A Progress Report . . .

Research in Beef Cattle Nutrition and Management

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of

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Foreword

In this day of high investment, high cost, and narrow economic margins in livestock operations it is not enough to increase the forage quantity and quality. The livestock rancher must increase the efficiency of his livestock in the job of converting forage to pounds of saleable product.

This increased efficiency may be attained by: (1) Scientific breeding and selection, (2) a higher standard of health and sanitation, (3) improving management, and (4) improving the nutritional status of the animals. Greater efficiency in livestock production must come from simultaneous improvement in all four areas. One neglected area can prevent the others from being beneficial. For example, there would be little benefit from breeding to efficiency tested high quality bulls and then wintering the breeding cows and fattening the calves on wheat straw. Improved nutrition and health through the use of feed additives and better feed quality is an important link in the chain of increased production efficiency.

The progress reports in this publication present a part of the program of nutrition research carried at the Squaw Butte Experiment Station. This information will help to strengthen the chain leading to greater economic return from beef cattle.

Papers and bulletins reporting completed work may be obtained by writing to the Station. Watch for new publications on work presently in progress.

W. A. Sawyer,
Superintendent

PERFORMANCE OF CALVES AS INFLUENCED BY TIME OF WEANING

Native grasses found on sagebrush-bunchgrass ranges typical of southeastern Oregon are usually fully mature by early July, and thereafter decline rather steadily in nutritive value. Consequently, milk production of range cows and weight gains of their offspring during the later part of the summer grazing period are reduced. In studying calf gains at different periods of the grazing season at Squaw Butte it was determined that the decline in rate of gain was considerably more abrupt about mid-September.

During recent years it has become a routine practice in the management of the Squaw Butte herd to wean calves when the cattle are moved off of summer range from the first to the middle of October. In the fall of 1959 a preliminary study involving a limited number of calves from the station herd indicated a definite advantage in winter performance when calves were weaned approximately a month earlier than usual. The purpose of the present study was to evaluate more thoroughly the influence of early weaning.

Experimental Procedure

Fifty-four calves were selected from the station herd on September 15 and randomly divided into two groups. Initial selection was based on uniformity of weight and previous gain. Experimental treatments assigned to each group were as follows:

Group 1: Weaned on September 15, transported to winter quarters, and placed on a ration consisting of meadow hay, ad libitum, two pounds of barley, and one pound of cottonseed meal per head daily.

Group 2: Left on summer range with their dams until October 18; then weaned, and transported to winter quarters and placed in lots with group 1 and on same feed.

Individual weights were taken on the animals at periodic intervals following overnight restriction from feed and water.

Observations

The calves will remain on the experiment until April 12. At that time final weights will be taken and the present study terminated.

Results of the experiment to date are summarized in the following table:

Table 1. Effect of time of weaning on winter performance

	Time of Weaning[1]	
	Early	Normal
Age at weaning (days)	177	214
Avg. weight, September 15 (lb.)	370	380
Average daily gain by periods (lb.)		
Birth to Sept. 15	1.67	1.66
Sept. 15 to Oct. 26 (41 days)	0.84	0.41
Oct. 26 to Nov. 30 (35 days)	1.51	0.63
Nov. 30 to Feb. 15 (76 days)	1.01	1.16
Sept. 15 to Feb. 15 (152 days, total)	1.08	0.84
Avg. weight, Feb. 15 (lb.)	534	507
Total winter gain (Sept. 15 to Feb. 15)	164	127
Total winter feed cost ($)	25.76	20.98
Value of gain @ $25 cwt Less winter feed cost ($)	15.24	10.77

1/ 27 calves per treatment.

During the period of September 15 to October 26 (41 days) the early weaned calves were on feed and the normal weaned group were suckling their dams 33 days and on feed 8 days. Average daily gains were over twice as high for the early weaned calves during this period.

Using current feed prices and a value of $25 cwt for accumulated gain the approximate dollar return over feed investment to date is $4.47 per head greater for the early weaned calves.

