.)			
		1	2	3	4
	(lb)	(lb)	(lb)	(lb)	(lb)
1 (5/2 to 5/26)	0.3	.07	0.1	0.3	0.25
2 (5/27 to 6/20)	0.9	.07	0.3	0.2	0.25
3 (6/21 to 7/15)	1.5	.07	0.5	0.1	0.25
4 (7/16 to 8/9)	2.1	.07	0.7	0.0	0.25

1/ All treatments received the same amount of cottonseed meal.

into 4 twenty-five day periods. The treatments used were: (1) constant low salt level to meet the normal salt requirement of animals; (2) an increasing salt level of 0.1, 0.3, 0.5 and 0.7 pounds of salt per head per day for the first through the fourth period, respectively; (3) a decreasing salt level of 0.3, 0.2, 0.1 and 0.0 pounds of salt per head per day for the first through the fourth period, respectively, and (4) a constant high level of 0.25 pounds of salt per head per day through the grazing season. All the animals received the same amount of cottonseed meal during each period of the grazing season. Cottonseed meal was fed at the rate of 0.3, 0.9, 1.5 and 2.1 pounds per head per day from the first through the fourth period, respectively.

The animals grazed in common on crested wheatgrass pasture from May 2 to August 9. Each morning they were sorted into pens according to treatment and fed their respective rations. The salt and cottonseed meal were mixed together. The animals were weighed at 25-day intervals during the trial after an overnight restriction from feed and water.

Observations

Average daily gain data by periods and over the total length of the trial are shown in table 2. A marked decline in rate of gain with advancing maturity of forage was evident among all treatments. The gain data by periods show an interrelationship between level of salt intake and period of grazing season.

During the first period of the experiment, the animals receiving the highest level of salt gained at a faster rate than those receiving lower levels of salt. This increased performance may in part be attributed to an adjustment in the sodium-potassium ratio in the rumen which provided a more suitable media for rumen bacteria.

During the last period of the trial, the experimental group of yearlings receiving the highest level of salt (treatment 2) gained at a considerably lower rate than the other treatments. This apparent restriction in performance resulting from high salt intake may be due to reduced forage intake brought about by increased water consumption.

The only difference noted in average daily gains over the total length of the grazing season was that animals receiving the increasing salt level (treatment 2) gained less than the other 3 treatment groups.

Results of this trial indicate that high salt intake can be detrimental rather than beneficial during the latter part of the grazing season. It should be pointed out that a supplement containing 25 percent salt reduced yearling gains during the last period of this trial. Under routine supplementation practices salt often makes up as much as 30 to 50 percent of a salt-oil meal mixture.

Table 2. Summary of Gain Data

Item	Salt Treatment 1 Control	2 Increasing	3 Decreasing	4 High-Constant
Yearlings per Treatment	8	8	8	8
Avg. initial weight, lb.	498	496	498	501
Avg. final weight, lb.	728	707	730	735
Avg. daily gain by periods, lb.				
1st (5/2 - 5/26)	3.72	3.56	4.06	3.67
2nd (5/27 - 6/20)	2.55	2.60	2.42	2.42
3rd (6/21 - 7/15)	1.95	2.17	2.18	2.50
4th (7/16 - 8/9)	1.17	0.26	0.83	0.96
Total (5/2 - 8/9)	2.35	2.15	2.37	2.39

THE INFLUENCE OF SALT AND WATER INTAKE ON THE PERFORMANCE OF PROTEIN SUPPLEMENTED YEARLINGS

The use of salt to control intake of supplements on the range and in the winter feedlot is an accepted practice. Protein supplement is most commonly controlled in this manner. In order to obtain adequate control of a supplement the salt intake often reaches one pound per day or possibly even higher. Generally, the ratio of salt to supplement ranges from about 1:4 to 1:1. It is commonly believed that once animals become adjusted to these high salt levels there is no detrimental effect from the excess salt.

In general, the animal does better with the supplements than without, but the question of the value or hindrance of the excess salt is rarely asked. Previous work at this station indicated a beneficial effect from forced salt feeding early in the grazing season. However, when a protein supplement and salt were fed in combination with or without barley, there was a detrimental effect on gains during the latter part of the grazing season. This lack of response or inhibition due to the salt during late summer might be due to a lowered dry matter intake brought about by an increased water intake.

The value of water to livestock has long been recognized but little understood. Water is one of the most important nutrients for animals but it is generally taken for granted. The normal water requirements of cattle are 0.3 to 0.4 gallons per pound of dry matter consumed. Factors which increase water intake, other than environmental, are diets with high protein or salt content, or an increased total dry matter consumption. Any of these factors can have an effect on one or more of the other factors. Forcing animals to consume an excess of water may limit their intake of nutrients because of the limited capacity of the digestive system.

