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Ground Flax and Other Protein Supplements with Corn for Fattening Calves and Pigs

**Animal Husbandry Department
Agricultural Experiment Station
South Dakota State College of
Agriculture and Mechanic Arts
Brookings, S. D.**

Ground Flax and Other Protein Supplements with Corn for Fattening Calves and Pigs

James W. Wilson and Turner Wright

This bulletin includes the results of an experiment in feeding supplements with corn to calves and pigs for the purpose of fattening.

Producers of finished meat animals are interested in using home grown feeds for this purpose. Flax and soybeans are grown in different sections of South Dakota. They are oil-bearing seeds. After the oil is extracted the by-products are highly proteinaceous and of great value in balancing a ration of carbonaceous grains such as corn and barley.

The soybean in itself is frequently mentioned as a good source of protein. From the 1934 yearbook of the United States Department of Agriculture, I quote the following: "Rapid expansion in the production of soybeans during the last decade has led to increased utilization of the crop in the feeding of livestock. Because of its high protein content, the soybean has become popular as a supplement to corn and other starchy feeds in the production of hogs. This often makes unnecessary the purchase of concentrated protein feeds. Soybeans contain about 36 per cent of protein and vary in oil content from 12.5 to 25.5 per cent, depending upon the variety, the more common varieties used in hog feed averaging approximately 18 per cent. Because of their high oil content, soybeans fed in large quantities produce soft oily carcasses of unsatisfactory market quality." In this connection it may be well to state that in our project, at this station, as to "how soybeans can be fed with corn to avoid soft pork" the results have been very discouraging. We should be careful with our soybeans when fattening hogs because a low quality of pork is produced which is not desired in the market.

In bulletin No. 193 of this station it is advised to sow northern soybeans as they are more likely to mature under our conditions.

Results given in bulletin No. 207 of this station of an experiment in which soybeans were planted in corn for "lambing off" two different years, do not show that the soybean is superior to rape as a forage plant but when planted in the cornfield the mixture was superior to cornfield alone. Reports of ground flax having been fed as a supplement to corn for fattening are not numerous. It has always been considered to be too oily a feed.

According to the chemical analysis of these two oil-producing seeds, as reported by Henry and Morrison in their book on Feeds and Feeding, the soybean contains one-third more digestible protein and about one-half as much digestible fat as flax. The chemical analysis of a feed does not determine its feeding value, since palatability is an important factor. In the feeding of ground soybeans and ground flax, it was more difficult to keep the calves on a full feed of corn than it was to keep similar lots of calves that were receiving soybean oil meal and linseed oil meal, indicating that the oily feeds were not suitable. For convenience, results of these experiments will be reported in two parts. Part one will give results of fattening calves with ground soybeans, ground flax and their by-products, soybean oil meal and linseed oil meal. Part two will include the feeding of ground flax to fatten pigs. Each experiment covered periods of three different years.

PART I

The Experiment

The experiment was started in the fall of 1931 and concluded during the summer of 1934. Three different lots of calves were used. We usually weighed the calves up in the winter and closed them out during hot weather. Calves do not do as well in fly-time warm weather as in cold weather. Then again we encountered some hot dry weather, which is not the best condition for fattening cattle. The feeding periods varied from 148 to 239 days. Calves as a rule require a longer feeding period than older cattle. The condition of the calves as to duration of feed-

ing period was the governing factor because it was desirable to learn whether soft carcasses would be produced with these oily supplements.

The 1932 lot of calves was a mixed bunch of heifers and steers, two-thirds of which were raised by the Animal Husbandry department. Those for 1933 and 1934 were Hereford steer calves purchased at St. Lawrence, South Dakota. Calves for the first year's work were heavier than those for other years and were in better condition at the beginning of the period than those for the other two years—hence the feeding period was for only 148 days.

TABLE I

TABLE 1.—Analysis of Grains fed 1932 by K. W. Franke, Station Chemist

	Moisture	Ash	Ether Extract	Crude Protein	Crude Fiber	Nitrogen Free Extract
Shelled corn	10.13	1.48	3.88	10.00	1.73	72.78
Soybean meal	4.38	5.58	7.63	43.49	5.40	33.52
Ground soybeans	3.62	5.55	21.84	32.07	5.78	31.14
Linseed oil meal	5.10	5.98	4.78	37.62	8.48	38.04
Ground flax	3.92	3.41	31.55	26.79	9.33	25.00

The Object of the Experiment

1. To determine the value of adding ground soybeans and ground flax to a ration of shelled corn and alfalfa hay for fattening calves.

2. What quantities of these oily seeds can be fed to the calf, to advantage when it is on a full feed of grain.

3. What effects will the feeding of these oily substances have on the condition of the calf during a reasonable length of time. Will there be indications of a soft condition of calf before slaughter.

4. Would the carcasses of beef so produced be soft.

Each year the calves were sold to the John Morrell & Company, packers at Sioux Falls, and an examination made of the carcasses in the cooler. These carcasses graded each year as follows:

TABLE 2.—Condition of Carcasses	1932	1933	1934	TOTALS
Lot I. Shelled corn and alfalfa hay	4 hard 1 soft	4 firm 1 Medium firm	One hard, 2 medium hard and 2 medium soft	12 firm—3 soft
Lot II. Shelled corn, alfalfa hay and linseed oil meal	1 soft 3 hard	Hard, soft, medium soft and 2 firm	Two hard, 2 very hard and 1 medium hard	11 firm—3 soft
Lot III. Shelled corn, alfalfa hay and ground flax	4 hard 1 soft	2 hard, 1 firm, 1 soft and 1 medium soft	Two medium hard and 2 medium soft	9 firm—5 soft
Lot IV. Shelled corn, alfalfa hay and soybean oil meal	Between medium and firm	Three hard 2 medium hard	Three hard, 1 medium hard and 1 medium soft	14 firm—1 soft
Lot V. Shelled corn, alfalfa hay and ground soybeans	Two of 5 are medium soft	Three medium firm and 2 medium soft	Three medium hard and 1 medium soft	9 firm—5 soft

From the above results in grading, no feed was outstanding in producing hard or soft carcasses, yet there were more soft carcasses in lots where oily feeds were fed than in other lots. A careful examination of each calf was made for softness, at station before marketing and none were found to be in an overdone condition. There was no difference in the color of the fat on the carcasses.