The data suggests a possible advantage in striving for a constant growth rate in calves under the existing conditions.

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FEED INTAKE AND PERFORMANCE OF STEER CALVES WINTERED ON MEADOW HAY WITH AND WITHOUT ADDED PROTEIN

The majority of the roughage used for wintering beef cattle in eastern Oregon, and in many range areas of the west, is a low quality native meadow hay. Several factors contribute toward the quality of this hay. Much of the hay is low yielding--less than a ton of dry matter per acre. Harvesting this hay after maturity generally leads to lowering the quality. Rush and sedge constitute the major part of the total yield. Legumes are present in very limited quantity. This hay is generally low in protein with crude protein ranging from 7 to 9%, but generally has a gross energy content approximating that of better quality roughages. Cellulose digestibility is high, ranging from 60 to 70%, but protein digestibility is quite low--ranging from 45 to 50%. One of the major problems in feeding this roughage is to get the animals to eat it in sufficient amounts to meet more than their maintenance requirements.

There is considerable research indicating that increasing the protein content of a low protein diet will increase feed intake and consequently gains. Urea has been used with varying results as a protein extender.

Experimental Procedure

A plot of meadow hay was left unharvested until the first of August with the intention of lowering the crude protein content of the hay to 7%, or less.

This plot was somewhat representative of the total meadow area except that it was an area that flooded deeper and contained less legumes than other areas.

Thirty yearling steers were stratified by weight into three replications of 10 each. These 10 steers in each group were then randomly allotted to treatments shown in table 2. The meadow hay contained 5.5% crude protein on an oven dry basis. Urea, cottonseed meal, and a mixture of urea and cottonseed meal were used to bring the crude protein levels up to 6, 9, and 12% as desired. When urea and cottonseed meal were both used in a diet they were supplied in amounts so that one-half the protein equivalent would come from urea and one-half from cottonseed meal. The entire diet was pelleted in a 7/16-inch diameter pellet. Salt and monosodium phosphate were mixed in equal parts to make up one percent of the diet. The steers were fed from November 4 until February 17 for a total of 15 weeks. The steers were tied to their feed bunks from 7:00 a.m. until 3:00 p.m. each day and ranged in a common lot the rest of the time. Water was available at their feed bunks and in the lots. Salt and bonemeal were available in the lots.

Observations

The animals took to the all-pelleted diet readily. However, as the feeding trial progressed they did a lot of wood chewing on the lot fences. This did not appear to effect their appetites or their gains. During the fifth week of the trial one of the animals on the 12% protein diet, made up of hay and urea alone, went off feed and went into a state of convulsion and died. One week later a second animal on this treatment became ill and died within 24 hours after the first symptoms appeared. Both of the animals exhibited the symptoms associated with ammonia toxicity. The third animal on this treatment was removed from the trial.

The gain data for the trial are presented in table 2. The animals on each higher level of protein outgained the animals on the lower levels. The steers receiving their protein supplement from cottonseed meal alone, regardless of level of protein, were thriftier looking animals with more gloss in their hair coat and appeared to carry a little more finish than those on corresponding levels of protein supplemented by urea and cottonseed meal or urea alone. Those animals receiving urea alone as a protein supplement were the most unthrifty appearing group.

The average daily feed intake and the feed required per 100 pounds gain are presented in tables 3 and 4. These animals all started the trial with essentially no difference in feed intake and as the trial progressed those receiving higher levels of protein continually increased their feed intake up to the end of the trial.

The costs of gains for the different treatments are given in table 5. This reflects only the cost of feed ingredients and not the cost of processing since this was the same for all feeds.

Table 2. Experimental design with average daily gain of the three animals on each treatment

	Crude protein levels (%)			
Diet ingredient	5.5	6.0	9.0	12.0
	(lb.)	(lb.)	(lb.)	(lb.)
Hay	0.27			
Hay + Urea		0.39	1.23	--[1/]--
Hay + Cottonseed meal		0.26	1.62	1.83
Hay + Urea and Cottonseed meal		0.41	1.35	1.51
Average	0.27	0.35	1.40	1.67

[1/] Two of these animals died and the third was removed from the experiment.