The purpose of the work reported here was to determine the effect of additional salt with limited and free choice water intake on the performance of yearlings on a wintering ration. The effect of additional salt on the utilization of protein was also studied but the chemical analyses were not completed at the time of the report so it will be reported later.

Experimental Procedure

Sixteen long yearling replacement heifers were selected for uniformity and stratified by weight into four replications. The four steers in each replication were then randomly allotted to treatments as shown in table 3. The animals all received chopped meadow hay free choice and 2 pounds of cottonseed meal per head daily. Individual hay intake records were kept. These heifers on the low salt ration received 0.07 pounds of salt per head daily and those on the high salt ration received 0.5 pounds per head daily. Half of the animals on each salt level received all the water they wanted and the other half received 60 percent of that amount.

The heifers were tied to their feed bunks from 7:00 a.m. until 3:00 p.m. each day and ranged in common lots the rest of the time. Salt and bonemeal were available in the lots. The animals were hand-watered once daily at their feed mangers. Water was not available in the lots. The animals were weighed every two weeks after an overnight fast from feed and water. They were kept on the treatments for ten weeks and on a common feed or recovery period of four weeks. During the "recovery" period they all received the same feed with free choice water.

Observations

The animals adjusted readily to the individual feeding and watering methods used. In no case did the limited water group fail to drink the 60 percent of the water intake of the other group.

However, difficulty was encountered in getting the heifers to consume cottonseed meal with the high level of salt. In several cases, animals completely refused the mixture and in others consumption was limited. After about three weeks of feeding the salt with the cottonseed meal, there was still several animals that would not clean it up, so the salt was then added to the drinking water. This was continued throughout the trial with no apparent objection from the animals and water intake remained the same. An important observation that can be made from this experience is that this same thing can happen when supplements are controlled by salt either on the range or the winter feedlot. The result would be a very uneven distribution of the supplement with those animals objecting to salt receiving little or no supplements and the others getting the "lions" share. Difficulty was experienced with weaner calves at this station where they were fed a supplement containing about 25 percent salt. Some of the calves ate the supplement quite readily and others ate only limited amounts.

The average daily gain, daily hay intake and feed efficiency are presented in table 3 and the body weight changes for the different treatments are shown in figure 1. Animals receiving the low salt and free choice water diet made the highest gains. However, those fed high salt and free choice water gained about as much. The gains of the heifers on the limited water treatments were considerably lower than those on the free choice water treatments. Heifers on the high salt treatment with limited water made poorer gains than those on low salt when water was limited.

The additional salt did not effect water intake. Water consumption was the same for all animals at each level of water regardless of salt level (figure 2). The hay intake and feed efficiency followed the same pattern as gains or body weight changes (table 3 and figure 3).

The animals on the restricted water diets made a large gain in the first two weeks of the "recovery" period. This is an indication of the influence of intestinal fill of water and tissue water on body weights. After the first two weeks of the recovery period, gains of the animals on the restricted water diet leveled off and followed the same pattern as those receiving full water.

Table 3. Experimental design with average daily gain, daily hay intake and feed required per pound of gain.

Measure	Salt level (lb./day)	Water level (% of total) 100	60	Average
		lbs	lbs	lbs
Daily gain	0.07	1.28	0.99	1.13
Daily hay intake		15.3	13.7	14.0
Feed per lb. gain 1/		13.5	15.8	14.8
Daily gain	0.50	1.16	0.67	0.91
Daily hay intake		12.7	10.1	11.9
Feed per lb. gain 1/		12.7	18.0	15.4
Daily gain	Avg.	1.22	0.83	1.02
Daily hay intake		14.5	11.4	13.0
Feed per lb. gain 1/		13.1	16.9	15.1

1/ Include 2 pounds of cottonseed meal which all animals received in addition to the hay.

