



103
048
THS

A STUDY OF RYE AS A FEED
FOR GROWING FATTENING SWINE
THESIS FOR DEGREE OF M. S.

GEORGE A. BRANAMAN

1926

THESIS

Feeding + growing supply
Rij:

A STUDY OF RYE AS A FEED
FOR
GROWING FATTENING SWINE

THESIS

Submitted to the faculty of the Michigan State College
in partial fulfillment of the requirements for the
degree of Master of Science.

M.

by
George A. Branaman
1926

THESIS

ACKNOWLEDGEMENTS

The author wishes to acknowledge his indebtedness to Professor George A. Brown, Head of the Department of Animal Husbandry, for his cooperation and assistance in planning and conducting the experimental work, and for his kindly criticisms and advice in preparing the manuscript.

He also wishes to express his gratitude to Doctor R. C. Huston, Professor of Chemistry, for his assistance and advice in planning the experiments.

To Professor W.E.J. Edwards, Associate in Animal Husbandry, and V.A. Freeman, Extension Specialist in Animal Husbandry, the author is likewise grateful for suggestions and cooperation in planning and conducting the trials.

Appreciation is also expressed to Doctor E.T. Hallman and Doctor L.B. Sholl, of the Department of Pathology, and Doctor W.L. Chandler, of the Bacteriology Department, for the conduction of autopsies and the suggestions regarding the health of the animals.

Likewise the analysis of feed by the Department of Experiment Station Chemistry is gratefully acknowledged.

TABLE OF CONTENTS

INTRODUCTION	a
GENERAL DISCUSSION AND REVIEW OF LITERATURE	1
I Preparation for Feeding	1
II Unfavorable Results with Rye	2
III Results at the Michigan Experiment Station	5
IV Other Favorable Results	9
V Some Laboratory Experiments	13
VI Further Chemical Phases	16
VII Digestibility	20
VIII Conclusions	21
EXPERIMENTAL FEEDING TRIALS	24
Experiment I	24
I Objects of the Experiment	24
II Plan of Experiment	26
III Previous Treatment of Pigs	26
IV Allotment of Pigs	27
V Method of Weighing	27
VI Lots, Water, Etc.	28
VII Rations Fed and Method of Feeding	28
VIII Treatment for Parasites	29
IX Experimental Data	29
A Gains of Pigs	29
(1) Gains of Pigs by Periods	30
(2) Some Pigs Fail to Gain	34
(3) All Pigs Gain Well on Corn	39
(4) Conclusions	39

B	Gains of Thrifty Pigs	40
C	Comparison of Rations	41
	(1) Feed Deduction for Pigs Removed	41
	(2) Average Daily Ration	44
	(3) Feed Required for Gain	46
	(4) Nutrient Requirement	49
	(5) Cost of Gains	50
	(6) Differences between Lots in rate of Gain with Probable Error	52
D	Summary of Results	53
E	Tables	
	Table 1	30
	Table 2	40
	Table 3	44
	Table 4	46
	Table 5	49
	Table 6	50
	Table 7	52
	Experiment II	54
I	Object of the Experiment	54
II	Plan of Experiment	55
III	Previous Treatment of Pigs	55
IV	Allotment of Pigs	56
V	Method of Weighing	56
VI	Lots, Water, Etc.	56
VII	Rations Fed and Method of Feeding	56

VIII	Experimental Data	57
A	Gains of Pigs	58
	(1) Influence of Iodine	65
B	Gains of Thrifty Pigs	66
C	Comparison of Rations	67
	(1) Feed Deduction for Pigs Removed	67
	(2) Average Daily Ration	68
	(3) Feed Required for Gain	71
	(4) Milk Lots Compared with Check Lot	73
	(5) Nutrient Requirement	74
	(6) Cost of Gains	75
	(7) Differences between Lots in rate of Gain with Probable Error	76
D	Summary of Results	77
E	Tables	
	Table 8	58
	Table 9	66
	Table 10	68
	Table 11	71
	Table 12	74
	Table 13	74
	Table 14	75
	Table 15	76
	BIBLIOGRAPHY	79

APPENDIX	83
Table I	84
Table II	91
Table III	92
Table IV	99
Table V	101
Table VI	103
Table VII	109
Table VIII	110
Table IX	116
Table X	118

INTRODUCTION

The use of rye as a grain feed for livestock in the State of Michigan is of considerable importance. Its greatest popularity is found in the areas of lighter soils where it makes a satisfactory growth and produces a moderate amount of grain on soil that will not produce a fair crop of the more popular grains. In a program of soil improvement, rye is often used as a cover crop and as a green manure crop on worn-out soil, and after a few rye crops have been grown and some organic matter and other fertilizing materials have been added to the soil, other crops may be grown more successfully. Rye will withstand the rigours of the spring wheat belt and on the lighter soils of that area it will produce a greater yield than the spring wheat.