Table 3. Average daily feed intake of steers on each treatment

Diet ingredient	Crude protein levels (%) 5.5	6.0	9.0	12.0
	(lb.)	(lb.)	(lb.)	(lb.)
Hay	9.53			
Hay + Urea		10.10	13.73	-----[1/]
Hay + Cottonseed meal		9.33	15.00	15.33
Hay + Urea and Cottonseed meal		11.03	14.33	14.50
Average	9.53	10.15	14.35	14.92

1/ Two of these animals died and the third was removed from the experiment.

Table 4. Average feed required for 100 pounds gain on each treatment

Diet ingredients	Crude protein levels (%) 5.5	6.0	9.0	12.0
	(lb.)	(lb.)	(lb.)	(lb.)
Hay	3,530			
Hay + Urea		2,590	1,116	---[1/]
Hay + Cottonseed meal		3,588	926	838
Hay + Urea and Cottonseed meal		2,690	1,061	960
Average	3,530	2,956	1,034	899

1/ Two of these animals died and the third was removed from the experiment.

Table 5. Average cost per 100 pounds of gain for steers on each treatment[1]

	Crude protein levels (%)			
Diet ingredient	5.5	6.0	9.0	12.0
	($)	($)	($)	($)
Hay	35.30			
Hay + Urea		26.18	11.84	-----[2]
Hay + Cottonseed meal		37.28	11.58	12.24
Hay + Urea and Cottonseed meal		27.57	12.26	12.34
Average	35.30	30.34	11.89	12.29

1/ Native hay was priced at $20.00, cottonseed meal at $70.00, and urea at $120.00 per ton in arriving at cost figures.

2/ Two of these animals died and the third was removed from the experiment.

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THE EFFECT OF COPPER AND IRON INJECTIONS ON RATE OF GAIN, AND ON HEMOGLOBIN AND PACKED CELL VOLUME OF THE BLOOD OF RANGE CALVES FROM BIRTH TO WEANING

Considerable research has been reported on the nutritional status of newborn dairy calves and newborn pigs. However, little work has been reported regarding the nutrition of newborn range calves. The performance of the range calf is generally attributed to the milking and mothering ability of it's dam. Anemia in baby calves does not seem to be as prevalent as with baby pigs. However, anemia in dairy calves on an exclusive milk diet has been reported by several workers.

Previous work at this station indicates that calves under normal management are marginal or submarginal with respect to anemia. Iron injections at birth maintained blood hemoglobin levels significantly higher than those receiving no additional iron. Rate of gain and packed cell volume followed these same trends.

The objectives of this study were: (1) To determine the normal hemoglobin and packed cell volume of the blood of range calves from birth to weaning, and (2) to determine the effect of iron and copper injections at birth and at three weeks after birth on rate of gain, packed cell volume, and hemoglobin of calves from birth to weaning.

Experimental Procedure

Seventy-two calves were selected at the time of birth and allotted to treatments in a factorial designed trial. The treatments were set up to compare the effects of a single and a double injection of either copper and iron alone, or in combination, with control calves receiving no injections. There were equal numbers of male and female animals on each treatment.

The calves were weighed and bled within 3 days of birth and those receiving iron or copper were injected at the same time. Those receiving iron were injected with 10 ml of an iron-dextron preparation and those receiving copper were injected with 0.5 ml of copper glycinate. The calves were kept with their mothers at their winter quarters until they were about six weeks of age, after which time they were moved to the Squaw Butte summer range.

Body weights and blood samples were obtained at birth, 3 weeks, 6 weeks, 15 weeks, and 25 weeks. Those calves receiving a second injection of copper and iron were injected at 3 weeks of age. Hemoglobin and packed cell volume was determined on the blood collected.

