

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Henry Norman Keldahl final oral examination for the degree of Master of Science. We recommend that the degree of Master of Science be conferred upon the candidate.

Minneapolis, Minnesota

May 31 1922

W. H. Peters,  
Chairman

E. F. Ferris

H. Bruce Price

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report  
of  
Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Henry Norman Kaldahl for the degree of Master of Science. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science.

W. H. Peters  
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Date May 31-1922

THE VALUE OF SEVERAL RATIONS FOR BABY BEEF PRODUCTION

A THESIS

PRESENTED TO THE FACULTY OF THE GRADUATE SCHOOL  
OF THE  
UNIVERSITY OF MINNESOTA

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER OF SCIENCE

BY

HENRY N. KALDAHL

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## INTRODUCTION

There is an increasing tendency at the present time for producers of beef cattle to fatten cattle at a younger age. There are two chief reasons for this tendency; first, consumers are demanding small cuts of meat of high quality; and second, the cost of producing beef, due to advance in land values and taxes, has increased to such an extent that feeders and breeders can seldom hold their cattle to advanced ages at a profit. This is especially true in the corn belt region and the nearby territory.

The tendency towards marketing of younger cattle is shown by the fat-stock shows. The champions of earlier days were large mature steers. In 1891 the Chicago Fat Stock Show eliminated classes for three-year-old steers and in 1918 the International Live Stock Exposition, successor to the Chicago Fat Stock Show, abolished the class for two-year-old steers.

Young cattle, of suitable beef type, which combine quality with condition and uniformity are generally spoken of as baby beef cattle. Vaughan (1) defines baby beef as "choice to prime fat cattle, between twelve and twenty months of age, weighing 800 to 1000 pounds".

Baby beef production has several advantages in its favor which perhaps account, to a certain degree, for its increasing popularity. Yearlings can make from twenty-five to fifty percent more meat for the grain consumed than the same animals would make if kept until two or three years old. The turn-over on the money invested in cattle is made more rapidly when baby beef steers are marketed than when they are grown to maturity before being marketed. The herd of cattle on hand at any one time is smaller, since the

cattleman selling yearlings no longer has two and three year old steers on his farm. Open heifers, which sell at a discount when over two years of age because of the large amount of internal fat, can be finished off to greater advantage at 900 to 950 pounds when they sell almost as well as steers. The market pays a premium for beef of this type. Baby beef steers have not been subject to the extreme price fluctuations which prevail in the case of most market classes of cattle.

For these reasons there has been a decided increase in the production of baby beef during the past few years. Feeders of baby beef, however, have encountered several problems which must be carefully and intelligently considered if they are to be successful. Calves of suitable type, breeding, quality, and condition must be bred or purchased. More skill in feeding is required when cattle are to be finished off at a young age. Young animals require a ration composed of a larger percentage of concentrated feeds than do more mature animals. Older cattle that have more nearly completed growth, can be fattened on a ration composed largely of cheap roughages with a small allowance of grain. The young steer, which must grow and fatten at the same time, lacks the capacity to handle a large amount of roughage in addition to the grain required and must be fed largely on grain.

In the production of any class of beef cattle the cost of feed is perhaps the largest single item which determines the profit. Grain is the highest priced feed fed to cattle. Because of the high percentage of grain in the rations of baby beeves it becomes increasingly important to consider the economy and suitability of various grain rations for baby beef production.

The purpose of the writer in presenting this thesis was to review all available feeding trials having any bearing on the production of baby beef under Minnesota conditions, and to conduct an original feeding trial with the object in view of verifying and supplementing the findings of experiment stations when applied to conditions prevailing in Minnesota.



REVIEW OF FEEDING TRIALS

The following review of feeding trials was made with the idea in view of analyzing and summarizing the findings of the several experiment stations which have conducted feeding trials with baby beef steers for the purpose of comparison with the results of the original feeding trial conducted by the writer.

The Amount of Feed Required to Produce 100 Pounds of Gain  
in Fattening Baby Beef Calves in the Dry Lot.

W. H. Pew and John M. Evvard (2) of the Iowa Experiment Station, report the results of a feeding trial carried on in cooperation with the Walnut Ridge Stock Farm, E. M. Cassady and Sons, proprietors, Whiting, Iowa. It will be noticed that 488.05 pounds of shelled corn and 35.16 pounds of linseed meal, or a total of 523.21 pounds of concentrates, were required to produce 100 pounds of gain. The amount of corn silage and alfalfa hay was 337.27 pounds and 191.37 pounds respectively, or a total of 528.64 pounds of roughage per 100 pounds of gain.

The results of the 1913 - 14 trial are set forth in Table I.

Table I. Summary of Results.

---

Number of days on feed .....	231
Average number of calves in trial .....	201
Average weight per calf:	
Initial weight, lbs. ....	359
Final weight, lbs. ....	845.11
Average daily gain, lbs. ....	2.09
Average daily feed per calf:	
Shelled corn, lbs. ....	9.39
Linseed meal, lbs. ....	.74
Corn silage .....	7.05
Alfalfa hay .....	4.00
Feed required per 100 pounds of gain:	
Shelled corn, lbs. ....	488.05
Linseed meal, lbs. ....	35.16
Corn silage, lbs. ....	337.27
Alfalfa hay, lbs. ....	191.37

---

The results of the 1915 trial which extended 386 days, from November 1915 to December 1916, show that the calves required considerably more feed per 100 pounds of gain than in the 1913 - 14 trial, due to the fact that they were on feed longer and were marketed in higher condition. To produce 100 pounds of gain 729.33 pounds of concentrates and 548.77 pounds of roughage were required.

Table II.

---

Number of days on feed .....	386
Average number of steers in lot .....	42
Average initial weight, lbs. ....	417
Average final weight, lbs. ....	1043
Average daily gain, lbs. ....	1.879
Average daily feed per calf:	
Shelled corn, lbs. ....	11.37
Oats, lbs. ....	1.36
Linseed meal, lbs. ....	.26
Cottonseed meal, lbs. ....	.76
Corn silage, lbs. ....	6.35
Alfalfa hay, lbs. ....	4.00
Feed required to produce 100 pounds of gain:	
Shelled corn, lbs. ....	602.71
Oats, lbs. ....	72.08
Linseed meal, lbs. ....	13.95
Cottonseed meal, lbs. ....	40.59
Corn silage, lbs. ....	336.85
Alfalfa hay, lbs. ....	211.92

---

W. P. Snyder (3) fed two lots of seventy-four and sixty-five calves for the two years of 1911 - 12 and 1912 - 13 respectively at the North

Platte Substation in Nebraska on different rations composed of: prairie hay, corn, and cottenseed cake; alfalfa hay, prairie hay, and corn; alfalfa hay, corn silage, and corn; prairie hay, corn silage, and corn; and prairie hay, corn silage, corn and cottenseed cake. The duration of both trials was 233 days.

The winter of 1911 - 12 was very severe while that of 1912 - 13 was very mild. The calves fed in 1911 - 12 required thirteen percent more grain and twenty-five percent more roughage per 100 pounds of increase in weight than did those fed in 1912 - 13. In spite of the unfavorable weather during the first feeding trial and the three rather poor rations fed, the concentrates required per 100 pounds of gain only amounted to 546.8 pounds while the roughage requirement was 712.6 pounds per 100 pounds of gain.

Table III. Summary of Results. Average of two trials.

Number of days on feed .....	233
Number of calves on feed .....	69.5
Average initial weight, lbs. ....	441
Average final weight, lbs. ....	856
Average daily gain per head, lbs. ....	1.852
Concentrates per 100 pounds of gain, lbs. ....	546.8
Roughage per 100 pounds of gain, lbs. ....	712.6

At the Kansas State Agricultural College, H. M. Cottrell, J. H. Haney and O. H. Elling (4) carried on a feeding trial with 130 head of calves. The calves were fed 210 days and averaged 800 pounds in weight at

the end of the trial. The feeds used were alfalfa hay, corn, kafir-corn, prairie hay and soy-beans. Two of the lots fed on alfalfa hay and corn made 100 pounds of gain on 439 and 470 pounds of corn and 436 and 544 pounds of alfalfa hay respectively.

A summary of the results of the trial is given in Table IV.

Table IV. Summary of Results.

