PART I. HIGH SALT RATIONS FOR RUMINANTS

PART II. CREEP-FEEDING BEEF CALVES

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ACKNOWLEDGEMENTS

The writer wished to express his appreciation to Dr. A. B. Nelson, of the Animal Husbandry Department, for his assistance during the conduct of this study and preparation of this manuscript. Grateful acknowledgment is also extended to W. D. Campbell and all the workers employed by the department for the care and feeding of the livestock involved. He also wishes to acknowledge Dr. R. W. MacVicar of the Department of Agricultural Chemistry for help in making the numerous chemical analyses necessary for the completion of this work.

J. C. M.

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PART I

HIGH SALT RATIONS FOR RUMINANTS

INTRODUCTION

The practice of self-feeding a mixture of salt (sodium chloride) and protein supplement appears to have originated with range sheepmen in the vicinity of the Pecos River in Texas, beginning about 1934. These ingenious operators devised the method in an attempt to alleviate a plant poisoning in sheep. Apparently the salt failed to prevent the plant poisoning, but the ranchers did notice that the salt controlled the consumption of concentrates. More recently, the practice has become wide-spread among cattlemen, receiving its greatest impetus with the labor shortage during World War II.

Early reports of cattlemen self-feeding controlled amounts of protein supplement on the range by regulating the amount of salt mixed with the meal were often dismissed as incredible, if not just a lazy man's way of supplemental feeding on the range. Practical ranchers and scientists alike were skeptical, fearing salt poisoning and other hazards. Nevertheless, the practice grew in popularity, even after the war-time labor shortage was over.

The use of common salt as a regulator of feed intake for livestock has stimulated interest in the effect of large amounts of salt on the health of ruminants. Rangemen have questioned the advisability of feeding mixtures of high salt content because of possible effects on pregnant animals. Reports have been circulated that high salt-containing rations may cause sterility and abortion.

At the present time there is no concrete evidence of detrimental effects if the animals have sufficient water, but the long-time

effect of the practice has not been thoroughly investigated.

The investigation reported herein was designed to determine the effect of self-feeding a cottonseed meal-salt mixture to beef breeding cows, to determine the effect of large quantities of salt on the digestibility by sheep of a ration consisting of prairie hay, cottonseed meal, and corn, and to measure the nitrogen, potassium, sodium and chloride balance of animals receiving high amounts of salt.

REVIEW OF LITERATURE

Sodium and Chloride Metabolism

Sodium and chloride are commonly ingested by man and animals as common salt (NaCl). Since salt serves as a condiment as well as a nutrient, the intake tends to be highly variable and frequently is in excess of needs. Its use as a condiment has physiological support since there is evidence that it stimulates salivary secretion and promotes the action of diastatic enzymes.

When salt intake is at a minimum, the body makes an adjustment whereby the output of sodium and chloride in the urine nearly ceases. In contrast, large intakes involve a correspondlingly large excretion. The kidney is the regulating organ which controls the concentration of these electrolytes in the blood.

Sodium and chloride make up the greater part of the extracellular electrolytes of the body fluids. They are essential, moreover, to the normal functioning of body cells.

Approximately 80 per cent of the sodium is stored in extracellular fluid. The most important sodium depots are the skin, subcutaneous tissue, muscle, and bony skeleton. The highest sodium concentrations are the cartilage, blood plasma, and lymph. The smallest sodium concentrations are in the gastric juice, muscle, pancreas, milk and saliva. Chlorides of the body are distributed much like sodium. They are needed in the "chloride shift" and for the formation of gastric hydrochloric acid.

Everett (1942) reported that high amounts of sodium and chloride caused sufficient increase in tissue fluid to produce a slight edema in adult animals. Sodium and chloride were rapidly absorbed from the small intestine and were transported to extracellular fluid by blood and lymph.

According to Maynard (1947), normal kidneys, with appropriate water intake, allow large amounts of sodium and chloride to be excreted without harm if salt intake is high.

Babcock (1905) reported that dairy cows exhibited an abnormal appetite for salt when not given any for two weeks. No ill effects were noted until much later when loss of appetite, general unthrifty condition, and loss of weight appeared. These effects occurred first in high producing cows. A breakdown occurred most frequently at calving, or shortly thereafter at the height of milk flow. Feeding salt to animals showing these salt deficiency symptoms resulted in a rapid recovery.

Aines and Smith (1952) noted the same symptoms with salt deficient dairy cows. They also noted shivering and irregular heart action. In an attempt to alleviate the deficiency, they fed sodium chloride to the deficient cows, and found that milk production rose 164 per cent and body weight increased 24 per cent during treatment. When sodium bicarbonate was fed, milk production increased 66 per cent and body weight increased 18 per cent. Feeding magnesium chloride failed to interrupt a progressive decline in milk production and body weight. When sodium bicarbonate and magnesium chloride were fed together, milk production increased 90 per cent and body weight increased 15 per cent. These results indicate that salt deficiency in lactating dairy cows is primarily due to an inadequacy of sodium.

Morrison (1947) lists the following salt requirements:

Dairy cow: 0.75 ounce per day for each 100 pounds of body weight

0.8 ounce per day for each 20 pounds of milk produced.

Beef cow: .2 pounds per month per head when on grass.

1 to 1.5 pounds per month per head when in dry lot.

Sheep: 1/4 to 1/2 ounce per day per ewe.

1/5 to 1/4 ounce daily for each fattening lamb.

Morrison (1947) observed that sheep show a special fondness of salt and consume considerably more salt per 100 pounds live weight than do cattle.

Smith and Parrish (1950) reported that salt requirements vary with the type of ration. Steers on full-feed of grain needed less salt than steers on dry feed or grass. Steers fed silage consumed more than three times as much salt as steers fed alfalfa hay. In this test, the 20 steers fed alfalfa hay consumed an average of 0.1 pound of salt per head daily, while 19 steers fed silage consumed salt at a rate of 0.31 pound per head per day.

Jardine and Anderson (1922) recommended two pounds of salt per month per head for range cattle when on succulent forage, and an average of one pound monthly for each animal the remainder of the season.

Sotola et al., (1924) found that range steers actually consumed 2.42 pounds of salt per head monthly during the early grazing season. After that, the average monthly salt consumption dropped to 1.77 pounds per head.

Sodium Chloride Toxicity

Cattlemen and sheepmen alike have believed that large amounts of salt had toxic effects on ruminants. The attributed many deaths of their animals to consumption of salt and saline waters. There has been little research on salt toxicity as a result, little scientific knowledge of the problem exists.

Ramsey (1924) reported that some waters in Australia were analyzed and permissible levels of salt were established for livestock through conferences with owners. These levels were based chiefly on opinions and not experimental data.

Scott (1924) reported the deaths of a number of cattle resulting from intake of water from a salt-polluted stream. However, the water was not analyzed, and is believed to have contained harmful factors other than assumed salt toxicity.

Worden (1945) observed that pigs will not voluntarily consume enough salt to give toxic effects. Further, many of the so-called salt-poisoning cases are believed to have been the results of the effects of other elements.

Ellis (1942) reported that a hog was found to have consumed a total daily ration of 8.4 pounds for 26 days. Of this daily ration, 1.1 pounds was salt.

In early work with sheep, Lundin and Scharf (1925) found that high salt administration resulted in a comparatively low salt retention in a normal animal. They gave as much as 100 grams of salt per day to each sheep. In two partially nephrectomized animals, considerable retention was noted. Highest retention occurred, however, with a pregnant ewe. The partially nephrectomized animals suffered kidney damage when the daily salt intake increased from 50 grams to 100 grams per day. The intact animals suffered no damage.

Jones (1930) reported that a cow fed one pound of salt in buttermilk every six hours developed salt-poisoning characteristics one hour after the second dose. She exhibited weakness, suffering from severe spasms, and diarrhea.

Heller (1933) Attempted to obtain toxic effects in dairy cows by requiring them to drink water of high salt content. The cows varied in stage of growth, reproduction and maintenance. Water of 1.5 to 2.0 per cent salt was given to the cows for two months, and no adverse effects were noted.

Cardon et al., (1951) conducted several experiments at the Arizona Agricultural Experiment Station to study the physiological effect of high salt intakes by ruminants. Symptoms of salt toxicity reported were: anxiety, hypersensitivity to touch, loss of coordination, increased rate and intensity of rumen contractions, gas formation in the rumen, progressive weakness, and finally, death without struggling.

In one of the Arizona experiments, two pounds of salt and three gallons of water were placed in the rumen of a fistulated Guernsey cow. The cow had been off feed and water for 36 hours prior to the experiment. Eight hours later, the blood had 642 mg. of sodium chloride per 100 ml. of blood. Nervousness and incoordination were also evidenced at that time. Within twelve hours, the cow's condition was critical and her rumen was washed out to save her life. She appeared normal twenty-four hours later.

The same cow was used in a later experiment and conditions were repeated as before except that the animal was allowed all the water she wanted to consume. Blood sodium chloride did not rise over 505 mg. per 100 ml. of blood and no distressing actions were observed.

A study to determine the effects of high salt intake during pregnancy was initiated by these same Arizona workers. Five cows were placed on maintenance rations and were fed one pound of salt per day. Four of the cows were pregnant at the beginning of the experiment and all four calved

normally about three months later. All five of the cows were rebred later, and all were found pregnant. Heller (1933) also found that high salt intake did not cause abortion.

Feeding Trials

Savage and McIlvain (1951) self-fed a cottonseed meal-salt mixture to different weight classes of range steers. The daily self-fed consumption of cottonseed meal was maintained at 2 pounds per head by mixing about 3/4 pound of salt with every 2 pounds of meal for steers weighing 700 pounds, 5/8 pound of salt for each 2 pounds of meal for steers weighing 450 pounds, and 1/2 pound of salt for every 2 pounds of cottonseed meal for steers weighing 300 pounds. These workers claimed that self-feeding a salt-cottonseed meal mixture resulted in reduced labor costs, and more uniform grazing over the entire range.

In a study to determine the best method to feed protein to steers on winter pastures, Smith and Pickett (1949) divided 40 steers into four equal lots. The steers of Lot 1 were fed three pounds of soybean pellets per head every other day; steers of Lot 2 were self-fed a cottonseed meal-salt mixture; steers of Lot 3 had alfalfa hay fed to them daily; and steers of Lot 4 were fed three pounds of soybean pellets (containing only 50 per cent soybean meal) per head daily. Average daily gains per head were -.07, .22, -.04, and .06 pound for the Lots 1, 2, 3, and 4, respectively. The greater gain for steers in the self-fed lot was due to their consuming an average of 2.83 pounds of cottonseed meal per head per day, while steers of Lot 4 actually consumed only 1.5 pounds of soybean meal per head per day. However, no detrimental effects were noted due to high salt consumption in Lot 2.

Studies by Smith and Cox (1951) showed that the daily feeding of steers resulted in greater gains than feeding every other day on dry grass. Steers of Lot 1 were fed 2 pounds of soybean oil meal pellets per head daily; steers of Lot 2 were fed 4 pounds of soybean oil meal pellets per head on alternate days; steers of Lot 3 were fed 6.9 pounds of alfalfa hay per head daily; and steers of Lot 4 were self-fed a mixture of soybean oil meal and salt. The self-fed mixture consisted of 12 parts soybean oil meal and 1 part salt. Average daily salt consumption for each steer in the self-fed lot was 0.58 pound. At the end of the 141-day experiment, steers of Lot 1 had gained 99 pounds per head; steers of Lot 2, 79 pounds per head; steers of Lot 3, 45 pounds per head; and steers of Lot 4, 46 pounds per head. No ill effects were noted in steers self-fed the soybean oil meal-salt mixture, but these steers did present a somewhat rougher haircoat than steers of the other lots at the close of the winter period.