Rye has not been so popular for milling purposes as has wheat in the United States, consequently the bulk of the crop grown has been used for feed.

The Yearbook of the Department of Agriculture for 1922 gives some interesting figures on the trend of rye production in the United States, summarized as follows: "The production of rye, being the result of both acreage and acre yield, has fluctuated considerably from year to year. A gradual increase was apparent, however, from 1874 to 1911 and a rapid increase from 1912 to 1918. In 1922 the production of 95,497,000 bushels was second only

to the record of 108,289,000 bushels in 1918."

The Crop Report for Michigan for July, 1926, prepared and issued by the U. S. Department of Agriculture, Bureau of Agricultural Economics, in cooperation with the Michigan Department of Agriculture, gives the condition of the various grain crops and the estimated 1926 yields for each crop for Michigan and for the United States. The rye crop is summarized as follows: "The indicated average yield is approximately 12.8 bushels per acre, based upon the reported condition of 80 per cent and a revised acreage of 199,000, or a total production of 2,547,000 bushels. The condition is eight per cent better than last year, but nine per cent below the ten year average.

The outlook for the United States is rather poor. The acreage is about ten per cent less than last year, and the prospective production of 39,666,000 bushels is 9,000,000 less than 1925 and only about 60 per cent of the 1924 crop."

The estimates given for the other grain crops show the relative importance of rye as compared to these other crops. The Michigan rye crop represents 6.4 per cent of the rye crop of the United States, while the estimates of the corn crop indicate that Michigan will have 1.5 per cent of the nations corn crop. Michigan's corn crop is estimated as practically the same as the United States' rye crop, consequently Michigan's rye crop

6

will represent 6.4 per cent of her corn crop, while the rye crop of the United States will be 1.5 per cent of her corn crop in bushels. The rye crop of Michigan will equal 4.4 per cent of her oat crop, and the rye crop of the United States is estimated at 3 per cent of her oat crop in bushels. The rye crop of the State is to be approximately 78.6 per cent of the barley crop in bushels, and the Nation's rye crop is to be 20.7 per cent of the barley crop. These comparisons show that rye is relatively more important in Michigan than it is in the Nation as a whole. In fact the Yearbook of the Department of Agriculture shows Michigan to be the leading rye producing State in 1909, second to North Dakota only in 1919, first again in 1920 but surpassed by both North Dakota and Minnesota since that time.

The use of rye as a feed for live stock and especially swine, has been a subject for considerable investigational work. The results have been almost as varied as there are numbers of investigators. In some cases the pigs have done as well or better than similar pigs have done on supposedly much better rations, while in other cases the pigs have not been maintained, in fact in a few cases they have actually wasted away. Many farmers and hog raisers maintain that they can grow pigs as well or better on rye than any other farm grain. Other feeders will assert just as firmly their experience that rye simply will not do as a hog feed. Yet no one seems

to be able to explain the difference in such results nor to offer a ration containing rye that will produce results in the feed-lot regularly under average conditions. The purpose of this work is to determine if possible the causes for such divergent results and to try to find a satisfactory combination of feeds in which rye may be the chief grain constituent.

GENERAL DISCUSSION AND REVIEW OF LITERATURE

Rye is one of the hard grains that must be prepared by either soaking or grinding before it may be eaten readily by live stock. Rye, wheat or barley are very seldom fed as dry whole grain. However, Hays (1) of the Delaware Experiment Station, conducted an experiment with pigs weighing from 65.1 to 78.9 pounds on the average, in which he compared soaking, grinding, and both grinding and soaking, with the whole dry rye and with hominy feed. Tankage was fed all lots as the protein supplement. The results of 80 days feeding showed the hominy feed lot to have made the fastest gains, 1.27 pounds, with the lowest feed per pound gain, 3.91 pounds. The whole rye and soaked rye lots made the same gains .91 pounds, with 4.96 and 5.71 pounds feed, respectively, per pound gain. The ground rye lot made 1.08 pounds gain per day on 4.36 pounds of feed, and the soaked ground rye lot made an average of 1.14 pounds gain on 4.51 pounds of feed per pound gain. Soaking the whole rye did not hasten the gains and increased the feed cost. Grinding the grain increased the rate of gain and lowered the feed cost. Soaking the ground grain increased the gains further but raised slightly the feed required per pound of gain. The two soaked lots showed practically the same daily feed consumption, 4.7 and 4.8 pounds of rye, which was some what higher than the whole rye lot or the ground rye lot, at 4.1 and 4.4 pounds, respectively.