Number of calves in the trial .....	130
Number of days fed .....	210
Average initial weight, lbs. ....	408
Average final weight, lbs. ....	800
Average gain per steer for entire period, lbs. ....	392
Average daily gain per head, lbs. ....	1.867
Grain per 100 pounds of gain .....	503
Hay per 100 pounds of gain .....	509

The Amount of Grain Required per 100 Pounds of Gain  
for Baby Beef Calves on Pasture.

W. H. Pew and John M. Evvard (5), in addition to the trial reported above, report a trial showing the effect of pasture upon the rate and economy of gains of baby beef calves. A group of fifty-one calves of light weight were held back from market in the spring of 1915 and carried through the summer on pasture with what grain, silage and alfalfa hay they would eat in addition. Not only was the amount of feed required per 100 pounds of gain increased by 3.16 pounds when the steers were turned on pasture, but the gains

were also decreased .448 of a pound per head per day as compared to the previous feeding period in the dry lot, indicating, in this instance, that cattle that have been on heavy feed for a period of time during the winter may be unprofitably turned on pasture.

Table V. Summary of Results.

	: : Nov. 22- : May 2	: : May 3- : Sept. 26	: : Sept. 27- : Nov. 29	: : Nov. 22- : Nov. 29
Number of days .....	: 162	: 147	: 64	: 373
Number of calves .....	: 57.87	: 37	: 37	: 46.06
Average initial weight per head, lbs.	: 439	: 618.65	: 867	:
Average final weight per head, lbs.	: 752	: 867	: 985.54	:
Average daily gain per head, lbs.	: 1.933	: 1.485	: 1.852	: 1.78
Feed required per 100 lbs. of gain:	:	:	:	:
Shelled corn, lbs. ....	: 655.57	: 951.67	: 877.51	: 765.62
Linseed meal, lbs. ....	: 28.26	:	:	: 16.74
Cottonseed meal, lbs. ....	: 9.24	: 57.8	: 55.75	: 28.74
Corn silage, lbs. ....	: 332.45	: 37.01	: 215.96	: 206.74
Alfalfa hay, lbs. ....	: 206.95	: 134.65	: 64.30	: 189.15
Pasture, acres .....	:	: .248	:	: .065
Total grain per 100 lbs. gain, lbs.	: 693.07	: 1009.47	: 933.6	: 811.1
Total roughage per 100 lbs. gain:	:	:	:	:
lbs. ....	: 539.4	: 171.908	: 280.26	: 395.96

J. H. Skinner and W. A. Cochel (6) fed twenty baby beef calves in two lots for three successive summers, 1907 - 08 - 09, to determine the effect of pasture upon the rate and economy of gains. The pasture lot of calves required ten pounds more grain per 100 pounds of gain than did the dry lot. When turned out on pasture the appetite for grain fell off and the average gains for the ninety day feeding period decreased from 151.8 pounds for the dry lot steers for the three trials to 127.1 pounds for the pasture fed steers.

Table VI. Summary of Results. Average of three trials.

	1907		1908		1909	
	: Dry lot:	Pasture:	: Dry lot:	Pasture:	: Dry lot:	Pasture:
Average initial weight per head, lbs. ....	: 879.6	: 880.0	: 870.1	: 875.1	: 827.3	: 808.8
Average final weight per head, lbs. ....	: 1028.8	: 991.6	: 1024.0	: 1013.0	: 979.6	: 940.6
Average gain (90 days) lbs. ....	: 149.2	: 111.6	: 153.9	: 137.9	: 152.3	: 131.8
Average daily gain, lbs.	: 1.658	: 1.24	: 1.71	: 1.532	: 1.692	: 1.465
Average amount of feed required per 100 lbs. of gain (90 days) :	:	:	:	:	:	:
Grain, lbs. ....	: 1028.47	: 955.19	: 946.06	: 944.73	: 989.48	: 1088.31
Roughage, lbs. ....	: 300.73	:	: 437.34	:	: 295.46	:

#Includes 194.98 pounds of silage.

The Amount of Feed Required to Produce One Hundred Pounds of Gain in Fattening Baby Beef Calves Compared to Older Cattle

During the three years of 1906 to 1909 inclusive, J. H. Skinner and W. A. Cochel (7) carried on three feeding trials at the Purdue Experiment Station to determine the relative economy in fattening baby beeves, yearlings and two-year-old steers. The calves produced 100 pounds of gain on less grain and roughage in each of the three trials, requiring 112.33 pounds less grain and 282 pounds less roughage than the yearlings, and 138.70 pounds less grain and 227 pounds less roughage than the two-year-old steers. The more mature steers, however, consumed a greater proportion of their ration in the form of roughage.

A summary of the three years work is given in Table VII.

Table VII. Summary of Results.

	Calves	Yearlings	Two-year-olds
Average length of feeding period, days .....	270	200	180
Average daily gain per head, lbs. ....	1.89	2.23	2.50
Average amount of feed required per 100 pounds of gain:			
Shelled corn, lbs. ....	597.33	686.66	708.33
Cottonseed meal, lbs. ....	88.6	111.6	116.3
Clover hay, lbs. ....	208.3	216.0	245.7
Corn silage, lbs. ....	385.0	659.5	573.0
Percent of feed per pound of gain using the requirements of two-year-old steers as the basis for one hundred percent:			
Shelled corn, per cent .....	84.3	96.9	100
Cottonseed meal, per cent .....	76.1	95.96	100



Table VII. (cont)

	Calves	Yearlings	Two-year-olds
Clover hay, per cent .....	84.84	87.9	100
Corn silage, per cent .....	67.2	111.6	100

D. H. Otis (8) of the Kansas Experiment Station conducted a feeding trial with steers of different ages during the year of 1902 - 03. Fifty-nine steers of average quality, divided up into three lots of nineteen calves, twenty yearlings and twenty two-year-old steers, were fed a ration of alfalfa hay, corn and kafir-corn for 210 days. The calves, while producing ninety percent as much daily gain as the two-year-old steers, only consumed seventy-three percent as much grain and seventy-four percent as much roughage as did the two-year-old steers.

Table VIII. Summary of Results.

Lot Number	II	III	IV
Average initial weight per head, lbs. ....	353.0	569.9	808.3
Average final weight per head, lbs. ....	728.9	997.1	1226.05
Average gain per head, lbs. ....	375.9	427.2	417.75
Average daily gain per head, lbs. ....	1.79	2.034	1.989
Grain per 100 pounds gain, lbs. ....	544.6	630.2	733.3
Roughage per 100 pounds gain, lbs. ....	356.8	409.8	483.5
Gains and feed requirements per 100 pounds of gain in percentages, using two-year-old steers as the basis for 100 percent:			
Average daily gain, percent .....	90	103	100
Grain per 100 lbs. of gain, percent ...	72.9	85.9	100
Roughage per 100 lbs. of gain, percent	73.8	84.8	100

THE COMPARATIVE VALUE OF SHELLED CORN AND GROUND BARLEY  
WHEN USED AS THE PRINCIPAL PART OF THE GRAIN RATION  
FOR FATTENING MARKET CATTLE.

Baby Beef.

A feeding trial was conducted at the Fort Hays Branch Station, Kansas, by J. G. Haney and E. O. Elling (9) during the season of 1903 and 1904 for the purpose of ascertaining the comparative value of corn and barley for fattening baby beeves. Eight steers per lot were fed for a period of 182 days, the trial ending on June 21, 1904. The grain was medium-finely ground. The steers receiving corn were fed corn-and-cob meal until the last three weeks, when they received straight corn meal. Good quality alfalfa hay was fed twice daily as the steers cleaned it up. The steers fed corn and alfalfa hay required twenty-six pounds more corn and thirty-three pounds less alfalfa hay than did those fed on ground barley and alfalfa hay. The corn steers gained .13 pounds more per steer per day and gave evidence of more condition at the end of the feeding trial than did the barley lot.

Table IX. Summary of Results.

