ABSTRACT OF THESIS

ALTERING THE CALCIUM-PHOSPHORUS RATIO FOR FATTENING STEERS

Submitted by
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Research workers have shown that gain in weight by steers can be enhanced by adding a calcium and/or phosphorus supplement to many common rations, but there is still uncertainty regarding the optimum amount or ratio of calcium and phosphorus to include in the steer fattening ration. This problem is complicated by several factors: for instance, (1) the calcium and phosphorus in various feeds and supplements are not available to the same extent, (2) there are certain other minerals which hinder the absorption of calcium or phosphorus, (3) under some conditions calcium and phosphorus are precipitated in the digestive tract as insoluble tricalcium phosphate, (4) vitamin D affects calcium and phosphorus utilization, and (5) there are physiological differences in steers which cannot be gauged accurately at the present time.

In addition to the above complications, there is another angle to the problem apparently overlooked by research workers; that is, the optimum quantity and ratio of calcium and phosphorus may not be constant for the whole fattening period. From two standpoints, at least, this possibility has promise. First, the feeding period may encompass two phases; the preliminary part being concerned more with promoting growth and the

latter part predominantly a fattening process. Each of these phases might require different amounts of calcium and phosphorus. From the second viewpoint, steers are normally taken off a grass pasture and put into the feedlot for fattening, and since grass ordinarily has a high ratio of calcium to phosphorus, it seems possible that the feeding of a ration high in phosphorus would stimulate growth for at least a temporary period.

Therefore, the objects of these experiments have been as follows:

(1) To determine in what respects, if any, the calcium and phosphorus metabolism of the yearling beef steer differs at the beginning as compared with the end of the fattening period.

(2) To determine what effect on gain in weight is induced by altering the amounts and ratio of calcium and phosphorus in the ration during the fattening period.

(3) To obtain some indication of the time, manner, and extent of change to which the amounts and ratio of calcium and phosphorus may be subjected with favorable results during the fattening period.

The study on the effects of altering the amounts and ratio of calcium and phosphorus was made as a supplementary part of two feeding experiments conducted by the Animal Investigations Section, using eight lots of 10 yearling Hereford steers each in 1941-42 and seven

similar lots in 1942-43. However, there was considerable variation in the kinds and amounts of feeds fed in the different lots and not nearly all the variation in gains could be attributed directly to the different amounts or ratios of calcium and phosphorus in the rations.

For more direct and specific data, blood analyses and digestion-balance trials were used. Blood samples were taken from the jugular veins of two average steers from each lot at the beginning and at the end of the experiment in 1941-42 and every 30 days during the experiment in 1942-43. These samples were analyzed for calcium and phosphorus content. Two digestion-balance trials were conducted each year, one when the steers had reached the feed level at which they were to be maintained and the other near the end of the fattening experiment. In 1941-42, each trial extended for a period of 14 days. In 1942-43, each trial covered a period of 22 days, with the first seven days being a preliminary period during which time no collection or sampling was done. Six steers were used for each trial in 1941-42, each steer from a different lot. Only six digestion-balance stalls were available, and it was believed the six lots selected would best represent the whole experiment. In 1942-43, four steers were used for each trial, two from lot I, in which the standard ration was fed,

and two from lot IV, in which the calcium-phosphorus ratio was altered during the feeding period.

In the first year's experiment, one lot of steers made temporarily accelerated gains following the addition of phosilage, a rather concentrated phosphorus supplement, to their ration early in the feeding period. However, this increased rate of gain only lasted slightly more than a month, and at the end of the feeding period these steers had about average gains compared with those in the other lots. Within a month after the addition of phosilage to their ration, the steers developed a luster and sheen to their hair coat not evidenced by the steers in any of the other lots, and they retained this appearance for the remainder of the experiment. The steers used in the digestion-balance trials retained more phosphorus during the first trial and more calcium during the second, excreting far more calcium in the urine during the first trial. This indicated that a phosphorus supplement would be more likely to induce a favorable response if added to the ration during the first part of the feeding period and a calcium supplement if added during the latter part. Also tending to indicate the same thing, there was an average loss of both calcium and phosphorus content of the blood from the beginning to the end of the experiment, calcium being decreased more than phosphorus.

In the second year's experiment, greater gains again followed the addition of phosilage to the ration of one lot of steers early in the feeding period, and also followed the addition of calcium carbonate and reduction of phosilage late in the experiment, but again these increased gains were temporary. The steers receiving phosilage again developed glossy hair coats which persisted well into the summer. In the digestion-balance trials, the retention of calcium and phosphorus tended to vary in accordance with the amount of each of these minerals included in the ration, provided the steers had sufficient time to adjust themselves to any changes in the ration. There was an increase from the beginning to the end of the feeding experiment of both calcium and phosphorus in the blood; these results differing from those of the previous year mainly because of a variation in the amount of calcium and phosphorus in the blood at the beginning of each year's experiment.

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Roy Philip Wilkes

ENTITLED ALTERING THE CALCIUM-PHOSPHORUS RATIO FOR FATTENING STEERS

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

MAJORING IN ANIMAL NUTRITION

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Permission to publish this thesis or any part of it must be obtained from the Dean of the Graduate School.

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INTRODUCTION

During the last few decades, since the time that minerals were found to be essential for adequate nutrition, much work has been done in trying to determine the optimum amounts of each mineral for different kinds of animals. It has been shown that calcium and phosphorus together make up by far the greater part of the body ash, and this fact has turned the attention of most workers to a study of these two minerals. They have repeatedly shown that gain in weight by steers can be enhanced by adding a calcium and/or phosphorus supplement to many common rations. Occasionally, an experiment has shown a disadvantage of adding too much. There must, therefore, be a favorable quantity somewhere between these limits.

The problem of establishing either an optimum amount or ratio of calcium and phosphorus in the steer fattening ration is complicated by several factors. For instance, (1) the calcium and phosphorus in various feeds and supplements are not available to the same extent, (2) there are certain other minerals which hinder the absorption of calcium or phosphorus, (3) under some conditions calcium and phosphorus are precipitated in the digestive tract as insoluble tricalcium phosphate, (4) vitamin D affects calcium and phosphorus utilization, and (5) there are physiological differences in steers which cannot be gauged accurately at the present time.

In addition to the above complications, there is another angle to the problem apparently overlooked by research workers; that is, the optimum quantity and ratio of calcium and phosphorus may not be

constant for the whole fattening period. From two standpoints, at least, this possibility has promise. First, the feeding period may encompass two phases; the preliminary part being concerned more with promoting growth and the latter part predominantly a fattening process. Each of these phases might require different amounts of calcium and phosphorus. From the second viewpoint, steers are normally taken off a grass pasture and put into the feedlot for fattening, and since grass ordinarily has a high ratio of calcium to phosphorus, it seems possible that the feeding of a ration high in phosphorus would stimulate growth for at least a temporary period.

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REVIEW OF LITERATURE

The field of literature is well supplied with references to calcium and phosphorus in livestock nutrition. This review is by no means complete, but is meant to point out some of the work which is more directly applicable to the object of this experiment.

Speaking of an experiment with 18-month-old steers and 15-month-old heifers, Theiler, Du Toit, and Malan (22) stated; "A daily intake of 19 grams of P_2O_5 of which 53 percent was retained by the steers and of 24 grams of P_2O_5 with a retention of approximately 63 percent by the heifers provided sufficient phosphorus for normal growth and development while 13 grams and 10 grams were insufficient for the steers and heifers respectively."

Otto (19), working with steers weighing about 500 pounds, found that rations containing 16.4 grams of calcium and 8.5 grams of phosphorus were adequate for growing steers; 12.0 grams of calcium and 5.8 grams of phosphorus and less were insufficient.

Results obtained by Watkins (24), using steers 13 to 18 months old, showed that a daily intake of 14.7 grams of phosphorus resulted in uniformly positive balances, but 11.6 grams of calcium and 8.5 grams of phosphorus daily was not enough.

A detailed experiment by Weber, McCampbell, Hughes, and Peterson (25) also indicated that a fattening calf needs more than 11 grams of calcium daily.

Schmidt (20) said; "Growing bovine should receive at least three grams of calcium and two grams of phosphorus per day for each

100 pounds of body weight. These amounts may be reduced by one-half for cattle approaching maturity. These are minimal amounts and may be greatly exceeded without harm as long as these minerals remain reasonably in proportion."

An experiment by Beeson, Bolin, and Hickman (2) showed that the minimum phosphorus requirement for fattening 600 pound steer calves is slightly less than 12 grams daily or an intake of about two grams daily per 100 pounds live weight.

Guilbert and Rochford (10) stated; "About 0.2 percent of phosphorus in the dry matter of feeds for young growing cattle appears to be the lower limit for optimum growth of normal bone. The requirement decreases with maturity, so that about 0.12 percent of phosphorus in the dry matter suffices for mature cattle if conditions are favorable for its utilization."

Mitchell and McClure (17) said; "For calves growing from 300 to 1000 pounds in weight the average necessary percentages of calcium and phosphorus in the dry ration are, respectively, 0.25 and 0.25 percent for growing beef calves, 0.29 and 0.25 percent for growing and fattening beef calves, and 0.19 and 0.22 percent for growing dairy calves. For rations less efficiently utilized with respect to their contents of calcium and phosphorus than 70 percent, these estimated percentages would be larger."

These reports indicate that about two grams of phosphorus daily per 100 pounds live weight is adequate for growing and fattening steers, while the smallest amount of calcium shown to be adequate for 500 pound steers is 16.4 grams daily, or approximately three

grams per 100 pounds live weight.

Regarding the ratio of calcium to phosphorus in the steer fattening ration, Morrison (18) said it should be between 1:1 and 2:1, Maynard (15) said between 1:2 and 2:1, while both admitted that adequate nutrition was possible outside of these limits.

According to Mitchell and McClure (17), "The utilization of any given source of dietary calcium and phosphorus depends upon (a) the concentration of each in the diet, (b) the ratio of one concentration to the other, (c) the presence or absence of vitamin D in the diet or its equivalent in ultraviolet irradiation, and (d) the rate of food consumption and hence the rate of growth. A failure to control all of these factors may seriously impair the significance of an experiment, while the assertion that any one, such as the ratio of calcium to phosphorus, is more important than another is logically absurd."