In spite of these results, soaking is commonly considered to be a desirable practise as compared to feeding the whole dry grain. However, grinding is recommended by Henry and Morrison (2) as a much more desirable method of preparation.

Unfavorable Results with Rye

Beginning in 1923, Ferrin and McCarty (3) have conducted a number of experiments at the University of Minnesota dealing with the problem of rye as a hog feed. "At first the effort was made to devise satisfactory methods of utilizing rye when the grain is cheap in price but during the past year the trials have been planned to locate the causes of the unfavorable results obtained from rye feeding." This statement explains the results being obtained by these investigators. During this time 21 lots of pigs were fed, chiefly without pasture. The average initial weight per pig has varied in the different trials from 62 to 104 pounds, although the average initial weight per lot in each trial was comparable. The protein supplements used were tankage, buttermilk, tankage and alfalfa hay, tankage and rape pasture, and milk casein. The pigs were carried to an average final weight of 200 pounds except when it was found to be impossible to get them to that weight on some of the heavy rye rations.

Some of the combinations found most satisfactory were rye and creamery buttermilk in equal parts; ground rye $\frac{2}{3}$, ground oats $\frac{1}{3}$, plus tankage; and ground rye $\frac{1}{2}$, either ground corn or ground barley $\frac{1}{2}$, plus tankage.

Rye, tankage and minerals was found to be in some way deficient as a satisfactory ration and various substances were added in an effort to solve the problem. Neither vitamin A as contained in butterfat, the vitamins from cod liver oil, protein from milk casein, iron oxide, potassium iodide, nor alfalfa hay were found to furnish anything of significance in improving the ration. Cooking the rye resulted in lower rates of gain with increased feed costs. When some of these same pigs were changed to rations containing chiefly corn, the gains immediately jumped up and in some cases more than trebled, which showed the trouble to be in the ration rather than in the pigs. The question of feed intake is thought by Ferrin to be one for investigation.

The favorable results secured in feeding rye in Montana (4) led Ferrin and McCarty to get a shipment of Montana rye to feed alongside some Minnesota rye. The results obtained were very much the same, with the Minnesota rye holding a very slight advantage. In these trials during the winter of 1925-6, alfalfa hay constituted the only supplement fed with the rye. The pigs made fairly satisfactory gains with a moderate feed cost. In fact near the close of the experiment the results were considered

to be more satisfactory than had been the case with the rye and tankage ration.

Fieldsted and Potter (5) compared rye and wheat as the sole feed for fattening swine under Oregon conditions. The rye fed pigs gained an average of 1.06 pounds per day as compared to 1.6 pounds for the wheat fed pigs. The feed required for one hundred pounds gain was not so much different, however, 440 pounds of rye and 423 pounds of wheat. They concluded that rye as a sole feed for fattening purposes was not satisfactory since it was not so palatable and did not give returns equal to other grains. The rye-fed pigs were lacking very much in finish as compared to the wheat-fed pigs.

Eastwood (6) found that pigs weighing 44 pounds could not hog down rye in the field successfully. They made an average gain of only 0.51 pounds, although the feed required per hundred pounds gain was only 372 pounds. When fed rye and tankage in a dry lot for 112 days after 49 days in the rye field, these same pigs gained exactly 1 pound per day on 4.44 pounds of feed. A lot beside them on corn and tankage gained only 1.09 pounds per day, and required 3.99 pounds of feed for each pound of gain.

Kennedy, Evvard, Kildee and Robbins (7) received a return of only 9.4 cents per bushel for rye hogged down in the field with pigs weighing 70 pounds and rye yielding 41.25 bushels per acre.

Mumford and Weaver (8), on the other hand, obtained

an acre return of \$16.93 for an average of five years with rye yielding slightly less than 14 bushels per acre. One pound of gain was made for each 1.96 pounds of rye consumed. Other additional feed was fed at times.