In still another experiment, these workers found that steers fed every other day gained an average of 75 pounds per head while steers fed daily averaged 62 pounds gain per head during the same period. Steers fed alfalfa hay gained only 46 pounds per head, making the smallest gains as similarly fed lots had in two previous trials. The steers self-fed a soybean oil meal salt mixture gained 54 pounds per head during the experimental period. It was difficult to regulate the salt-meal intake of the self-fed steers to maintain meal consumption at approximately 2 pounds per head daily. The average daily salt consumption was almost 0.7 pound per steer in the lot self-fed the soybean oil meal-salt mixture. The amount of soybean meal consumed by the steers

in the self-fed lot was 1.97 pounds per head daily while steers fed pellets consumed an average of 2 pounds soybean oil meal per head daily.

Weir and Miller (1953) fed a cottonseed meal-salt mixtures to breeding ewes to determine whether or not protein intake could be controlled without producing adverse affects. Eighteen ewes were divided into two equal lots. The ewes of one lot were self-fed a 25 per cent salt and 75 per cent cottonseed meal mixture. The ewes of the control lot were hand-fed cottonseed meal. Both lots were fed the basal ration of 3/4 pound alfalfa hay, and barley straw, free-choice. Only when the average consumption of salt reached 90.8 gms. per day per ewe in the self-fed lot did a significant difference exist in chlorides of blood samples from the two lots. Differences in sodium and potassium levels were not significant. Ewes of the two lots did not differ in lambing performances, adrenal glands, or kidneys after the ewes had been carried through gestation and lactation. This indicated that sheep may be self-fed a three-to-one ration of cottonseed meal-salt without encountering "salt poisoning".

Following this, Weir and Torell (1953) repeated the above experiment under range conditions. They used 48 ewes in each of two lots. From October 1 to March 2 they hand-fed cottonseed meal to the ewes of one lot and self-fed the ewes of the other lot a 75 per cent cottonseed meal and 25 per cent salt mixture. High salt intake by ewes of the self-fed lot caused no adverse effects or significant differences in lamb production, wool production, or ewe weights.

The advantages of self-feeding a mixture of protein supplement and salt as reported by these workers are: 1) animals do not need to be fed every day, 2) each animal has an opportunity to take as much supplement

as it desires, 3) each animal can increase its intake as other feed supply decreases, 4) less feeder space required, 5) all the animals do not have to be at feeding grounds at feeding time to get their share of supplements, 6) little feed is wasted as there is no crowding at feeder.

Some disadvantages they reported are: 1) animals aren't seen as often as is usually considered good management, 2) added cost of salt and cost of covered self-feeders, 3) water must be plentiful, 4) range animals may need training before they will eat from a self-feeder.

Riggs et al., (1953) found that cows which were self-fed a cottonseed meal-salt mixture lost nearly the same amount of weight as cows that were hand-fed cottonseed meal during the winter. Some scouring occurred in the cows self-fed the cottonseed meal-salt mixture and one cow died, but it is believed that a higher level of feed would have alleviated this. Average daily salt intake in the lot of cows that were self-fed was between 1.0 and 1.5 pounds per head at the time of scouring and when one of the cows died.

The same workers fed four lots of cows on different nutritive levels. This was accomplished by limiting the hay intakes of the cows in each of the lots. Three lots of cows were self-fed cottonseed meal and salt in a mixture in such a way that the average daily consumption of cottonseed meal was restricted to approximately two pounds per head daily. The cows of one of these lots were fed a sufficiently low level of hay to cause a rapid loss of weight. The cows of the second lot were fed hay at a maintenance level and the cows of the third lot on the high-salt mixture were fed all the hay they would consume. The cows of the fourth lot served as a control lot and were hand-fed cottonseed meal daily and self-fed hay. By comparing hay consumption of the cows in the third lot and of the cows

in the fourth lot, these workers attempted to determine whether salt actually limited the intake of hay. They found that cows fed all the hay they would eat but self-fed a cottonseed meal-salt mixture, ate less hay than cows hand-fed cottonseed meal. Calves were lighter when the cows were fed limited quantities of hay and the salt mixture. Levels of chloride in blood and milk samples were not significantly different among the groups.

Later these workers fed each of two dry cows in dry lot a 25 pound daily ration consisting of 30 per cent chopped alfalfa hay, 30 per cent cottonseed hulls, 30 per cent ground milo, and 10 per cent cottonseed meal. The cows also had access to a mineral mixture. At intervals salt was substituted for cottonseed hulls in 1 per cent increases. Average daily feed consumption per cow was reduced two pounds when the ration contained 10 per cent salt. When the ration contained 15 per cent salt mass refusals resulted and daily intakes of the ration steadily decreased until the cows practically refused to eat at all. Salt consumption per head averaged over 2 pounds per day for 150 days and over 3 pounds per day for 40 days. Average daily weight gains per head for each of the two cows was 1.85 pounds for 152 days. The cows became fat and sleek during the 243-day trial. When they calved at the end of the period, the chloride levels of blood and milk samples were normal. It appeared that dry cows can tolerate extremely high levels of salt under conditions of ample feed and water supply.

Digestion and Metabolism Trials

Smith, Parrish and Clawson (1951) compared the digestibility of silage and protein supplement by two groups of steer calves. One group

had received no salt during the trial and for four or five months prior to the trial. The other group of calves was fed the same ration plus 20 to 28 grams of salt per head daily. The coefficients of digestibility of dry matter, crude protein, ether extract, crude fiber, and nitrogen-free extract were 0 to 4.0 per cent greater for steers that had been fed salt.

Archer (1952) fed steers a ration containing cottonseed meal and salt in approximately a three-to-one ratio and found that nitrogen retention was slightly decreased as compared to nitrogen retention of the same steers fed a normal amount of salt with cottonseed meal. The digestion coefficients for the steers fed the high amounts of salt were slightly lower than when a normal amount of salt was fed. The digestibility of organic matter decreased from 63.2 to 62.2 per cent, crude protein decreased from 61.8 to 60.0 per cent, and ether extract decreased from 63.2 to 62.5 per cent. More than 98 per cent of the chloride was excreted in the urine and less than one per cent in the feces. Sodium was not absorbed as efficiently as chloride from the intestinal tract. Potassium absorption seemed to increase as sodium content of the ration increased.

Riggs et al., (1953) found that when cows consumed 15 times as much salt as the control cattle, they excreted seven times as much in the urine. The urine contained 16 times as much salt as the urine of the control cows, but the feces from the cows receiving large amounts of salt contained less salt than feces from the control cows. This indicated a greater efficiency of absorption of salt when salt was fed at a high level.

A study of the effect of high salt intake on digestibility was made by these same workers with cows during a seven-day collection period.

A high salt intake appeared to improve protein digestibility approximately 8 per cent. The digestibility of crude fiber, nitrogen-free extract, and ether extract also improved slightly when salt was fed at a high level of consumption.

EXPERIMENT 1

The Self-feeding of Cottonseed Meal-Salt Mixtures To Beef Cows

Experimental Procedure

In October, 1952, 50 grade Hereford cows were divided into two lots on the basis of weight, age, average weaning weights of their calves produced in previous years, and past treatment. This was the third winter for this experiment. Most of the cows were receiving the same treatment for the third consecutive winter period.

During the winter season the cows were allowed to graze dry, cured grass and, in addition, they consumed at least 2.5 pounds of either 41 per cent cottonseed cake or cottonseed meal. The cottonseed cake was hand-fed to the cows of Lot 1 every other day. The cottonseed meal was available to the cows of Lot 2 as a mixture with salt in a self-feeder.

The level of salt in the self-fed mixture was gradually increased from 25 per cent at the beginning of the period to 33 per cent about two weeks later in order to control the consumption of cottonseed meal. The average salt content of the mixture for the entire period was 32.33 per cent. This mixture also contained steamed bone meal in sufficient quantities to equal the bone meal intake of the cows in Lot 1. A mineral mixture containing two parts salt and one part steamed bone meal was available to cows of Lot 1.

All of the cows were weighed at intervals throughout the wintering period. Blood samples were collected from the cows at these times and

from the calves twice during their early life. These samples were analyzed for plasma sodium, potassium, and chlorides.

Samples of the four main grasses in the winter pastures were obtained for proximate chemical composition.

Results and Discussion

The cows self-fed the cottonseed meal-salt mixture (Lot 2) had an average gain of 19 pounds per head from the beginning of the winter period until the last weighing before the first calf was born. The cows hand-fed cottonseed cake (Lot 1) had an average gain of 7 pounds per head during the same period. The average loss for the entire winter feeding period was 145 pounds per head for the cows in Lot 1 and 155 pounds per head for the cows in Lot 2. The two lots consumed nearly the same amount of protein supplement during this period.

The average birth weight of the calves in Lot 1 was 73 pounds per head while the average birth weight for calves in Lot 2 was 67 pounds per head. The calves in Lot 2 appeared normal and as vigorous and healthy as the calves in the cottonseed cake lot. This has been the case in the previous two years of this experiment. A summary of the weight changes, feed consumption and calving data is presented in Table 1.

Blood analyses for the cows, Table 2, show a great similarity of plasma sodium, potassium, and chloride levels for the two lots of cows throughout the experimental period. Blood samples from the calves also had essentially the same plasma sodium, potassium and chloride levels (Table 3). The chemical composition of the cottonseed meal and cake fed during the winter period is given in Table 4, and that of the predominant grasses is given in Table 5.

The experimental cattle seemed to tolerate a high salt intake and suffered no apparent ill effects through three winters. It must be real-

ized, however, that during this test the winters were quite mild and different results might be obtained during severe winters.

Table 1

Summary of Production Data, 1952-53

	Lot 1 Cottonseed cake, hand-fed	Lot 2 Cottonseed meal--salt, self-fed
Number of cows	23	23
Average weight per cow (lbs.)[1]		
Beginning winter period 10-28-52	1010	1022
Before calving 1-31-53	1017	1041
Gain to calving	7	19
End of winter period 4-9-53	865	867
Change during winter	-145	-155
Average daily winter ration (lbs.)[2]		
Cottonseed cake	2.5	---
Cottonseed meal	---	2.63
Salt	.0569	1.25
Steamed bone meal	.0285	.0185
Average birth weight of calves	73	67
Average date of calves	March 4	March 8

[1]Data includes only cows that produced calves.

[2]In addition to winter grazing.

Table 2

Chemical Composition of Cow Blood, 1952-53
(mg. per 100 ml. plasma)

Lot	1952		1953			
	Oct. 28	Dec. 4	Jan. 10	Jan. 31	Mar. 17	Apr. 9
			Chloride			
1	341	340	329	348	334	330
2	337	354	351	346	342	323
			Sodium			
1	308	285	311	344	260	270
2	304	292	334	339	256	262
			Potassium			
1	---	15.3	14.7	14.1	14.8	16.5
2	---	16.0	15.1	14.5	15.3	16.4

Table 3

Chemical Composition of Calf Blood, 1953
(mg. per 100 ml. plasma)

Lot	1953	
	March 17	April 9
	Chloride	
1	327	334
2	325	333
	Sodium	
1	263	276
2	269	276
	Potassium	
1	19.2	18.9
2	20.5	18.6

Table 4

Chemical Composition of Protein Supplements

	Percent dry matter	Percentage composition of dry matter						
		Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Calcium	Phosphorus
Cottonseed cake	94.37	6.50	42.21	7.27	10.41	33.61	.18	.76
Cottonseed meal	94.79	6.30	42.55	5.72	11.97	33.46	.14	.68

Table 5

Chemical Composition of Range Grasses

Grass	Percent dry matter	Percentage composition of dry matter						
		Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Calcium	Phosphorus
February 3, 1953								
Big bluestem	91.78	6.09	2.54	2.60	34.60	54.17	.34	.056
Little bluestem	92.50	5.49	2.75	2.15	27.69	61.92	.29	.055
Indian	92.47	6.49	2.04	2.57	32.25	56.65	.31	.041
Switch	92.78	7.36	2.27	2.43	32.61	55.33	.41	.042
March 17, 1953								
Big bluestem	95.52	6.38	2.61	2.03	35.96	53.02	.30	.048
Little bluestem	95.54	6.76	2.64	1.84	36.04	52.72	.27	.022
Indian	95.76	7.93	1.86	1.51	36.95	51.75	.30	.010
Switch	95.16	6.58	2.29	1.99	37.01	52.13	.35	.027

EXPERIMENT 2

A Metabolism Study of the Effect of a High Salt Diet upon Sheep

Experimental Procedure

Six range type wether lambs of the same general breeding were used in the metabolism studies. They weighed between 60 and 75 pounds each. These lambs were placed in a pen for a preliminary period of 10 days. They were individually fed in a stanchion type of feeder so that the intake of each wether could be controlled. Following the preliminary period, each sheep was placed in a metabolism crate. Collection of feces and urine was started two days later and continued for 10 days.