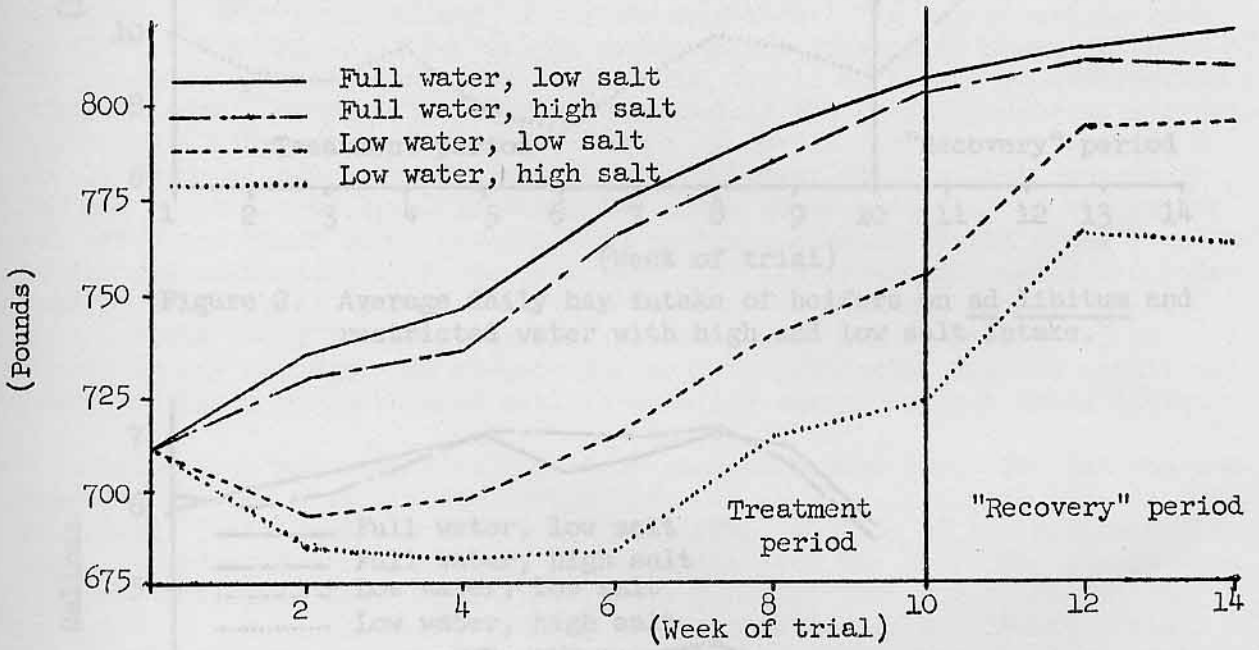

Figure 1. Body weight change of heifers on ad libitum and restricted water with high and low salt intake.

The results of this work seem to indicate that additional salt in the diet did not effect performance of the heifers when adequate water was available but did have a detrimental effect when water was restricted. The question of the application of these results to pasture or range where feed

may not be as readily available as it was in this trial, or when supplementation is used to "stretch" winter feed needs further study. Also, the observation made earlier on the effect of salt on uniformity of intake of a supplement requires more investigation. This work stresses the need for the consideration of water in a salt controlled supplementation program. When supplements are controlled with salt on the range, the availability of adequate water needs to be considered. In winter salt supplementation, the temperature of the water could be a factor effecting performance.