Lot number	I (8 steers)	II (8 steers)
Ration fed	Corn and Alfalfa	Barley and Alfalfa
Average initial weight, per head, lbs.	399	401
Average final weight per head, lbs.	737	698
Average daily gain per head, lbs.	1.85	1.62
Amount of feed required per 100 lbs. of gain:		
Grain, lbs. ....	545	519
Alfalfa hay, lbs. ....	388	421
Number in good market condition .....	8	6

Because of the fact that, with the exception of the above trial, no reports of any other experiments bearing upon the comparative feeding value of corn and ground barley for baby beef production could be found, it was deemed advisable to present the results of several comparisons of barley to corn with older cattle.

Two-year-old Steers.

N. K. Carnes (10) at the Minnesota Experiment Station, made a comparison of ground barley and shelled corn for feeding two-year-old steers during the winter of 1920 - 21. Six lots of eight steers each were fed for a period of 112 days. Ground barley proved fully equal to shelled corn, pound for pound, when used for fattening two-year-old cattle.

A summary of the shelled corn versus ground barley portion of the feeding trial is given in Table X.

Table X. Summary of Results.

Ration	:Corn, :linseed :meal, :corn :silage, :clover hay:	:Barley, :linseed :meal, :corn :silage, :clover hay:	:Corn :and :Clover :Hay	:Barley :and :Clover :Hay
Lot number	: I	: II	: IV	: V
Average initial wght.per head,lbs:	1011	:1014	:1014	:1008
Average final weight per head,lbs:	1273	:1301	:1248	:1243
Average gain, lbs. ....	262	: 287	: 234	: 235
Average daily gain per head, lbs.:	2.33	: 2.56	: 2.08	: 2.09
Average daily ration:-				
Shelled corn, lbs. ....	14.58		: 18.21	
Ground barley, lbs. ....		: 14.88		: 19.50
Linseed meal, lbs. ....	2.57	: 2.57		
Corn silage, lbs. ....	26.98	: 27.61		
Clover hay, lbs. ....	6.6	: 7.12	: 12.13	: 12.06
Feed required per 100 lbs. gain:-				
Shelled corn, lbs. ....	623.09		: 872.0	
Ground barley, lbs. ....		: 580.66		: 929.78
Linseed meal, lbs. ....	109.92	: 100.34		
Corn silage, lbs. ....	1163.16	:1077.52		
Clover hay, lbs. ....	282.44	: 278.22	: 591.55	: 575.23

Luther Foster and H. H. Simpson (11) fed two lots of five two-year-old steers during the spring of 1909 at the New Mexico Experiment Station on different fattening rations. The steers fed a ration of alfalfa hay, ground barley and cottonseed meal averaged 2.04 pounds of gain per head daily, while those fed a ration of alfalfa hay, ground corn and cottonseed meal made a daily gain of 2.11 pounds per head. The steers receiving ground corn consumed slightly more grain and hay per day than did the barley fed lot. The corn lot also required four pounds less grain per 100 pounds of gain than did the barley lot.

James W. Wilson (12) fed two lots of four steers each at the South Dakota Experiment Station during the winter of 1913 - 14 on rations consisting of corn and corn silage, and barley and corn silage, supplemented in both instances with oil meal. The steers fed ground corn and corn silage, finished off much nicer than the steers fed ground barley and corn silage. The barley was not very palatable and considerable difficulty was encountered in getting the barley fed steers on feed. The corn fed lot gained more but required slightly more grain per 100 pounds of gain than did the barley fed lot.

The following year at the same station, James W. Wilson (13) again fed two lots of four steers each for 192 days to determine the comparative feeding value of corn and barley for fattening steers. The average daily gain per head and the feed required per 100 pounds of gain was very nearly the same in both lots. In this trial the barley fed steers showed a higher degree of finish, attributable in part to the fact that alfalfa hay was fed to the barley lot and clover hay to the corn lot.

THE EFFECT OF SILAGE UPON THE RATE AND ECONOMY OF GAINS

IN FEEDING BABY BEEF STEERS

W. P. Snyder (14) fed two lots of fifteen baby beef steers each for 223 days, at the North Platte Substation, Nebraska, during the year of 1911 - 12, to determine the value of corn silage for baby beef production. The gains in both lots were practically identical but the silage lot required a trifle less grain and considerably more roughage per one hundred pounds of gain. The trial was repeated the following year with substantially the same results.

A summary of the two year's feeding trial follows.

Table XI. Summary of Results.

Average number of days in trial, 228. Average number of calves per lot, 14.

Lot Number	I	V
Ration	Prairie hay, Corn 90% Cottonseed cake 10%	Prairie hay, Silage Corn 90% Cottonseed cake 10%
Average initial weight per calf, lbs.	432	434.4
Average final weight per calf, lbs.	844.9	847.8
Average gain per calf, lbs.	412.9	413.4
Average daily gain per calf, lbs.	1.80	1.80
Feed required per 100 lbs. gain:-		
Grain, lbs.	576.0	566.0
Roughage, lbs.	555.0	797.0

Commenting on the above results Snyder states "the results of these two tests indicate that silage as fed herein was not worth the value usually given it."

ORIGINAL FEEDING TRIAL

Purpose of the Trial

The feeding trial reported in the following pages was made possible by the assignment to the writer of a part of the beef cattle feeding experiment conducted by the Division of Animal Husbandry during the winter of 1921 - 22. The purpose of this trial was to gain information relative to the feeding of calves for baby beef under Minnesota conditions. The part of the trial supervised and conducted by the writer included the feeding of forty head of pure bred Hereford steer calves in four lots of ten each, on four different rations. Inasmuch as this trial was designed especially for Minnesota conditions the feeds used were feeds grown in Minnesota or by-product feeds that are readily available in Minnesota.

Object of the Trial

While it was the aim of the writer to gain all the information possible relative to the feeding of baby beef calves, much of this information has been gained from daily observations taken during the progress of the trial. These observations are reported and discussed under the data taken. The principal objects, however, were as follows:

1st. To determine the amount of feed required to produce 100 pounds of gain in fattening baby beef calves when using calves of suitable type and breeding, and several rations commonly available in Minnesota.

2nd. To determine the cost of producing gains in feeding baby beef from the time the calves are weaned to the time when they are ready for market.

3rd. To determine the comparative value of shelled corn and ground barley when used as the principal part of the grain ration in fattening baby beef calves.

4th. To determine the effect of silage full fed, silage fed at the rate of one half the full fed ration, and no silage when used with the standard ration of shelled corn 60 percent, oats 30 percent, linseed oilmeal 10 percent, and alfalfa hay.

It will be noticed that in planning the trial in addition to securing figures on feed requirements, costs, and gains, two feed comparisons have been included, one being a comparison of a full feed of silage with a half feed of silage and both of these with no silage in a standard ration of corn, oats, linseed oilmeal and alfalfa hay. This effort to determine the most economical amount of silage to use in a ration for fattening baby beef calves should prove of interest and value because of the varied opinion existing at present in the minds of feeders of baby beef calves on this point.

The second comparison is that of shelled corn to ground barley as the major part of the grain ration for fattening baby beef calves. This is of interest in Minnesota because of the extensive production and use of both grains in the state. The result of this comparison should give the feeder in Northern Minnesota where barley is grown, an idea as to the possibility of his competing successfully in the production of baby beef with the farmer in Southern Minnesota where corn is grown.

#### Method of Procedure

1. Animals Used. It has been maintained by practically every writer on the subject of baby beef production, that one of the essentials



to successful baby beef production is the use of calves of superior beef type and calves showing beef breeding to start with. It was therefore decided that calves fulfilling these qualifications would be used. During the month of September and early October of 1921, a study was made of the cattle coming to the market at South St. Paul with a view to purchasing whenever a sufficiently uniform and attractive looking lot of calves was located. Two trips a week were made to the market with the result that one of the chief problems of the baby beef feeder was forcibly impressed upon the writer. In other words, after making six trips to market and having instructed two commission firms to buy whenever the right calves arrived, we found ourselves still without calves. The significance of this experience is simply that cattlemen of the Northwest at least, do not market good beef type calves in the fall of the year, and that the farmer who wishes to make a business of fattening baby beef will probably find that the easiest, most economical, and most satisfactory method of securing suitable calves will be to raise them himself in place of attempting to purchase them.