Experiments by Theiler, Du Toit, and Malan (22) and by Otto (19) showed that the ratio of calcium to phosphorus became increasingly important as the amount of these minerals was reduced. When the ratio of calcium to phosphorus was high, and the amount of phosphorus insufficient, the steers soon lost their appetite, but regained it to some extent later on. However, when the steers were on a low calcium high phosphorus ratio, their appetite was not particularly affected and gains were normal.

The controversy regarding the availability of calcium and phosphorus in different mineral supplements can be simplified by accepting Maynard's (15) statement: "Assuming no harmful substances are present in the supplements and that the animals are in a suitable

physical condition, all may be considered to be of equal value per unit of calcium and phosphorus present... While the minerals must be in solution in order to be absorbed, the factors which determine solubility in the intestine are more important than the form ingested."

While the literature thus contains numerous reports on the quantity and ratio of calcium and phosphorus for fattening steers, it still leaves the issue in doubt, and surprisingly seems not to consider that the amount and ratio might be changed with advantage during the fattening period.

MATERIALS AND METHODS

The regular steer fattening experiments conducted by the Animal Investigations Section involved 80 yearling Hereford steers in 1941-42 and 70 in 1942-43. These steers were selected for uniformity of size and type and most of them came from the same ranch each year. From the time of their arrival at the College until the beginning of the experiment, a period of approximately two weeks, they were fed only alfalfa hay, salt, and water. During this time, the steers were ear-tagged with duplicate numbers, one in each ear, and were tested by the College Veterinarians for tuberculosis and Bang's disease. Also, they were vaccinated against blackleg and hemorrhagic septicemia.

At the beginning of the experiment, each steer was weighed three consecutive days and these weights averaged for his initial weight.

During the first day, each steer was graded on his type, condition, and color. Then the steers were allotted, as fairly as possible, into lots of 10 steers each. On the second day, the steers were sorted into their proper lots and placed on feed.

The steers in lots I, II, III, and IV received practically the same rations both years, except for variations in mineral supplements. In 1941-42, the steers in lots V and VI received a low level of grain and hay and were fed beet tops, while in lots VII and VIII, they received a high grain level and less hay. In 1942-43, the steers in lot VI received a high grain level fed in a cut mixture, while lot VII corresponded to the previous year's lot VI. The exact rations which the steers received are given in appendix tables VII and XIV, but the above serves to show that all variations in gains of the steers cannot be attributed directly to different amounts or ratios of calcium and phosphorus in the rations.

For more direct and specific data, blood analyses and digestion-balance trials were used. Blood samples were taken from the jugular veins of two average steers from each lot at the beginning and at the end of the experiment in 1941-42 and every 30 days during the experiment in 1942-43. These samples were analyzed for calcium and phosphorus content. Two digestion-balance trials were conducted each year, one when the steers had reached the feed level at which they were to be maintained and the other near the end of the fattening experiment. In 1941-42, each trial extended for a period of 14 days. In 1942-43, each trial covered a period of 22 days, with the first seven days being a preliminary period during which time no

collection or sampling was done. Six steers were used for each trial in 1941–42, one average steer from each of lots I, II, IV, V, VII, and VIII. Only six digestion-balance stalls were available, and it was believed the six lots selected would best represent the whole experiment. In 1942–43, four steers were used for each trial, two from lot I, in which the standard ration was fed, and two from lot IV, in which the calcium-phosphorus ratio was altered during the feeding period.

The digestion-balance stalls were constructed in such a manner that a steer, held in place by a stanchion, would stand with his rear feet either on or immediately in front of an iron grill built across an opening in the floor. The feces would drop through this grill, on through a metal chute, and into a pan in the basement. The urine was collected by means of a rubber funnel held in place with a special harness. To the bottom of the funnel was fastened a rubber tube which led to a carboy in the basement.

Weights were recorded in grams for all feeds and water fed and refused, as well as for all urine and feces excreted. Samples were taken daily of urine and feces, and samples of feed and of alfalfa hay and beet tops refused were taken every three days. Much care was used in obtaining representative samples. The urine and the feces were each collected at the same time every afternoon, each thoroughly mixed, and one-one hundredth by weight of the urine and one-thirtieth by weight of the feces taken as samples. Toluene was added to the urine and chloroform was sprinkled on the feces to reduce mold and bacterial action.

Analyses were conducted in the chemical laboratories of the Animal Investigations Section. All samples of each feed and feces were made into composites and analyzed by accepted chemical methods for dry matter, ash, calcium, phosphorus, and nitrogen. The urine samples were analyzed for all of these except dry matter and were further analyzed for specific gravity and hydrogen-ion concentration. The results thus obtained were applied to the consumption and excretion figures from each digestion-balance trial and the calcium and phosphorus balances for each steer determined.

In 1941-42, samples were taken weekly of each feed used in the fattening experiment and composites made of all except wet beet pulp. The samples of wet beet pulp were dried each week and analyzed separately. The composite samples of each of the other feeds were brought in about the middle of the experiment and another group brought in at the end of the experiment.

All samples, except urine, were reduced to an air-dry basis in a large drier, then ground, and preserved in air-tight glass jars until there was sufficient time to analyze them.

TABLE I. DIGESTION-BALANCE TRIALS —— 1941-42

(Figures in terms of grams per steer per day)

DIGESTION-BALANCE TRIAL I	Lot I Steer 49		Lot II Steer 44		Lot IV Steer 43		Lot V Steer 79		Lot VII Steer 38		Lot VIII Steer 48	
Jan. 29 - Feb. 11, 1942	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.
Ground corn	0.445	6.749	0.686	10.398	0.493	7.474	0.365	5.538	0.649	9.836	0.709	10.749
Cottonseed cake	0.180	2.069					0.241	2.768	0.211	2.421		
Wet beet pulp	1.857	0.385	2.465	0.510	1.233	0.255	3.037	0.629	2.386	0.494	0.667	0.138
Beet tops							7.093	2.928				
Alfalfa hay	3.464	3.325	3.868	3.591	4.695	4.159	2.843	2.851	4.031	3.617	4.369	3.800
Phosilage						12.031						
Bone meal			7.965	3.767							8.346	3.946
Water	0.062	0.001	0.061	0.001	0.080	0.001	0.067	0.001	0.103	0.001	0.106	0.001
AVERAGE DAILY INTAKE	6.008	12.529	15.045	18.267	6.501	23.920	13.646	14.715	7.380	16.369	14.197	18.634
Urine	1.404	0.085	4.685	0.100	1.724	9.460	5.274	0.155	1.824	0.352	2.015	0.377
Feces	6.169	8.674	11.322	12.755	7.596	10.150	16.688	13.104	8.272	10.986	10.392	9.402
AVERAGE DAILY OUTPUT	7.573	8.759	16.007	12.855	9.320	19.610	21.962	13.259	10.096	11.338	12.407	9.779
AVERAGE DAILY BALANCE	-1.565	3.770	-0.962	5.412	-2.819	4.310	-8.316	1.456	-2.716	5.031	1.790	8.855

DIGESTION-BALANCE TRIAL II	Lot I Steer 49		Lot II Steer 44		Lot IV Steer 43		Lot V Steer 79		Lot VII Steer 38		Lot VIII Steer 48	
April 12 - April 26, 1942	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.
Ground corn	0.336	5.529	0.521	8.560	0.428	7.045	0.398	6.541	0.401	6.600	0.593	9.755
Cottonseed cake	0.153	1.923					0.207	2.604	0.163	2.056		
Wet beet pulp	0.452	0.135	0.465	0.139	0.556	0.167	1.547	0.463	0.636	0.190	0.573	0.172
Beet tops							4.968	3.318				
Alfalfa hay	6.005	2.486	6.679	2.756	6.772	2.789	3.764	1.598	4.686	1.927	4.924	2.022
Phosilage						7.137						
Bone meal			4.298	2.033								
Phosphate											16.173	5.914
Water	0.080	0.001	0.077	0.001	0.104	0.001	0.079	0.001	0.089	0.001	0.107	0.001
AVERAGE DAILY INTAKE	7.026	10.074	12.040	13.489	7.860	17.139	10.963	14.525	5.975	10.774	22.370	17.864
Urine	0.111	0.659	0.067	0.075	0.255	4.006	0.118	0.095	0.131	1.105	0.151	0.697
Feces	7.561	8.699	8.356	10.677	2.002	9.492	10.503	9.863	3.712	5.495	6.377	9.600
AVERAGE DAILY OUTPUT	7.672	9.358	8.423	10.752	2.257	13.498	10.621	9.958	3.843	6.600	6.528	10.297
AVERAGE DAILY BALANCE	-0.646	0.716	3.617	2.737	5.603	3.641	0.342	4.567	2.132	4.174	15.842	7.567

DIGESTION-BALANCE TRIALS --- 1941-42

Each of the digestion-balance trials extended for a period of 14 days. All figures are in terms of grams, and represent one average day.

In trial I, the average daily calcium intake ranged from 6.008 to 15.045, the output was from 7.573 to 21.962, and the balance was negative in all lots but one, ranging from - 8.316 to 1.790. The average daily phosphorus intake ranged from 12.529 to 23.920, the output was from 8.759 to 19.610, and the balance was positive in all lots, ranging from 1.456 to 8.855.

In trial II, the average daily calcium intake ranged from 5.975 to 22.370, the output was from 2.257 to 10.621, and the balance was positive in all lots, with one exception. The average daily phosphorus intake ranged from 10.074 to 17.864, the output was from 6.600 to 13.498, and the balance was again positive in all lots, though the retention was not as high, with one exception, as during trial I.

Therefore, the retention of calcium was greater during trial II than trial I, and the retention of phosphorus was opposite, being greater during trial I.

In trial I, the calcium excretion seemed to be somewhat dependent upon calcium intake, whereas the phosphorus varied considerably. In trial II, the phosphorus excretion was apparently more dependent upon intake and the calcium excretion more variable.

The urine, in trial I, was much higher in calcium content than

it was in trial II, ranging from 7.55 to 78.27 times as much. The urine, with one exception in each case, was higher in calcium than in phosphorus during trial I and higher in phosphorus than in calcium during trial II.

This calcium and phosphorus in the urine must first have been absorbed from the intestines and thus made available for use by the body. Since calcium was nevertheless thrown off in such relatively large quantity during digestion-balance trial I, conducted in the first part of the fattening period, it is suggestive that the body was not in need of additional calcium at that time. However, during trial II, conducted near the end of the fattening period, far less calcium was excreted in the urine and more was retained in the body. On the other hand, more phosphorus was retained by five of the six steers during trial I than during trial II. From these facts, it seems reasonable to expect that a calcium supplement would have been more likely to induce a favorable response if added to the ration during the latter part of the fattening period, and a phosphorus supplement if added during the first part.