The ration fed to each wether was changed in the second trial so that each sheep was fed each experimental ration. The sheep were fed twice daily and water was available before and after feeding. It was not possible to get the sheep on the high-salt rations to consume the desired amount of salt as a mixture due to the abnormal surroundings of the metabolism period. The desired consumption was achieved by feeding the basal ration which contained eight grams of salt and then giving the additional salt required in gelatin capsules. The two rations fed were the same except for the added 42 grams of salt in the high-salt ration.

The total quantity of feces excreted was collected daily, placed in trays, dried for approximately 24 hours, placed in loosely covered metal containers, and held at room temperature until the end of the collection period. The total dried feces were weighed and proximate composition was

determined as described by the Association of Official Agricultural Chemists (1945). Chlorides were determined by the method of McLean and Van Slyke (Peters, 1932); sodium and potassium contents of feed, urine and feces by means of a Perkin-Elmer flame photometer using lithium as an internal standard.

Urine was collected daily in glass containers equipped with glass funnels located beneath the sheep.* The urine was measured daily and a five per cent aliquot, acidified with concentrated sulphuric acid, was placed under refrigeration. Total urinary nitrogen from each sheep was determined by the Kjeldahl method on the composite samples for each collection period.

The hay used in this study was good quality chopped hay grown in the vicinity of Stillwater. The cottonseed meal used was 41 per cent protein expeller process cottonseed meal. Salt used was finely ground and suitable for human consumption. The corn was coarsely ground. Pure gelatin was fed to the lambs on the control ration in the same quantities as given in the capsules to those lambs on the high-salt ration.

Results and Discussion

The chemical composition of the feeds used in this study is given in Table 6.

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* A small quantity of formaldehyde was placed in the glass containers daily in an attempt to prevent loss of nitrogen as ammonia.

Table 6

Chemical Composition of Feed Stuffs

Feed	Percent dry matter	Percentage composition of dry matter: Crude protein	Ether extract	Crude fiber	N-free extract	Ash
Trial I						
Prairie hay	94.10	5.08	2.47	34.63	51.39	6.43
Cottonseed meal	93.40	44.50	5.96	11.03	32.35	6.16
Corn	91.22	9.37	4.89	2.52	81.42	1.80
Salt	99.95	----	----	----	----	100.00
Gelatin	100.00	100.00	----	----	----	----
$CaCO_3$	100.00	----	----	----	----	100.00
Trial II						
Prairie hay	93.79	4.50	2.44	33.24	51.62	8.20
Cottonseed meal	93.61	43.77	5.93	13.31	30.52	6.47
Corn	90.80	9.00	2.53	2.24	84.71	1.52
Salt	99.95	----	----	----	----	100.00
Gelatin	100.00	100.00	----	----	----	----
$CaCO_3$	100.00	----	----	----	----	100.00

The daily allowances for ration A were as follows: chopped prairie hay, 300 grams; cottonseed meal, 150 grams; corn, 150 grams; gelatin, 4.5 grams; calcium carbonate ($CaCO_3$), 3 grams; and salt, 8 grams. Table 7 shows that the only differences in ration B was to increase the salt intake to 50 grams.

Table 7

Average Daily Intake of Ration Ingredients

Feed	Daily allowance (grams): A	B
Prairie hay	300.0	300.0
Cottonseed meal	150.0	150.0
Corn	150.0	150.0
Salt	8.0	50.0
Gelatin	4.5	4.5
$CaCO_3$	3.0	3.0
	615.5	657.5

The mineral composition of each feedstuff is given in Table 8.

Table 8

Mineral Composition of Feed Stuffs

Feed	Percentage composition		
	Sodium	Potassium	Chloride
Trial I			
Prairie hay	.013	0.640	.078
Cottonseed meal	.002	2.560	.014
Corn	.001	0.340	.041
Salt	38.800	0.053	52.710
Trial II			
Prairie hay	.005	0.640	.077
Cottonseed meal	.014	2.620	.011
Corn	.005	0.330	.041
Salt	38.800	0.053	52.710

The cottonseed meal:salt ratio was 3:1 during the high-salt phase of the experiment.

Some feed was refused by one sheep (number 5) during the time it was on the high salt ration. These orts were collected, dried and analyzed by the previously described methods. Allowance for the orts was made by subtracting the quantity of the nutrients refused from the total amount fed. The chemical composition of the orts is given in Footnote 1 of Table 14. The mineral composition of the orts is given in Footnote 1 of Table 15.

The average nitrogen balance data are given in Table 9. There is an indication that the addition of large quantities of salt to the ration increased the amount of nitrogen excreted by the sheep. The average daily nitrogen retention for the lambs on ration A was 6.19 grams, and for ration B, 3.79 grams. Although the feeding of high amounts of salt tended to increase the amount of nitrogen excreted, a positive nitrogen balance existed throughout

the experiment. Thus, no detrimental effects are believed to have been caused in this respect by the high salt ration. The results presented here are in agreement with results with steers as reported by Archer (1952).

Table 9

Average Daily Nitrogen Balance Data

Sheep number	Trial number	Ration letter	Nitrogen data (grams) Nitrogen intake	Fecal nitrogen	Urinary nitrogen	Nitrogen balance
1	1	B	15.80	4.64	6.92	4.24
1	2	A	14.54	4.40	3.97	6.17
2	1	B	15.80	4.16	7.19	4.45
2	2	A	14.54	4.21	4.16	6.17
3	1	B	15.80	4.42	7.31	4.07
3	2	A	14.54	4.36	8.38	1.80
4	2	B	14.54	4.57	6.79	3.18
4	1	A	15.80	4.21	4.04	7.55
5	2	B	12.60	3.81	3.60	5.19
5	1	A	15.80	4.26	3.58	7.96
6	2	B	14.54	4.32	8.68	1.54
6	1	A	15.80	4.41	3.90	7.49
Average		A	15.17	4.31	4.67	6.19
Average		B	14.85	4.32	6.75	3.50

The average apparent digestion coefficients for the rations are shown in Table 10. For ration A, the average coefficients of digestibility were: organic matter, 69.20; crude protein, 70.86; ether extract, 72.82; crude fiber, 59.04; and Nitrogen-free extract, 72.24 per cent. For ration B the average digestion coefficients were: organic matter, 66.77, crude protein, 70.05; ether extract, 74.30; crude fiber, 55.77; and Nitrogen--free extract, 69.46 per cent. There is a tendency for the high salt intake to decrease the digestibility of all nutrients except ether extract. The reason for this exception is not apparent. Because of limited num-

bers of animals and considerable variation within treatment, the significance of these differences is unknown. Table 14 gives the amount and chemical composition of the fecal dry matter of each sheep.

Table 10

Average Apparent Digestion Coefficients

Sheep number	Trial number	Ration letter	Apparent percentage digestibility: Organic matter	Crude protein	Ether extract	Crude fiber	N-free extract
1	1	B	65.83	69.15	76.18	56.41	67.67
1	2	A	68.01	69.74	65.93	54.62	72.70
2	1	B	67.76	72.36	77.32	54.37	70.80
2	2	A	70.95	71.05	67.01	59.83	75.37
3	1	B	67.53	70.62	77.59	58.92	69.17
3	2	A	68.77	70.02	64.86	58.78	72.11
4	2	B	64.85	68.56	73.02	50.85	68.56
4	1	A	68.68	72.02	80.27	60.49	69.96
5	2	B	66.73	69.29	74.90	56.32	69.41
5	1	A	69.36	71.67	79.55	59.24	71.81
6	2	B	67.93	70.31	66.79	57.76	71.14
6	1	A	69.43	70.66	79.27	61.28	71.47
Average		A	69.20	70.86	72.82	59.04	72.24
Average		B	66.77	70.05	74.30	55.77	69.46

Archer (1952) found a decrease in digestibility of all nutrients in steers on a high-salt ration. In a short trial with cows, Riggs et al., (1953) found an increase in the digestibility of all nutrients.

Table 11 gives the chloride balance data. Less than one per cent of the chloride was excreted in the feces, and more than 98 per cent of the chloride was excreted in the urine. The average chloride retention of each sheep was 0.676 gram per day when the sheep were fed ration B. When the sheep were fed ration A, they excreted an average of 0.533 gram of chloride in excess of their intake. The mineral composition of the

feces and urine of each sheep is given in Tables 15 and 16, respectively. The reason for the unusually large quantity of urine excreted by Sheep 3 is not apparent.

The data on sodium intake and excretion are given in Table 12. The data indicate that sodium is not absorbed from the intestinal tract as efficiently as is chloride. Archer (1952) reported similar results with steers. When the sheep were fed ration B, their average sodium retention was 1.021 gram per day per sheep. Then the sheep were fed ration A, they excreted an average of 0.126 gram of sodium in excess of their average intake.

Table 11

Average Daily Chloride Balance Data

Sheep number	Trial number	Ration letter	Chloride data (grams) Chloride intake	Fecal chloride	Urinary chloride	Chloride balance
1	1	B	26.669	0.027	26.300	0.342
1	2	A	4.525	0.005	5.060	-0.540
2	1	B	26.669	0.020	25.650	0.999
2	2	A	4.525	0.010	5.220	-0.705
3	1	B	26.669	0.002	25.930	0.737
3	2	A	4.525	0.008	4.850	-0.300
4	2	B	26.661	0.002	24.990	1.669
4	1	A	4.533	0.000	5.470	-0.937
5	2	B	26.286	0.010	25.570	0.706
5	1	A	4.533	0.019	4.290	-0.224
6	2	B	26.661	0.008	27.058	-0.397
6	1	A	4.533	0.013	5.132	-0.610
Average		A	4.529	0.009	5.003	-0.553
Average		B	26.603	0.012	25.915	0.676

There was also a tendency for potassium absorption to be increased from the intestinal tract as the sodium content of the ration was increased. The data are shown in Table 13.