The calves used in this trial were finally secured from several purebred herds of Hereford cattle located at several different points in the state. Bull calves and steer calves that had been dropped in March, April or May were selected. They comprised the medium calves from the spring calf crop from each herd. In each case the best calves were retained by the breeders to be sold as bulls and the inferior ones were rejected by us in purchasing. In this way quite a uniform group of forty-six head of calves were secured. They were purchased during the week of October 17th to 22nd, 1921. Practically all of the calves were running in the pasture with their

mothers at the time they were purchased and had received no grain. They were shipped to University Farm the following week and were placed in the feeding shed and yards in which they were to be fed immediately upon arrival. About one-third of them had been castrated when young, the others still being bulls. All of them had horns.

#### Starting on Feed

As the calves arrived they were started directly on a feed of seventy percent whole oats, twenty percent bran, and ten percent linseed meal. They were started at the rate of four pounds of grain per head per day with what alfalfa hay they cared to eat. It was soon learned that here we have another problem requiring a great deal of attention on the part of the feeder of baby beef calves who proposes to purchase his feeders and have them shipped to his farm. The weaning, shipping and change from pasture to dry feed all at the same time seemed to upset these calves a great deal. For some time after their arrival they were nervous, irregular about their feeding--a number of them scoured and they seemed to shrink in weight a good deal. At first it was thought that the feeding of the alfalfa hay might be the cause of the scouring because good green alfalfa is known to have a somewhat laxative effect upon cattle at any time, consequently the hay feeding was changed to one feed of alfalfa and one feed of upland prairie hay per day. This seemed to help some in checking the scouring but it was still impossible to increase the grain feeding without noticing increased scouring among the calves. It was noticed that the calves did not seem to relish the whole oats so a change was made to ground oats. This seemed to help a little also in

checking the scouring and after about two weeks all but one or two calves had settled down and were feeding regularly and began taking more than the original four pounds of grain per head per day without going off feed.

#### Gastrating and Dehorning.

As soon as most of the calves had settled down on feed and quit scouring the bull calves were castrated. They were given about ten days to recover from the shock of castration, after which all were dehorned, a clipper being used for dehorning. The castration proved more of a shock to the calves than the dehorning. One calf was lost from excessive bleeding following castration and one died of pneumonia following dehorning. This case of pneumonia can hardly be charged directly against the dehorning but was no doubt aggravated by the weakened resistance of the calf following the loss of blood occasioned by dehorning. The calves required about ten days to recover from the castration and about five to recover from dehorning. During this period practically no gains were made although on the other hand no appreciable shrinkage seemed to be taking place.

#### Allotment of Steers

The steers were divided into four groups of ten each on November fifteenth. The aim in grouping them was to make the average weight of the lots as near equal as possible and to have the calves in the different lots as uniformly balanced up in appearance and type as possible. It was necessary to put some steers in each lot that were a little heavier than the average,

also some that were lighter than the average. Taking the group as the unit, however, they were quite uniform after the necessary shifting had been done.

Weights.

Individual weights were taken of all the calves on three successive days, at the beginning and at the close of the trial. These weights were averaged and the average taken as the correct weight of the steer on the middle day. The middle day then marked the beginning of the trial so far as feed records were concerned. The same plan was followed in getting the final weight at the close of the trial. Weights were also taken at the close of each twenty-eight day period during the progress of the trial, though for these weights the cattle were weighed on one day only. Neck straps, with large metal tags bearing numbers attached to them, were used in identifying the calves through the trial.

Rations Fed.

The rations used were as follows:

Lot I.

Shelled corn, 60%	)	
Ground oats, 30%	)	Full fed twice daily.
Linseed Oilmeal, 10%	)	
Alfalfa hay,		full fed twice daily.
Corn silage,		full fed twice daily.

Lot II.

Shelled corn, 60% )  
Ground oats, 30% ) Full fed twice daily.  
Linseed Oilmeal, 10% )

Alfalfa hay, full fed twice daily.

Corn silage, Fed one-half the amount consumed by the calves in Lot I.

Lot III.

Ground barley, 60% )  
Ground oats, 30% ) Full fed twice daily.  
Linseed oilmeal, 10% )

Alfalfa hay, full fed twice daily.

Lot IV.

Shelled corn, 60% )  
Ground oats, 30% ) Full fed twice daily.  
Linseed Oilmeal 10% )

Alfalfa hay, full fed twice daily.

The steers were put on the above rations on November fifteenth, in the hope that the trial could be started at that time. It was soon found, however, that they were not yet settled down and well enough started to take hold of the rations satisfactorily so that each lot had to be fed practically the same for several weeks longer. The feeds consumed during this period therefore, were charged against the cost of the calves up to December fifteenth, and a new start made then. By this time all the calves had settled down

and were feeding regularly on the rations they were to receive through the trial.

#### Method of Feeding.

The steers were fed twice daily at the hours of 6:30 A.M. and 4:30 P.M. Insofar as possible the method used in feeding all lots was alike. The lots which were getting corn silage were fed silage first and the mixed grain was sprinkled over it. The respective grain mixtures of the remaining two lots were then fed, following which alfalfa hay was fed to all lots.

The general plan of feeding was to feed as much grain as the calves could handle without going off feed. In determining the amount of corn silage to feed the full-fed silage lot, it was the object to give them as much silage as they would eat without cutting down the consumption of concentrates to any appreciable degree. The lot getting a half-feed of corn silage was fed one-half as much silage as the full-fed lot, a little more grain being required in addition to appease their appetites. Each lot was fed as much alfalfa hay as it would eat by the next feeding time.

Salt was kept before the steers at all times in boxes nailed to the wall for that purpose.

#### Length of Feeding Trial

While accurate records were kept of all feeds consumed from the time the steers arrived in the feeding lots, the feeding trial proper did not commence until December 15th, 1921. The trial was conducted for five twenty-eight day periods, beginning on December 15th, 1921 and lasting until

May 4th, 1922, or a total feeding period of 140 days.

#### Sheds, Lots and Water Supply

Similar quarters were occupied by each lot of ten steers. These quarters consisted of a shed, twenty-three feet by twenty-four feet, opening into an uncovered lot twenty-four feet by one-hundred and twenty feet by means of a sliding door on the south side. The lots had a gentle south slope which afforded good drainage and the lots were generally in fairly dry condition.

The steers were fed inside of the feeding shed. The feed bunks were placed along the shed walls and directly above them were the racks for hay. About two and one-half feet of rack and bunk space was allowed per steer.

Water was supplied in galvanized iron tanks inside the sheds. These tanks were insulated and covered. On cold nights the covers were let down and very little freezing of the water occurred. The water tanks were cleaned at intervals and care was taken to keep fresh clean water before the calves at all times.

The sheds were cleaned once a week and bedded as often as necessary. Careful records were kept of all straw used and manure produced.

#### Quality of Feeds

The corn fed in this trial was sound and of good quality, grading Number 2 yellow. The Barley, while a trifle light, was of good quality and graded Number 3 feed barley. The oats was also a little light in weight but still good enough to grade Number 2. The linseed meal was choice grade old

process meal guaranteed to contain thirty-two percent protein, six percent fat, forty-two percent nitrogen-free extract and not to exceed ten percent of fibre. The linseed meal was purchased in the fall and stored in the main cattle barn and remained in good condition throughout the feeding trial.

The corn silage was excellent in quality although the amount of corn grain in the silage was rather low. The silage was made from corn yielding nine and one-half tons of green material per acre. The alfalfa hay, while not very uniform in quality, graded Number 2 alfalfa hay. Most of the hay, while not bright and green, was of fair quality although a small amount showed some evidence of heating during shipping.



Table XII. Analysis of Feeding Stuffs Used  
By C. H. Bailey, Assoc. Agr. Biochemist  
University of Minnesota

Sample	Moisture	Calculated to dry basis				
		Crude Protein (N x 6.25)	Ash	Ether Extract	Crude Fibre	Nitrogen Free Extract
	percent	percent	percent	percent	percent	percent
Corn silage	78.63	6.41	5.24	3.23	26.48	58.64
Oats, ground	8.45	14.17	3.53	5.28	11.83	65.19
Barley	10.18	15.34	2.62	2.75	5.46	73.83
Corn	14.21	10.85	1.20	5.14	1.47	81.34

By using the average digestibility of the nutrients of the above feeds according to Henry and Morrison (15), a calculation of the digestible nutrients per 100 pounds of feed was made.