“Grubs” or “Warbles”

The cattle in the immediate vicinity of Brookings do not have “grubs” or “warbles”. The several lots of cattle used in our experiments, purchased in other parts of the state, have developed “grubs” or “warbles” in the spring, but the local conditions have not been suitable for their development.

Of the 25 calves used in the 1933 experiment purchased at St. Lawrence, South Dakota, 11 had grubs and 14 did not have grubs. Grubby calves were found in each of the five lots. We often hear that cattle that have grubs will not do well in the feed yard. Since we have the record of these calves, we thought it would be of interest to the reader and therefore report it on a gain per head, daily, basis. The period is 120 days and extends from January 26 to May 26. We do not claim this period to be the most critical but it is at a time when the grub is in evidence. From bulletin No. 1369 of April, 1926, United States department of Agriculture, on the subject of Cattle Grubs or Ox Warbles, Their Biologies and Suggestions for Control, we quote as follows:

“There are two distinct species of cattle grubs, and these of course present differences in appearance and habits in each of their stages. In a general way, however, the life histories of the two are similar, and the following summary of that of *Hypoderma lineatum* will serve as an illustration. Beginning with the large grubs which are well known to practically everyone who handles livestock, the life may be traced as follows:

As the grubs reach maturity in the subdermal tissues of the back during the late fall, winter, spring or early summer, the holes through the skin gradually become larger and finally the grubs crawl out and drop to the ground. They seek protection under any loose material at hand and the outside skin shrinks, becoming hard, and within this the flies develop, emerging from thirty to sixty days later. These flies mate soon after emerging and without partaking of food begin to deposit eggs on cattle. The eggs are laid for the most part on the legs, probably the majority of them being below the knee or hock joint. The eggs hatch in from 2½ to 6 days, depending upon the temperature. The young larvae crawl down the hair to the skin and immedi-

ately begin burrowing into it. At the point of entrance serum usually exudes and rather characteristic scabby and tender areas remain for a few days. After penetration, little is known of the minute larvae from the time they pass through the skin until they appear in the body cavity, especially in the submucous layers of the gullet of the host, having increased considerably in size and become more opaque, and evidently having passed through a molt. They spend several months in the host, mainly in the tissues between the mucous membranes and the muscular walls of the gullet, and evidently, as shown by one of the writers (Laake, 57, 58), pass through a molt in that situation or enroute to the back. Growth continues during the summer months, and in the fall or winter the grubs have attained a length of from 15 to 17 millimeters and are ready to start on their migration to the back. Here again the exact route followed is not absolutely known: but these larvae, which are of sufficient size to be found easily, have been met with in various places in the chest and abdomen and on the diaphragm. Not infrequently they are observed in the spinal canal and a little later are to be found in the connective tissue beneath the skin along the back. A hole is cut through the skin almost immediately after the larva reaches that situation and within 2 to 6 days the larva again molts and a wall of tissue begins to form around it in the form of an encystment sac. The next molt takes place about 24 days later, and the insect is now in its final larval stage. The duration of this stage averages about 30 days. It is thus seen that the development requires approximately a year's time, there being one generation during the year. The major part of this time, from 9 to 11 months, is spent within the body of the host."

Totals

TABLE 3.—Showing the average gain per head daily by calves that were grubby and those not grubby in the same lots, from January 26 to May 26, 1933

	Grubby	Not Grubby
Lot 1. Shelled corn and alfalfa hay -----	3.10	2.93
Lot 2. Shelled corn, alfalfa hay and linseed oil meal	2.96	3.00
Lot 3. Shelled corn, alfalfa hay and ground flax ---	3.10	2.71
Lot 4. Shelled corn, alfalfa hay and soybean oil meal	2.51	2.84
Lot 5. Shelled corn, alfalfa hay and ground soybeans	2.68	2.70

From the above record it is not apparent that the grub infestation was a serious menace to the daily gain of the calf. In fact the averages of these gains are 2.87 for grubby and 2.83 for non-grubby calves. Of course it is understood that these grub-free calves never had grubs..

In bulletin 1396, United States Department of Agriculture, there is a reference to an experiment by Schottler and Glaser German experimenters on the effect of grubs on fattening cattle, from which I quote as follows: "The grubs were extracted from one-half of the herd and the other half kept as a check. The portion from which the grubs were removed showed a gain in weight of 5.16 per cent over the infested portion of the herd."

The Finish

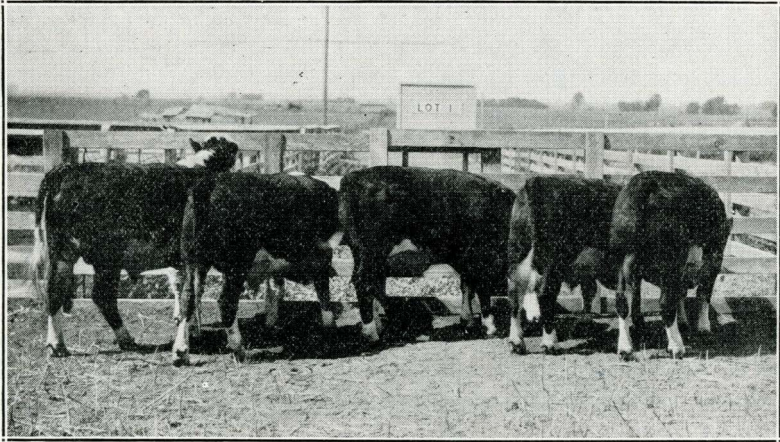
The finish of a beef animal is what appeals to the purchaser in the market. Equally well-bred animals carrying different degrees of finish are rated accordingly by the butcher because his daily training in buying has taught him much as to the probable dressed weight and the demand for such qualified meat by the trade.