Results at the Michigan Experiment Station

Brown, and later Brown and Edwards (9) of the Michigan Experiment Station, have also found some conflicting results in their rye feeding experiments. A ration has failed entirely in some trials to give results while the same or a very similar ration may give fairly good results in another trial. In November, 1923, a series of experiments was begun in which the ground grains of barley, rye and corn were fed with tankage as a protein supplement. In one series of three lots the ration was mixed and self-fed and in another three lots the grain and tankage were self-fed, free choice. In another lot the three grains were mixed equal parts and balanced with tankage. A simple mineral mixture was offered in self feeders. The pigs were thrifty spring pigs, weighing approximately 120 pounds. After 60 days on feed, the two corn lots averaged approximately 220 pounds per pig, one of the barley lots 183 pounds and the other 211 pounds, the mixed grain lot 186 pounds, and the rye lots only 136 and 126 pounds per pig. The feed consumption was small in the rye lots as compared with the other lots which would indicate that the palatability of the ration might be a limiting factor.

Four lots of pigs were started on feed by Brown

and Edwards (9) in March 1924, to compare the value of corn, oats and middlings in mixtures with rye and tankage. Two parts of rye was mixed with one part of the other grain and the mixture balanced with tankage. A lot fed corn and tankage mixed and self-fed was also used as a check. The pigs weighed 98 pounds when started on feed. At the end of 90 days the check lot averaged 233 pounds while the other lots varied from 158 to 174 pounds in weight. The corn mixture showed slightly superior to the other two, and the oat mixture a trifle better than the middlings. The check lot made an average gain of 1.52 pounds as compared to 0.67 pounds for the middlings lot. The feed consumption and the gains during the first 30 days were very good in the lot fed the mixture containing corn and the one containing oats. The mixture with middlings did not show so well, however. Even the second 30 days was still fairly good with those lots. During the last period the feed consumption fell markedly, and a loss in weight was shown by the corn and the oat mixture lots. While the middlings lot did not show a loss during this period, their gains were still very low. The behaviour of the two lots would indicate that there might be something lacking in the ration, or that something in the ration finally upset the system so that they did not relish the feed. It did not seem to be a simple case of palatability, however, since pigs on a fairly low feed intake usually continue to grow slowly and show a thrifty appearance.

In June, 1924, a lot of 17 pigs averaging 45 pounds in weight was started on a self feeder of rye and tankage on rape pasture. At the end of 60 days these pigs averaged 60 pounds in weight. Only a few days after the beginning of the experiment the pigs started to scour badly. Their consumption of tankage was very heavy, in fact it was found necessary to hand feed the tankage to keep them within reasonable limits. At the end of 60 days, the pigs were divided into two lots and an attempt made to get them on rations of rye and tankage and rye and buttermilk fed as slop feeds. They refused almost completely to take either ration for a period of 30 days, and were turned out to pasture on a mixed ration of corn, oats, middlings and tankage. They soon began to grow and take on flesh so that before winter they were all thrifty feeder pigs.

In fact some of these same pigs were in a drove that was sorted up in November of the same year and put on another experiment. Four lots of pigs averaging 125 pounds were fed on rations of rye, oats and tankage, with minerals in a simple mixture. Another lot was self-fed free choice on rye, tankage, and minerals. The four lots were all fed a mixture of oats 1 part and rye 2 parts, balanced with tankage. In one lot the mixture was self-fed, in another slop-fed, another mixture was soaked 24 hours before feeding and the fourth mixture was fermented with yeast for 24 hours. The average daily gain varied from 1.23 pounds in the self-fed mixture lot to 1.48 pounds in the yeast fermented lot, with

the self-fed free choice lot showing an average gain of 1.36 pounds. An average weight of 225 pounds was reached in each lot in from 68 to 79 days.

This trial would indicate that the age of the pig might change his appetite or make his system more tolerant of the disagreeable features of rye as a feed.

In January, 1925 another series of trials was launched at the Michigan Experiment Station (9) with a bunch of pigs averaging 70 pounds in weight. Identically the same rations were fed as in the previous trial. No lot made a satisfactory gain, in fact some of them were carried for a period of 171 days and had not yet reached a weight of 200 pounds. Contrary to the previous trial the self-fed mixture lot was highest in average gain and the self-fed free choice lot was second low lot. These pigs did not seem to relish their feed and they took on an appearance of unthriftiness, recognized by a harsh rough coat of hair and a listless attitude. Such a condition would again indicate that it was more than a mere case of unpalatability.