Table XIII. Digestible Nutrients per 100 Pounds of Feed.  
Calculated on wet basis.

	Crude protein	Carbohydrates	Fat	Total Digestible Nutrients
Corn, shelled	6.89	66.31	4.10	82.43
Barley, ground	12.13	65.01	2.14	81.96
Oats, ground	9.84	51.02	4.22	70.36
Corn silage	6.99	12.56	.57	13.97
Alfalfa hay x	10.6	3.9	.9	51.6
Linseed meal x	30.2	32.6	6.7	77.9

x According to Henry and Morrison.

The digestible nutrients per 100 pounds of gain for the different lots considered in the feeding trial are given in Table XIII (a).

Lot I, receiving a full feed of corn silage, required the least number of pounds of digestible nutrients per 100 pounds of gain, followed in order by Lots II, IV, and III respectively. This would seem to indicate that corn silage has a feeding value greater than the chemical analysis would seem to indicate.

A comparison of Lots III and IV shows that Lot IV, which received corn as the major part of the grain ration, required 26.18 pounds less digestible nutrients per 100 pounds of gain than did Lot III which received barley as the principal portion of the grain ration. This may be interpreted to indicate that corn is a trifle more efficient in the production of gains with young cattle.

Table XIII (a)  
Digestible Nutrients per 100 lbs. of gain

	Lot I	Lot II	Lot III	Lot IV
Shelled corn,	232.76	252.165		268.418
Ground barley,			275.38	
Ground oats,	99.433	107.198	118.206	114.66
Oilmeal,	36.699	39.542	43.601	42.292
Silage	67.66	35.419		
Alfalfa	87.667	105.181	137.87	123.51
Total	524.219	539.505	575.057	548.88

Prices of Feeds

The prices of corn, barley, oats and alfalfa hay used in calculating the financial results of the feeding trial were average farm prices for the State of Minnesota for the duration of the trial. These figures were obtained from the Monthly Crop Reporter and the paper which succeeded it on January 1st, 1922, Weather, Crops and Markets, published weekly by the United States Department of Agriculture.

The price charged for linseed meal was the average Minneapolis price which was also obtained from the above papers. The price of tankage used was the price paid at the South St. Paul market for the tankage used during the trial.

The price for corn silage was worked out on the basis of the price of corn at silo filling time plus the cost of filling the silo, minus the cost of husking the corn. The price of straw and salt used were actual costs on the central market.

Table XIV. Average Farm Prices of Minnesota Feeds. (16)

	Corn	Barley	Oats	Alfalfa hay	Wild hay
Oct. 15,	\$.35	\$.41	\$.24	\$11.80	\$8.10
Nov. 15,	.27	.34	.19	12.50	7.60
Dec. 15,	.32	.34	.24	12.20	7.80
Jan. 15,	.36	.41	.26	12.30	
Feb. 15,	.43	.43	.30	13.50	
Mar. 15,	.45	.45	.28	13.00	
Average Price	.3633	.3966	.25166	12.55	7.83

Linseed meal \$45.00 per ton, average Minneapolis price from Nov. 12, 1921 to April 15, 1922.

Tankage, \$65.00 per ton, South St. Paul price.

Salt, \$23.52 per ton, Minneapolis market price.

#### Hogs

No hogs were put with these cattle at the beginning of the trial because the grain consumption of the calves was rather light and practically no corn seemed to be coming through them undigested. The pens were therefore kept under observation and it was decided not to put hogs with the cattle until a sufficient amount of wastage seemed to be taking place to warrant the use of hogs in rescuing it. Not until the middle of February did it seem to be advisable to put hogs in the pens. By this time there was some whole corn appearing in the droppings from the calves. Pigs were placed with them on February, twenty-first.

The pigs used for this purpose were secured from the swine section of the Division of Animal Husbandry. They had been farrowed in late September and early October, and following weaning had been wintered on self feeders. As a consequence they were fat and rather phlegmatic when placed in the yards with the steers. A few of the smaller pigs were rough-haired and a trifle unthrifty.

Fifteen hogs averaging eighty-two pounds per head, were used - three in each of the four steer lots and three were placed in a dry lot on corn and tankage as a check lot. An attempt was made to divide the hogs as nearly equally as possible with respect to breed and weight.

Enough corn and tankage were fed to the hogs following steers in all cases to secure satisfactory gains, but it was always planned to keep the pigs a little hungry so that all the feed in the droppings would be utilized. The pigs following the steers, with the exception of one, did much better than was expected of them, considering the condition they were in when placed in the lots. The exercise obtained in working over the droppings and the variation in the feed seemed to have a stimulating effect on the pigs and they commenced growing more rapidly and becoming smoother and thriftier looking.

One pig in Lot II and one pig in the check lot had to be replaced because of deformed limbs, which made it impossible for them to make suitable gains. The pigs available for replacement were considerably heavier but as the number of pounds of pork produced and the consequent feed saving from the droppings was the object of having the hogs following the steers, no appreciable experimental error was involved.

Because of the fact that there were only nine steers in Lot II during the extent of the hog trial, the amount of feed saved and pounds of pork produced by Lot II is a trifle lower than in Lots I and III, the other lots which were fed corn.

A study of the summary of the hogs following steers in Table XXI would seem to indicate that the hogs following the steers fed ground barley (Lot III), effected a feed saving from the droppings of \$2.64 when compared to the check lot. In most feeding trials where hogs have been used to follow steers fed barley, there has been no feed saved by the hogs. For this reason it would seem plausible that the apparent saving in feed in Lot III was due perhaps in part to the beneficial effect of exercise upon the general health and vigor of the pigs following steers.

The check lot which was fed corn and tankage in the dry lot, did not gain as well as was expected. The hogs were sluggish and inactive, and were not forced to take exercise as were the pigs following steers. For this reason the check lot hogs probably did not make as efficient use of the feed supplied them as did the other pigs.

#### Valuing

In order that an accurate valuation of the steers in the trial be made on the basis of the South St. Paul market, Joseph Prybl, Cattle buyer for Armour and Company, and Anthony Moscrip, Cattle salesman for the commission firm of Percy Vittum and Company, of South St. Paul, were asked to value them. The different lots were valued as follows: -

Table XV. Valuation of Baby Beef Steers, May 4, 1922.

<u>Firm represented</u>	<u>Packer Buyer</u>	<u>Commission Salesman</u>
Lot I	\$8.00	\$8.50 two out at \$7.50
II	8.25	8.25
III	8.25	8.00
IV	8.25	8.35

Preference for Lot IV over Lots I, II and III was expressed by both parties valuing the lots. An average of both valuations was used by the writer in preparing the financial statement. This average is not mathematically exact because on the market bids are made with five cents as the unit.

Table XVI. Average Valuation of Baby Beef Steers  
By Packer Buyer and Commission Salesman.

Lot I	\$8.20
Lot II	8.25
Lot III	8.15
Lot IV	8.30

DISCUSSION OF DATA

On January 31st, steer number thirty-one in Lot II was noticed to be off feed and removed to a box stall in the main cattle barn. He declined gradually in weight and died on February 14th. A post mortem examination was held and a finishing nail was found lodged between the rumen and reticulum. No steer was available of suitable type and size for the purpose of replacing the dead steer. For this reason no substitution was made and Lot II continued through the remainder of the feeding trial with nine steers.

The gains for steer number thirty-one during the month of January were decidedly sub-normal as compared to the previous month of December. For this reason it was deemed advisable to exclude steer number thirty-one in considering feed requirements and gains for the month of January.

The average amount of feed consumed daily per steer by twenty-eight day periods, and the average daily ration for each lot for the entire feeding period of 140 days is given in Tables XVII<sup>a</sup> and XVII<sup>b</sup> respectively.

The lot receiving a full feed of corn silage (lot I) consumed practically as much grain the first two twenty-eight day periods as did the lots not receiving silage. The following twenty-eight day periods, however, the steers not getting silage consumed slightly more grain per day, the difference increasing as the feeding period progressed. During the fifth twenty-eight day period, the lots not receiving corn silage (lots III and IV) consumed almost two pounds per steer per day more grain than did Lot I. The same holds true for Lot II (the lot fed a half feed of silage) to a lesser degree. The corn silage lots (I and II) also consumed less alfalfa hay



than did the lots not getting corn silage (III and IV). The full fed silage lot (Lot I) required 1.51 pounds less of alfalfa hay per steer per day than did Lots III and IV, and the half silage lot (Lot II) required .85 pounds less alfalfa hay per steer per day.