The prices received each year by lot for these fat calves delivered in Sioux Falls were as follows:

TABLE 4.—Prices

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
1932	6.25	6.50	6.25	6.25	6.25
1933	4 @ 6.00	4 @ 6.00		3 @ 6.00	
	1 @ 5.50	1 @ 5.50	6.00	2 @ 5.50	6.00
1934	3 @ 8.00	4 @ 9.00		3 @ 8.00	4 @ 8.50
	2 @ 8.75	1 @ 8.00	8.50	2 @ 8.75	1 @ 5.00

The bidders on these cattle were not familiar as to how the different lots had been fed. From the above table it will be seen that cattle in lot II were favored each year. Those in lot III, that received ground flax, were the only cattle that sold straight each year, indicating that feeding ground flax was an advantage.



Calves 1933 Experiment

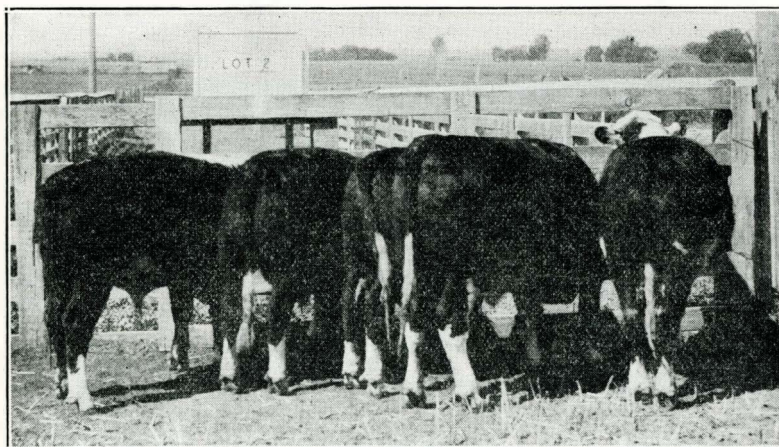
TABLE 5.—Shelled Corn and Alfalfa Hay

	Lot 1.		
	1932	1933	1934
Number of days fed	148	223	239
Av. weight at beginning	520	443	381
Av. weight at close	869	1035	927
Av. gain per head	339	592	544
Av. gain per head daily	2.35	2.65	2.27
Shelled corn for 100 pounds gain	593	576	548
Alfalfa hay for 100 pounds gain	268	238	304

Shelled corn and alfalfa hay furnishes a good ration for fattening calves. Students and visitors who examined these calves did not in a single instance decide that this lot was the best. They did not shed off as soon as calves in other lots and the buyers did not neither year favor them. Some judges claimed they were leggy compared to calves in other lots.

The average largest maximum consumption of feed per head daily was 17.8 pounds of shelled corn and 4.6 pounds of alfalfa hay.

Valuing shelled corn at 56c a bushel and alfalfa hay at \$15 a ton, the average cost of producing 100 pounds of gain for the three years was \$7.27.



Calves 1933 Experiment

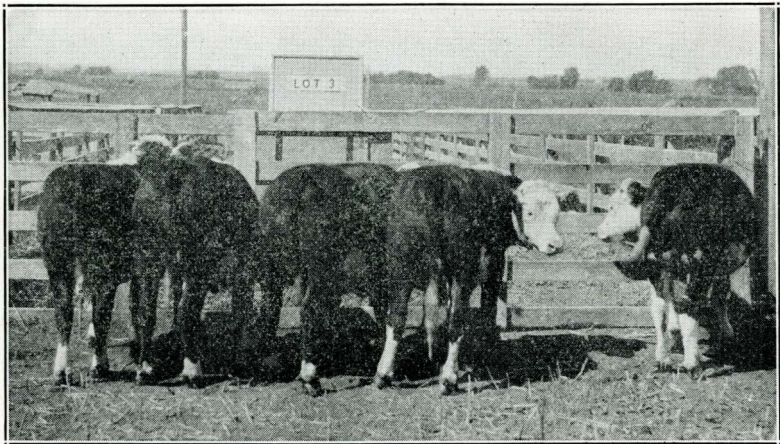
TABLE 6.—Shelled Corn, Alfalfa Hay and Linseed Oil Meal
Lot 2

	1932	1933	1934
Number of days fed -----	148	223	239
Av. weight at beginning -----	569	444	381
Av. weight at close -----	960	1020	898
Av. gain per head -----	391	576	517
Av. gain per head daily -----	2.64	2.58	2.16
Shelled corn for 100 pounds gain -----	528	539	505
Alfalfa hay for 100 pounds gain -----	250	202	285
Linseed oil meal for 100 pounds gain ---	47	53	43

These five head received shelled corn, alfalfa hay and linseed oil meal. There was a finish on these calves that attracted the attention of the buyers; hence, they brought each year the top prices. See table 4.

The average largest maximum consumption of feed per head daily was 17.5 pounds of shelled corn, 4.7 pounds of alfalfa hay and 1.18 pounds of linseed oil meal.

Valuing shelled corn at 56 cents a bushel, alfalfa hay at \$15 a ton, and linseed oil meal at 2c a pound, the average cost of producing 100 pounds of gain for the three years was \$8.01.