Table 12

Average Daily Sodium Balance Data

Sheep number	Trial number	Ration letter	Sodium data (grams) Sodium intake	Fecal sodium	Urinary sodium	Sodium balance
1	1	B	19.444	0.137	17.986	1.321
1	2	A	3.148	0.314	3.006	-0.172
2	1	B	19.444	0.128	17.815	1.501
2	2	A	3.148	0.278	3.229	-0.359
3	1	B	19.444	0.302	17.899	1.243
3	2	A	3.148	0.067	2.957	0.124
4	2	B	19.444	0.073	17.576	1.868
4	1	A	3.148	0.125	3.397	-0.374
5	2	B	18.659	0.135	18.834	-0.310
5	1	A	3.148	0.345	2.602	0.201
6	2	B	19.444	0.130	18.810	0.504
6	1	A	3.148	0.232	3.093	-0.177
Average		A	3.148	0.227	3.047	-0.126
Average		B	19.313	0.151	18.141	1.021

Table 13

Average Daily Potassium Balance Data

Sheep number	Trial number	Ration letter	Potassium data (grams) Potassium intake	Fecal potassium	Urinary potassium	Potassium balance
1	1	B	4.396	0.232	3.497	0.677
1	2	A	4.448	0.649	2.761	1.038
2	1	B	4.396	0.243	4.408	-0.255
2	2	A	4.448	0.778	1.652	2.018
3	1	B	4.396	0.403	3.790	0.203
3	2	A	4.448	0.629	3.663	0.156
4	2	B	4.471	0.473	3.861	0.137
4	1	A	4.373	0.211	3.998	0.164
5	2	B	4.042	0.464	3.915	-0.337
5	1	A	4.373	0.816	2.949	0.608
6	2	B	4.471	0.559	3.861	0.051
6	1	A	4.373	0.716	3.493	0.164
Average		A	4.411	0.633	3.086	0.692
Average		B	4.362	0.396	3.888	0.078

With the exception of Sheep 4, the percentage of potassium remaining in the feces was lowered when the sodium content of the ration was increased. The reason for the exception is not apparent. The average potassium retention of each sheep when on ration B was 0.078 gram, and when on ration A, 0.692 gram. In general, the results follow the same trend as indicated by Archer (1952) in his metabolism experiment with steers.

Table 14

Average Fecal Dry Matter and Its Chemical Composition

Sheep number	Ration number	Chemical composition (grams) Dry matter	Crude protein	Ether extract	Ash	Crude fiber	N-free extract
		Trial 1					
1	B	203.74	29.00	5.24	21.08	50.86	97.56
2	B	195.48	25.98	4.99	23.14	53.24	88.13
3	B	194.90	27.62	4.93	21.36	47.93	93.06
4	A	187.52	26.30	4.34	20.12	46.10	90.66
5	A	183.35	26.63	4.50	19.57	47.56	85.09
6	A	186.30	27.58	4.56	22.88	45.18	86.10
		Trial 2					
1	A	195.88	27.49	6.35	26.88	52.31	82.85
2	A	178.85	26.30	6.15	25.37	46.30	74.73
3	A	190.68	27.24	8.91	25.73	47.52	81.28
4	B	210.41	28.57	5.03	24.74	56.66	95.41
5	B	180.54	23.80	4.19	22.48	45.26	84.81
6	B	194.61	26.98	6.19	25.18	48.69	87.57
[1]Orts (5)	B	547.25	121.49	17.79	106.17	63.59	238.21

Table 15

Mineral Composition of Fecal Dry Matter

Sheep number	Ration letter	Percentage composition		
		Sodium	Chloride	Potassium
		Trial 1		
1	B	0.067	0.013	0.114
2	B	0.065	0.010	0.124
3	B	0.155	0.001	0.207
4	A	0.067	0.000	0.113
5	A	0.188	0.010	0.445
6	A	0.125	0.007	0.384
		Trial 2		
1	A	0.161	0.002	0.331
2	A	0.155	0.005	0.435
3	A	0.035	0.004	0.330
4	B	0.035	0.009	0.225
5	B	0.075	0.005	0.257
6	B	0.068	0.004	0.287
1Orts (5)	B	1.435	0.784	0.686

Table 16

Volume of Urine Excreted and Its Mineral Composition

Sheep number	Ration number	Volume in ml.	Mineral composition (mg. per ml.)		
			Sodium	Chloride	Potassium
			Trial 1		
1	B	24,980	7.20	10.53	1.40
2	B	22,840	7.80	11.23	1.93
3	B	45,660	3.92	5.68	0.83
4	A	19,410	1.75	2.82	2.06
5	A	3,540	7.35	12.12	8.33
6	A	7,850	3.94	6.54	4.45
			Trial 2		
1	A	10,660	2.82	4.75	2.59
2	A	12,420	2.60	4.20	1.33
3	A	44,130	0.67	1.10	0.83
4	B	25,740	6.80	9.71	1.50
5	B	14,830	12.70	17.24	2.64
6	B	24,750	7.60	10.93	1.56

Summary

A third year of study was conducted to determine the effects of a high salt intake on beef cows. Two lots of cows grazed the native grass pastures at the Lake Carl Blackwell experimental range area of the Oklahoma Agricultural Experiment Station. One lot of cows was hand-fed cottonseed cake for the three consecutive wintering periods. The other lot was self-fed a mixture of cottonseed meal and salt. The salt effectively controlled the intake of cottonseed meal. The results of the third year of study do not indicate any harmful effect upon the cows as indicated by weight loss during the winter period or birthweight of calves produced. No other detrimental effects were noted among the cows fed the high salt diet. The large amount of salt consumed had no effect on the plasma chloride, potassium, or sodium levels of blood samples taken at intervals during the winter period. The excretion of increased quantities of urine by cows fed the high-salt ration indicated that cows receiving such a mixture should have access to abundant water.

A metabolism study was conducted using six sheep to determine the effect of a high salt ration on digestibility and nitrogen, chloride, sodium, and potassium balance. Each received both a normal ration and a high salt ration. No real differences were noted in the digestion coefficients although the coefficients for all nutrients except ether extract were lower when the sheep were fed high amounts of salt. The amount of nitrogen retained by each sheep was also slightly decreased. In every case, less than one per cent of the chloride was excreted in the feces.

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PART II

CREEP-FEEDING BEEF CALVES

INTRODUCTION

In recent years there has been an increasing demand for lighter cuts of beef in the United States. In the attempt to satisfy this changing demand, producers have striven to have cattle fat enough for slaughter when they are comparatively young. The fact that cattle make more economical gains when young has favored creep-feeding and fattening young cattle. Thus, the feeding of grain to well-bred beef calves before weaning, so as to have the calves fat enough to sell for beef at or within a short time after weaning has been the logical phase of beef production to which many producers have turned.

Smith et al., (1952) listed the following advantages for creep-feeding: 1) adds weight and finish to the calves, 2) cows are not suckled down so much, 3) calves grow out more uniformly in size and condition, 4) calves shrink very little at weaning time, 5) aids in development of future breeding stock, 6) shortens feeding period after weaning, 7) serves as a good market for home-grown feeds, 8) calves that are creep-fed usually sell for a higher price than calves that are not creep-fed.

Reported herein are two years' results of a test designed to determine the value of creep-feeding suckling calves born in February and March and sold at weaning, creep-feeding steer calves prior to fattening in drylot, and creep-feeding heifer calves that are to be wintered on prairie hay and cottonseed cake.

REVIEW OF LITERATURE

Trowbridge (1927) used three lots of grade Shorthorn steer calves born in the fall and sired by a purebred Shorthorn bull. The calves of Lot 1 were with their mothers on pasture and received no grain. Calves of Lot 2 were allowed to run with their mothers and were fed grain and alfalfa hay in a creep. In Lot 3, calves were separated from their mothers but were allowed to nurse them night and morning. These calves were also fed grain and alfalfa hay and ran in a grass lot. At the end of the period, the two lots of grain-fed calves had an average weight of approximately 600 pounds per head, 100 pounds heavier per head than the calves which received no grain. Both lots of creep-fed calves brought greater net returns.

Trowbridge (1929) compared four methods of handling calves from the age they were able to eat until weaning. They also tested the subsequent performance of these calves in the feedlot. Calves of Lot 1 had no supplemental feed; calves of Lot 2 were creep-fed while with their dams on pasture; calves of Lot 3, separated from their dams, were fed grain in a creep and allowed to nurse twice daily; and calves of Lot 4, with their dams on pasture, were creep-fed only the last four to eight weeks prior to weaning. A summary by Black and Trowbridge (1933) showed that cows whose calves had supplemental feed throughout the suckling period made greater gains than cows whose calves either had no supplemental feeding at all or had it only the last four to eight weeks. The average weight gains during the suckling period were 19, 55, 35, and 16 pounds per cow for Lots 1, 2, 3, and 4, respectively.

Calves of Lot 1 had an average gain of 269 pounds per head; calves of Lot 2 had an average gain of 371 pounds per head; and calves of Lot 4 had an average gain of 310 pounds per head. Calves that were creep-fed were appraised higher at the end of the suckling period, and had greater net returns than the calves of Lot 1.

However, in the subsequent 196-day drylot feeding trial, calves that were creep-fed made 7 per cent less gain and consumed 8 per cent more feed per hundredweight gain than calves that were not creep-fed. Creep--fed calves had a higher average grade at the end of the feeding period than the non-creep-fed calves.

Jones and Jones (1932) found that 48 creep-fed Hereford range calves had an average gain of 223 pounds per head during a 160-day period. Forty-six non-creep-fed calves had an average gain of 109 pounds per head, of 114 pounds less per head than the creep-fed calves. Calves that were creep-fed were fed mainly ground ear corn and cottonseed meal. The creep--fed calves were appraised higher and had the greater net return at the end of the suckling period than the calves that were not creep-fed. The dams of the creep-fed calves had an average gain of 79.7 pounds per head while dams of the non-creep-fed calves had an average gain of 28.8 pounds per head. The dams of the creep-fed calves were appraised higher due to their better condition.

After weaning, the calves were returned to their pastures for an 86-day period. Calves of both lots were fed the same ground ear corn and cottonseed meal rations in self-feeders. Calves that had been creep-fed had an average gain of 166.3 pounds per head. Calves that were not creep-fed had an average gain of 47 pounds per head during the same period. During the drylot period, the net sales value of

the creep-fed calves increased more than that of the non-creep-fed calves. At the end of the period, the creep-fed calves were acceptable fat yearlings, not highly finished, but of good slaughter value, and were comparable to calves fed a grain ration for a six-month period in drylot. Net value after deducting feed costs was $20.67 per head for the creep-fed calves and $16.75 per head for the non-creep-fed calves.

Creep-feeding was tested in Colorado by Morton (1932) who fed a creep ration of rolled oats. At weaning time, the creep-fed calves were an average of 8.39 pounds heavier per head than the non-creep-fed calves. The cost of this additional gain was high at 26 cents per pound. After weaning both groups of calves were put in drylot and fed rations consisting of corn, barley, cottonseed cake, corn silage, and alfalfa hay to determine the effects of creep-feeding on the finishing ability of the calves. At the end of the fattening period the creep-fed calves were 18.2 pounds heavier per head and were appraised at 50 cents more per hundredweight than the non-creep-fed calves. After feed costs were deducted the creep-fed calves lost 57 cents less per head than the other calves.

Moxley (1933) found that early calves that were creep-fed ate about 10 bushels of corn per head by weaning. They weighed about 100 pounds more per head and sold at a higher price per hundredweight than calves not creep-fed.

A comparison of different grain rations for creep-feeding and finishing beeves was made by Trowbridge and Moffet (1930). Calves of Lot 1 were fed shelled corn; calves of Lot 2 were fed eight parts shelled corn and one part cottonseed cake, by weight; calves of Lot 3 were fed

two parts shelled corn and one part oats, by weight. During the suckling period, the average gain was 279 pounds per head for calves of Lot 1, 301 pounds per head for calves of Lot 2, and 276 pounds per head for calves of Lot 3. The calves of Lot 2 were appraised at 50 cents more per hundredweight than the other calves. This increased value more than offset the cost of feed. The average consumption of shelled corn per hundredweight gain was 177 pounds for each calf of Lot 1; consumption of shelled corn and cottonseed cake per hundredweight gain averaged 199 pounds for each calf of Lot 2; the average consumption of shelled corn and oats per hundredweight gain was 251 pounds for each of Lot 3. The dams of calves in Lot 1 had an average gain of 77 pounds per head. The dams of calves in Lots 2 and 3 had average gains of 47 and 10 pounds per head, respectively.

Black and Trowbridge (1933) reported that gains for these same lots of calves were not significantly different in a dry-lot feeding test of 196 days following weaning. For the entire period covering suckling and dry-lot phases, the corn and cottonseed cake mixture produced significantly greater gains. This was due to greater gains made by the calves during the suckling phase. In each lot during the drylot phase, it was noted that toward the end of the feeding period, more grain was consumed for every 100 pounds of gain.