Observations

The average hemoglobin values for treatment and ages are shown in table 6. The hemoglobin control of all the calves at birth ranged from 9.3 to 13.4 g % with an average of 11.2 g %. At each later period the averages were slightly lower but the ranges were of the same magnitude.

The packed cell volumes are shown in table 7. The packed cell volumes at birth ranged from 28.9 to 43.4% with an average of 37.7%. These values followed the same trend as hemoglobin content at each subsequent collection date.

The gain data are presented in table 8. The average gain of all the calves for the 25-week period was 1.64 pounds per day. There appears to be no differences in gain with respect to treatments. The steer calves made slightly better gains than the heifers throughout the season. The drop in rate of gain after 15 weeks of age cannot be attributed to treatments, but rather to a lowering of quality in the forage which would result in a decrease in milk production.

Table 6. Average hemoglobin values in g % of calves for each treatment at different ages

Treatment	Number of injections	Number of animals1/	Birth	Weeks	Weeks	Weeks	Weeks	Avg.
Copper	0	24	11.30	10.93	10.80	10.08	10.02	10.63
	1	24	10.93	10.93	19.90	9.75	10.02	10.51
	2	24	11.39	11.05	11.13	9.93	9.79	10.66
Iron	0	24	11.76	10.35	10.45	10.02	9.98	10.51
	1	24	11.00	11.32	10.93	9.92	9.98	10.67
	2	24	10.88	11.26	11.43	9.81	9.98	10.67
Sex	1	36	11.10	10.77	10.86	9.70	9.87	10.46
	2	36	11.32	11.18	11.02	10.13	10.02	10.73
Average		72	11.21	10.98	10.94	9.92	9.94	10.60

1/ These numbers represent the total number of animals that received the specified copper or iron injections. They represent only the main effects of the treatments and it should be noted that the 72 animals listed under copper treatments are the same 72 that are listed under iron treatments and under sex.

Table 7. Average percent packed cell volume of calves for each treatment at different ages

Treatment	Number injections	Number of animals1/	Birth	Weeks	Weeks	Weeks	Weeks	Avg.
Copper	0	24	37.9	38.9	38.5	42.7	40.1	39.6
	1	24	36.9	38.5	38.9	39.0	40.8	38.8
	2	24	38.2	38.7	40.0	40.9	40.5	39.7
Iron	0	24	39.6	36.5	37.2	41.7	40.5	39.1
	1	24	36.7	40.0	38.9	41.5	40.7	39.6
	2	24	36.7	39.5	41.2	39.4	40.3	39.4
Sex	1	36	37.0	37.8	38.7	39.5	39.9	38.6
	2	36	38.4	39.6	39.6	42.3	41.1	40.2
Average		72	37.7	38.7	39.1	40.9	40.5	39.4

1/ These numbers represent the total number of animals that received the specified copper or iron injections. They represent only the main effects of the treatments and it should be noted that the 72 animals listed under copper treatments are the same 72 that are listed under iron treatments and under sex.

Table 8. Average daily gain of calves on each treatment for age interval

Treatment	Number of injections	Number of animals[1/]	Age interval: Birth to 3 wks.	3 wks. to 6 wks.	6 wks. to 15 wks.	15 wks. to 25 wks.	Birth to weaning
			(lb.)	(lb.)	(lb.)	(lb.)	(lb.)
Copper	0	24	1.63	1.75	1.82	1.46	1.66
	1	24	1.68	1.92	1.79	1.40	1.65
	2	24	1.61	1.84	1.78	1.38	1.63
Iron	0	24	1.69	1.77	1.77	1.42	1.64
	1	24	1.65	1.86	1.80	1.39	1.64
	2	24	1.59	1.88	1.82	1.42	1.66
Sex	1	36	1.72	1.96	1.86	1.39	1.69
	2	36	1.56	1.71	1.73	1.43	1.60
Average		72	1.64	1.84	1.80	1.41	1.64

1/ These numbers represent the total number of animals that received the specified copper or iron injections. They represent only the main effects of the treatments and it should be noted that the 72 animals listed under copper treatments are the same 72 that are listed under iron treatments and under sex.