Table XVII (a)

Average Amount of Feed Consumed Daily per Head of Fattening Calves  
Dec. 15, 1921 to May 4, 1922

Ration	Lot I	Lot II	Lot III	Lot IV
	Corn 60% Oats 30% Oilmeal 10% Alfalfa Corn silage Full feed	Corn 60% Oats 30% Oilmeal 10% Alfalfa Corn silage Half feed	Barley 60% Oats 30% Oilmeal 10% Alfalfa	Corn 60% Oats 30% Oilmeal 10% Alfalfa
<u>1st 28 day period, Dec. 15th to Jan. 12th.</u>				
Grain per day, lbs.	9.21	9.21	9.21	9.21
Corn, lbs.	5.53	5.53		5.53
Barley, lbs.			5.53	
Oats, lbs.	2.76	2.76	2.76	2.76
Linseed Oilmeal, lbs.	.92	.92	.92	.92
Corn silage, lbs.	9.02	4.54		
Alfalfa hay, lbs.	3.85	4.40	5.43	4.45
<u>2nd 28 day period, Jan. 12th to Feb. 9th</u>				
Grain per day, lbs.	11.11	11.12	11.18	11.11
Corn, lbs.	6.66	6.67		6.66
Barley, lbs.			6.71	
Oats, lbs.	3.34	3.34	3.35	3.34
Linseed Oilmeal, lbs.	1.11	1.11	1.12	1.11
Corn silage, lbs.	11.0	5.49		
Alfalfa hay, lbs.	3.28	4.31	5.86	
<u>3rd 28 day period, Feb. 9th to March 9th</u>				
Grain per day, lbs.	11.50	11.56	12.3	12.3
Corn, lbs.	6.9	6.93		7.38
Barley, lbs.			7.38	
Oats, lbs.	3.45	3.47	3.69	3.69
Linseed Oilmeal, lbs.	1.15	1.16	1.23	1.23
Corn silage, lbs.	11.9	6.01		
Alfalfa hay, lbs.	3.98	4.59	5.89	5.38

Table XVII (a) (continued)

	Lot I :	Lot II :	Lot III :	Lot IV
<u>4th 28 day period, March 9th to April 6th</u>				
Grain per day, lbs.	11.72	12.60	13.21	13.21
Corn, lbs.	7.03	7.56		7.93
Barley, lbs.			7.93	
Oats, lbs.	3.52	3.78	3.96	3.96
Linseed Oilmeal, lbs.	1.17	1.26	1.32	1.32
Corn silage, lbs.	12.36	6.56		
Alfalfa hay, lbs.	4.39	4.88	6.00	5.65
<u>5th 28 day period, April 6th to May 4th</u>				
Grain per day, lbs.	12.88	14.00	14.53	14.53
Corn, lbs.	7.73	8.40		8.72
Barley, lbs.			8.72	
Oats, lbs.	3.86	4.20	4.36	4.36
Linseed Oilmeal, lbs.	1.29	1.4	1.45	1.45
Corn silage, lbs.	13.0	6.56		
Alfalfa hay, lbs.	4.61	5.30	5.69	5.49

Table XVII (b)

Average Daily Ration for Entire Period (140 days)

Lot	I	II	III	IV
Grain per day, lbs.	11.28	11.70	12.09	12.08
Shelled corn, lbs.	6.77	7.02		7.25
Ground barley, lbs.			7.25	
Ground oats, lbs.	3.38	3.51	3.63	3.62
Linseed Oilmeal, lbs.	1.13	1.17	1.21	1.21
Corn silage, lbs.	11.58	5.83		
Alfalfa hay, lbs.	4.03	4.70	5.77	5.32

Table XVIII shows that the silage fed lots made the largest gain per head per day for the entire feeding period.

The lots receiving corn and barley as the principal part of the grain ration and getting no silage, made practically the same gains per head per day, there being an advantage of .06 pounds per steer per day in favor of the corn lot.

The addition of a half feed of corn silage raised the daily gains per steer per day from 2.224 to 2.305, or an additional gain of .08 pounds per steer per day.

The addition of a full feed of corn silage per day raised the daily gain per steer per day from 2.224 to 2.396 pounds per day, or an additional gain of .172 pounds per steer per day.

In the three lots getting corn as the major portion of their grain ration there was a distinct correlation between rate of gain and length of feeding period. As the feeding period progressed the gains decreased from an average daily gain for the corn lots of 2.595 pounds per head per day to 1.972 pounds per head per day. The barley lot (Lot III) was very irregular in daily gains by 28 day periods and did not show such a distinct correlation between rate of gain and length of feeding period as did the corn lots.

Table XVIII.

Average Weight, Gain and Daily Gain per Steer by 28 day Periods,  
Dec. 15, 1921 to May 4, 1922.

Ration	Lot I	Lot II	Lot III	Lot IV
	Corn 60% Oats 30% Oilmeal 10% Alfalfa Corn silage Full feed	: : Corn 60% : Oats 30% : Oilmeal 10% : Alfalfa : Corn silage : Half feed	: : Corn 60% : Oats 30% : Oilmeal 10% : Alfalfa : Corn silage : Half feed	: : Barley 60% : Oats 30% : Oilmeal 10% : Alfalfa : :
<u>1st 28 day period, Dec. 15th to Jan. 12th</u>				
Average weight, lbs.	569.2	: 557.3	: 554.6	: 554.0
Average gain, lbs.	75.8	: 75.8	: 60.3	: 66.4
Average daily gain, lbs.	2.707	: 2.707	: 2.155	: 2.372
<u>2nd 28 day period, Jan. 12th to Feb. 9th</u>				
Average weight, lbs.	636.7	: 626.1	: 611.0	: 617.8
Average gain, lbs.	67.5	: 68.8	: 56.4	: 63.8
Average daily gain, lbs.	2.411	: 2.457	: 2.014	: 2.278
<u>3rd 28 day period, Feb. 9th to March 9th</u>				
Average weight, lbs.	707.7	: 684.9	: 684.3	: 678.5
Average gain, lbs.	71.0	: 58.8	: 73.3	: 60.7
Average daily gain, lbs.	2.536	: 2.10	: 2.618	: 2.168
<u>4th 28 day period, March 9th to April 6th</u>				
Average weight, lbs.	773.1	: 752.3	: 733.4	: 741.9
Average gain, lbs.	65.4	: 67.4	: 49.2	: 63.4
Average daily gain, lbs.	2.336	: 2.407	: 1.754	: 2.264
<u>5th 28 day period, April 6th to May 4th</u>				
Average weight, lbs.	829.867	: 804.148	: 796.7	: 793.966
Average gain, lbs.	56.767	: 51.848	: 63.3	: 57.066
Average daily gain, lbs.	2.027	: 1.852	: 2.261	: 2.038
Total gain per steer, lbs.	336.467	: 322.648	: 302.4	: 311.366
Average daily gain, lbs.	2.396	: 2.305	: 2.160	: 2.224

Table XIX shows that with the addition of corn silage to the standard ration of corn, oats, linseed oilmeal and alfalfa, a smaller amount of corn was required per 100 pounds of gain.

Comparing Lots I and IV we find that 11.1 pounds of silage replaces one pound of shelled corn, .5 pounds of ground oats, .17 pounds linseed oilmeal and 1.65 pounds of alfalfa hay in the feed required to make a pound of gain. Comparing Lots II and IV we find that it requires 11.9 pounds of silage to replace 1 pound of shelled corn, .5 pounds of ground oats, .17 pounds of linseed oilmeal and 1.67 pounds of alfalfa hay.

When ground barley and shelled corn are compared in Lots III and IV it is found that 102 pounds of barley are required to replace 100 pounds of shelled corn in the feed required to produce a pound of gain. A slightly larger amount of ground oats, linseed meal and alfalfa hay were also required in the barley lot.