Calves 1933 Experiment

TABLE 7.—Shelled Corn, Alfalfa Hay and Ground Flax
Lot 3

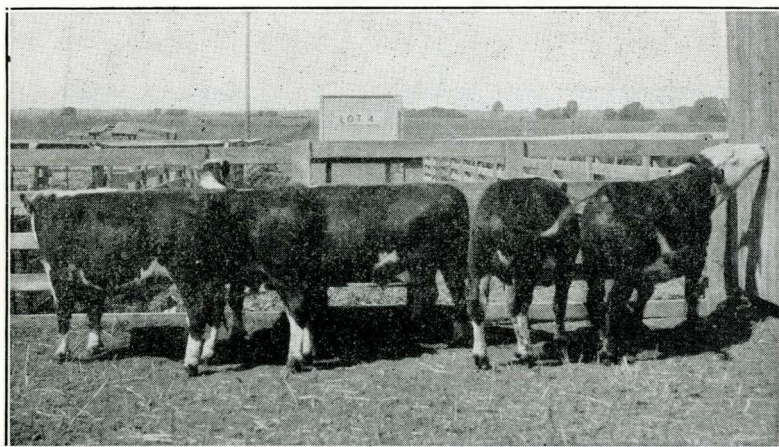
	1932	1933	1934
Number of days fed -----	148	223	239
Av. weight at beginning -----	516	445	382
Av. weight at close -----	884	1008	864
Av. gain per head -----	368	563	482
Av. gain per head daily -----	2.49	2.52	2.02
Shelled corn for 100 pounds gain -----	528	534	521
Alfalfa hay for 100 pounds gain -----	268	245	294
Ground flax for 100 pounds gain -----	25	28	24

Each year the calves that received the supplement ground flax with their shelled corn and alfalfa hay presented an extra good appearance.

A small allowance of ground flax could be given but our experience is that calves picked shelled corn out and left the flax in the trough where the flax was increased much over one pound per head per day, when calves were receiving a full feed of shelled corn and alfalfa hay.

The average largest maximum consumption of feed per head daily was 17.7 pounds of shelled corn, 4.7 pounds of alfalfa hay and .95 of a pound of ground flax.

Valuing corn at 56 cents a bushel, alfalfa hay at \$15 a ton, and ground flax at 27 cents a pound, the average cost of producing 100 pounds of gain for the three years was \$8.13.



Calves 1933 Experiment

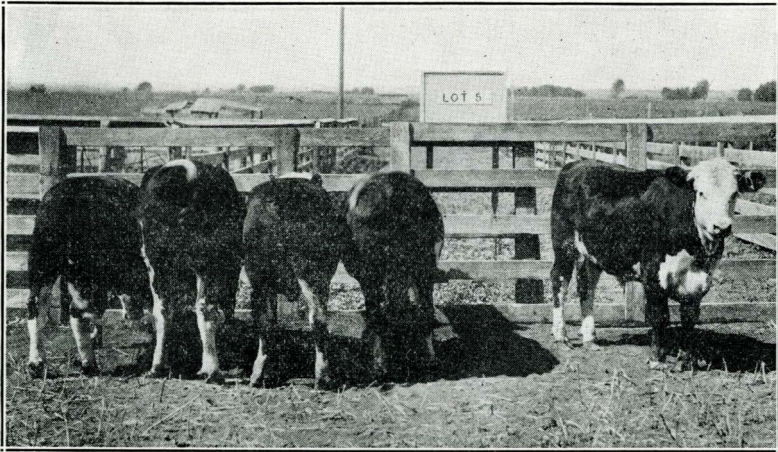
TABLE 8.—Shelled Corn, Alfalfa Hay and Soybean Oil Meal
Lot 4

	1932	1933	1934
Number of days fed -----	148	223	239
Av. weight at beginning -----	523	443	383
Av. weight at close -----	876	1009	877
Av. gain per head -----	353	566	494
Av. gain per head daily -----	2.35	2.54	2.07
Shelled corn for 100 pounds gain -----	518	539	503
Alfalfa hay for 100 pounds gain -----	246	239	305
Soybean oil meal for 100 pounds gain --	44	52	39

These calves received soybean oil meal with their shelled corn and alfalfa hay. Neither year were the calves rated equal to calves that received linseed oil meal. They were not so well finished and evidently made more growth than calves in lot 2.

The average largest maximum consumption of feed per head daily was 18.4 pounds of shelled corn, 4.66 of alfalfa hay and 1.52 of soybean oil meal.

Valuing shelled corn at 56 cents a bushel, alfalfa at \$15 a ton, and soybean oil meal at 2.5 cents a pound, the average cost of producing 100 pounds for the three years was \$8.34.



Calves 1933 Experiment

TABLE 9.—Shelled Corn, Alfalfa Hay and Ground Soybeans
Lot 5

	1932	1933	1934
Number of days fed	148	223	239
Av. weight at beginning	516	439	376
Av. weight at close	870	985	893
Av. gain per head	354	546	517
Av. gain per head daily	2.39	2.45	2.16
Shelled corn for 100 pounds gain	515	525	465
Alfalfa hay for 100 pounds gain	279	210	304
Ground soybeans for 100 pounds gain	47	38	31

These calves received ground soybeans with shelled corn and alfalfa hay. Our experience was that when on a full feed of shelled corn and alfalfa hay they did not eat much more than a pound of the ground beans per head daily. An effort was made to get them to consume more but when ground soybeans were increased the calves picked out the shelled corn.

The average largest maximum consumption of feed per head daily was 17.3 pounds of shelled corn, 5.3 pounds of alfalfa hay and 1.05 pounds of ground soybeans.

Valuing shelled corn at 56 cents a bushel, alfalfa hay at \$15 a ton, and ground soybeans at 2.5 cents a pound, the average cost of producing 100 pounds of gain was \$7.93.

In the three following tables will be found a report in detail of each year's feeding.

1932

TABLE 10.