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THE INFLUENCE OF AN ANTIBIOTIC SUPPLEMENT, A FLAVOR ADDITIVE, AND AN ARSENICAL APPETITE STIMULANT ON WEANER CALF PERFORMANCE

Previous studies at the Squaw Butte Station have shown that supplementing weaner calf rations with an antibiotic during the first few weeks after weaning resulted in both increased weight gains and improved feed efficiency. Some reports have indicated that antibiotics may be at least partially effective in the control of shipping fever.

A wide variety of flavoring compounds for all types of livestock feeds are commercially available. Most of these compounds are composed chiefly of sweetening materials. The inclusion of such an additive in a ration supposedly renders it more desirable to livestock.

Small amounts of arsenical compounds have been shown to have appetite- and gain-stimulating properties when added to poultry and swine rations. In the few experiments in which arsenicals have been tested in beef cattle feeding, their value has been questionable.

The objectives of this experiment were: (1) To study the influence of antibiotic supplementation in presence or absence of shipping fever inoculation, (2) to study the influence of a flavor additive with and without an antibiotic, on feed consumption and calf performance, and (3) to study the influence of an arsenical additive with and without an antibiotic on feed consumption and weaner calf performance.

Experimental Procedure

Thirty-six steer and 24 heifer calves were stratified by weight and randomly allotted to six experimental treatments. Six steers and four heifers were assigned to each treatment. Experimental treatments were: (1) Control, (2) Sessalom flavor additive[1/], (3) "3-Nitro" arsenical additive[2/], (4) antibiotic (Terramycin)[3/], (5) Sessalom flavor + antibiotic, and (6) "3-Nitro" arsenical + antibiotic.

One-half of the animals receiving antibiotic supplementation were vaccinated for shipping fever while the other half were not.

A basal ration of chopped meadow hay *ad libitum*, two pounds of rolled barley, and one pound of cottonseed meal was fed to each animal daily. Water, salt, and a 50:50 salt:bonemeal mix were available to the animals at all times.

Calves receiving the flavor additive were fed hay which was treated with 1/2 pound of Sessalom powder (dissolved in water) per ton of hay. The arsenical was mixed with cottonseed meal at a rate to supply 1.75 g of 3-Nitro per head daily for animals receiving this additive. The antibiotic was mixed with cottonseed meal in an amount to supply 75 mg Terramycin per calf daily.

Individual weights were taken on all experimental animals at 14-day intervals during the study. The experiment was conducted over a period of 76 days.

Observations

A summary of feed consumption and gain data is presented in table 9.

The inclusion of either 3-Nitro arsenical or flavor did not materially influence weight gains or feed conversion.

1/ Sessalom Flavor Additive supplied by Flavor Corporation of America.

2/ "3-Nitro" Arsenical Additive was supplied by Salsbury's Laboratories, Charles City, Iowa.

3/ Terramycin was furnished by Chas. Pfizer and Co., Terre Haute, Indiana.

Calves receiving antibiotic in this study gained 0.30 pound more per day than those receiving no antibiotic. The main response resulting from antibiotic feeding occurred during the first 6 weeks of the study. The antibiotic supplement increased gains essentially the same whether calves were vaccinated for shipping fever or not. The antibiotic-fed calves scoured less, stayed on feed better, and were thriftier appearing animals at the close of the study.

Table 9. Summary of the feed consumption and gain data

Item	Treatment					
	Control	Flavor	3-Nitro	Terr.	Terr. + Flavor	Terr. + 3-Nitro
No. calves per treatment	10	10	10	10	10	10
Avg. initial weight (lb.)	371	373	374	370	372	372
Avg. final weight (lb.)	416	419	426	448	434	443
Avg. daily gain (lb.)	0.59	0.61	0.68	1.03	0.81	0.94
Avg. feed cons. (lb.)	9.34	9.07	9.48	10.24	9.32	9.90
Feed/100 lb. gain (lb.)	15.83	14.86	13.94	9.94	11.51	10.53
Feed cost/100 lb. gain ($)[1]	25.08	23.93	22.06	15.24	18.27	16.38

[1] Feed charges used: Meadow hay $20 per ton, barley $50 per ton, and cottonseed meal $70 per ton (additive charges not included).