The cheapest gains were made by the lot receiving a full feed of corn silage in addition to the standard ration of 60 percent shelled corn, 30 percent ground oats, 10 percent linseed oilmeal, and alfalfa hay (lot I). The gains in Lot I cost \$5.76 per cwt. The lot receiving a half feed of corn silage in addition to the standard ration (Lot II) made gains costing \$.22 more per cwt. than did Lot I. The gains of the barley lot (Lot III) and of the corn lot (Lot IV) were made at an increased cost of \$1.27 and \$.36 above the cost of gains in the lot receiving a full feed of silage.

Table XIX.

Average Amount of Feed Consumed per Hundred Pounds of Gain  
And Cost per Hundred Pounds of Gain.

Dec. 15th, 1921 to May 4th, 1922 (140 days)

Ration	Lot I	Lot II	Lot III	Lot IV
	Corn 60% Oats 30% Oilmeal 10% Alfalfa hay Corn silage Full feed	Corn 60% Oats 30% Oilmeal 10% Alfalfa hay Corn silage Half feed	Barley 60% Oats 30% Oilmeal 10% Alfalfa hay	Corn 60% Oats 30% Oilmeal 10% Alfalfa hay
<u>Feed required per 100 lbs. gain</u>				
Shelled corn, lbs.	282.48	304.54		325.75
Ground barley, lbs.			335.83	
Ground oats, lbs.	141.24	152.27	167.92	162.87
Linseed Oilmeal, lbs.	47.11	50.76	55.97	54.29
Corn silage, lbs.	483.31	252.99		
Alfalfa hay, lbs.	167.96	203.84	267.19	239.36
<u>Cost per 100 lbs. gain, excluding hogs</u>				
	\$5.76	\$5.98	\$7.03	\$6.12
<u>Crediting feed saved by hogs</u>				
	\$5.49	\$5.80	\$6.94	\$5.91
<u>Crediting hog gains at \$9.90 per cwt.</u>				
	\$5.11	\$5.53	\$6.81	\$5.58

A summary of the data collected from the four lots of steers for the entire period of 140 days is given in Table XX.

A summary of the data collected on the five lots of hogs from the time they were placed in the feeding lot on February 21st until the end of the trial is given in Table XXI.

The prices for feeds used in calculating the financial returns of the feeding trial presented in this thesis are given in Table XIV, page 30.

In arriving at the financial returns of the feeding trial the value of the manure produced was used to offset the cost of labor, bedding, salt and interest on the investment.

Table XX.

Summary of Entire Feeding Trial  
Dec. 15th, 1921 to May 4th, 1922 (140 days)

Lot	I	II	III	IV
Initial cost per 100 lbs.	\$8.09	\$8.09	\$8.09	\$8.09
Initial cost per steer	39.92	38.95	39.99	39.45
Average initial weight per head, lbs.	493.4	481.5	494.3	487.6
Average final weight per head, lbs.	829.867	804.148	796.7	798.966
Total gain per head, lbs.	336.467	322.648	302.4	311.366
Average daily gain per head, lbs.	2.403	2.305	2.160	2.224
Average daily feed:-				
Shelled corn, lbs.	6.77	7.02		7.245
Ground barley, lbs.			7.254	
Ground oats, lbs.	3.38	3.51	3.63	3.62
Linseed Oilmeal, lbs.	1.13	1.17	1.21	1.21
Corn silage, lbs.	11.575	5.83		
Alfalfa hay, lbs.	4.025	4.70	5.77	5.32
Feed required for 100 lbs. of gain:-				
Shelled corn, lbs.	281.66	304.54		325.75
Ground barley, lbs.			335.83	
Ground oats, lbs.	140.83	152.27	167.92	162.87
Linseed Oilmeal, lbs.	46.95	50.758	55.972	54.292
Corn silage, lbs.	481.62	252.99		
Alfalfa hay, lbs.	167.47	203.84	267.19	239.36

Table XX (cont)

Lot	I	II	III	IV
Total feed cost per steer	\$19.38	\$19.27	\$21.26	\$19.04
Feed Cost per 100 lbs. of gain:-				
Excluding hogs	5.76	5.98	7.03	6.12
Crediting feed saved by hogs	5.49	5.80	6.94	5.91
Crediting hog gains at \$9.90 per 100 lbs.	5.11	5.53	6.81	5.58
Necessary selling price of steers per 100 lbs. to break even:-				
Excluding hogs,	7.15	7.24	7.69	7.32
Crediting feed saved by hogs,	7.05	7.17	7.66	7.24
Crediting hog gains at \$9.90 per 100 lbs.	6.88	7.06	7.61	7.11
Selling price based on So. St. Paul, on May 4, 1922	8.20	8.25	8.15	8.30
Selling price University Farm,	8.00	8.05	7.95	8.10
Profit per steer:				
Excluding hogs,	7.08	6.53	2.09	6.23
Crediting feed saved by hogs,	7.96	7.11	2.35	6.90
Crediting hog gains at \$9.90	9.28	8.00	2.75	7.91

Table XXI.

## Summary of Hogs Following Steers (71 days)

Ration	Lot I	Lot II	Lot III	Lot IV	Check Lot
	Corn-Tank.	Corn-Tank.	Corn-Tank.	Corn-Tank.	Corn-Tank.
Initial Value per cwt.	\$11.25	\$11.25	\$11.25	\$11.25	\$11.25
Initial weight, lbs.	245.0	354.83	241.6	242.66	335.5
Initial value	\$27.56	\$39.92	\$27.18	\$27.30	\$37.75
Total feed consumed:					
Corn	215.5	244.5	616.5	246.5	838.0
Tankage	71.625	71.625	71.625	71.625	71.75
Total cost of feed	\$3.73	\$3.92	\$6.33	\$3.93	\$7.77
Final weight, lbs.	561.33	602.5	469.33	512.0	532.5
Total gain, lbs.	316.33	247.47	227.73	269.34	197.0
Cost per lb. of gain in check lot					\$ .0394
Value of feed saved	\$8.73	\$5.83 <sup>x</sup>	\$2.64	\$6.68	0
Credit gains at \$9.90,	221.66	147.98	67.07	169.59	0
	\$21.94	\$14.65 <sup>x</sup>	\$ 6.64	\$16.79	0

x Feed saved and pork credit from nine steers.



A summary was made of the results obtained at the different experiment stations with the calves which were considered in the review of feeding trials. The purpose of making this summary was to compare the feed requirements and gains of the baby beef calves fed out at other experiment stations with the feed requirements and gains of the calves included in the original feeding trial conducted by the writer. The average amount of grain and roughage per 100 pounds of gain and the rate of gain were considered. Only those lots of calves that were fed in dry lot were included in this summary.

In comparing Lot I with the average of the lots as shown in Table XXII<sup>a</sup> it will be seen that 110 pounds less grain and 108 pounds more roughage were required per 100 pounds of gain. Lot I also gained .54 pounds more per day. The smaller grain requirement and the more rapid gains of Lot I, when compared with the average of the feeding trials reported in the summary, may be explained as due to the shorter feeding period. This may be interpreted to indicate that young cattle will make greater gains with a smaller grain requirement per 100 pounds of gain in a short feeding period than they would if fed over a longer period of time. The difference in roughage requirement is due to the fact that a full feed of corn silage was fed Lot I and very little silage was fed to the calves reported in the summary. Lot II required 71.9 pounds less grain and 84.37 pounds less roughage than the average of the lots considered in the summary. Lot II gained .432 pounds more per day. Lots III and IV required a trifle less grain and about one-half as much roughage per 100 pounds of gain while gaining a little more daily.

The feeding trial conducted by the writer, however, only lasted 140 days as compared to 244 days for the average of the trials considered in the summary. Had the feeding trials been more nearly equal in length the differences in grain and roughage requirements per 100 pounds of gain and the rate of gain of the calves considered would doubtless have been much smaller.

Table XXII.(a)  
Average Grain and Roughage Requirements per 100 pounds  
of Gain and Rate of Gain for all Lots fed in dry lot  
considered in Review of Feeding Trials.