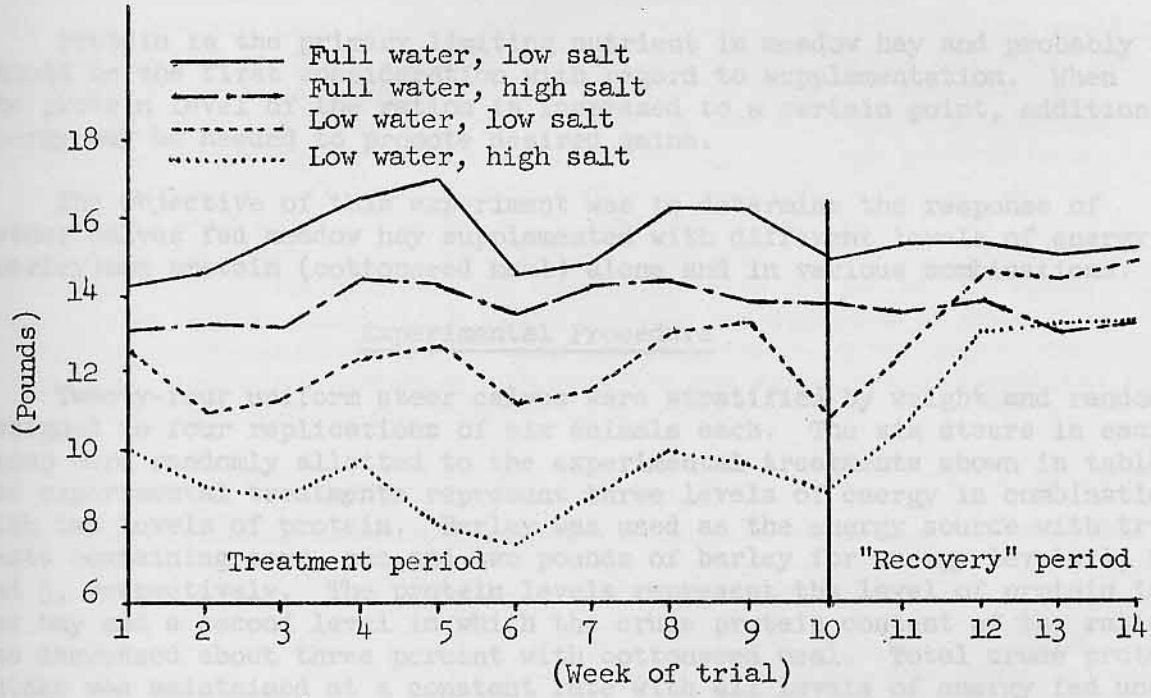

Figure 2. Average daily hay intake of heifers on ad libitum and restricted water with high and low salt intake.

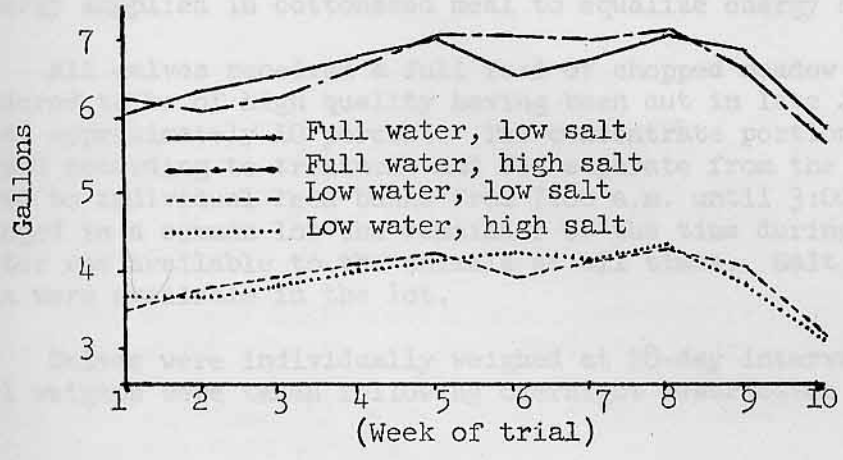

Figure 3. Average daily water consumption of heifers on ad libitum and restricted water with high and low salt intake.

RESPONSE OF WEANER CALVES TO VARIOUS LEVELS OF ENERGY AND PROTEIN SUPPLEMENTATION

Wintering calves on meadow hay alone is a costly practice. 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.

Protein is the primary limiting nutrient in meadow hay and probably should be the first consideration with regard to supplementation. When the protein level of the ration is increased to a certain point, additional energy may be needed to promote desired gains.

The objective of this experiment was to determine the response of weaner calves fed meadow hay supplemented with different levels of energy (barley)and protein (cottonseed meal) alone and in various combinations.

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 group were randomly allotted to the experimental treatments shown in table 4. The experimental treatments represent 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 for energy levels 1, 2 and 3, respectively. 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 about three percent with cottonseed meal. Total crude protein intake was maintained at a constant rate with all levels of energy fed under each protein level. A small amount of cottonseed meal was added with low energy 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 to equalize energy content among diets.

All calves received a full feed of chopped meadow hay. The hay was considered to be of high quality having been cut in late June with a crude content approximately 10 percent. The concentrate portion of the ration was mixed according to treatment and fed separate from the hay. The steers were tied to individual feed bunks from 7:00 a.m. until 3:00 p.m. each day and ranged in a common lot the remainder of the time during the 140-day trial. Water was available to the animals at all times. Salt and a salt:bonemeal mix were available in the lot.

Calves were individually weighed at 28-day intervals during the trial. All weights were taken following overnight restriction from feed and water.

Observations

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 steers receiving the low level of protein with no additional energy supplement gained at a significantly lower rate than those on other experimental treatments (table 4). The low gaining group was primarily on meadow hay and their performance was similar to earlier results obtained from feeding meadow hay alone. Considering the quality of the hay fed this gain was lower than might be expected and poses the question of whether crude protein alone can be used for determining meadow hay quality. 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. It was not expected that the steers in the low protein group even with one pound of barley would gain as well as those receiving one pound of cottonseed meal. Probably the best explanation for this is that the protein and other nutrients in the barley along with those of the rather high crude protein hay combined to make the nutrients more available to the animals than those in the hay alone. This situation might not have occurred had the crude protein content of the hay been around the usual 7 or 8 percent.