Bray (1934) reported the results of two years of creep-feeding trials in Louisiana. Grade Angus, Hereford and Shorthorn calves were used. The calves of the creep-fed lot were fed two and one-half parts ground corn, two and one-half parts rice bran, and one part cottonseed meal by weight. Calves of the creep-fed lot had an average gain that was 44.8

pounds greater per head, were appraised higher, and had higher net returns than calves that were not creep-fed.

In a third trial, the creep-fed mixture consisted of equal parts of ground corn, wheat bran, and cottonseed meal with 12 per cent blackstrap molasses. During the 87-day trial, the creep-fed calves had an average gain per head that was 26 pounds greater than the gain of each non-creep-fed calf. The creep-fed calves were appraised higher and had larger net returns than the non-creep-fed calves.

The following year, four lots of calves were on trial for 133 days. Grade Hereford and Angus calves were used in Lots 1, 2, and 3. Calves of Lot 1 were creep-fed for the full time; calves of Lot 2 were creep-fed for the last 70 days; calves of Lot 3 had access to pasture only; and calves of Lot 4 were Brahman crossbred calves that had access to pasture only. Calves of Lot 1 had an average gain of 236.9 pounds per head; calves of Lot 2, 216.8 pounds per head; calves of Lot 3, 168.8 pounds per head; and calves of Lot 4, 235.4 pounds per head. The calves of Lot 1 were appraised at a higher price per hundredweight, had a higher dressing percentage, and had a higher average net return per head than did the calves of the other lots. Calves of Lot 2 compared more favorably with calves of Lot 1 than calves of the other two lots. The Brahman crossbred calves gained almost as rapidly as the calves of Lot 1, but were appraised lower per hundredweight.

In all four of the Louisiana trials creep-feeding was more profitable than not creep-feeding. He did not, however, recommend that creep-feeding be used by everyone, but that individual circumstances should be considered.

A summary of two years of investigation comparing four creep-feeding mixtures was reported by Black and Trowbridge (1937) using grade Short-

horn calves. Calves of Lot 1 were fed eight parts shelled corn and one part cottonseed cake. Calves of Lot 2 were fed the same mixture except for having the corn cracked. Calves of Lot 3 were fed a mixture of eight parts shelled corn, one part cottonseed cake, and one part alfalfa-molasses mix. Calves of Lot 4 were fed the same ration as that fed calves of Lot 3 except that the corn was cracked. For an average suckling period of 140 days, calves of Lot 1 had an average gain of 320 pounds per head; calves of Lot 2, 312 pounds per head; calves of Lot 3, 298 pounds per head; calves of Lot 4, 307 pounds per head. Appraisal values did not differ significantly. Calves of Lot 2 had the highest feed cost per 100 pounds of gain. Twenty-five per cent more feed per 100 pounds of gain was required when molasses was added and corn was ground as for calves of Lot 4. When the alfalfa-molasses mixture was added, consumption appeared to increase only 2.2 per cent, but when the corn was ground and the molasses mixture added, consumption appeared to be increased by 18.2 per cent.

During a dry-lot feeding period of 196-days, the same calves were fed the same feed they had been fed previous to weaning. The calves of each lot did not differ significantly in total gains or average net values per calf. Grinding the corn, or adding the alfalfa-molasses mixture, or both, was not justified in these experiments.

Three years of creep-feeding experiments were reported by McComas and Wilson (1938) using three lots of Herefords each year. Calves of Lot 1 were on good pasture while calves of Lot 2 were on the same kind of pasture and were creep-fed a mixture of eight parts shelled corn and one part cottonseed meal. Calves of Lot 3 were on a less fertile mountain pasture and were not creep-fed. Calves of Lot 1 had an average

gain of 361 pounds per head during the suckling period. During the same period, calves of Lot 2 had an average gain of 334 pounds per head, and calves of Lot 3 had an average gain of 288 pounds per head. The creep--fed calves consumed only 123 pounds of grain for every 100 pounds of gain. Calves of Lot 1 possessed sufficient finish to satisfy market requirements for slaughter nearly four months sooner than calves of Lots 2 and 3 that were fed alfalfa hay, corn, and cottonseed meal in the drylot after weaning. Calves fattened in drylot after weaning actually did not attain as high a degree of finish as the creep-fed calves had when they were marketed.

At weaning time, calves of Lot 2 had a larger average net return per calf than the average net return of each calf in either of the other two lots. However, a marketing charge of $3.71 was deducted from the returns of each of the calves of Lot 1, whereas such a deduction was not made from the returns of the calves in Lots 2 and 3 since they were not marketed at this time. If this charge had been also deducted from the returns of each calf in Lot 2 and 3, and the average net return from each calf of Lot 1 would have been the highest each year. The average net return from each calf of Lot 2 after having been fed in the drylot was more consistent than the average net returns from calves of the other lots. However, the average net returns per calf in Lot 2, when fattened, was $1.83 less than it would have been at weaning, and $0.88 less than the average net return per calf of Lot 1.

Taylor et al., (1938) reported on creep-feeding and the subsequent value of it in finishing beeves in the feedlot. Two years' creep--feeding data and four years' data on the drylot phase were reported.

In the first year, high grade Hereford creep-fed calves had an average gain of 170 pounds per head as compared to an average gain of 135 pounds per head for calves not creep-fed. Each calf in the creep-fed lot consumed an average of 154 pounds whole oats. An increased appraisal value of 16 cents per hundredweight would have paid for the oats consumed.

The creep-fed mixture in the next experiment consisted of ground corn, oats, wheat bran, and cottonseed meal. The creep-fed calves had an average gain that was 47.9 pounds greater per head than the average gain of each non-creep-fed calf. This was an average daily gain of 1.41 pounds per head for creep-fed calves as compared to 0.84 pounds per head for non-creep-fed calves. As pastures were dry, calves gained less than usual, but creep-fed calves consumed a larger amount of grain than they had the previous years. The creep-fed calves were valued at $1.50 more per hundredweight than similar calves not creep-fed. This increased value per hundredweight for the creep-fed calves would have slightly more than paid for the cost of grain consumed by them.

For four years, these same workers compared the dry-lot finishing ability of creep-fed and non-creep-fed calves. At the start of the dry-lot feeding period, the creep-fed calves weighed an average of 34.9 pounds more per animal than the non-creep-fed calves. At the end of the dry-lot fattening period of 160 days, the non-creep-fed calves had an average gain of 355 pounds per head and the creep-fed calves had an average gain of 344.4 pounds per head. The non-creep-fed calves ate less corn and more roughage during the drylot period than the creep-fed calves. As a result, the cost per 100 pounds of gain was less for the non-creep-fed calves. The creep-fed calves sold at an average price

that was 10 cents greater per hundredweight than the price of the non-creep-fed calves. The creep-fed calves weighed more and brought a higher selling price than the non-creep-fed calves. However, the average net return from a non-creep-fed calf was consistently greater, averaging $4.50 more than the average net return from a creep-fed calf. Creep-fed calves yielded higher dressing carcasses, but only in one year did they sell for a higher price per hundredweight than the non-creep-fed calves.

Taylor et al., (1942) creep-fed the heifer calves but not the steer calves of two calf crops. A two-year average showed that the creep-fed heifers had an average gain that was 48 pounds greater per head than that of the non-creep-fed steer calves during the suckling period. The appraisal price of the heifers was 25 cents higher per hundredweight. The increased appraisal price of the heifers increased the value enough to cover the cost of the feed they consumed. At weaning, the heifers returned about a dollar more per head than the steers.

When the heifers were full-fed in drylot for 48 days following weaning, they gained an average of 103 pounds per head. The heifers returned $7.70 more per head at the end of the drylot feeding period than at weaning.

Kyzer and Jones (1941) reported four years' work in which they used purebred Angus calves. Part of the calves were creep-fed while the remaining calves were not creep-fed. The creep-fed mixture consisted of three parts corn, two parts oats, and one part cottonseed meal. The summary of the experiments showed that creep-fed calves had an average daily gain of 1.90 pounds per head as compared to an average daily gain of 1.30 pound per head for the non-creep-fed calves. At the end of the suckling

period, the creep-fed calves averaged 80.6 pounds heavier per head than the calves that were not creep-fed.

Starkey (1943), also reporting on this experiment, found that the feed costs for each creep-fed calf was $6.49. At weaning, creep-fed calves had an average net return that was $8.03 greater per head than the return for each non-creep-fed calf. When the calves were valued for breeding purposes, the average net return was $9.28 greater per head for the creep-fed calves.

Southwell (1940, 1941, 1942, 1943, 1944) at the Georgia Coastal Plains Experiment Station, reported several years' work that was started in 1940. He used native grade Jersey and Hereford-Jersey crossbred cows to produce calves from high grade Hereford bulls. The creep ration consisted of six or seven parts ground, snapped corn and one part peanut meal. A five-year average of the experimental data is presented here. Calves of the creep-fed lot averaged 47.4 pounds heavier per head than each calf that was not creep-fed. The average daily gain for each creep-fed calf was 1.96 pounds as compared to 1.69 pounds average daily gain for each non-creep-fed calf. The creep-fed calves were appraised at a higher price per hundredweight each year. This resulted in an average net sales return that was $5.89 greater per head than the average return of each non-creep-fed calf.

The fattening value of two creep-feed mixtures was compared by Hazen and Comfort (1943) using good grade Shorthorns. Calves of Lot 1 were fed a mixture consisting of eight parts shelled corn, one part chopped alfalfa hay, and one part cottonseed cake. Calves of Lot 2 were fed a mixture consisting of four parts shelled corn, four parts cane molasses, one part chopped alfalfa hay, and one part cottonseed cake.

Calves of Lot 1 consumed more feed per head than calves of Lot 2. Calves of Lot 1 had an average gain of 371.8 pounds per head and calves of Lot 2 had an average gain of 324.7 pounds per head. The amount of feed consumed for 100 pounds of gain was nearly the same in both lots, though the cost of the feed was a little higher in Lot 1. Appraisal values were higher for calves of Lot 1, and these calves had a slightly higher total value, after feed costs were deducted, than calves of Lot 2.

In this drylot feeding period of 168 days which followed weaning, the calves of Lot 1 had an average gain of 297.8 pounds per head and calves of Lot 2 had an average gain of 268.9 pounds per head. Calves of Lot 1 were appraised higher than calves of Lot 2. Calves of Lot 1 consumed less concentrate per 100 pounds of gain than did the calves of Lot 2, but cost of gain was slightly higher. However, the lower feed cost resulting when one-half the corn was replaced with molasses did not offset the lower sale value for calves of Lot 2 as the calves of Lot 1 had a greater net return per head.

Johnson and Fenn (1943) conducted a four-year study with calves from grade Shorthorn cows. One-half of the calves were creep-fed a mixture of ground corn, ground barley, and whole oats in equal parts. The remaining calves were not creep-fed. During the last two suckling periods, the creep-feed mixture also contained 10 per cent linseed meal. The creep-fed calves had an average gain that was 72.5 pounds greater per head than the gain of the non-creep-fed calves. The calves that were creep-fed were higher in quality and condition. The creep-fed calves were appraised at a higher price per hundredweight at weaning and had an average net return that was $2.97 greater per head than each non-creep-fed calf. The creep-fed calves returned a profit each year,

while the non-creep-fed calves returned a profit in only three of the years. Results indicate that if calves are to be sold at weaning, and if cattle feeders are willing to pay a higher price for fleshier calves, it pays to creep feed.

During the drylot phase of the experiment, both lots were fed shelled corn, linseed meal, and alfalfa hay. Each year the creep-fed calves had a lower rate of gain and required more feed per 100 pounds of gain than the non-creep-fed calves. They were finished a few weeks ahead of the non-creep-fed calves and outsold them slightly. At market time, the average grade for the creep-fed calves was "Top Good" and for the non--creep-fed calves, "Good". During the fattening period the profit for the non-creep-fed calves was $3.05 greater per head. Profit for complete baby beef production was greater for the non-creep-fed calves. Meat from both lots of calves did not differ significantly in quality and palatability. The workers concluded that creep-feeding did not pay if calves were to be fattened in drylot.