Number Calves	Number Days	Grain	Roughage	Avg.Daily Gain
201	231	523.21	528.64	2.09
42	386	729.33	548.77	1.879
69.5	233 (2 trials)	546.8	712.6	1.852
130	210	503.0	509.0	1.867
30	270 (3 trials)	685.93	593.3	1.89
19	210	544.6	356.8	1.79
16	182	532	404.5	1.735
30	228	571	676.0	1.80
67.2	244	579.47	541.2	1.863

Table XXII. (b)  
Feed Requirements per 100 lbs. and  
Rate of Gain for Feeding Trial covered in this Thesis

Lot	No. Calves	No. Days	Grain	Roughage	Avg. Daily Gains
I	10	140	469.44	649.09	2.403
II	9	140	507.57	456.83	2.305
III	10	140	559.72	267.19	2.160
IV	10	140	542.91	239.36	2.224
Average		140	520.05	403.12	2.273

WEIGHTS AND GAINS OF INDIVIDUAL STEERS.

In order to get a check of the effect of individuality in the steers upon the gains made by the steers in the several lots, all weights were taken and recorded individually and careful observations were taken on the appearance of each steer at the beginning and at the close of the experiment. Table XXIII gives the initial weights, final weights, total gain and notations made on the appearance of the individual steers.

Table XXIII

Lot I				
No.	Initial wt.	Final wt.	Total gain	Remarks
3	669	980.66	311.66	Heavy boned, well balanced
7	572	890.66	318.66	Medium
14	530	905.33	375.33	Big upstanding, not very fat
41	523.33	883.33	360.00	Medium
9	484.66	800.33	315.67	Narrow, lacking thickness, light chest, light hindquarter
28	469.66	843.33	373.67	Coarse, not very fat
50	456.33	721	264.67	Narrow front, upstanding, very light hindquarter.
34	431.66	801	369.34	Long bodied, slack top, narrow head.
19	406.33	751	344.67	Medium
44	391	722	331	Small, otherwise well balanced.
Lot II.				
56	727.33	1086.33	359.00	Coarse boned, paunchy
32	519.66	821.33	301.67	Medium
26	515	776.33	261.33	Old appearing, stunted
25	470.66	782	311.34	Medium
27	452	798	346.00	Light bone, thick fleshed
39	446	791.33	345.33	Small appearing, good type
31	440	(Died)		
6	439	762.33	323.33	Medium
43	417.66	695.66	278.00	Narrow, light hindquarter, upstanding
46	388	724	336.00	Narrow, poor in hind flanks, upstanding, light bone.

Table XXIII (cont)

<u>No.</u>	<u>Initial wt.</u>	<u>Final wt.</u>	<u>Total gain</u>	<u>Remarks</u>
Lot III				
48	674.66	925	250.34	Big, smooth, deep bodied, fairly thick fleshed
1	624.66	885	260.34	Upstanding, rough appearing
40	506.66	785.33	278.67	Narrow, otherwise medium
45	481.33	824.33	343	Medium
37	474	800.66	326.66	Heavy bone, narrow bodied, not very fat
10	467.33	784	316.67	Very smooth, a trifle upstanding.
42	456	819.66	363.66	Medium
13	448	722.66	274.66	Medium
29	407.66	661.66	254.00	Small, fine boned
38	402.66	758.66	356.00	Medium
Lot IV				
55	765.33	1014	248.67	Big, paunchy
5	565	898.66	333.66	Medium
2	549.33	881	330.67	Medium
30	474	813.33	339.33	Shallow, long, narrow bodied
8	466.66	741.33	274.67	Medium
4	459	758	299	Medium
12	425.66	743.33	317.67	Coarse boned, thin in flesh, low backed
36	399	727	328	Small, fine boned
49	389	690	301	Trifle narrow in body
33	383.33	723	339.67	Medium, but thin in flesh

It will be noticed by this table that the steers in each lot varied in weight quite a little at the beginning of the trial but as previously mentioned, there were some heavier, some medium, and some light weight ones in each group, but that the groups taken as units averaged very uniform. A study of Table XXIII reveals that the medium or average steers in weight and type, quite uniformly show the larger gains in each lot, the small steers coming next and the steers that were the heaviest at the beginning of the trial quite uniformly show the lowest gains. In a way it

is a little bit difficult to account for this difference in gains though it may be explained to some extent by the fact that the heaviest steers at the beginning were a little the fattest and naturally would not make quite such rapid gains as those that were a little thinner. The smaller steers made smaller gains than the average because they were not quite such good individuals and did not possess the capacity to consume feed and utilize it to as great an extent as the medium ones. The medium calves were the best gainers because they were good in type and moderate in flesh at the beginning and were able to consume large quantities of feed and utilize it efficiently in making gains. Table XXIII does show that no experimental error is introduced because of the difference in gains by individuals steers as there were about the same number in each lot that made large gains, medium gains and low gains respectively.

SUMMARY

The early part of this feeding trial brought out some very striking experiences that were not entirely covered in stating the objects of the trial. The results of these experiences generally, however, have so direct a bearing on economical baby beef production that they cannot be overlooked.

It was clearly demonstrated that shipping young calves directly from the pastures where they have been running with their dams, to a distant feed lot, then castrating and dehorning them and attempting to start them on feed at the same time is a questionable procedure. This practice means combining the weaning of the calf, changing his feed and subjecting him to the hardship of shipping, dehorning and castrating all in a short period of time. A period of six weeks to two months, during which the calf will gain very little, is required for the process.

The ideal method of handling the baby beef calf would be to raise him on the same farm on which he is to be fattened, dehorn with caustic potash when he is a few days old, castrate when he is a few weeks old, and get him started on grain feed before he is weaned. This can be done without much inconvenience on the medium sized farm where a carload of two or three calves only are produced.

The rancher cannot very well either dehorn or castrate calves when young. The feeder buyer who buys such calves will do well not to dehorn them at all. They should be given a chance to get well rested following shipping after which they should be castrated. Sufficient time should be

given for the calves to thoroughly recover from castration before attempting to increase the grain allowance.

In general the results secured by the addition of all the silage the calves would eat, without a material reduction in grain consumption, to the standard ration of grain and hay proved successful and economical as did also, to a lesser extent, the addition of a smaller amount of silage. The silage feeding produced larger gains, cheaper gains and a more thrifty, healthy and sappy appearance as shown by the early shedding and sleek coats of the calves receiving silage.

Ground barley proved practically equal to shelled corn for feeding baby beef calves. There was no appreciable difference in the appetites of the steers fed shelled corn and ground barley, the same amount of gain being fed each lot during the trial. The cost per 100 pounds of gain and the profit per steer was decidedly in favor of the steers fed shelled corn. This difference becomes more apparent when the feed saved by the hogs or the pork credit is considered. Whether to feed corn or barley depends largely upon the comparative prices of the two feeds and whether or not hogs are to be used following the steers.

The feeding trial presented in this thesis shows that the average feed requirements per 100 pounds of gain of all lots was 520.05 pounds of grain and 403.12 pounds of roughage. On the basis of the amount of grain required per 100 pounds of gain, the different lots ranked as follows: Lot I, which received the full feed of corn silage in addition to the standard ration of sixty percent corn, thirty percent oats, ten percent linseed meal, and alfalfa hay, ad libitum, first; Lot II, which received a half feed of



corn silage fed in addition to the standard ration, second; Lot IV, fed the standard ration, third; and Lot III, receiving ground barley in place of shelled corn in the standard ration was last.

When cost per 100 pounds of gain from the time the calves were weaned until the end of the feeding trial is considered, the lots assume the same order as above, namely Lot I, first, Lot II second, Lot IV third, and Lot III fourth.

Ground barley proved practically equal to shelled corn in feeding baby beef calves. 102 pounds of ground barley being required to replace 100 pounds of shelled corn in the feed required to produce a pound of gain. Hogs following steers fed ground barley made practically no saving of feed.

Silage, full fed with the standard ration, produced the largest and most economical gains and proved to be the most profitable with a half fed silage, in addition to the standard ration, second.

Minnesota farms furnish feeds well suited to the production of baby beeves. Northern Minnesota farmers may secure suitable gains by utilizing ground barley as the major portion of the grain ration. Silage, wherever available at moderate cost, has its place in the ration. The Southern Minnesota farmer possesses a distinct advantage over his more northerly neighbor when baby beef feeding is considered, in an abundant supply of shelled corn and corn silage as staple feeds. The variety of feeds afforded by Southern and Central Minnesota farms would seem to especially adapt these regions of the state to profitable production of baby beef.

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