Lot No.	1	2	3	4	5
Ration fed	Shelled corn alfalfa hay	Shelled corn linseed oil meal alfalfa hay	Shelled corn ground flaxseed alfalfa hay	Shelled corn soybean oil meal alfalfa hay	Shelled corn ground soybeans alfalfa hay
No. of cattle -----	5	4	4	5	5
Average No. of days fed -----	148	148	148	148	148
Average initial weight per head -----	520	569	516	523	516
Average final weight per head -----	869	960	884	876	870
Total gain per head -----	349	391	368	353	354
Average daily gain per head -----	2.35	2.64	2.49	2.38	2.39
Feed consumed for 100 pounds gain					
Shelled corn -----	539	528	528	518	515
Linseed oil meal -----		47			
Ground flaxseed -----			25		
Soybean oil meal -----				44	
Ground soybeans -----					47
Alfalfa Hay -----	268	250	268	246	279

A calf in lot 2 made poor gains and was eliminated. The feed consumed was adjusted in computing final data. One steer in lot 3 died and computation was made on a four steer basis.

1933

TABLE 11

Lot No.	1	2	3	4	5
Ration fed	Shelled corn alfalfa hay	Shelled corn linseed oil meal alfalfa hay	Shelled corn ground flaxseed oil meal hay	Shelled corn soybean oil meal alfalfa hay	Shelled corn ground soybeans alfalfa hay
No. of cattle -----	5	5	5	5	5
Average No. of days fed -----	223	223	223	223	223
Average initial weight per head -----	443	443	445	443	439
Average final weight per head -----	1035	1020	1008	1009	985
Total gain per head -----	592	576	563	566	546
Average daily gain per head -----	2.65	2.58	2.52	2.54	2.45
Feed consumed for 100 pounds gain					
Shelled corn -----	576	539	534	539	525
Linseed oil meal -----		53			
Ground flaxseed -----			28		
Soybean oil meal -----				52	
Ground soybeans -----					38
Alfalfa Hay -----	238	202	245	239	210

1934

TABLE 12

Lot No.	1	2	3	4	5
Ration fed	Shelled corn alfalfa hay	Shelled corn linseed oil meal alfalfa hay	Shelled corn ground flaxseed alfalfa hay	Shelled corn soybean oil meal alfalfa hay	Shelled corn ground soybeans alfalfa hay
No. of cattle -----	5	5	5	5	4
Average No. of days fed -----	239	239	239	239	239
Average initial weight per head -----	383	381	382	383	376
Average final weight per head -----	927	898	864	877	893
Total gain per head -----	544	517	482	494	517
Average daily gain per head -----	2.27	2.16	2.02	2.07	2.16
Feed consumed for 100 pounds gain --					
Shelled corn -----	548	505	521	503	465
Linseed oil meal -----		43			
Ground flaxseed -----			24		
Soybean oil meal -----				39	
Ground soybeans -----					31
Alfalfa Hay -----	304	285	294	305	304

TABLE 13.—Summary, Three Years 1932-33-34

Lot No.	1	2	3	4	5
Ration fed	Shelled corn alfalfa hay	Shelled corn linseed oil meal alfalfa hay	Shelled corn ground flaxseed alfalfa hay	Shelled corn oil meal soybeans alfalfa hay	Shelled corn ground soybeans alfalfa hay
No. of cattle -----	15	14	14	15	14
Average No. of days fed -----	203	207	207	203	201
Average initial weight per head -----	449.3	457.5	443.5	449.6	449.1
Average final weight -----	943.8	959.5	921.6	920.8	917.9
Total gain per head -----	494.6	502.0	478.1	471.2	468.9
Average daily gain per head -----	2.4	2.4	2.31	2.32	2.34
Feed consumed for 100 pounds gain					
Shelled corn -----	534.6	524	528	521	503.5
Linseed oil meal -----		47.9			
Ground flaxseed -----			31.5		
Soybean oilmeal -----				45.8	
Ground soybeans -----					28.3
Alfalfa Hay -----	257.0	242.9	267.9	264.2	258.6

The record also shows that more shelled corn was required for 100 pounds of gain with lot 1, the check lot where no supplement was fed, than with other four lots where they received a supplement. This is true with all three years of experiment.

TABLE 14.—Gains of Pigs Following Steers

	1932	1933	1934	Total 3 years
Shelled corn and alfalfa hay	74	281	241	596
Shelled corn, alfalfa hay and linseed oil meal _	190	322	268	780
Shelled corn, alfalfa hay and ground flax ----	164	311	235	710
Shelled corn, alfalfa hay and soybean oil meal	201	288	282	771
Shelled corn, alfalfa hay and ground soybeans	186	247	249	682

An effort was made each year, to have enough pigs in the yards to pick up the waste. This is an important item in fattening cattle.

Pigs following steers in 1933 were slaughtered at the close of the experiment to determine the firmness of carcasses, suspecting probably some of the pigs would kill soft, especially those in lots where steers were getting the oily feeds. The result was that all carcasses were firm or hard.

Summary

1. The feeding of supplements reduced pounds of corn required for 100 pounds of gain. See table 13.
2. The fact that part of the calves in the 1933 experiment developed grubs in the back did not affect their gains. See table 3.
3. Ground flax and ground soybeans can be fed to advantage with shelled corn and alfalfa hay in the production of baby beef.
4. Calves receiving ground soybeans shed coats earlier than calves in other lots. Calves in the check lot were slowest to shed old hair.
5. An examination of the calves each year at the close of the experiment did not reveal that any were in an overdone condition.
6. Difficulty was experienced in keeping calves that received ground flax with their shelled corn on a full feed of grain showing that ground flax is not so palatable as some of other supplements used.
7. In feeding either ground flax or ground soybeans it should be remembered that the oil is in the feed, while with

linseed oil meal and soybean oil meal the oil has been extracted. When ground flax was increased to much over a pound daily per head the calves would leave the ground flax and pick out the corn.