TABLE II

BLOOD ANALYSES --- 1941-42
(Mgms. per 100 cc. blood plasma)

Lot	Steer	At Beginning of Experiment		At End of Experiment		Difference	
		Ca.	P.	Ca.	P.	Ca.	P.
I	49*	11.66	9.47	7.96	7.39	-3.70	-2.08
	97	8.14	8.57	—	8.90	—	0.33
II	44*	12.38	10.51	7.95	7.44	-4.43	-3.07
	73	9.42	8.12	8.73	8.17	-0.69	0.05
III	2	10.10	10.63	6.47	6.75	-3.63	-3.88
	65	9.34	10.61	6.60	7.14	-2.74	-3.47
IV	43*	9.44	9.13	8.25	8.90	-1.19	-0.23
	86	10.22	9.16	8.50	12.50	-1.72	3.34
V	26	9.72	8.29	5.95	6.35	-3.77	-1.94
	79*	9.94	10.99	6.30	8.17	-3.64	-2.82
VI	11	8.52	10.38	8.40	7.77	-0.12	-2.61
	75	8.64	10.31	9.40	7.84	0.76	-2.47
VII	10	8.88	8.61	7.93	8.17	-0.95	-0.44
	38*	9.01	8.86	6.60	8.90	-2.41	0.04
VIII	1	10.18	10.18	8.40	6.97	-1.78	-3.21
	48*	--	9.21	8.73	7.84	—	-1.37
Average		9.82	9.56	7.67	8.08	-2.14	-1.49

* Used in digestion-balance trials.

BLOOD ANALYSES --- 1941-42

Blood samples were taken from the two most representative steers from each of the eight lots at the beginning and at the end of the feeding experiment and analyzed for inorganic calcium and phosphorus. The figures are expressed in terms of milligrams of calcium and of phosphorus per 100 cubic centimeters of blood plasma.

During the process of analyzing for calcium content, one sample from each of steers 48 and 97 was accidentally destroyed; therefore neither of the other two blood calcium analyses for these steers is included in the averages.

The range in calcium content of blood at the beginning of the experiment was from 8.52 to 12.38, and the average was 9.82. At the end of the experiment, the range was from 5.95 to 9.40, and the average was 7.67. The difference ranged from a gain of 0.76 to a loss of 4.43, with the average loss being 2.14.

The phosphorus content of blood at the beginning ranged from 8.12 to 10.99, and the average was 9.56. At the end, it ranged from 6.55 to 12.50, and the average was 8.08. The difference ranged from a gain of 3.34 to a loss of 3.88, with the average loss being 1.49.

Thus, from the beginning to the end of the fattening period, there was a reduction of both calcium and phosphorus in the blood, though calcium was lost to the greater extent. This is in line with the hypothesis that additional calcium would more likely be of benefit during the latter part of the steer fattening period.

The change in the calcium and phosphorus content of the blood

generally varied in accordance with the maximum and minimum amounts of each of these minerals included in the ration; that is, the steers receiving the most calcium or phosphorus in their ration (see appendix table VIII) gained the most calcium or phosphorus, respectively, in their blood, while those receiving the least amount of phosphorus in their ration lost the most in their blood. The least amount of calcium intake in the ration, however, did not result in the greatest amount of calcium loss in the blood.

TABLE III.

STEER GAINS —— 1941-42
(Figures in terms of daily average per steer)

Period	Lot I Gain (Lbs.)	Lot I Ca. (Grams)	Lot I P. (Grams)	Lot I Ca.-P. Ratio	Lot IV Gain (Lbs.)	Lot IV Ca. (Grams)	Lot IV P. (Grams)	Lot IV Ca.-P. Ratio
Nov. 13 - 23		13	11	1.2:1	-0.30	20	11	1.8:1
Nov. 23 - Dec. 3		14	14	1.0:1	3.10	21	15	1.4:1
Dec. 3 - 13	0.72	15	16	0.9:1	1.10	21	38	0.6:1
Dec. 13 - 23		16	16	1.0:1	4.60	22	53	0.4:1
Dec. 23 - Jan. 2		29	22	1.3:1	2.80	23	51	0.5:1
Jan. 2 - 12	3.61	29	23	1.3:1	0.85	24	59	0.4:1
Jan. 12 - 22		30	23	1.3:1	2.60	25	56	0.4:1
Jan. 22 - Feb. 1		29	23	1.3:1		25	55	0.5:1
Feb. 1 - 11	2.11	21	19	1.1:1	3.03	20	51	0.4:1
Feb. 11 - 21		21	21	1.0:1	2.50	20	55	0.4:1
Feb. 21 - Mar. 3		19	21	0.9:1	1.95	20	56	0.4:1
Mar. 3 - 13	2.32	19	21	0.9:1	2.55	20	56	0.4:1
Mar. 13 - 23		19	22	0.9:1	3.00	22	57	0.4:1
Mar. 23 - April 2	2.50	16	20	0.8:1	1.45	22	57	0.4:1
April 2 - 12	1.67	16	19	0.8:1	3.30	22	57	0.4:1
April 12 - 22		15	17	0.9:1		15	51	0.3:1
April 22 - May 2	1.61	15	18	0.8:1	0.88	15	53	0.3:1
May 2 - 12	2.11	15	19	0.8:1	1.85	14	55	0.3:1
May 12 - 22	2.70	15	19	0.8:1	1.35	15	55	0.3:1

STEER GAINS —— 1941-42

One steer was removed from lot I on March 28, and corrections were made up to that time for feed consumed and weight gained. Because of this, the average daily gains of the remaining nine steers could only be calculated from the individual weights taken every 30 days. No weights were taken during the digestion-balance trials.

The calcium-phosphorus ratio in lot I varied somewhat during the early part of the feeding period while the steers were getting adjusted to their feed, but from that time until the end of the experiment the ratio gradually decreased. There was hardly enough variation in the ratio, however, to materially affect the rate of gain.

In lot IV, the calcium-phosphorus ratio was rather quickly reduced from 1.8:1 to 0.4:1. This change was effected by mixing phosilage, a rather concentrated supplement similar to phosphoric acid, in with the wet beet pulp. In the second 10-day period following the addition of phosilage to the ration, the steers gained more weight than was gained by any other lot of steers during any 10-day period of the experiment. They continued to gain well until sometime between April 12 and May 2, when the final digestion-balance trial and a lowered calcium-phosphorus ratio of 0.3:1 together apparently depressed the rate of gain.

These results indicate that the steers in lot IV were stimulated by the phosphorus supplement early in the feeding period, and might have made better gains during the latter part had the amount of phosphorus been reduced, or a calcium supplement added, or both.

RESULTS OF 1941-42 EXPERIMENT

When phosilage, a rather concentrated phosphorus supplement, was added to the ration of one lot of steers early in the feeding experiment, these steers gained rapidly enough within two weeks to outweigh the steers in any other lot, and maintained this lead for another two weeks.

During digestion-balance trial I, conducted early in the feeding experiment, the urine from each of the six steers used was from 7.5 to 78 times as high in calcium as it was from the same steers during digestion-balance trial II, conducted near the end of the feeding experiment, though the average daily intake of calcium was comparable for each steer in both trials.

The average daily calcium balance was negative, with one exception, in trial I and positive, with one exception, in trial II.

The retention of phosphorus was higher during trial I than during trial II, with one exception.

In trial I, the excretion of calcium tended to be roughly in proportion to its intake, whereas the phosphorus varied considerably. In trial II, the phosphorus excretion was apparently more dependent upon intake and the calcium more variable.

Blood analyses at the beginning and end of the fattening experiment showed the inorganic calcium and phosphorus contents reduced an average of 2.14 and 1.49 milligrams, respectively, per 100 cubic centimeters of blood plasma.

Within a month after phosilage was added to their ration, the

steers in lot IV developed a luster and sheen to their hair coat not evidenced by the steers in any other lot, and they retained this appearance for the remainder of the fattening experiment.

Although incidental, there was a distinct variation in the condition of the livers of those steers receiving phosilage compared with those not receiving it. Liver flukes caused condemnation of two livers in the lot receiving phosilage and from five to nine livers in each of the other seven lots; telangiectasis caused condemnation of six livers in the lot receiving phosilage and from none to two livers in each of the other lots.

TABLE IV. DIGESTION-BALANCE TRIALS----1942-43

(Figures in terms of grams per steer per day)

DIGESTION-BALANCE TRIAL I	Lot I Steer 52		Lot I Steer 22		Lot IV Steer 8		Lot IV Steer 35	
Feb. 28 - March 15, 1943	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.
Ground corn	0.703	9.027	0.702	9.015	0.767	9.851	0.762	9.781
Cottonseed cake	0.308	2.879	0.306	2.865				
Wet beet pulp	1.625	0.126	1.741	0.135	1.723	0.134	1.705	0.133
Alfalfa hay	14.547	3.937	19.796	5.512	19.235	5.356	18.454	5.103
Phosilage						29.148		28.995
Water	0.087	0.001	0.102	0.001	0.110	0.001	0.080	0.001
AVERAGE DAILY INTAKE	17.270	15.970	22.647	17.528	21.835	44.490	21.001	44.013
Urine	0.059	2.577	0.407	0.069	0.205	3.121	0.125	14.412
Feces	10.444	6.787	10.644	7.042	9.673	15.857	10.453	11.125
AVERAGE DAILY OUTPUT	10.503	9.364	11.051	7.111	9.878	18.978	10.578	25.537
AVERAGE DAILY BALANCE	6.767	6.606	11.596	10.417	11.957	25.512	10.423	18.476

DIGESTION-BALANCE TRIAL II	Lot I Steer 52		Lot I Steer 22		Lot IV Steer 8		Lot IV Steer 35	
May 24 - June 8, 1943	Ca.	P.	Ca.	P.	Ca.	P.	Ca.	P.
Ground corn	0.819	17.369	0.913	19.352	0.901	19.102	0.767	16.257
Cottonseed cake	0.276	2.767	0.278	2.795				
Wet beet pulp	1.805	0.268	2.175	0.323	1.881	0.279	2.098	0.312
Alfalfa hay	10.435	2.635	13.602	3.216	14.476	3.352	11.908	2.870
Phosilage						8.556		9.597
Calcium carbonate					8.251		9.251	
Water	0.111	0.001	0.111	0.001	0.138	0.001	0.103	0.001
AVERAGE DAILY INTAKE	13.446	23.040	17.079	25.687	25.647	31.290	24.127	29.037
Urine	0.086	1.104	0.360	0.086	0.534	0.099	0.049	4.795
Feces	8.887	7.531	8.213	7.973	18.686	16.318	13.510	7.307
AVERAGE DAILY OUTPUT	8.973	8.635	8.573	8.059	19.220	16.417	13.559	12.102
AVERAGE DAILY BALANCE	4.473	14.405	8.506	17.628	6.427	14.873	10.568	16.935

DIGESTION-BALANCE TRIALS —— 1942-43

In lot I, during trial I, the intake of calcium and phosphorus was in a ratio of approximately 1:1 and the retention also 1:1; in trial II, the intake was near 1:2 and 1:1.5 for each steer, respectively, and the retention 1:3 and 1:2.