The average results of three earlier feeding trials are reported by Brown (11) in which rye compares very favorably with corn and barley. Neither the initial weights of the pigs nor the length of the feeding period is given. All feed was fed in self feeders. The rye and barley were ground and the corn fed as shelled corn. Arranged in order of rapidity of gains produced on the pigs, the rations

were as follows:

	Average da. gain lbs.	Feed per cwt. gain lbs.
Corn-tankage	1.56	477
Corn-rye-barley-tankage	1.50	487
Barley-tankage	1.31	515
Rye-tankage	1.24	493
Rye-barley-tankage	1.19	486
Barley-middlings-tankage	1.17	482
Rye-middlings-tankage	1.16	457

The feed consumed per hundred pounds gain does not follow the rate of gain, in fact the greater the gain the more feed required in many of the lots. The author concludes that "considering the rate of gain and time required to get the pigs ready for market the ration..... consisting of corn, rye, barley and tankage and the ration of corn and tankage proved most satisfactory. ... The above experiments would show that a much better return would be received from rye and barley when fed in combination with some middlings in addition to the tankage."

Other Favorable Results

Ferrin and Winchester (12) report an experiment in which 60 pound pigs were fed on various grains both free choice style and in mixtures. On a percentage basis of efficiency in production of gains, the rations ranked as follows: ground rye-ground wheat equal parts, 491.5 lbs., 100%; ground corn-tankage free choice, 507.5 lbs., 96.85%;

ground rye-tankage free choice, 510.18 lbs., 96.34%;
ground rye-ground corn equal parts, tankage self fed,
518.08 lbs., 94.87%; ground rye-shorts equal parts, 553.14
lbs., 88.86%.

A preliminary report of hog feeding trials in Montana (4) gives some comparisons of barley and rye as feeds for hogs. Four trials were conducted, chiefly under dry-lot conditions with alfalfa hay in racks. Quite consistent results were obtained both when fed alone and in combinations. The barley seemed to be the more palatable feed and the hogs gained a little more rapidly. Considering the cost of gains, there seemed to be but little difference in the rations irrespective of the proportions of rye or barley contained. The rye fed pigs ate somewhat more alfalfa than the barley fed pigs. The rye produced a larger percentage of lean meat and the hogs fed largely on this grain were preferred by local butchers.

Gibson (13) fed three lots of pigs during the winter with mixed rations containing shorts and tankage and combined with either barley, oats or rye. The average initial weight was approximately 120 pounds and the feeding period 62 days. The barley lot gained 1.59 pounds per day on 315.4 pounds of feed per hundred pounds gain. The other two lots gained at the same rate but somewhat slower than the barley lot, 1.35 pounds, and at a greater feed requirement, 360.4 and 364 pounds. Still the rate of gain was good and the feed requirement low.

Mathews (14) fed another bunch of 54 pound pigs comparing oat chop with mixtures of oat and rye chop, and oat and barley chop. The average daily gains were 1.21, 1.33 and 1.35 pounds, respectively. The feed per hundred pounds gain was 520, 551 and 535 pounds, respectively. The rate of gain was fairly good and the feed requirement was not especially high considering the type of ration.

Snyder (15) summarizes two series of seven lots each and ten pigs per lot, one series with alfalfa hay in racks and the other without: "Ground rye moistened ranked slightly lower than ground wheat moistened and higher than shelled corn in rapidity of gain and slightly lower than corn in the amount of grain to produce 100 pounds of gain. This would make the feeding value of ground rye and shelled corn about equal per bushel for fattening hogs. Grinding the rye increased its feeding value 15 per cent and also increased the rate of gain. Whole rye was unsatisfactory. It produced slow gain and required too much grain for the gains produced. One bushel of corn produced the same gain as 1.16 bushels of whole rye."

Hays (4), as mentioned before, obtained only fair gains, 1.08 and 1.14 pounds, on ground rye fed dry and soaked. However, the feed required was relatively low, 436 and 451 pounds, respectively, per hundred pounds gain.

Faville (16) secured very good results in feeding rye to fattening pigs farrowed during the previous summer and carried through the winter on a maintenance ration.