8. The kind of feed did regulate to an extent the condition of the carcass, although there were soft and hard carcasses found in each lot. The calves that received the oily feeds, ground flax and ground soybeans, produced the largest number of soft carcasses, while the calves that received the soybean oil meal had the largest number of firm carcasses. See table 2.

9. Eleven of the 25 calves purchased for the 1933 experiment proved to be infested with grubs and 14 had no grubs. A record of the first 120 days of this year's test, from January 26, to May 26, when the grubs had disappeared, was noted and table No. 3 furnishes the information in detail. It cannot be stated that there was any benefit or detriment to the experiment because of this condition of part of the calves.

PART II

Ground Flax Compared With Linseed Oil Meal and Tankage for Fattening Pigs

During the four or five years prior to 1932, the Animal Husbandry Department of South Dakota State College received many inquiries relative to the use of ground flax as a hog feed. During this period, large quantities of flax seed were being produced, much of which were mixed with grain or weed seed, and had a relatively low market value when compared to clean flax. Further, during that same period of years the protein supplements commonly used for hog feeding were high priced as compared with the market prices of hogs. These conditions caused many growers of hogs to consider the use of ground flax seed in their feeding operations.

Accordingly, a series of feeding tests were planned to be conducted during a period of three years. It was decided that six lots of pigs should be used in each of the three tests, and that rations for each lot as follows would be compared:

- Lot 1.— Shelled corn, alfalfa hay and a mineral mixture.
- Lot 2.— Shelled corn, tankage, alfalfa hay and a mineral mixture.
- Lot 3.— Shelled corn, a protein supplement consisting of tankage and linseed oil meal, alfalfa hay and a mineral mixture.
- Lot 4.— Shelled corn, mixture of tankage and ground flaxseed, alfalfa hay and a mineral mixture.
- Lot 5.— Shelled corn, ground flaxseed, alfalfa hay and a mineral mixture.
- Lot 6.— Shelled corn, linseed oil meal, alfalfa hay and a mineral mixture.

In all cases, each feed or feed mixture and the mineral mixture were self-fed, free choice method. Where a combination of tankage and oil meal was used, the proportion was two parts tankage to one part linseed oil meal by weight. Where the combination of tankage and ground flaxseed was used, the two feeds were mixed in the same proportion, that is, two parts of tankage to one part of ground flaxseed. The mineral used in all three trials was mixed as follows: fifty pounds ground limestone, twenty-eight pounds steamed bone meal, twenty pounds common salt, two pounds iron oxide, one ounce potassium iodide and one-half ounce copper sulphate. The pigs used in each trial were weighed on three consecutive days at the beginning of the test, at regular two weeks intervals during the test and on three consecutive days when the pigs in each lot, with the exception of lot 1, had reached an average weight of approximately two hundred twenty-five to two hundred thirty pounds. The pigs in lot 1, fed corn and alfalfa hay, were weighed out at a lighter average weight. This was due to the pigs making a much slower gain and having to be carried for a much longer time. Good quality yellow corn and good quality green leafy alfalfa was used in all the experiments. Sixty per cent protein tankage, forty-three per cent protein linseed oil-meal and good clean flaxseed was used in each trial. Every pig used in the three feeding trials was in good thrifty condition at the beginning of the test.

At the close of each feeding trial, the hogs were trucked to the John Morrell Packing Plant at Sioux Falls and killed under test to determine the degree of firmness of the carcass. It is well known that some feeds produce soft pork, which is undesirable. One of the objects of this experiment was to determine if the use of ground flaxseed as a protein supplement would reduce the firmness of the carcass to the point it would be

objectionable. Hog carcasses which are soft do not retain attractive shape and appearance when taken from the cooler and put on the butcher's block. Further, the fat from carcasses which are soft melts at a lower temperature than fat from hogs which kill firm, and for that reason the lard from soft carcasses is not so desirable as that made from firm carcasses. The killing data on hogs in each of the three trials are presented in table No. 19.

The first of this series of feeding trials was started in January, 1932. The pigs used—forty-eight in number—were raised by the Animal Husbandry Department of South Dakota State College and were farrowed in the fall of 1931. They were of the Chester White, Duroc Jersey and Poland China breeds. These pigs were separated as evenly as possible with regard to breed, sex, weight and litter mates into six lots of eight pigs each.

The corn used in this first experiment was grown in northwest Iowa, had a moisture content of 16.7 per cent and was graded No. 3. Notwithstanding that the pigs used in this first test had access to sunshine every day, one pig in lot 5 developed what appeared to be a case of rickets. This pig was unable to walk on March 11 and was put in a separate pen on that day. The same ration as fed before was continued and one tablespoon of cod liver oil given twice each day. On March 24 this pig had completely recovered. It was then put back in the lot with the others and the cod liver oil discontinued. This was the only pig in any of the lots that showed evidence of rickets. One pig in lot 1, fed corn, alfalfa hay and mineral, which had been making good growth before being put in this experiment, failed to make gains from the start. By April 8 it was apparent that this pig would die if left in the experiment. It was taken out on that date. The data for this lot has been computed on the basis of seven pigs.

The weights and the gains of the pigs, the number of days fed, and the feed required for one hundred pounds gain are given in table No. 15.