In lot IV, during trial I, the intake was about 1:2 and the retention 1:2; during trial II, the intake was almost 1:1 and the retention 1:2 and 1:1.5 for each steer.

In lot I, the calcium intake and retention were greater during trial I than during trial II; in lot IV, the calcium intake was less during the first trial, yet the calcium retention was greater for one steer and approximately the same for the other.

In lot I, the phosphorus intake and retention were less during trial I, while in lot IV, they were greater.

The amount of calcium excreted in the urine was about the same during each trial; the amount of phosphorus in the urine was generally less during trial II.

The retention of calcium and phosphorus in lot I varied in the same direction and almost to the same extent as the intake of each of these minerals. A somewhat similar variation in the phosphorus retention occurred in lot IV, but the calcium retention apparently was not dependent upon intake.

Since the calcium carbonate supplement had been introduced into the ration of lot IV only a month previous to balance trial II, it is possible the steers had not completely adjusted themselves to

this increased calcium intake and were still not efficiently utilizing all of it.

The results of these two digestion-balance trials indicate that the retention of calcium and phosphorus varied in accordance with the amount of each of these minerals consumed, provided the steers had sufficient time to adjust themselves to any changes in the ration.

TABLE V. BLOOD ANALYSES --- 1942-43
(Mgms. per 100 cc. blood plasma)

Calcium

Lot	Steer	12/23	1/22	2/21	3/23	4/22	5/22	6/21	Gain
	22*	6.20	6.47	8.26	6.88	7.60	11.22	11.02	4.82
I	52*	—	6.08	6.54	8.04	7.40	7.98	9.18	—
	23	6.00	8.82	9.62	8.30	7.80	11.80	10.02	4.02
II	54	6.40	6.47	6.54	8.84	7.80	9.04	8.34	1.94
	14	6.80	12.55	10.20	7.26	8.00	12.26	10.06	3.26
III	82	7.40	10.00	8.46	5.42	7.40	11.38	10.22	2.82
	35*	7.60	7.06	3.46	6.62	7.80	6.90	9.80	2.20
IV	78	7.20	—	4.42	8.66	8.80	14.66	10.38	3.18
	30	5.80	13.92	6.92	8.08	10.00	13.96	8.64	2.84
V	53	7.20	10.59	10.58	7.70	10.40	13.20	9.52	2.32
	4	7.40	6.67	6.74	8.66	8.80	11.42	8.10	0.70
VI	21	6.60	—	4.80	7.42	7.60	13.52	10.60	4.00
	1	6.60	8.82	6.34	6.96	8.60	9.58	8.84	2.24
VII	48	6.20	8.63	8.46	8.50	9.80	9.36	8.68	2.48
Average		6.72	8.84	7.24	7.67	8.41	11.16	9.53	2.81

Phosphorus

Lot	Steer	12/23	1/22	2/21	3/23	4/22	5/22	6/21	Gain
	22*	4.36	7.18	—	7.74	8.72	7.38	7.00	2.64
I	52*	5.69	6.90	4.36	8.36	6.68	8.12	8.74	3.05
	23	5.98	8.62	—	9.06	7.90	9.14	9.42	3.44
II	54	6.53	7.39	8.02	8.98	7.58	7.48	8.60	2.07
	14	6.53	6.59	7.44	7.48	8.12	5.84	8.48	1.95
III	82	6.42	8.17	—	9.26	6.56	9.56	7.38	0.96
	35*	6.96	7.65	9.20	9.80	9.14	7.28	8.60	1.64
IV	78	6.27	4.35	—	10.20	9.44	8.00	7.48	1.21
	30	5.99	4.28	6.44	7.20	8.24	7.28	7.06	1.07
V	53	5.76	4.08	5.44	6.20	7.58	6.60	9.00	3.24
	4	7.16	8.72	8.24	8.70	5.84	8.60	8.24	1.08
VI	21	4.59	8.86	7.00	9.54	7.58	7.20	9.00	4.41
	1	7.27	5.63	—	9.26	7.90	5.78	7.90	0.63
VII	48	8.15	4.67	5.26	9.56	7.00	7.28	8.86	0.71
Average		6.26	6.65	6.82	8.67	7.73	7.54	8.27	2.01

* Used in digestion-balance trials.

BLOOD ANALYSES —— 1942-43

Blood samples were taken from two average steers from each of the seven lots every 30 days during the feeding period and analyzed for inorganic calcium and phosphorus.

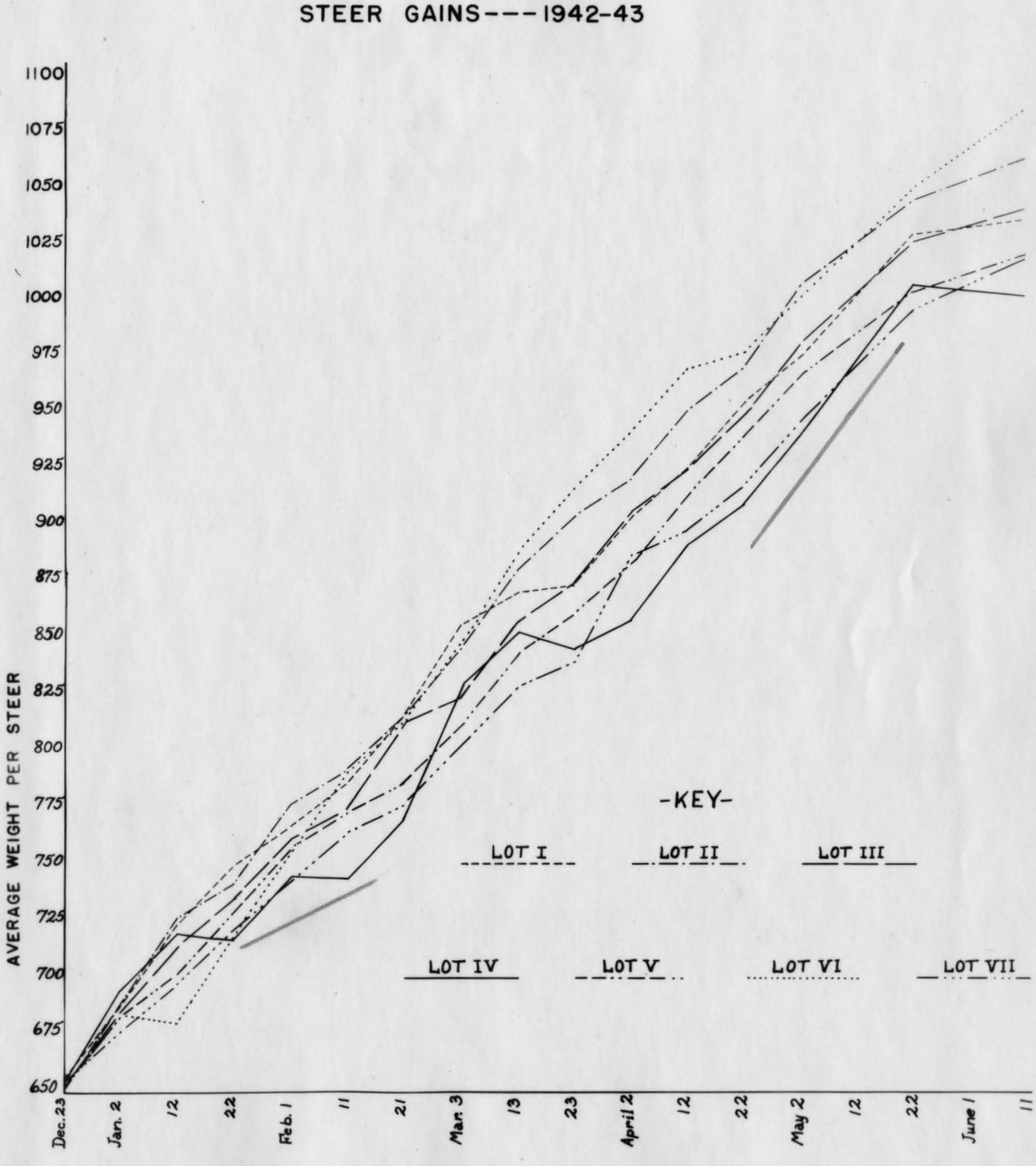
The range in calcium content at the beginning of the feeding period was from 5.80 to 7.60 milligrams per 100 cubic centimeters of blood plasma, and the average was 6.72. At the end of the experiment the range was from 8.10 to 11.02, and the average was 9.53. The gain in calcium content ranged from 0.70 to 4.82, with an average of 2.81.

The phosphorus content at the beginning ranged from 4.36 to 8.15, and the average was 6.26. At the end, it ranged from 7.00 to 9.42, and the average was 8.27. The gain in phosphorus content ranged from 0.63 to 4.41, and the average was 2.01.

From the beginning to the end of the feeding period, there was an increase in the calcium and phosphorus content of the blood of every steer from which samples were taken. The average gain was somewhat greater for calcium than for phosphorus.

These results differ from those of the previous year in which there was a loss in calcium and phosphorus content in the blood. However, at the beginning of the feeding period in 1941, analyses showed the blood plasma to contain an average of 9.82 milligrams of calcium and 9.56 milligrams of phosphorus per 100 cubic centimeters, compared with 6.72 and 6.26, respectively, at the beginning of the experiment in 1942. This difference, more than three milligrams for each mineral, represents the larger part of the variation.

PLATE I.