Starting at a weight of 88 pounds, an average gain of 1.53 pounds was made on rye and water as compared to 1.46 pounds on barley and water for a period of ten weeks. The feeds were soaked during the last four weeks of that time and greater feed consumption was noted but less gain per pound of feed than was made earlier in the period. He attributes the less gain late in the feeding period to the fact that the hogs were near a market finish.

Hultz (17) draws the following conclusions from the first years work in feeding rye to fattening pigs:

- "1. Ground rye ranked highest and above shelled corn for producing rapid gains on fattening pigs.
- "2. Less grain was required for 100 pounds gain when rye was fed than when the grain consisted of hulled barley, bald barley, or shelled corn.
- "3. Pigs receiving bald barley or rye as a grain feed consumed a relatively negligible quantity of mineral mixture.
- "4. Pigs fed corn and bald barley dressed a higher percentage of carcass to live weight than pigs fed rye or hull barley.
- "5. Pigs receiving bald barley, rye or shelled corn finished with the fat in good hard condition. Hull barley produced a flabby, oily, fat.
- "6. In general, it appears that Wyoming small grains can be very profitable substituted for corn in a fattening ration, and that either bald barley or rye is superior to hull barley for this purpose."

Freeman (18) reports quite a few farmers in the

State of Michigan who get good results in feeding rye to growing fattening pigs during the summer. In fact one or two ton litters have been produced with a considerable percentage of rye in the ration. In most cases the farmers who get good results from rye are feeding it with milk in the form of a slop, and many of them allow the rye to soak in the milk from one feed to the next. The milk is no doubt sour before it is fed when it is allowed to stand.

Some Laboratory Experiments

Osborne and Mendel (19) made a comparative study of barley, oats, rye and wheat as sources of protein in rations for rats. The finely ground entire grain was fed with an adequate salt mixture and sufficient butter fat to supply the fat soluble vitamin. It was considered that the grains supplied ample water soluble vitamins B and C. "Barley proteins as a whole were sufficient for nutrition and growth. The total protein of oats and wheat was also adequate for nutrition and growth. Rye gave rise to growth but rats failed to attain large size and showed exceptionally high mortality on prolonged feeding. This mortality can scarcely be attributed to the rye proteins. Gliadin is comparatively deficient in lysine, containing enough of that amino acid for repair, but insufficient to produce growth."

McCollum et al (20) conducted a series of experiments with rats dealing with the supplementary value of proteins derived from two seeds. Rations were prepared

each containing 9 per cent protein derived from two seeds, one furnishing two-thirds and the other one-third of the total protein, supplemented with dextrin, certain salts and fat-soluble vitamine A. The growth curves on these rations were compared with those on diets containing 9 per cent of cereal grain proteins which have been shown to bring about growth at approximately half the normal rate. "The most interesting point brought out by the growth curves in these experiments is the failure of the proteins of two seeds to supplement each other to any greater degree than they do in most cases,.....one striking exception noted was the case of six per cent rye protein and three per cent flaxseed protein. This mixture has superior biological value to an equal amount of protein from any single variety of seed yet examined. Indeed this proportion appears nearly or equal to milk protein for growth. Charts show much better growth secured with a ration containing eight per cent protein from milk powder than with nine per cent protein from wheat, rye, maize, flaxseed, barley, oats or kaffir, and that in a mixture of rye and flaxseed, six per cent and three per cent, protein was secured which has superior biological value to an equivalent amount of protein from any single variety of seed yet examined." With the protein from rye alone two females produced three litters. The mothers were aged at eight months. Only in case of wheat was another litter born, and no others were weaned from single grains.

In another trial, McCollum, Simmonds and Parsons (21)

fed a lot of rats on a nine per cent protein ration derived from rye six per cent and milk powder three per cent. Growth was slow but the animals reached nearly the adult size after some delay. These rats aged decidedly early, they looked old at fourteen months. The second generation were all more undersized than the first. Of three females, two were sterile, the other had 28 in three litters. In a ration with maize substituted for rye, growth was slow but the animals reached nearly the full size. All three females were sterile. The hair was short and silky, suggestive of a moleskin.

Osborne and Mendel (22) fed other groups of white rats finely ground seed of barley, oats, wheat or rye each mixed with three per cent solution of salt mixture, five per cent butter fat, and corn starch sufficient to make the total protein of the ration five, eight, or ten per cent. They concluded that the total proteins in the kernels of the grains studied can furnish all the nitrogen units essential for growth if the intake of food and its concentration of protein are adequate, and the proteins of the four grains are not widely different in their efficiency in promoting growth. "Many ultimate failures of growth and well being and numerous deaths were encountered in the later periods of many of the experiments, but sufficient successful prolonged growth in the case of all the cereals studied has been observed to make it unlikely, not to say improbable, that the protein factor is responsible for this

untoward outcome of many of the cereal experiments."