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LOW LEVELS OF ALFALFA IN THE WINTER RATION FOR WEANER CALVES

Weaner calves wintered on native meadow hay alone in southeastern Oregon generally gain not more than 0.3 pound per day. In order to increase gain, an energy and a protein supplement should be provided. A general practice at this station has been to provide meadow hay ad libitum, and feed 2.0 pounds of rolled barley and 1.0 pound of cottonseed meal per head daily. This has resulted in an average daily gain of 1.25 pounds, or more.

In previous work at this station feeding phosphorus fertilized meadow hay increased the rate of gain of weaner calves. This increase was apparently brought about by the increased legume content of the hay, rather than by the increased phosphorus content of the hay. Supplying additional phosphorus with unfertilized meadow hay did not result in increased gains when fed to weaner calves.

Phosphorus fertilization on native flood meadows quite often results in an increase of annual white-tip clover which substantially improves hay quality. It is quite accepted that legumes provide a stimulatory action in the rumen, generally resulting in increased feed efficiency. Comparatively small amounts of legume feeds in the diet will provide these factors.

The purpose of this research was to determine if alfalfa meal could beneficially replace part of the protein from cottonseed meal and, if so, what level of alfalfa would bring about the greatest increase in animal performance.

Experimental Procedure

Forty weaner calves were stratified by weight and randomly allotted to four treatments with ten animals per lot. Meadow hay was fed free choice and all animals received 2 pounds of rolled barley daily in addition to the protein supplement. The calves were weighed every two weeks and hay consumption was recorded weekly. Salt and bonemeal were provided in all the lots.

The treatments were calculated so each would have the same total crude protein. Treatments were as follows:

a. One pound of cottonseed meal per head daily.

b. 0.22 pound of cottonseed meal and 2.0 pounds of alfalfa meal per head daily.

c. 0.5 pound of cottonseed meal and 1.33 pounds of alfalfa meal per head daily.

d. 0.75 pound of cottonseed meal and 0.67 pound of alfalfa meal per head daily.

The cottonseed and alfalfa meal were mixed for each treatment and fed daily in feed bunks. Meadow hay was fed daily in hay mangers.

Observations

A summary of gain and feed data for the first 70 days of the study is presented in table 10. The present study will be terminated April 12, 1961.

To date, calves fed the lowest level of alfalfa have made greater and more economical gains than either the calves receiving higher levels of alfalfa or those fed cottonseed meal as the sole protein supplement.

The consumption of meadow hay has been consistently lower in lots receiving the two higher levels of alfalfa meal.

Table 10. Summary of gain and feed data

	Source and amounts of daily protein supplement[1]			
	(lb.)	(lb.)	(lb.)	(lb.)
Alfalfa meal:	----	2.00	1.33	0.67
Cottonseed meal:	1.00	0.22	0.50	0.75
No. of calves per treatment	10	10	10	10
Average daily gain (lb.)	1.26	1.17	1.13	1.43
Avg. daily meadow hay cons. (lb.)	9.64	8.94	9.20	9.89
Feed/100 lb. gain[2] (lb.)	1003	1125	1153	931
Feed cost/100 lb. gain[3] ($)	14.36	16.32	16.72	13.28

[1] The daily protein supplement per animal for all lots was calculated to supply total crude protein equivalent of 1 pound of cottonseed meal.

[2] Includes consumption of meadow hay, protein supplement, and barley which was fed at a rate of 2 pounds per head daily in all lots.

[3] Feed costs used were: Meadow hay $20 per ton, cottonseed meal $70 per ton, alfalfa meal $45 per ton, and barley $50 per ton.