——— Period of phosphorus increase in ration of lot IV.

——— Period of calcium increase and phosphorus decrease in ration of lot IV.

TABLE VI.

STEER GAINS --- 1942-43
(Figures in terms of daily average per steer)

Period	Lot I Gain (Lbs.)	Lot I Ca. (Grams)	Lot I P. (Grams)	Lot I Ca.-P. Ratio	Lot IV Gain (Lbs.)	Lot IV Ca. (Grams)	Lot IV P. (Grams)	Lot IV Ca.-P. Ratio
Dec. 23 - Jan. 2	3.15	30	15	2.0:1	4.05	24	14	1.7:1
Jan. 2 - 12	3.60	30	22	1.4:1	2.60	25	20	1.3:1
Jan. 12 - 22	2.55	30	24	1.3:1	-0.35	25	22	1.1:1
Jan. 22 - Feb. 1	1.75	29	23	1.3:1	2.70	25	26	1.0:1
Feb. 1 - 11	1.95	29	24	1.2:1	-0.15	24	32	0.8:1
Feb. 11 - 21	2.95	28	22	1.3:1	2.65	24	47	0.5:1
Feb. 21 - Mar. 3	3.84	28	24	1.2:1	5.80	24	53	0.5:1
Mar. 3 - 13	1.56	28	26	1.1:1	2.50	22	55	0.4:1
Mar. 13 - 23	0.35	27	25	1.1:1	-0.70	21	53	0.4:1
Mar. 23 - April 2	3.10	27	26	1.0:1	1.30	21	53	0.4:1
April 2 - 12	2.00	27	27	1.0:1	3.25	21	55	0.4:1
April 12 - 22	2.95	27	29	0.9:1	1.80	21	55	0.4:1
April 22 - May 2	2.00	26	29	0.9:1	3.00	24	54	0.4:1
May 2 - 12	—	25	31	0.8:1	—	25	47	0.5:1
May 12 - 22	2.79	25	30	0.8:1	3.40	27	34	0.8:1
May 22 - June 1	—	24	27	0.9:1	—	34	28	1.2:1
June 1 - 11	0.38	24	28	0.9:1	-0.26	35	31	1.1:1

STEER GAINS --- 1942-43

The rate of gain of the steers in lot IV was rather erratic, both before and during the time that phosilage was included in their ration. This condition probably was caused largely by the fact that three of the steers were extremely nervous, retreated to the farthest corner of the lot when visitors approached, and kept the entire lot upset during a large part of the experiment. All of the steers were nervous during the time of allotment, not being accustomed to close handling, and it was merely an unfortunate coincidence that three of the wildest steers happened to be put into the same lot.

On January 23, phosilage was added to the ration of the steers in lot IV at the rate of 10 milliliters per steer per day. This was increased to 25 milliliters in 10 days and to 75 milliliters in 22 days. Immediately following the increase of phosilage to 75 milliliters on February 14, the steers made a greatly increased rate of gain for the next 30 days, including one 10-day period in which their gain was greater than that made by any other lot of steers during any 10-day period of the experiment. From February 14 to May 2, a period of 78 days during which each steer received 75 milliliters per day, the ratio of calcium to phosphorus was approximately 0.4:1, and the rate of gain was very good, with the exception of one 10-day period.

On April 23, 11.3 grams of calcium carbonate per steer was added to the ration. This amount was increased by an additional 11.3 grams each of two following 10-day periods, and then 22.6 grams

extra were added on May 23, bringing the total amount per steer per day to 56.7 grams. While the calcium carbonate was being increased, the phosilage was being decreased. On May 3, the phosilage was reduced to 50 milliliters per steer per day; on May 13, to 25 milliliters; and on May 23, to 10 milliliters. From May 23 until July 6, when the steers were shipped to market, the ration contained 57.6 grams of calcium carbonate and 10 milliliters of phosilage; the calcium-phosphorus ratio was 1.1:1.

While the calcium-phosphorus ratio was changed from 0.4:1 on April 23 to 1.2:1 on May 23, the steers made exceptionally good gains of better than three pounds per steer per day, which was better than that made by any other lot of steers during this period. This rate of gain was interrupted by a digestion-balance trial from May 17 to June 8, causing the steers to lose weight. Had the steers been able to maintain their rate of gain uninterrupted for 20 more days, they would have had a total gain exceeded by only the lot of steers receiving a high grain level.

These results indicate that the steers were stimulated to temporarily greater gains by the addition of phosilage to the ration during the first part of the feeding period and by the addition of calcium carbonate, together with the reduction of phosilage, during the latter part.

RESULTS OF 1942-43 EXPERIMENT

In the fourth 10-day period following the addition of phosilage to their ration early in the feeding period, the steers in lot IV gained more weight than was gained by any other lot of steers in any 10-day period in the experiment.

Immediately after the addition of calcium carbonate and the reduction of phosilage in their ration late in the feeding period, the steers in lot IV gained an average of more than three pounds per steer per day for a month.

During the digestion-balance trials, the retention of calcium and phosphorus in lot I varied in the same direction and almost to the same extent as the intake of each of these minerals. A somewhat similar variation in the phosphorus retention occurred in lot IV, but the calcium retention apparently was not dependent upon intake.

From the beginning to the end of the feeding period, there was an increase in the inorganic calcium and phosphorus content of the blood of every one of the 14 steers from which samples were taken. The gain in calcium content ranged from 0.70 to 4.82 milligrams per 100 cubic centimeters of blood plasma, with an average of 2.81; gain in phosphorus ranged from 0.63 to 4.41, with an average of 2.01.

The steers in lot IV developed a glossy hair coat within a month after phosilage was added to their ration and maintained this appearance well into the summer, until the amount of phosilage in their ration was reduced from 75 to 10 milliliters per steer per day.

SUMMARY

Two feeding experiments were conducted, using eight lots of 10 yearling Hereford steers each in 1941-42 and seven similar lots in 1942-43.

Two digestion-balance trials were conducted each year, one in the first part of the feeding period and the other in the latter part. In 1941-42, each trial was for a period of 14 days and one steer from each of six lots was used; in 1942-43, each trial extended 22 days and two steers from each of two lots were used.

Blood samples were taken from two average steers in each lot at the beginning and at the end of the feeding period in 1941-42 and every 30 days during the experiment in 1942-43. These samples were analyzed for inorganic calcium and phosphorus.

In 1941-42, one lot of steers made temporarily accelerated gains following the addition of phosilage, a rather concentrated phosphorus supplement, to their ration early in the feeding period; the steers used in digestion-balance trials retained more phosphorus during trial I and more calcium during trial II; and there was an average loss in both calcium and phosphorus content of the blood from the beginning to the end of the experiment, calcium being decreased more than phosphorus.

In 1942-43, temporarily greater gains followed the addition of phosilage to the ration of one lot of steers early in the feeding period, and also followed the addition of calcium carbonate and reduction of phosilage late in the experiment; in the digestion-balance

trials, the retention of calcium and phosphorus tended to vary in accordance with the amount of each of these minerals included in the ration; and there was an increase from the beginning to the end of the feeding period of both calcium and phosphorus in the blood of all steers from which samples were taken.

CONCLUSIONS

In two consecutive years, there was a temporarily accelerated rate of gain made by one lot of steers soon after the addition of phosilage to their ration early in the feeding period.

The steers receiving phosilage were apparently stimulated to temporarily greater gains by the addition of calcium carbonate and reduction of phosilage in their ration late in the feeding period.

The digestion-balance trials and blood analyses in the first year's experiment indicated that a phosphorus supplement would be more likely to induce a favorable response if added to the ration during the first part of the feeding period and a calcium supplement if added during the latter part.

Within a month after the addition of phosilage to their ration, the steers developed a glossy hair coat which persisted for the duration of the experiment in the first year and until the amount of phosilage was reduced from 75 to 10 milliliters per steer per day in the second year.

TABLE VII.

STEER FEEDING EXPERIMENT — 1941-42
Fed 190 days - Nov. 13, 1941 to May 22, 1942
(Figures in terms of pounds per average steer)

Lot Number	I	II	III	IV	V	VI	VII	VIII
Ration Fed:	Corn	Corn	Corn	Corn	Corn	Corn	Corn	Corn
Alfalfa hay fed in all lots	Cs. cake	Wet pulp	Wet pulp	Wet pulp	Cs. cake	Wet pulp	Cs. cake	Wet pulp
Salt self-fed in all lots	Wet pulp	Bone meal (force-fed)	Bone meal (self-fed)	Phosilage (force-fed)	Wet pulp Beet tops	Beet tops Bone meal (force-fed)	Wet pulp	Phosphorus supplement* (force-fed)
Initial Weight	732.8	714.0	721.7	721.0	725.2	719.8	738.9	725.5
Final Weight	1142.6	1128.7	1142.2	1126.0	1073.3	1063.7	1156.9	1106.0
Total Gain	409.8	414.7	420.5	405.0	348.2	343.8	418.0	380.5
Daily Gain	2.16	2.18	2.21	2.13	1.83	1.81	2.20	2.00
Average Daily Ration								
Ground corn	9.88	10.38	10.44	10.43	4.94	5.43	14.16	14.14
Cottonseed cake	0.49				0.50		0.49	
Wet beet pulp	18.09	18.20	18.27	18.04	18.30	18.25	6.48	5.47
Beet tops					11.67	11.77		
Alfalfa hay	7.07	7.67	8.00	7.67	7.04	6.81	2.92	2.90
Bone meal		0.097	0.012			0.098		0.082
Phosilage				0.295				
Salt	0.046	0.040	0.048	0.038	0.032	0.028	0.059	0.086
Feed Required Per Cwt. Gain								
Ground corn	458.1	475.7	471.7	489.5	269.7	300.1	643.5	706.2
Cottonseed cake	22.9				27.1		22.1	
Wet beet pulp	838.7	833.7	825.4	846.4	998.5	1008.7	294.4	272.9
Beet tops					636.6	650.6		
Alfalfa hay	327.7	351.6	361.6	359.7	384.1	376.3	132.7	145.0
Bone meal		4.5	0.6			5.4		4.1
Phosilage				13.8				
Salt	2.1	1.9	2.2	1.8	1.8	1.6	2.7	4.3

* Bone meal and defluorinated tricalcium phosphate.

trials, the retention of calcium and phosphorus tended to vary in accordance with the amount of each of these minerals included in the ration; and there was an increase from the beginning to the end of the feeding period of both calcium and phosphorus in the blood of all steers from which samples were taken.