Further Chemical Phases

Studies of the chemical nature of the subject seem to cause almost as much difference in results and equally as much difference in their interpretation as do the more simple feeding experiments.

Ostwald (23) made a study of the proteins of wheat and rye in their relation to the colloidal chemistry of bread making. He found that "gliadin behaved in a manner similar to that of other proteins. The particles are charged positive in acid, negative in alkali and near neutral in pure water. Under the influence of acid or alkali gliadin swells, suffers dehydration and the neutral particles become ionized because salts are formed. The properties of gliadin from rye differ very little from those of wheat gliadin."

Groh and Friedl (24), on the other hand, found considerable difference between wheat gliadin and the proteins from rye meal. The several fractions of gliadin obtained from wheat gluten and rye meal were examined by physico-chemical (colloidal chemistry) methods. They found wheat gluten to contain only one individual protein soluble in alcoholic gliadin. The protein extracted from rye meal is a mixture of several proteins whose separation is very difficult. A preparation identical with wheat gliadin could not be obtained. The methods used were viscosity determination according to Scarpa, estimation of surface

tension, specific rotation, gold number according to Zsigmondy, and refraction."

The following conclusions concerning the supplementary value of protein and of amino acids were made by McCollum, Simmonds and Parsons (25) in discussing the results of a series of experiments dealing with the feeding of legume seeds: "It is a most remarkable fact that the legume seeds when combined with each other do not form protein mixtures which are superior to the proteins of the individual seeds themselves. This is apparently to be explained on the assumption that a certain amino acid, which is present in such small amounts as to be the limiting factor in determining the biological value of the proteins of these seeds, is the same in each of the legume seeds used in these experiments. Otherwise, it seems that a supplementary effect should have been observed in some of these combinations. It is by no means demonstrated that all the indispensable amino acids have been indentified, but if one may judge from the recorded data relating to yields of various amino acids it seems suggestive that the low content of cystine yielded by legume proteins may be the explanation for their failure to enhance each others values when combined."

In an earlier article, Hart and Bentley (26) take a somewhat different view of the situation. "It is needless to say that the hopes expressed in certain quarters of formulating rations on their amino acid content, secured by

direct hydrolysis will not even begin realization until at least safer methods for the quantitative estimation of these substances are available. The very fact that there is no approximate agreement between the results secured by Grindley on cottonseed meal and those of Nollan on the same material indicates inherent difficulties in the quantitative estimation of amino acids by direct hydrolysis of the feeding stuff.

	arginine	lysine
Grindley	19.5%	4.7%
Nollan	12.7%	1.9%

"..... the amide nitrogen of feeding stuffs is largely composed of free amino acids and peptide linkings. In most cases the nitrogen in these structures constitutes fifty to seventy per cent of the water soluble nitrogen. The acid amide nitrogen is relatively small, seldom exceeding twenty per cent of the water soluble nitrogen and more often below ten per cent. Corn stover is an interesting exception, showing approximately forty per cent of the water soluble nitrogen in acid amide form. The ammonia nitrogen rarely exceeds five per cent of the total water soluble nitrogen and in some cases was wholly absent."

The following table shows the distribution of nitrogen in the various proteins as determined by Turner and Spears (27):

	Rye grain	Wheat bran	Maize kernel	Oat grain	Barley grain	Swift's digester tankage
	%	%	%	%	%	%
Ammonia N.	15.	9.67	4.63	13.31	16.19	10.03
Melanin N.	1.54	13.75	7.	2.97	2.87	6.88
Cystine N.	2.2	5.96	4.06	4.48	4.38	2.46
Arginine N.	10.49	12.53	16.19	11.42	8.65	12.34
Histidine N.	10.48	3.84	4.45	9.58	6.7	2.18
Lysine N.	1.24	4.04	8.53	0	0	2.5
Amino Nitrogen of filtrate	37.96	49.95	49.69	43.49	44.16	54.73
Mono-amino acid						
Non-amino acid of filtrate	21.63	0	0	11.29	18.37	9.01
proline, oxy- proline, tryptophane etc.						
Total	100.52	99.74	94.55	96.54	101.32	100.13