Table 4. Experimental design with average daily gain of calves on each treatment.

	Energy (lb. barley/da.)		
Protein	0	1.0	2.0
%	(lb.)	(lb.)	(lb.)
10	.27	.61	.68
13	.62	.84	.90

Rate of gain increased when higher levels of cottonseed meal and/or barley were fed. The combination of protein and energy supplement produced considerably higher gains than either supplement alone. The feeding of two pounds of barley per head daily as compared to only one pound did not substantially improve gains in this trial.

The average daily feed intake, feed required per pound of gain and cost per pound of gain are presented in tables 5, 6 and 7, respectively. Feed intake followed the same pattern as body weight gains. Feed efficiency and cost per pound of gain were more favorable when one pound of barley was fed with the high level of protein.

Table 5. Average daily feed intake on each treatment.

	Energy (lb. barley /da.)		
Protein	0	1.0	2.0
%	(lb.)	(lb.)	(lb.)
10	8.83	9.86	10.01
13	9.37	10.32	11.11

Table 6. Average feed required per pound of gain on each treatment.

	Energy (lb. barley/da.)		
Protein	0	1.0	2.0
%	(lb.)	(lb.)	(lb.)
10	32.70	16.16	14.72
13	15.11	12.28	12.34

Table 7. Average cost per pound of gain on each treatment.1/

	Energy (lb. barley/da.)		
Protein	0	1.0	2.0
%	(¢)	(¢)	(¢)
10	.344	.192	.191
13	.192	.175	.187

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

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 would have undoubtedly 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.

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THE INFLUENCE OF ENZYME ADDITIONS TO MEADOW HAY RATIONS FOR WEANER CALVES

Various enzymes are secreted from cells, which line the digestive tract in animals. These enzymes aid in the process of food breakdown and digestion. It has generally been assumed that sufficient enzymes are secreted in the digestive tract of cattle to promote maximum digestion. The feeding of different enzyme preparations with poultry and swine rations has proven beneficial in many cases. More recently the feeding of various enzyme mixtures with cattle rations has been investigated. Generally speaking, the results obtained from feeding enzymes to cattle have been quite variable.

The objectives of this experiment were to study the influence of feeding "Cellulase 4000"[1/] (a product rich in cellulose digesting enzymes) and "Agrozyme"[2/] (a concentrated combination of protein and starch digesting enzymes) with a meadow hay ration for weaner calves when 2 levels of supplementation were used.

Experimental Procedure

Seventy-two weaned heifer calves were stratified by weight and randomly assigned to six feeding lots of 12 animals each. All lots received a full feed of native meadow hay. Three lots were fed 0.5 pound cottonseed meal and one pound of barley per head daily while the remaining three lots received one pound cottonseed meal and two pounds of barley per head daily. Under each level of supplementation, one lot served as a control, one lot received Cellulase 4000 and one lot received Agrozyme.

Cellulase 4000 and Agrozyme were fed at a rate of 3 grams and 3.4 grams per head per day, respectively.

Water, salt, and a 50:50 salt bonemeal mix were available to the animals at all times. Individual weights were taken on all experimental animals at 28-day intervals during the study. The experiment was conducted over a 112-day period.

1/ Supplied by Miles Chemical Company, Elkhart, Indiana.

2/ Supplied by Merck & Company, Inc., Rathway, New Jersey.

Observations

A summary of gain and feed consumption data is presented in table 8. Calves receiving Cellulase 4000 gained at a faster rate than control animals under the higher level of supplementation, whereas little difference was noted under the lower level of supplementation. The feeding of Agrozyme increased the rate of gain of calves receiving each level of supplementation as compared to the control calves. The margin of difference in average daily gain attributed to Agrozyme feeding was greater at the lower level of supplementation. Feed conversion and gain cost data followed similar trends.

Results of this experiment suggest the need for further study before a conclusive evaluation of enzymes for wintering cattle can be made.

Table 8. Summary of gain and feed consumption data.

Supplement fed	Enzyme treatment	Average daily gain	Average daily hay intake	Feed per lb. gain	Feed cost[1/] per lb. gain
		(lb.)	(lb.)	(lb.)	(¢)
.5 lb. CSM + 1 lb. barley					
	Control	0.54	8.5	18.5	.237
	Cellulase	0.56	8.8	18.4	.234
	Agrozyme	0.71	8.9	14.6	.186
1 lb. CSM + 2 lb. barley					
	Control	0.90	8.4	12.7	.188
	Cellulase	1.01	8.7	11.6	.170
	Agrozyme	1.00	8.6	11.6	.171

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