In considering these data it will be noted that the pigs in lot 1, fed shelled corn, alfalfa hay, and a mineral mixture, required 225 days to reach an average weight of 201 pounds; while the pigs in lot 2, fed shelled corn, tankage, alfalfa hay,

TABLE 15

Lot No.	1	2	3	4	5	6
Ration fed	Shelled corn alfalfa hay mineral mixture	Shelled corn alfalfa hay mineral mixture tankage	Shelled corn alfalfa hay mineral mixture tankage linseed oil meal	Shelled corn alfalfa hay mineral mixture tankage ground flaxseed	Shelled corn alfalfa hay mineral mixture ground flaxseed	Shelled corn alfalfa hay mineral mixture linseed oil meal
No. of pigs -----	7	8	8	8	8	8
No. of days fed -----	225	137	116	116	148	132
Av. initial wt. per pig -----	87.0	83.5	83.8	83.2	83.9	83.6
Av. final wt. per pig -----	201.6	228.6	232.4	230.7	227.6	235.3
Av. daily gain per pig -----	.51	1.06	1.28	1.27	1.01	1.15
Feed consumed per 100 lbs. gain:						
Shelled corn -----	748.8	429.3	391.7	385.6	484.2	436.6
Tankage -----		18.9	19.8	20.5		
Linseed oil meal -----			19.9			22.9
Ground flaxseed -----				10.2	20.8	
Alfalfa hay -----	17.2	9.3	4.1	6.0	8.4	9.8
Mineral mixture -----	6.1	1.2	1.5	1.7	2.3	2.8

and a mineral mixture, required only 137 days to make an average weight of 228 pounds. Likewise, the feed required for 100 pounds of gain was much greater in the case of the pigs not getting the tankage than with those getting tankage. These data show clearly the gain from adding tankage to a ration of corn and alfalfa hay when the pigs are to be fattened in a dry lot. The lowest feed requirement was for the pigs fed a mixture of tankage and linseed oil meal and a mixture of tankage and ground flaxseed. It should be noted that the pigs fed ground flaxseed required more corn for 100 pounds gain than did the pigs fed tankage, or linseed oil meal. The pigs fed the ground flaxseed also were second lowest in rate of gain.

The second feeding trial was started on February 18, 1933. Thirty six pigs, or six to the lot, were used in this test. As in the previous test they were fall pigs raised by the Animal Husbandry department of South Dakota State College and were of the Chester White, Duroc Jersey and Poland China breeds. The same precautions in separating the pigs to obtain uniform lots taken in 1932 were observed in 1933. The corn used in this experiment as before was clean and of good quality. It was grown in eastern South Dakota instead of Iowa. The data showing the weights and gains of the pigs with the amounts of feeds required for 100 pounds of gain are given in table 16.

One pig in lot 4 showed evidence of a slight attack of pneumonia on March 18. This pig did not gain in weight from March 18 to April 15 and on that date was taken out of the experiment. The data for this lot, therefore, have been computed on the basis of 5 pigs. The pigs in lot 1, fed shelled corn, alfalfa hay, and a mineral mixture, as in 1932, made very slow gains and feed required for 100 pounds gain was much higher than the requirement in any of the other lots. The fastest gains were made by the pigs in lots 2, 3 and 4, all of which were fed tankage either alone or in combination with linseed oil meal or ground flaxseed. The pigs in lot 2, fed tankage and in lot 6, fed linseed oil meal required practically the same amount of feed for 100 pounds of gain. The pigs in lot 5 fed shelled corn, ground flaxseed, alfalfa hay and a mineral mixture made somewhat faster gains with a lower feed requirement than the pigs in lot 1, fed shelled corn, alfalfa hay and a mineral mixture.

TABLE 16

Lot No.	1	2	3	4	5	6
Ration fed	Shelled corn alfalfa hay mineral mixture	Shelled corn tankage alfalfa hay mineral mixture	Shelled corn tankage linseed oil meal mixture alfalfa hay mineral mixture	Shelled corn tankage ground flaxseed mixture alfalfa hay mineral mixture	Shelled corn ground flaxseed alfalfa hay mineral mixture	Shelled corn linseed oil meal alfalfa hay mineral mixture
No. of pigs -----	6	6	6	5	6	6
No. of days fed -----	156	90	91	98	127	119
Av. initial wt. per pig -----	94.0	94.0	93.4	92.8	93.0	92.8
Av. final wt. per pig -----	221.7	232.0	225.7	224.3	220.3	226.1
Av. daily gain per pig -----	0.82	1.52	1.45	1.34	1.0	1.12
Feed consumed per 100 lbs. gain:						
Shelled corn -----	544.3	437.0	399.0	389.0	456.8	435.0
Tankage -----		30.4	24.7	30.0		
Linseed oil meal -----			12.3			34.5
Ground flaxseed -----				15.0	37.1	
Alfalfa Hay -----	6.7	3.3	2.1	1.9	3.0	2.5
Mineral mixture -----	3.0	1.0	2.0	1.8	2.0	1.6

The third of this series of feeding trials was started on March 14, 1934. As in the previous tests, fall pigs grown by the Animal Husbandry department were used. These pigs, 48 in number, were divided as evenly as possible into the six lots. Again, good quality yellow corn grown in eastern South Dakota was used. The data giving the weights and gains of the pigs and the feed required for 100 pounds of gain are given in table 17, page 27.

The results given in this tabulation again show clearly the value of using tankage or some other concentrated protein feed to supplement a ration of shelled corn, alfalfa hay, and a mineral mixture when fed in dry lot. Ground flax seed again did not prove so efficient as tankage. It was, however, practically equal to linseed oil meal.

A summary of the data obtained in the three feeding trials is given in table 18, page 28.

As was brought out in each of the three trials this summary shows that the ration of corn, alfalfa hay, and a mineral mixture was the most expensive used. If we value corn at 56 cents a bushel, linseed oil meal and tankage at 2 cents a pound, ground flaxseed at 2.7 cents a pound, alfalfa hay at \$15 a ton, and the mineral mixture at 3 cents a pound the cost of 100 pounds of gain for each of the six lots was as follows: lot 1, \$6.22; lot 2, \$4.68; lot 3, \$4.61; lot 4, \$4.62; lot 5, \$5.39; and lot 6, \$4.86.

The slaughter data for each lot for the three years are given in table 19, page 29.

Two hogs in lot 3, one hog in lot 2 and 1 hog in lot 5 were not included in the 1932 slaughter test because they were not finished and would kill soft regardless of the ration fed. One hog in lot 5 was sick the morning the other hogs were sent to Sioux Falls for the slaughter test and so was not included.