TABLE IX-A. DIGESTION-BALANCE TRIAL I — Jan. 29 - Feb. 11, 1942

(Figures in terms of grams per steer per day)

	Lot I - Steer 49						Lot II - Steer 44					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	2826.50	2376.52	38.780	0.445	6.749	41.90	4354.50	3661.26	59.744	0.686	10.398	64.55
Cottonseed cake	143.93	132.47	9.426	0.180	2.069	9.44						
Wet beet pulp	3501.36	356.09	16.149	1.857	0.385	8.83	4647.57	472.66	21.436	2.465	0.510	11.72
Alfalfa hay	1513.43	1271.56	106.894	3.464	3.325	25.74	1655.29	1385.05	116.040	3.868	3.591	28.03
Bone meal							27.00			7.965	3.767	
Salt	6.43						6.43					
Water	6418.29			0.062	0.001		6394.43			0.061	0.001	
Av. Daily Intake				6.008	12.529	85.91				15.045	18.267	104.30
	Excretion						Excretion					
Urine	3409.08		81.477	1.404	0.085	66.45	2992.58		91.872	4.685	0.100	60.11
Feces	5191.86	741.40	77.221	6.169	8.674	26.36	6939.93	1067.36	100.480	11.322	12.755	45.06
Av. Daily Output				7.573	8.759	92.81				16.007	12.855	105.17
Av. Daily Balance				-1.565	3.770	-6.90				-0.962	5.412	-0.87

	Lot IV - Steer 43						Lot V - Steer 79					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	3130.00	2631.70	42.944	0.493	7.474	55.18	2319.36	1950.12	31.822	0.365	5.538	34.38
Cottonseed cake							192.57	177.24	12.612	0.241	2.768	12.63
Wet beet pulp	2325.14	236.47	10.724	1.233	0.255	5.86	5727.57	582.49	26.417	3.037	0.629	14.45
Beet tops							3806.71	1198.39	491.099	7.093	2.928	25.47
Alfalfa hay	1952.14	1623.75	135.366	4.695	4.159	32.86	1277.29	1078.93	91.098	2.843	2.851	21.84
Phosilage	50.57				12.031							
Salt	6.43						6.43					
Water	8330.64			0.080	0.001		6983.07			0.067	0.001	
Av. Daily Intake				6.501	23.920	93.90				13.646	14.715	108.77
	Excretion						Excretion					
Urine	5579.67		111.593	1.724	9.460	68.29	5792.23		187.668	5.274	0.155	68.69
Feces	5972.21	885.68	80.996	7.596	10.150	31.86	8357.43	1554.48	420.936	16.688	13.104	48.97
Av. Daily Output				9.320	19.610	100.15				21.962	13.259	117.66
Av. Daily Balance				-2.819	4.310	-6.25				-8.316	1.456	-8.89

TABLE IX-B.

DIGESTION-BALANCE TRIAL I —— Jan. 29 - Feb. 11, 1942
(Figures in terms of grams per steer per day)

	Lot VII - Steer 38						Lot VIII - Steer 48					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	4119.29	3463.50	56.517	0.649	9.836	61.06	4501.36	3784.74	61.759	0.709	10.749	66.72
Cottonseed cake	168.43	155.02	11.031	0.211	2.421	11.05						
Wet beet pulp	4499.57	457.61	20.754	2.386	0.494	11.35	1258.07	127.95	5.803	0.667	0.138	3.17
Alfalfa hay	1689.07	1407.25	117.479	4.031	3.617	28.48	1796.57	1490.90	124.050	4.369	3.800	30.18
Bone meal							28.29			8.346	3.946	
Salt	6.43						6.43					
Water	10709.86			0.103	0.001		11049.71			0.106	0.001	
Av. Daily Intake				7.380	16.369	111.94				14.197	18.634	100.07
	Excretion						Excretion					
Urine	6171.27		88.866	1.824	0.352	81.54	4942.75		88.970	2.015	0.377	64.35
Feces	6592.43	1123.35	115.599	8.272	10.986	42.83	6287.71	1014.21	121.938	10.392	9.402	39.96
Av. Daily Output				10.096	11.338	124.37				12.407	9.779	104.31
Av. Daily Balance				-2.716	5.031	-12.43				1.790	8.855	-4.24

TABLE X-A.

DIGESTION-BALANCE TRIAL II --- April 12 - April 26, 1942
(Figures in terms of grams per steer per day)

	Lot I - Steer 49						Lot II - Steer 44					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	2628.00	2168.10	37.469	0.336	5.529	35.54	4069.00	3356.93	58.014	0.521	8.560	55.02
Cottonseed cake	146.71	135.88	9.845	0.153	1.923	9.12						
Wet beet pulp	2143.14	116.59	6.150	0.452	0.135	2.45	2205.07	119.96	6.328	0.465	0.139	2.52
Alfalfa hay	1658.57	1439.86	103.114	6.005	2.486	26.65	1837.07	1595.10	114.429	6.679	2.756	29.53
Bone meal							14.57			4.298	2.033	
Salt	4.57						6.36					
Water	8367.07			0.080	0.001		8013.93			0.077	0.001	
Av. Daily Intake				7.026	10.074	73.76				12.040	13.489	87.07
	Excretion						Excretion					
Urine	4326.92		81.779	0.111	0.659	74.74	3356.80		103.389	0.067	0.075	63.96
Feces	4801.50	725.51	82.835	7.561	8.699	27.56	5566.21	767.58	100.023	8.356	10.677	35.52
Av. Daily Output				7.672	9.358	102.30				8.423	10.752	99.48
Av. Daily Balance				-0.646	0.716	-28.54				3.617	2.737	-12.41

	Lot IV - Steer 43						Lot V - Steer 79					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	3348.57	2762.57	47.743	0.428	7.045	45.28	3109.21	2565.10	44.330	0.398	6.541	42.04
Cottonseed cake							198.71	184.05	13.335	0.207	2.604	12.35
Wet beet pulp	2639.07	143.57	7.573	0.556	0.167	3.02	7338.79	399.23	21.059	1.547	0.463	8.40
Beet tops							2799.43	1285.19	278.891	4.968	3.318	31.40
Alfalfa hay	1859.07	1614.33	115.890	6.772	2.789	29.88	1071.71	929.26	65.767	3.764	1.598	17.20
Phosilage	30.00				7.137							
Salt	5.64						5.57					
Water	10827.07			0.104	0.001		8247.36			0.079	0.001	
Av. Daily Intake				7.860	17.139	78.18				10.963	14.525	111.39
	Excretion						Excretion					
Urine	6239.73		97.340	0.255	4.006	76.66	5847.46		182.441	0.118	0.095	82.93
Feces	5396.79	861.33	71.164	2.002	9.492	27.70	8989.79	952.92	247.570	10.503	9.863	48.26
Av. Daily Output				2.257	13.498	104.36				10.621	9.958	131.19
Av. Daily Balance				5.603	3.641	-26.18				0.342	4.567	-19.80

TABLE X-B.

DIGESTION-BALANCE TRIAL II --- April 12 - April 26, 1942
(Figures in terms of grams per steer per day)

	Lot VII - Steer 38						Lot VIII - Steer 48					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	3137.29	2588.26	44.730	0.401	6.600	42.42	4637.14	3825.64	66.115	0.593	9.755	62.70
Cottonseed cake	156.86	145.28	10.526	0.163	2.056	9.75						
Wet beet pulp	3018.36	164.20	8.662	0.636	0.190	3.45	2721.21	148.03	7.809	0.573	0.172	3.11
Alfalfa hay	1284.14	1115.18	80.114	4.686	1.927	20.64	1347.00	1169.84	84.096	4.924	2.022	21.65
Phosphate							43.14			16.173	5.914	
Salt	4.14						5.00					
Water	9223.21			0.089	0.001		11142.14			0.107	0.001	
Av. Daily Intake				5.975	10.774	76.26				22.370	17.864	87.46
	Excretion						Excretion					
Urine	6389.40		67.089	0.131	1.105	89.69	4945.83		83.090	0.151	0.697	81.31
Feces	4599.14	627.32	76.129	3.712	5.495	31.28	5435.57	814.25	90.185	6.377	9.600	36.36
Av. Daily Output				3.843	6.600	120.97				6.528	10.297	117.67
Av. Daily Balance				2.132	4.174	-44.71				15.842	7.567	-30.21

TABLE XI-A. CHEMICAL ANALYSES OF FEEDS USED IN STEER FEEDING EXPERIMENT --- 1941-42
(Based on dry matter in sample at time taken)

Sample Number	Sample	Percent Dry Matter	ASH (Gms. per 100 gms. of D.M.)	CALCIUM (Mgms. per gm. of D.M.)	PHOSPHORUS (Mgms. per gm. of D.M.)	NITROGEN (Mgms. per gm. of D.M.)
61	Ground corn	86.12	1.4013	0.0876	2.68	18.40
101	Ground corn	84.08	1.6318	0.1873	2.84	17.63
154	Ground corn	78.93	1.6729	0.1770	3.14	17.84
199	Ground corn	82.50	1.7282	0.1551	2.55	16.39
Average		82.91	1.6086	0.1518	2.80	17.57
62	Cottonseed cake	92.45	6.9649	1.2359	11.71	74.01
100	Cottonseed cake	92.04	7.1158	1.3581	15.62	71.25
156	Cottonseed cake	92.83	7.2102	1.6646	15.70	73.23
198	Cottonseed cake	92.62	7.2453	1.1226	14.15	67.12
Average		92.49	7.1341	1.3453	14.30	71.40
11	Wet beet pulp	3.69	4.0038	5.5506	1.14	21.27
12	Wet beet pulp	4.88	3.5479	3.9670	1.24	22.56
19	Wet beet pulp	5.86	3.9330	4.5648	1.26	22.71
46	Wet beet pulp	10.00	3.3146	3.9848	1.24	25.76
47	Wet beet pulp	7.83	4.3499	4.3777	1.33	26.52
56	Wet beet pulp	8.04	3.3463	6.2178	1.14	22.50
99	Wet beet pulp	7.05	2.8844	5.0905	1.06	22.30
109	Wet beet pulp	6.80	3.1147	4.5716	1.18	22.96
117	Wet beet pulp	5.98	3.8253	4.7306	1.03	23.32
123	Wet beet pulp	7.51	3.7861	5.1962	0.92	22.35
128	Wet beet pulp	6.61	3.5427	---	---	23.90
134	Wet beet pulp	9.78	3.0485	4.9675	1.01	22.60
135	Wet beet pulp	10.17	4.5352	5.2143	1.08	24.80
140	Wet beet pulp	7.52	4.1201	4.9402	1.16	23.77
152	Wet beet pulp	5.98	3.9488	5.3352	1.14	26.24
196	Wet beet pulp	5.44	5.2750	3.8740	1.16	21.03
Average		7.07	3.7860	4.8389	1.14	23.41