Kyzer (1944) studied the effect of limiting the amount of grain creep-fed to purebred Angus calves. The mixture of three parts ground corn, two parts oats, and one part cottonseed meal was full-fed to calves of Lot 1, but limited to calves of Lot 1.

Three successive trials showed that calves of Lot 1 had an average daily gain of 1.95 pounds per head while calves of Lot 2 had an average daily gain of 1.74 pounds per head. Calves of Lot 1 consumed 213 pounds of grain for each 100 pounds of gain while calves of Lot 2 consumed only 111 pounds of feed for each 100 pounds of gain. The slaughter value for calves of Lot 1 was $52.26 per head while calves of Lot 2 were valued at $45.29 per head. When valued for breeding purposes, calves of Lot 1 were

valued at $95.25 per head and those of Lot 2 were valued at $92.72 per head.

Four years of work by Foster et al., (1946) in North Carolina showed that creep-feeding calves did not increase their value enough to pay for the cost of the feed. Calves of Lot 1 were allowed to graze on native range without supplemental feeding. Calves of Lot 2 were creep-fed throughout the summer. Calves of Lot 3 were creep-fed from the first of August until November. The creep-feed mixture consisted of four parts shelled corn and one part cottonseed meal.

The calves did not consume much of the supplement until later in the season when the pastures started drying. Reasons for this were that cows were heavy milkers and ample green forage was always available. Cows of the different lots made no significant differences in gains. The four--year average showed that calves of Lot 1 had an average gain of 195 pounds per head, calves of Lot 2 had an average gain of 199 pounds per head.

Duncan et al., (1946-1949) reported four trials in Tennessee comparing calves not creep-fed with calves that were creep-fed. The creep--fed ration consisted of five parts ground shelled corn, three parts ground oats, and one part cottonseed meal. The non-creep-fed calves had a larger net return per calf for three of the years. In only one year, when the season was dry, did the creep-fed calves have a larger net return per calf than the non-creep-fed calves. That year, the creep-fed calves had an average gain that was 88.9 pounds greater per head than that of the calves not creep-fed. The average net return of each creep-fed calf was $7.92 greater than the average net return of each non-creep-fed calf. The four-year average gain of the creep-fed calves

was 52 pounds greater per head than the average gain of each non-creep-fed calf. Calves that were not creep-fed had an average net return that was $0.57 greater per head than the average net return of the creep-fed calves. Each year, however, the appraisal price per hundredweight for the creep--fed calves was one to three dollars greater than the appraisal price per hundredweight for the non-creep-fed calves.

Kyd (1945) obtained creep-feeding records from 99 herds in Missouri. These records covered the four-year period of 1928 through 1931. The 1780 calves were sold for slaughter at weaning time or shortly thereafter. The creep-fed calves had an average daily gain of 2.10 pounds per head during the average creep-feeding period of 176 days. Each creep-fed calf consumed an average of 21.6 bushels of corn, 49 pounds of protein supplement and 117 pounds of hay during the creep-feeding period.

Production records of 10,362 calves that were not creep-fed were obtained for the ten-year period of 1939 through 1948. The calves that were not creep-fed had an average daily gain of 1.76 pounds per head although considerable variation was evident. Fifteen per cent of the herds reported average daily gains of over 2 pounds per head and almost 11 per cent of the herds reported average daily gains under 1.5 pounds per head. Non-creep-fed calves that were on bluegrass pasture had average daily gains of 1.49 pounds per head. Non-creep-fed calves that were on lespedeza-bluegrass pasture had an average daily gains of 1.67 pounds per head. Non-creep-fed calves that were allowed bluegrass pasture in the spring and stubble lespedeza in harvested grain fields in the summer, had average daily gains of 1.95 pounds per head.

Creep-fed calves had an average total gain that was 26 pounds greater per head that the average total gain of non-creep-fed calves on bluegrass

pasture in the spring and stubble lespedeza in the summer, 75 pounds greater per head than the average total gain of non-creep-fed calves on a bluegrass and lespedeza pasture, and 107 pounds greater per head than the average total gain of non-creep-fed calves on bluegrass pasture.

Creep-Feeding Beef Calves

Experimental Procedure

The cattle used in these experiments were good grade Herefords. The calves were born in February and March from cows that were wintered on dry native range and approximately two and one-half pounds of cottonseed cake or meal per day.

On April 28, 1951, the cows and calves were divided into two lots and allowed to graze the native grass pastures at the Lake Carl Blackwell range area. The calves were divided on the basis of sex, age, and the winter ration of the cow. There were 26 cows and their calves in Lot 1 and 25 in Lot 2. The calves of Lot 1 were offered a concentrate mixture in a creep-feeder. For the first six weeks the mixture consisted of four parts coarsely ground shelled corn, four parts oats and one part cottonseed meal. During the remainder of the summer grazing season the mixture was six parts shelled corn, three parts oats and one part cottonseed meal. All cattle had access to a mineral mixture of two parts salt and one part steamed bone meal.

Weights of the cows and calves were recorded at intervals during the grazing season.

The calves were weaned in October. The heifer calves were then wintered in a trap and fed prairie hay and cottonseed cake. The steers were full-fed fattening rations in drylot. Weights were taken at approximately monthly intervals on both steers and heifers. The steers were marketed when it was estimated that an average carcass grade of U. S. Choice would result when they were slaughtered.

Dry-lot feeding was started on October 6, 1951. The steers of both lots were full-fed ground shelled corn. Each lot was also fed one pound alfalfa hay (fed separately each morning) one and one-half pounds cottonseed cake, and a limited amount of Atlas Sorgo silage per head daily. A mineral mixture of one part salt, one part ground limestone, and one part steamed bone meal was available.

The heifers, wintered in a trap, were fed a ration of prairie hay, free-choice, and one pound cottonseed cake daily per head. A mineral mixture of two parts salt and one part steamed bone meal was available.

The experiment was continued during the grazing period of 1952 using the same cows and their next crop of calves. The calves were alloted on May 24. There were 24 cows and their calves in each lot. The creep-feed mixture consisted of six parts coarsely ground shelled corn, three parts oats, and one part cottonseed cake. All cattle had access to a mineral mixture of two parts salt and one part steamed bone meal.

There were 11 steer calves in Lot 1 and 10 in Lot 2 during the creep--feeding period. The number of steers per lot was equalized at 9 each at the beginning of the fattening period. Dry-lot feeding was started October 21, 1952. The steers of both lots were full-fed ground shelled corn. Each lot was also fed one pound alfalfa hay, one and one-half pounds cottonseed meal, and a limited amount of prairie hay per head daily.

There were 13 heifers in Lot 1 and 14 in Lot 2 during the summer. At the beginning of the winter period, one heifer was removed from Lot 2 to equalize the number per lot.

Prevailing prices of feeds were used in calculating the feed costs each year.

Results and Discussion

1951-1952

The average weight of the Lot 1 calves was 161 pounds at the start of the experiment as compared to an average weight of 155 pounds for the calves of Lot 2. The average weaning weights were 458 and 432 pounds for calves of Lots 1 and 2, respectively. The calves of Lot 1 gained an average of 297 pounds during the summer while those of Lot 2 gained an average of 277 pounds. This was an advantage of only 20 pounds resulting from creep--feeding. It is believed that the above-average conditions of the pastures was responsible for the small advantage of creep-feeding. The 336 pounds of creep-feed mixture consumed by each calf of Lot 1 cost $9.45.

The average appraisal value of the calves in each lot was $37.50 per hundredweight. Therefore, the 20 pounds advantage in gain was valued at $7.50. In order to pay for $9.45 worth of feed, the advantage in gain needed was 25 pounds.

The summary of the creep-feeding phase of the experiment is shown in Table 1.

Table 2 shows that the cows of Lot 1 had an average gain of 220 pounds per head during the suckling phase of the experiment as compared to 195 pounds average gain for each cow of Lot 2. This was a 25 pound gain advantage for the dams of the creep-fed calves.

The steers were placed in the drylot and full-fed fattening rations after weaning. Although the steer calves which were creep-fed gained 13 pounds more during the summer months than similar calves not creep-fed, all steers were appraised at $39.00 per hundredweight at the end of the summer period.

Table 1

Creep-Feeding Data, 1951

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of days	161	161
Average birth date of calves	February 27	February 27
Number of calves	26	25
Steers	13	12
Heifers	13	13
Average weight per calf (lbs.)		
Initial, 4-28-51	161	155
Final, 10-6-51	458	432
Total gain	297	277
Daily gain	1.84	1.72
Average feed per head (lbs.)		
Corn	197	---
Oats	105	---
Cottonseed cake	34	---
Feed cost per head (dollars)[1]	9.45	---
Average appraisal per hundredweight (dollars)	37.50	37.50
Value of 20 lbs. gain advantage at $37.50 per hundredweight (dollars)	7.50	---
Gain advantage needed to pay for feed (lbs.)	25	---

[1] Corn, $1.45 per bushel; oats, $.93 per bushel; cottonseed meal, $77.50 per ton.

Table 2

Cow Gains, 1951

	Lot 1 Calves creep-fed	Lot 2 Calves not creep-fed
Number of cows	26	25
Average weight per cow (lbs.)		
Initial, 4-28-51	851	883
Final, 10-6-51	1071	1078
Total gain	220	195
Advantage in gain per cow for Lot 1	25	---

The steers of Lot 2 were eight pounds heavier than the steers of Lot 1 at the time of slaughter. The average total gain and average daily gain for steers of Lot 1 during the fattening period were 298 and 2.11 pounds per head, respectively, compared to 331 pounds average total gain per head and 2.13 pounds average daily gain per head for the steers of Lot 2. Table 3 shows the complete data of the dry-lot fattening period.

The creep-fed steers (Lot 1) were marketed after feeding in drylot for 141 days. The steers of Lot 2 were fed 14 days longer when it was estimated that the average carcass grade would be similar to the carcass grade of the steers of Lot 1.

The carcass grades of the steers in Lot 1 were 11 Choice and two Good. The carcass grades of the Lot 2 steers were one Prime and 11 Choice. The average dressing percentage was 60.0 and 58.9 for the steers of Lots 1 and 2, respectively. The creep-fed steers (Lot 1) had a higher dressing percentage and selling price per hundredweight, although the average carcass grade was slightly higher for the Lot 2 steers. The reason for this is not apparent, because the steers of Lot 1 appeared to be fatter than those of Lot 2 when slaughtered.

There was a difference of only $0.46 in the profit per steer during the feeding period. The steers which were not creep-fed (Lot 2) sold for $0.50 less per hundredweight than the steers of Lot 1. This was because there were two calves in Lot 2 which were lighter in weight and appeared to carry less finish than the remaining calves in Lot 2 or the calves of Lot 1.