In the 1933 test one hog in lot 1 and one in lot 5 died after reaching market weight, and therefore do not show in the killing test.

Five hogs used in lot 1 and two hogs in lot 5 in the 1934 test were not finished when the slaughter test was made and therefore were not included.

TABLE 17

Lot No.	1	2	3	4	5	6
Ration fed	Shelled corn alfalfa hay mineral mixture	Shelled corn alfalfa hay mineral mixture tankage	Shelled corn alfalfa hay mineral mixture tankage linseed oil meal	Shelled corn alfalfa hay mineral mixture tankage ground flaxseed	Shelled corn alfalfa hay mineral mixture ground flaxseed	Shelled corn alfalfa hay mineral mixture linseed oil meal
No. of pigs -----	8	8	8	8	8	8
No. of days fed -----	113	78	75	84	99	93
Av. initial wt. per pig -----	97.8	99.5	98.3	99.4	98.4	98.0
Av. final wt. per pig -----	198.2	225.2	226.5	232.6	226.2	234.0
Av. daily gain per pig -----	.89	1.61	1.71	1.59	1.29	1.46
Feed consumed per 100 lbs. gain:						
Shelled corn -----	508.5	359.3	329.4	331.7	363.0	360.4
Tankage -----		31.7	38.4	30.3		
Linseed oil meal -----			19.2			42.0
Ground flaxseed -----				15.2	48.4	
Alfalfa Hay -----	16.4	6.0	4.5	4.6	8.1	7.9
Mineral mixture -----	2.6	.6	.5	.8	1.1	1.7

The results given in this tabulation again show clearly the value of using tankage or some other concentrated protein feed to supplement a ration of shelled corn, alfalfa hay and a mineral mixture when fed in dry lot. Ground flaxseed again did not prove so efficient as tankage. It was, however, practically equal to linseed oil meal.

TABLE 18

Lot No.	1	2	3	4	5	6
Ration fed	Shelled corn alfalfa hay mineral mixture	Shelled corn alfalfa hay mineral mixture tankage	Shelled corn alfalfa hay mineral mixture tankage linseed oil meal	Shelled corn alfalfa hay mineral mixture tankage ground flaxseed	Shelled corn alfalfa hay mineral mixture ground flaxseed	Shelled corn alfalfa hay mineral mixture linseed oil meal
No. of pigs -----	21	22	22	21	22	22
Av. No. of days fed -----	163	103	94	100	124	114
Av. initial wt. per pig -----	93.1	92.1	91.6	91.6	91.6	91.3
Av. final wt. per pig -----	206	228.0	228.4	229.9	225.0	232.3
Av. daily gain per pig -----	0.69	1.32	1.45	1.39	1.07	1.23
Feed consumed per 100 lbs. gain:						
Shelled corn -----	601.3	407.9	372.4	366.6	435.0	409.4
Tankage -----		26.3	27.4	26.3		
Linseed oil meal -----			13.7			32.6
Ground flaxseed -----				13.1	34.7	
Alfalfa Hay -----	12.9	6.5	3.7	4.5	6.9	7.3
Mineral mixture -----	3.8	.9	1.3	1.4	1.8	2.1

A summary of the data obtained in the three feeding trials is given in table above.

TABLE 19

Ration Fed	1932	1933	1934
	48 hours chill not included in slaughter test	48 hours chill	36 hours chill
Shelled corn, alfalfa hay and mineral mixture		2 hard 2 firm 1 medium soft	3 hogs in killing test. All hard
Shelled corn, tankage, alfalfa, hay and mineral mixture	3 firm 4 hard	1 hard 5 firm	8 hard
Shelled corn, tankage and linseed oil meal mixture, alfalfa hay and mineral mixture	6 firm	2 hard 4 firm	8 firm
Shelled corn, tankage and ground flaxseed mixture, alfalfa hay and mineral mixture	2 firm 4 not quite firm 1 medium soft 1 soft	3 firm 2 soft	6 firm 1 medium soft 1 soft
Shelled corn, ground flaxseed, alfalfa hay and mineral mixture	4 slightly soft 2 medium soft	1 hard 3 medium soft 1 soft	4 medium soft 2 soft
Shelled corn, linseed oil meal, alfalfa hay and mineral mixture	6 firm 1 medium soft 1 soft	1 hard 5 firm	4 not quite firm 4 medium soft

Two hogs in lot 3, one hog in lot 2 and 1 hog in lot 5 were not included in the 1932 slaughter test because they were not finished and would kill soft regardless of the ration fed. One hog in lot 5 was sick the morning the other hogs were sent to Sioux Falls for the slaughter test and so was not included.

In the 1933 test one hog in lot 1 and one in lot 5 died after reaching market weight, and therefore do not show in the killing test.

Five hogs used in lot 1 and two hogs in lot 5 in the 1934 test were not finished when the slaughter test was made and therefore were not included.

Summary Swine

1. Tankage and linseed oil meal are more economical supplements to a ration of corn, alfalfa hay, and mineral than ground flaxseed.

2. Ground flaxseed proved more efficient when fed with tankage than when fed as the only concentrated protein supplement.

3. Feeding a mixed protein supplement composed of tankage and linseed oil meal or tankage and ground flaxseed lowered the amount of corn required for 100 pounds gain but did not decrease the amount of tankage required. In each case linseed oil meal and ground flaxseed replaced corn rather than tankage.

4. Ground flaxseed fed as a supplement tended to produce soft pork. While some of the hogs fed ground flaxseed did not yield soft carcasses, all of the carcasses from the hogs fed flaxseed were decidedly lacking in firmness when compared with the carcasses from the hogs fed tankage.

5. Under ordinary conditions of feeding it will pay to sell the flaxseed and buy other protein supplements to supplement the ration for fattening pigs.