TABLE XI-B. CHEMICAL ANALYSES OF FEEDS USED IN STEER FEEDING EXPERIMENT — 1941-42
(Based on dry matter in sample at time taken)

Sample Number	Sample	Percent Dry Matter	ASH (Gms. per 100 gms. of D.M.)	CALCIUM (Mgms. per gm. of D.M.)	PHOSPHORUS (Mgms. per gm. of D.M.)	NITROGEN (Mgms. per gm. of D.M.)
63	Alfalfa hay	87.44	7.9243	7.7013	1.93	23.16
103	Alfalfa hay	82.69	8.2954	2.9904	2.53	20.24
155	Alfalfa hay	85.89	7.4811	7.2528	1.86	20.71
201	Alfalfa hay	86.87	7.2069	4.2346	1.73	18.51
Average		85.72	7.7269	5.5448	2.01	20.66
		Percent Dry Matter in Whole Tops				
64A	Beet top leaves	35.16	39.2254	2.5954	1.71	19.07
64B	Beet top crowns	19.75	15.8619	2.0137	2.42	23.54
97A	Beet top leaves	23.01	54.0297	6.5576	1.90	17.67
97B	Beet top crowns	10.13	26.5797	3.4018	3.11	27.86
153A	Beet top leaves	36.88	37.7266	11.9045	2.15	24.26
153B	Beet top crowns	11.53	20.2019	2.3881	2.43	22.05
202A	Beet top leaves	27.58	30.9135	6.4764	1.91	21.48
202B	Beet top crowns	18.38	24.3827	3.5651	3.39	27.32
Average for leaves		30.66	40.4738	6.8835	1.92	20.62
Average for crowns		14.95	21.7566	2.8422	2.84	25.19

TABLE XII.

CHEMICAL ANALYSES OF FEEDS AND FECES FROM DIGESTION-BALANCE TRIALS --- 1941-42
(Based on dry matter in sample at time taken)

Digestion-Balance Trial I - Jan. 28 to Feb. 11, 1942

Sample Number	Sample	Percent Dry Matter	ASH (Gms. per 100 gms. of D.M.)	CALCIUM (Mgms. per gm. of D.M.)	PHOSPHORUS (Mgms. per gm. of D.M.)	NITROGEN (Mgms. per gm. of D.M.)
101	Ground corn	84.08	1.6318	0.1873	2.84	17.63
100	Cottonseed cake	92.04	7.1158	1.3581	15.62	71.25
99	Wet beet pulp	10.17	4.5352	5.2143	1.08	24.80
97A	Beet top leaves	23.01	54.0297	6.5576	1.90	17.67
97B	Beet top crowns	10.13	26.5797	3.4018	3.11	27.86
103	Alfalfa hay	82.69	8.2954	2.9904	2.53	20.24
98	Beet top leaves refused	51.03	76.6282	3.4253	1.12	9.36
102	Alfalfa hay refused	77.62	7.8366	4.0890	2.18	16.20
96	Feces - Steer 49 - Lot I	14.28	10.4155	8.3201	11.70	35.56
95	Feces - Steer 44 - Lot II	15.38	9.4139	10.6073	11.95	42.22
94	Feces - Steer 43 - Lot IV	14.83	9.1451	8.5766	11.46	35.97
93	Feces - Steer 79 - Lot V	18.60	27.0789	10.7355	8.43	31.50
91	Feces - Steer 38 - Lot VII	17.04	10.2906	7.3633	9.78	38.13
92	Feces - Steer 48 - Lot VIII	16.13	12.0230	10.2461	9.27	39.40

Digestion-Balance Trial II - April 12 to April 26, 1942

199	Ground corn	82.50	1.7282	0.1551	2.55	16.39
198	Cottonseed cake	92.62	7.2453	1.1226	14.15	67.12
196	Wet beet pulp	5.44	5.2750	3.8740	1.16	21.03
202A	Beet top leaves	27.58	30.9135	6.4764	1.91	21.48
202B	Beet top crowns	18.38	24.3827	3.5651	3.39	27.32
201	Alfalfa hay	86.87	7.2069	4.2346	1.73	18.51
197A	Beet top leaves refused	44.78	52.0781	10.4841	2.12	18.18
197B	Beet top crowns refused	1.36	28.6552	6.6409	5.59	32.02
200	Alfalfa hay refused	87.66	7.8323	5.1215	1.78	16.54
190	Feces - Steer 49 - Lot I	15.11	11.4175	10.4218	11.99	37.99
191	Feces - Steer 44 - Lot II	13.79	13.0310	10.8860	13.91	46.27
192	Feces - Steer 43 - Lot IV	15.96	8.2621	2.3245	11.02	32.16
193	Feces - Steer 79 - Lot V	10.60	25.9801	11.0224	10.35	50.64
194	Feces - Steer 38 - Lot VII	13.64	12.1356	5.9174	8.76	49.87
195	Feces - Steer 48 - Lot VIII	14.98	11.0758	7.8315	11.79	44.66

TABLE XIII. CHEMICAL ANALYSES OF URINE —— 1941-42

Sample Number	Sample	Specific Gravity	pH	ASH (Gms. per 100 gms. urine)	CALCIUM (Mgms. per gm. of urine)	PHOSPHORUS (Mgms. per gm. of urine)	NITROGEN (Mgms. per gm. of urine)
Digestion-Balance Trial I - Jan. 28 to Feb. 11, 1942							
U96	Urine - Steer 49 - Lot I	1.0406	8.53	2.39	0.4118	0.0248	19.4921
U95	Urine - Steer 44 - Lot II	1.0499	8.42	3.07	1.5654	0.0335	20.0871
U94	Urine - Steer 43 - Lot IV	1.0278	7.47	2.00	0.3089	1.6955	12.2394
U93	Urine - Steer 79 - Lot V	1.0438	8.50	3.24	0.9106	0.0268	11.8586
U91	Urine - Steer 38 - Lot VII	1.0132	8.78	1.44	0.2956	0.0570	13.2128
U92	Urine - Steer 48 - Lot VIII	1.0302	8.62	1.80	0.4077	0.0763	13.0184
Digestion-Balance Trial II - April 12 to April 26, 1942							
U190	Urine - Steer 49 - Lot I	1.0354	8.42	1.89	0.0256	0.1522	17.2744
U191	Urine - Steer 44 - Lot II	1.0492	8.88	3.08	0.0200	0.0223	19.0525
U192	Urine - Steer 43 - Lot IV	1.0265	7.07	1.56	0.0409	0.6420	12.2863
U193	Urine - Steer 79 - Lot V	1.0440	8.74	3.12	0.0201	0.0163	14.1830
U194	Urine - Steer 38 - Lot VII	1.0232	8.85	1.05	0.0205	0.1730	14.0375
U195	Urine - Steer 48 - Lot VIII	1.0323	8.89	1.68	0.0305	0.1409	16.4411

TABLE XIV.

STEER FEEDING EXPERIMENT — 1942-43

Fed 170 days - Dec. 23, 1942 to June 11, 1943

(Table based on one average steer)

Lot Number	I	II	III	IV	V	VI	VII
Feeds Fed: Salt self-fed in all lots	Gr. corn Cs. cake Wet pulp Alf. hay	Gr. corn Cs. cake Wet pulp Chop. alf.	Gr. corn Wet pulp Alf. hay	Gr. corn Wet pulp Alf. hay Phosilage Ca. carbonate	Gr. corn Wet pulp Beet tops Alf. hay	Gr. corn Cs. cake Wheat bran Corn silage Chop. alf.	Gr. corn Wet pulp Beet top sil. Alf. hay
Initial Weight	656.5	650.0	652.2	654.5	653.5	667.4	655.5
Final Weight	1036.3	1063.3	1041.5	1001.7	1021.2	1094.8	1018.8
Total Gain	379.8	413.3	389.3	347.2	367.7	427.4	363.3
Daily Gain	2.23	2.43	2.29	2.04	2.16	2.51	2.14
Average Daily Ration							
Ground corn	9.79	9.99	10.46	10.07	5.08	14.84	5.08
Cottonseed cake	.49	.49				.47	
Wheat bran						.84	
Wet beet pulp	20.10	20.39	20.35	19.98	39.84		39.69
Beet tops					9.07		
Beet top silage							18.34
Corn silage						6.92	
Alfalfa hay	7.70		6.96	6.04	5.55		5.42
Chopped alfalfa		8.01				2.18	
Phosilage				.163			
Calcium carbonate				.023			
Salt	.025	.028	.023	.027	.027	.022	.043
Feed Required Per Cwt. Gain							
Ground corn	438.0	410.8	456.6	493.1	234.7	590.0	237.5
Cottonseed cake	22.0	20.3				18.9	
Wheat bran						33.6	
Wet beet pulp	899.8	838.6	888.4	978.6	1842.3		1857.2
Beet tops					419.3		
Beet top silage							857.9
Corn silage						275.4	
Alfalfa hay	344.7		304.1	295.7	256.5		253.8
Chopped alfalfa		329.3				86.5	
Phosilage				8.0			
Calcium carbonate				1.1			
Salt	1.1	1.1	1.0	1.3	1.2	.9	2.0

TABLE XV. MINERAL INTAKE DURING FEEDING EXPERIMENT — 1942-43

(Figures in terms of grams per steer per day)