When the steers of Lot 1 were marketed, the appraised selling price per hundredweight of the steers of Lot 2 was $34.36. At this time the total gain and average daily gain were 305 and 2.16 pounds per head,

Table 3

Fattening Steer Calves in Drylot After Creep-Feeding, 1951-52

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	13	12
Creep-feeding phase[1] (161 days)		
Average weight per calf (lbs.)		
Initial, 4-28-51	172	160
Final, 10-6-51	460	435
Total gain	288	275
Average birth date	February 25	February 21
Cost of feed per head (dollars)	9.45	---
Dry-lot fattening phase		
Number of days fed	141	155
Average weight per calf (lbs.)		
Initial, 10-6-51	460	435
Final, 2-24-52	758	740
Final, 3-9-52	---	766
Gain to 2-24-52	298	305
Daily gain to 2-24-52	2.11	2.16
Gain to 3-9-52	---	331
Daily gain to 3-9-52	---	2.13
Average daily ration (lbs.)		
Ground corn	9.7	10.1
Cottonseed cake	1.5	1.5
Alfalfa hay	1.1	1.1
Silage (Atlas Sorgo)	8.1	8.3
Salt	.02	.02
Mineral mixture[2]	.03	.03
Feed per hundredweight gain (lbs.)		
Ground corn	459	474
Cottonseed cake	71	70
Alfalfa hay	52	52
Silage (Atlas Sorgo)	383	390
Salt	1.0	1.0
Mineral mixture[2]	1.4	1.3
Financial (dollars)		
Feed cost per hundredweight gain[3]	20.26	20.78
Selling price per hundredweight	35.00	34.50
Total value per steer (3 per cent shrink)	257.25	256.34

(Table 3 continued on next page)

Table 3 (continued)

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Initial cost ($39.00 per hundredweight)	179.40	169.65
Feed cost per steer[3]	60.39	69.77
Total cost (steer plus feed)	239.79	238.42
Profit per steer	17.46	17.92
If Lot 2 steers were sold on 2-24-52		
Total value per steer ($34.36 per hundredweight)	---	254.26
Feed cost	---	61.37
Total cost (steer plus feed)	---	231.02
Return per steer	---	23.24
Profit summary, both phases (dollars)		
Value per steer when sold	257.25	256.34
Feed cost	69.84	68.77
Profit (steer value minus feed cost)	187.41	187.57

[1]Detailed results may be found in Table 1.

[2]Equal parts of ground limestone, steamed bone meal, and salt.

[3]Corn, $1.90 per bushel; oats, $0.98 per bushel; cottonseed cake, $81.00 per ton; cottonseed meal, $80.00 per ton; alfalfa hay, $25.00 per ton; prairie hay, $15.00 per ton; silage, $6.00 per ton; bone meal, $96.00 per ton; ground limestone, $15.00 per ton; salt, $15.00 per ton.

respectively. The feed cost per hundredweight gain for the steers in Lot 2 was $20.12 for the period ending February 24.

For the complete fattening period, the feed efficiency tended to be slightly higher in Lot 1. The creep-fed steers consumed about 967 pounds of feed per hundredweight gain while Lot 2 steers consumed 988 pounds of feed for the same gain. The feed cost per hundredweight gain was $20.26 and $20.78 for the steers of Lots 1 and 2, respectively.

For the entire experiment (creep-feeding and fattening), the value per steer when sold minus the feed cost was $187.41 and $187.57 for the steers in Lots 1 and 2, respectively.

The weanling heifers that had been creep-fed had an average gain per head that was 30 pounds greater that the average gain of each non-creep-fed heifer. However, at the start of the winter period, both lots of heifers were appraised at $36.00 per hundredweight.

The value of the 30 pounds advantage in gain was $10.80. When only feed cost ($9.45) was considered, the increased return resulting from creep-feeding heifer calves which were sold at weaning was only $1.35 per head.

Table 4 shows that the heifers which had been creep-fed gained 64 pounds per head during the winter feeding period. The heifers of Lot 2 gained 96 pounds per head, or 32 pounds more per head, during the same period. At the end of the winter period, the average weight per head was 521 and 524 pounds for the heifers of Lots 1 and 2, respectively. The increased gain from creep-feeding resulted in decreased gains during the winter period. The net worth per head from the start of creep-feeding until the end of winter feeding was $132.26 and $142.67 for heifers of Lots 1 and 2, respectively.

1952-1953

Results of the second year of the studies were similar to the results in the previous year. Calves that were creep-fed (Lot 1) had an average gain of 291 pounds per head. Calves that were not creep-fed (Lot 2) had an average gain of 246 pounds per head. To produce the extra 45 pounds gain, the creep-fed calves consumed an average of 265 pounds of corn, 130 pounds of oats, and 44 pounds of cottonseed cake. The cost of this feed was $14.30. Table 5 summarizes the data for the creep-feeding of calves during the summer of 1952.

Table 4

Wintering Heifer Calves After Creep-Feeding, 1951-52.

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	13	13
Creep-feeding phase[1] (161 days)		
Average weight per calf (lbs.)		
Initial, 4-28-51	149	150
Final, 10-6-51	457	428
Total gain	308	278
Average birth date	March 2	March 4
Cost of feed per head (dollars)	9.45	---
Wintering phase (175 days)		
Average weight per calf (lbs.)		
Initial, 10-6-51	457	428
Final, 3-29-52	521	524
Total gain	64	96
Daily gain	0.37	0.55
Average daily ration (lbs.)		
Prairie hay	7.35	7.35
Cottonseed cake	.99	.99
Mineral mixture[2]	.07	.07
Financial (dollars)		
Initial cost ($36.00 per hundredweight)	164.52	154.08
Final appraisal per hundredweight	32.00	32.00
Value per heifer (3 per cent shrink)	161.60	162.56
Feed cost per heifer[3]	19.89	19.89
Profit per heifer	-22.81	-11.41
Profit summary, both phases (dollars)		
Value per heifer, 3-29-52	161.60	162.56
Feed cost[3]	29.34	19.89
Net worth (heifer value minus feed cost)	132.26	142.67

[1]Detailed results may be found in Table 1.

[2]Two parts salt and 1 part steamed bone meal.

[3]See prices in Table 3, Footnote 3.

Table 5

Creep-Feeding Data, 1952

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of days	150	150
Average birth date of calves	March 11	March 12
Number of calves	24	24
Steers	11	10
Heifers	13	14
Average weight per calf (lbs.)		
Initial, 5-24-52	195	193
Final, 10-21-52	486	439
Total gain	291	246
Daily gain	1.93	1.64
Average feed per head (lbs.)		
Corn	265	---
Oats	130	---
Cottonseed cake	44	---
Feed cost per head (dollars)[1]	14.30	---
Average appraisal per hundredweight (dollars)	27.00	27.00
Value of 45 lbs. gain advantage at $27.00 per hundredweight (dollars)	12.15	---
Gain advantage needed to pay for feed (lbs.)	53	---

[1]See prices in Table 3, Footnote 3.

At weaning, both lots of calves were appraised at $27.00 per hundredweight. The value of the 45 pounds advantage in gain was $12.15. In this experiment an advantage in gain of 53 pounds would have been necessary to pay for the feed consumed by the creep-fed calves. As was true in the 1951 creep-feeding test, the increased gain resulting from creep-feeding did not increase the value of the calf enough to pay for the feed.

Table 6 shows that only an eight-pound advantage in gain of the dams resulted when their calves were creep-fed during the suckling period.

The creep-fed steer calves gained 40 pounds more during the summer months than similar calves not creep-fed. Both lots were appraised at $28.00 per hundredweight at the end of the summer period, although the

creep-fed calves were fatter and heavier than the calves of Lot 2. The average feed cost per calf in the creep-fed lot was $14.30. Therefore it was not profitable to creep-feed suckling calves if they were to be sold at weaning.

Table 6

Cow Gains, 1952

	Lot 1 Calves creep-fed	Lot 2 Calves not creep-fed
Number of cows	24	24
Average weight per cow (lbs.)		
Initial, 5-24-52	957	964
Final, 10-21-52	1056	1055
Total gain	99	91
Advantage in gain per cow for Lot 1	8	--

When the calves were weaned, the steers were started on the dry-lot fattening period. A summary of the dry-lot phase of this experiment is given in Table 7. The creep-fed steers were marketed after 117 days of feeding in the drylot. The steers in Lot 2 were fed 131 days, at which time it was estimated that the average carcass grade would be similar to the carcass grade of the steers in Lot 1 when they were marketed. The carcasses of all steers in Lot 1 were graded U. S. Choice. The carcass grades of the steers of Lot 2 were one U. S. Prime and six U. S. Choice. The average dressing percentage was 60.7 and 59.6 for steers of Lots 1 and 2, respectively. Both groups of steers were sold at $23.50 per hundredweight.

The total gain and average daily gain for the steers of Lot 1 during the fattening period were 223 and 1.90 pounds per head, respectively. Steers of Lot 2 had an average total gain per head of 293 pounds and an

Table 7

Fattening Steer Calves in Drylot After Creep-Feeding, 1951-52.

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	9	7[1]
Creep-feeding phase[2] (150 days)		
Average weight per calf (lbs.)		
Initial, 5-24-52	210	200
Final, 10-21-52	494	444
Total gain	284	244
Cost of feed per head (dollars)	14.30	----
Dry-lot fattening phase		
Number of days fed	117	131
Average weight per calf (lbs.)		
Initial, 10-21-52	494	444
Final, 2-15-53	717	701
Final, 3-1-53	----	737
Gain to 2-15-53	223	257
Daily gain to 2-15-53	1.90	2.20
Gain to 3-1-53	----	293
Daily gain to 3-1-53	----	2.24
Average daily ration (lbs.)		
Ground corn	11.5	12.1
Cottonseed meal	1.5	1.5
Alfalfa hay	1.0	1.0
Prairie hay	2.3	2.4
Salt	.02	.02
Mineral mixture[3]	.03	.03
Feed per hundredweight gain (lbs.)		
Ground corn	607	545
Cottonseed meal	79	67
Alfalfa hay	53	45
Prairie hay	124	106
Salt	1.0	0.9
Mineral mixture[3]	1.4	1.3
Financial (dollars)		
Feed cost per hundredweight gain[4]	25.73	22.80
Selling price per hundredweight	23.50	23.50
Total value per steer(3 per cent shrink)	168.50	173.20
Initial cost($28.00 per hundredweight	138.32	124.35

(Table 7 continued on next page)

Table 7 (continued)

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Feed cost per steer[4]	55.81	67.03
Total cost (steer plus feed)	194.13	191.35
Profit per steer	-25.63	-18.15
If Lot 2 steers were sold on 2-15-53		
Total value per steer ($21.50 per hundredweight)	---	150.72
Feed cost	---	59.91
Total cost (steer plus feed)	---	184.26
Return per steer	---	-33.54
Profit summary, both phases (dollars)		
Value per steer when sold	168.50	173.20
Feed cost	70.11	67.03
Profit (steer value minus feed cost)	98.39	106.17

[1]Two steers were foundered and were not included in the average data.

[2]Detailed results may be found in Table 5.

[3]One part ground limestone, one part steamed bone meal, one part salt.

[4]Corn, $1.80 per bushel; oats, $1.03 per bushel; cottonseed meal, $106.00 per ton; cottonseed cake, $108.25 per ton; alfalfa hay, $30.00 per ton; prairie hay, $20.00 per ton; bone meal, $115.00 per ton; ground limestone, $15.00 per ton; salt, $15.00 per ton.

average daily gain per head of 2.24 pounds. The steers of Lot 2 were 20 pounds heavier per head than the steers of Lot 1 at the time of slaughter. During the first month of the fattening period the steers which had been creep-fed gained more rapidly than those of Lot 2. However, the rate of gain was greater in Lot 2 the remainder of the period. The 50-pound weight advantage per head for steers of Lot 1 at the beginning of the fattening phase was reduced to a 16-pound weight advantage per head when Lot 1 was sold on February 15.

A financial loss resulted in both groups during the dry-lot fattening period. The greatest loss was in Lot 1, -$25.63 per head as compared to

-$18.15 for each steer of Lot 2. When the steers of Lot 1 were marketed, the appraised selling price per hundredweight of steers in Lot 2 was $21.50. At this time the average total gain and average daily gain of the steers in Lot 2 were 257 and 2.20 pounds per head, respectively. If both groups had been sold on February 15, the greater loss would have been in Lot 2, losing an average of $33.54 per head.