	Lot I						Lot II					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	4445	3757	83.89	1.003	16.422	72.66	4535	3833	85.59	1.023	16.754	74.13
Cottonseed cake	222	201	14.32	0.287	2.782	14.96	222	201	14.32	0.287	2.782	14.96
Wet beet pulp	9125	436	43.10	2.727	0.310	9.58	9257	442	43.70	2.765	0.315	9.71
Alfalfa hay	3496	2963	250.97	23.215	5.870	78.73						
Chopped alfalfa							3637	3082	308.05	24.147	6.105	81.89
Salt	11.4						12.7					
Av. Daily Intake				27.232	25.384	175.93				28.222	25.956	180.69
	Lot III						Lot IV					
Ground corn	4749	4014	89.63	1.072	17.545	77.63	4572	3865	86.31	1.032	16.894	74.75
Wet beet pulp	9239	442	43.70	2.765	0.315	9.71	9071	434	42.91	2.715	0.309	9.53
Alfalfa hay	3160	2678	226.83	20.982	5.305	71.15	2742	2324	196.84	18.209	4.604	61.75
Phosilage							65.6				16.656	
Calcium carbonate							10.4			2.889		
Salt	10.4						12.3					
Av. Daily Intake				24.819	23.165	158.49				24.845	38.463	146.03
	Lot V						Lot VII					
Ground corn	2306	1949	43.52	0.520	8.519	37.69	2306	1949	43.52	0.520	8.519	37.69
Wet beet pulp	18087	865	85.51	5.411	0.616	19.00	18019	861	85.12	5.386	0.613	18.92
Beet tops	4118	2965	889.50	9.500	3.460	49.05						
Beet top silage							8326	1915	574.50	6.136	2.235	31.68
Alfalfa hay	2520	2136	180.92	16.736	4.231	56.75	2461	2086	176.68	16.344	4.132	55.43
Salt	12.3						19.5					
Av. Daily Intake				32.167	16.826	162.49				28.386	15.499	143.72
	Lot VI											
Ground corn	6737	5695	127.17	1.521	24.893	110.14						
Cottonseed cake	213	193	13.75	0.276	2.671	14.37						
Wheat bran	381	345	22.86	0.457	5.029	9.64						
Corn silage	3142	889	53.41	2.199	1.885	11.63						
Chopped alfalfa	990	839	71.06	6.574	1.662	22.29						
Salt	10.0											
Av. Daily Intake				11.027	36.140	168.07						

TABLE XVI. DIGESTION-BALANCE TRIAL I —— Feb. 28 - March 15, 1943

(Figures in terms of grams per steer per day)

	LOT I - STEER 52						LOT I - STEER 22					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	2791	2298	44.40	0.703	9.027	42.26	2787	2295	44.34	0.702	9.015	42.21
Cottonseed cake	226	205	14.69	0.308	2.879	15.23	224	204	14.61	0.306	2.865	15.15
Wet beet pulp	6874	265	11.98	1.625	0.126	6.15	7350	284	12.84	1.741	0.135	6.59
Alfalfa hay	2195	1873	156.85	14.547	3.937	55.53	3151	2671	219.50	19.796	5.512	75.61
Salt	2.1						6.1					
Water	9104			0.087	0.001		10632			0.102	0.001	
Av. Daily Intake				17.270	15.970	119.17				22.647	17.528	139.56
	Excretion						Excretion					
Urine	6726			0.059	2.577	70.26	7499			0.407	0.069	72.45
Feces	7548	719	83.55	10.444	6.787	47.12	8914	791	90.35	10.644	7.042	49.54
Av. Daily Output				10.503	9.364	117.38				11.051	7.111	121.99
Av. Daily Balance				6.767	6.606	1.79				11.596	10.417	17.57

	LOT IV - STEER 8						LOT IV - STEER 35					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	3045	2508	48.45	0.767	9.851	46.12	3024	2490	48.11	0.762	9.781	45.79
Wet beet pulp	7291	281	12.70	1.723	0.134	6.52	7203	278	12.57	1.705	0.133	6.45
Alfalfa hay	3064	2596	213.32	19.235	5.356	73.46	2901	2463	203.28	18.454	5.103	70.47
Phosilage	114.8				29.148		114.2				28.995	
Salt	8.2						2.7					
Water	11480			0.110	0.001		8346			0.080	0.001	
Av. Daily Intake				21.835	44.490	126.10				21.001	44.013	122.71
	Excretion						Excretion					
Urine	6695			0.205	3.121	61.63	6231			0.125	14.412	58.38
Feces	8363	736	127.92	9.673	15.857	54.02	7618	822	107.77	10.453	11.125	48.13
Av. Daily Output				9.878	18.978	115.65				10.578	25.537	106.51
Av. Daily Balance				11.957	25.512	10.45				10.423	18.476	16.20

TABLE XVII. DIGESTION-BALANCE TRIAL II --- May 24 - June 8, 1943

(Figures in terms of grams per steer per day)

	LOT I - STEER 52						LOT I - STEER 22					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	4161	3608	91.43	0.819	17.369	73.21	4636	4020	101.87	0.913	19.352	81.57
Cottonseed cake	224	203	14.38	0.276	2.767	15.15	226	205	14.52	0.278	2.795	15.30
Wet beet pulp	4970	283	43.16	1.805	0.268	5.87	5992	341	52.00	2.175	0.323	7.07
Alfalfa hay	1412	1197	107.13	10.435	2.635	34.24	1910	1620	142.44	13.602	3.216	42.05
Salt	1.0						5.5					
Water	11560			0.111	0.001		11562			0.111	0.001	
Av. Daily Intake				13.446	23.040	128.47				17.079	25.687	145.99
	Excretion						Excretion					
Urine	5880			0.086	1.104	73.51	4965			0.360	0.086	86.96
Feces	6927	734	97.71	8.887	7.531	53.53	7947	690	88.27	8.213	7.973	53.27
Av. Daily Output				8.973	8.635	127.04				8.573	8.059	140.23
Av. Daily Balance				4.473	14.405	1.43				8.506	17.628	5.76

	LOT IV - STEER 8						LOT IV - STEER 35					
	Cons.	D.M.	Ash	Ca.	P.	N.	Cons.	D.M.	Ash	Ca.	P.	N.
Ground corn	4576	3968	100.55	0.901	19.102	80.51	3895	3377	85.57	0.767	16.257	68.52
Wet beet pulp	5177	295	44.99	1.881	0.279	6.12	5776	329	50.17	2.098	0.312	6.82
Alfalfa hay	2055	1741	152.31	14.476	3.352	43.90	1654	1402	123.90	11.908	2.870	37.46
Phosilage	33.7				8.556		37.8				9.597	
Calcium carbonate	29.7			8.251			33.3			9.251		
Salt	5.1						1.4					
Water	14330			0.138	0.001		10686			0.103	0.001	
Av. Daily Intake				25.647	31.290	130.53				24.127	29.037	112.80
	Excretion						Excretion					
Urine	6207			0.534	0.099	79.00	6244			0.049	4.795	62.55
Feces	7276	800	140.37	18.686	16.318	45.06	6698	695	88.92	13.510	7.307	40.81
Av. Daily Output				19.220	16.417	124.06				13.559	12.102	103.36
Av. Daily Balance				6.427	14.873	6.47				10.568	16.935	9.44

TABLE XVIII. CHEMICAL ANALYSES OF FEEDS — 1942-43

(Based on dry matter in sample at time taken)

Sample Number	Sample	Percent Dry Matter	ASH (Gms. per 100 gms. of D.M.)	CALCIUM (Mgms. per gm. of D.M.)	PHOSPHORUS (Mgms. per gm. of D.M.)	NITROGEN (Mgms. per gm. of D.M.)
321	Ground corn	82.35	1.932	0.306	3.928	18.39
365	Ground corn	86.71	2.534	0.227	4.814	20.29
Average		84.53	2.233	0.267	4.371	19.34
322	Cottonseed cake	90.86	7.164	1.500	14.045	74.27
366	Cottonseed cake	90.57	7.082	1.358	13.632	74.61
Average		90.72	7.123	1.429	13.839	74.44
323	Wet beet pulp	3.86	4.521	6.132	0.477	23.20
367	Wet beet pulp	5.69	15.250	6.377	0.947	20.74
Average		4.78	9.886	6.255	0.712	21.97
324	Alfalfa hay	84.74	8.208	7.389	2.061	28.22
368	Alfalfa hay	84.75	8.731	8.280	1.901	24.92
Average		84.75	8.470	7.835	1.981	26.57
325	Hay refused	81.98	7.370	5.487	1.856	21.02
369	Hay refused	84.68	8.298	7.413	1.307	17.61
Average		83.33	7.834	6.450	1.582	19.32

		CALCIUM (Percent)	PHOSPHORUS (Percent)
	Phosilage		25.39
	Calcium carbonate	27.78	

TABLE XIX. CHEMICAL ANALYSES OF FECES AND URINE —— 1942-43

Sample Number	Sample	Percent Dry Matter	ASH (Gms. per 100 gms. of D.M.)	CALCIUM (Mgms. per gm. of D.M.)	PHOSPHORUS (Mgms. per gm. of D.M.)	NITROGEN (Mgms. per gm. of D.M.)
326	Feces - Steer 52 - Trial I	9.53	11.621	14.526	9.439	65.54
370	Feces - Steer 52 - Trial II	10.60	13.312	12.107	10.260	72.93
327	Feces - Steer 22 - Trial I	8.87	11.422	13.456	8.903	62.63
371	Feces - Steer 22 - Trial II	8.68	12.793	11.903	11.555	77.21
328	Feces - Steer 8 - Trial I	8.80	17.380	13.143	21.545	73.39
372	Feces - Steer 8 - Trial II	10.99	17.546	23.357	20.397	56.33
329	Feces - Steer 35 - Trial I	10.79	13.111	12.716	13.534	58.55
373	Feces - Steer 35 - Trial II	10.38	12.794	19.439	10.513	58.72

		Specific Gravity	pH	CALCIUM (Mgms. per gram)	PHOSPHORUS (Mgms. per gram)	NITROGEN (Mgms. per gram)
U326	Urine - Steer 52 - Trial I	1.0243	8.26	0.0087	0.3832	10.4463
U370	Urine - Steer 52 - Trial II	1.0285	9.17	0.0147	0.1878	11.8185
U327	Urine - Steer 22 - Trial I	1.0295	8.62	0.0543	0.0092	9.6609
U371	Urine - Steer 22 - Trial II	1.0391	9.12	0.0725	0.0173	16.2207
U328	Urine - Steer 8 - Trial I	1.0245	7.60	0.0306	0.4661	9.2060
U372	Urine - Steer 8 - Trial II	1.0296	9.05	0.0861	0.0160	12.0056
U329	Urine - Steer 35 - Trial I	1.0290	7.09	0.0200	2.3129	9.3686
U373	Urine - Steer 35 - Trial II	1.0221	8.12	0.0079	0.7680	9.5884

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