The feed cost per hundredweight gain for the steers in Lot 2 for the period ending February 15 was $23.31. For the complete fattening period, the feed cost per hundredweight gain was $25.73 and $22.80 for the steers of Lots 1 and 2, respectively. The feed efficiency for the fattening periof was higher for the steers that had not been creep-fed (Lot 2). The Lot 2 steers needed only 763 pounds of feed for every hundred pounds as compared to 863 pounds for the Lot 1 steers. It is noted that the steers of Lot 2 gained at a lower cost per pound than the selling price of that gain.

For the entire experiment (creep-feeding and fattening), the value per steer when sold minus the feed cost was $98.39 for each steer of Lot 1 and 106.17 for each steer of Lot 2.

The 13 weanling heifers which were creep-fed gained 44 pounds more than the heifer calves not creep-fed, but both groups were appraised at $26.00 per hundredweight. The average cost of the additional gain was $14.30 worth of feed. As the value of the 44 pounds gain advantage of each heifer in Lot 1 was $11.44, the value of the heifers was not increased enough to make creep-feeding profitable. Table 8 summarizes the winter data of the heifers for the 1952-53 season.

The heifers which had been creep-fed gained 68 pounds per head during the winter period. The heifers of Lot 2 had an average gain of

33 pounds more per head, or 101 pounds per head, during the same period. The increased gain from creep-feeding during the summer resulted in decreased gains during the winter period. At the end of the winter period, both groups of heifers weighed nearly the same.

Table 8

Wintering Heifer Calves After Creep-Feeding, 1952-53.

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	13	13
Creep-feeding phase[1] (150 days)		
Average weight per calf (lbs.)		
Initial, 5-24-52	191	199
Final, 10-21-52	485	449
Total gain	294	250
Cost of feed per head (dollars)	14.30	---
Wintering phase (163)		
Average weight per calf (lbs.)		
Initial, 10-21-52	485	449
Final, 4-2-53	553	550
Total gain	68	101
Daily gain	0.42	0.62
Average daily ration (lbs.)		
Prairie hay	9.94	9.94
Cottonseed cake	.92	.92
Mineral mixture[2]	.06	.06
Financial (dollars)		
Initial cost($26.00 per hundredweight)	126.10	116.74
Final appraisal per hundredweight	20.00	20.00
Value per heifer(3 per cent shrink)	107.28	106.70
Feed cost per heifer[3]	24.55	24.55
Profit per heifer	-43.37	-34.59
Profit summary, both phases (dollars)		
Value per heifer, 4-2-53	107.28	106.70
Feed cost[3]	38.85	24.55
Net worth (heifer value minus feed cost)	68.43	82.15

[1]Detailed results may be found in Table 5.
[2]Two parts salt and one part steamed bone meal.
[3]See prices in Table 7, Footnote 4.

At the end of the winter period, the appraised selling price was $20.00 per hundredweight for both lots of heifers. The loss per head during the winter period was $43.37 and $34.59 for Lots 1 and 2, respectively. Thus, $8.78 greater loss resulted from wintering calves which were creep-fed while suckling during the summer months.

The net worth per head from the start of creep-feeding until the end of winter feeding was $68.43 and $82.15 for Lots 1 and 2, respectively.

An Average of the Two Years' Results

Calves that were creep-fed had an average gain of 294 pounds per head during the creep-feeding period. Calves that were not creep-fed had an average gain of 262 pounds per head during the same period. The extra 32 pounds of gain per head was produced by the creep-fed calves at a feed cost of $11.88. The average value of the 32-pound gain advantage was $10.32. It would have been necessary for each creep-fed calf to have had an average gain advantage of 37 pounds in order to pay for the feed consumed. Table 9 give the average of the two years creep-feeding data.

The average gains of the dams are given in Table 10. The dams of the creep-fed calves had an average gain advantage of only 18 pounds per head over the average gain of the dams whose calves were not creep-fed.

The creep-fed steer calves had an average summer gain that was 26 pounds greater per head than that of the non-creep-fed steer calves. Both lots, however, had an average appraisal price of $33.50 per hundredweight.

After weaning each year, the steers were started on a dry-lot fattening ration. Table 11 shows the complete average data of the dry-lot fattening period. The creep-fed steers were marketed after an average feeding period of 129 days. The non-creep-fed steers were fed an average

Table 9

Creep-Feeding Data, 2-Year Average

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of days	156	156
Average birth date of calves	March 7	March 7
Number of calves	25	25
Steers	12	11
Heifers	13	14
Average weight per calf (lbs.)		
Initial	178	174
Final	472	436
Total gain	294	262
Daily gain	1.88	1.68
Average feed per head (lbs.)		
Corn	291	---
Oats	118	---
Cottonseed cake	39	---
Feed cost per head (dollars)	11.88	---
Average appraisal per hundredweight (dollars)	32.25	32.25
Value of 32 pounds gain advantage at $32.25 per hundredweight (dollars)	10.32	---
Gain advantage needed to pay for feed (lbs.)	37	---

Table 10

Cow Gains, 2-Year Average

	Lot 1 Calves creep-fed	Lot 2 Calves not creep-fed
Number of cows	25	25
Average weight per cow (lbs.)		
Initial	902	923
Final	1064	1067
Total gain	162	144
Advantage in gain per cow of Lot 1	18	

period that was 14 days longer. The average carcass grade for each lot was U. S. Choice. The average dressing percentage was 60.4 and 59.3 for the steers of Lot 1 and 2, respectively.

Table 11

Fattening Steer Calves in Drylot After Creep-feeding, 2-Year Average

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	11	11
Creep-feeding phase[1] (average 156 days)		
Average weight per calf (lbs.)		
Initial	191	180
Final	477	440
Total gain	286	260
Cost of feed per head (dollars)	11.88	---
Dry-lot fattening phase		
Number of days fed	129	143
Average weight per calf (lbs.)		
Initial	477	440
Final(when creep-fed calves were marketed)	738	721
Final(when non-creep-fed calves were marketed)	---	752
Gain to marketing of creep-fed calves	261	281
Daily gain to marketing of creep-fed--calves	2.02	2.18
Gain to marketing of non-creep-fed calves	---	312
Daily gain to marketing of non-creep--fed calves	---	2.18
Average daily ration (lbs.)		
Ground corn	10.6	11.1
Cottonseed cake	1.5	1.5
Alfalfa hay	1.1	1.1
Silage (Atlas Sorgo)	4.1	4.2
Prairie hay	1.2	1.2
Salt	0.02	0.02
Mineral mixture[2]	0.03	0.03
Feed per hundred weight gain (lbs.)		
Ground corn	533	510
Cottonseed cake	75	68.5
Alfalfa hay	53	48.5
Silage (Atlas Sorgo)	192	195
Prairie hay	62	53
Salt	1.0	0.9
Mineral mixture[2]	1.4	1.3
Financial (dollars)		
Feed cost per hundredweight gain[3]	23.00	21.79
Selling price per hundredweight	29.25	29.00
Total value per steer(3 per cent shrink)	215.87	218.08

(Table 11 continued on next page)

Table 11 (continued)

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Initial cost ($33.50 per hundredweight)	159.80	147.40
Feed cost per steer[3]	58.10	67.90
Total cost (steer plus feed)	217.90	215.30
Profit per steer	-2.03	2.78
If Lot 2 steers were sold when creep-fed steers were		
Total value per steer ($27.93 per hundredweight)	---	201.38
Feed cost	---	60.64
Total cost (steer plus feed)	---	208.04
Return per steer	---	-6.66
Profit summary, both phases (dollars)		
Value per steer when sold	215.87	218.08
Feed cost	69.98	67.90
Profit (steer value minus feed cost)	145.89	150.18

[1]Detailed results may be found in Table 9
[2]Equal parts of ground limestone, steamed bone meal, and salt.
[3]From average prices of the two years.

The total gain and average daily gain for the steers of Lot 1 during the fattening period were 261 and 2.02 pounds per head, respectively. The steers of Lot 2 had an average total gain per head of 312 pounds and and average daily gain per head of 2.18 pounds.

The two-year average shows that a financial loss resulted in the creep-fed lot during the dry-lot fattening period. The average loss was $2.03 per head. The calves that had not been creep-fed had an average profit of $2.78 per head.

If the steers of Lot 2 had been sold each year at the time of marketing the Lot 1 steers, an average loss of $6.66 per head would have resulted. At the time of marketing the Lot 1 steers, the average total gain for the steers of Lot 2 was 281 pounds per head and average daily gain was 2.18

pounds per head. The average appraisal price for the Lot 2 steers at this time was $27.93 per hundredweight.

The feed efficiency for the fattening period was higher for the steers that had not been creep-fed (Lot 2). The Lot 2 steers needed an average of 877.2 pounds of feed for every 100 pounds of gain as compared to an average of 917.4 pounds for the Lot 1 steers.

For the entire experiment (creep-feeding and fattening), the value per steer when sold minus the feed cost was $145.89 for each steer of Lot 1 and $150.18 for each steer of Lot 2.

The heifers which were creep-fed had an average gain that was 37 pounds greater per head than the average gain of the heifers not creep--fed, but both groups of heifers were appraised at an average of $31.00 per hundredweight. As the average value of the 37 pounds gain advantage of each heifer in Lot 1 was $11.47, the value was not increased enough to make creep-feeding profitable.

Table 12 shows that the creep-fed heifers had an average gain of 66 pounds per head during the winter feeding period. The heifers of Lot 2 gained 98 pounds per head during the same period. Both groups of heifers had the same average weight per head at the end of the winter period. The increased gain from creep-feeding during the summer resulted in decreased gains each year during the winter period.

The average losses during the winter period were $28.61 per head for heifers of Lot 1 and $18.69 per head for heifers of Lot 2.

The net worth per head from the start of creep-feeding until the end of winter feeding was $105.52 and $117.40 for Lots 1 and 2, respectively.

Table 12

Wintering Heifer Calves After Creep-Feeding, 2-Year Average

	Lot 1 Creep-fed	Lot 2 Not creep-fed
Number of calves	13	13
Creep-feeding phase[1] (average 156 days)		
Average weight per calf (lbs.)		
Initial	170	175
Final	471	439
Total gain	301	264
Cost of feed per head (dollars)	11.88	---
Wintering phase (average 169 days)		
Average weight per calf (lbs.)		
Initial	471	439
Final	537	537
Total gain	66	98
Daily gain	0.39	0.59
Average daily ration (lbs.)		
Prairie hay	8.65	8.65
Cottonseed cake	0.96	0.96
Mineral Mixture[2]	0.07	0.07
Financial (dollars)		
Initial cost ($31.00 per hundredweight)	146.01	136.09
Final appraisal per hundredweight	26.00	26.00
Value per heifer (3 per cent shrink)	139.62	139.62
Feed cost per heifer[3]	22.22	22.22
Profit per heifer	-28.61	-18.69
Profit summary, both phases (dollars)		
Value per heifer, final	139.62	139.62
Feed cost[3]	34.10	22.22
Net worth (heifer value minus feed cost)	105.52	117.40

[1]Detailed results may be found in Table 9.
[2]Two parts salt and one part bone meal.
[3]From average prices of the two years.

Summary

Trials were initiated at the Oklahoma Agricultural Experiment Station to determine whether an advantage could be realized for creep-feeding calves to be sold at weaning, for steer calves to be fattened in drylot after weaning, and for heifer calves to be wintered after weaning.

Under north central Oklahoma conditions, and prevailing prices, no economic advantage resulted from creep-feeding.

The dams of the creep-fed calves gained slightly more (18 pounds per head) than dams of calves not creep-fed.

The creep-fed calves gained an average of 32 pounds more per head during the summer than calves not creep-fed, but feed prices and market demands were such that there was no economic advantage for creep-feeding in any phase.

It should be realized that under conditions of drouth, lower feed prices, or market demands favoring heavier weanlings, creep-feeding may have a definite advantage. A purebred breeder wishing to develop his calves to their utmost may find a creep-feeding program to his advantage.

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The content and form have been checked and approved by the author and thesis adviser. The Graduate School Office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

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