A study of this table indicates that rye is not particularly low in any of the nitrogen forms except in those in which the other grains that give very good results as feeds for livestock are also approximately as low. Probably, cystine has given the most noticeable results in nutrition experiments of any of the known nitrogen carrying compounds. Osborne and Mendel (28) concluded that "such information as we have indicates lysine and tryptophane are relatively abundant," in the ration under investigation. "The addition or withdrawal of cystine facilitates or represses growth at will." The cystine content of rye is approximately half of that of any of the other grains and slightly less than that of tankage. However, the addition

of these other grains to a ration of rye and tankage does not improve the ration as much as might be expected, and the addition of wheat middlings, which should show much the same analysis as wheat bran, has given poorer results than the addition of the other grains although it is considerable higher in cystine than the grains. Such results would tend to eliminate the theory of a lack of amino acids in the ration. The indifferent results from rations containing various protein supplements which are recognized as efficient supplements to any of the other grains would further tend to eliminate such a conclusion.

Digestibility

Digestion trials were conducted with sheep fed the brans of wheat and rye in conjunction with meadow hay and dried Brewers yeasts by HonCamp and Nolte (29). The flour extraction was made in three different degrees. These trials showed that the crude protein of the wheat bran was slightly more digestible than that of the rye bran with a smaller extraction of flour. The ether extract, or fat, of the wheat bran was more digestible than that of the rye bran in all cases. The nitrogen free extract of the rye bran was less digestible with a heavy extraction of flour but more digestible with a lighter extraction. The organic matter and crude fiber of the rye bran was more digestible in all cases.

A digestion experiment of coarse rye meal and coarse wheat meal was conducted by HonCamp, Neumann and Mullner (30)

with both sheep and swine. The protein of rye was slightly less digestible in the case of the sheep than was the protein of wheat but was practically the same in the case of swine. The fat was more digestible in wheat meal in both trials. The crude fiber of the wheat was slightly more digestible. In all other nutrients there was very little difference but slightly in favor of the rye meal.

It was estimated that the meals of rye and wheat vary in digestibility according to the degree of grinding, the coarser meals being invariably the more digestible.

Conclusions

A survey of the experiments cited shows a wide variation in the rates of gain made by the pigs in the different trials conducted. In some cases the pigs have done almost as well as in the check lots fed a recognized standard ration. In other cases very disappointing results have been secured. A study of the feed consumption indicates that in most cases fairly good gains were made for the feed consumed, regardless of the rapidity of gains. The pigs sometimes made very good gains for a time on feed and then more or less suddenly dropped off in the feed consumption and in the rate of gain. In fact, it appears that the pigs either do well on rye ration or else they practically refuse to do at all.

A more detailed study of several of the experiments conducted at the Michigan Agricultural Experiment Station shows that in the same lot some pigs may eat well, gain well

and present a very thrifty appearance while other pigs make a complete failure of the fattening and growing process. The ability of such pigs to thrive and make satisfactory gains when removed from the lots and put on most any type of standard ration indicates that it was a fault of the ration rather than of the pig. Although no data is available comparing pigs fed on rye with pigs fed on a similar energy or total nutrient intake of other feeds, these pigs that fail to thrive on a lighter ration than is necessary for satisfactory gain do not present the thrifty appearance of growing pigs that are often being carried on a limited ration of other feeds. The question of mere palatability of the ration would thus seem to be somewhat upset, although it may still be quite a factor, especially in the rations fed in self feeders.

No consistent results have been obtained that would indicate the need for a study of the proteins.

The excellent condition of the bones of the pigs fed at the Michigan Station, the lack of any particular craving for minerals when fed on rye, and the complete failure of some pigs to thrive when on pasture, or when offered other mineral and vitamin carrying feeds under favorable conditions, helps to eliminate minerals as a vital consideration.

Neither do such substances as butterfat, cod liver oil, milk casein, iron compounds, or potassium iodide seem to have lent any beneficial effects to otherwise apparently

complete rations.

The following investigational work was therefore planned with the idea that there may be some factor present, or absent, in those cases in which favorable results are obtained, and that same factor may be omitted, or present, in those cases in which entirely unfavorable results are obtained. If that factor, or at least its sources, can be determined by some means, then successful rations may be intelligently planned.

EXPERIMENTAL FEEDING TRIALS

Experiment I.

July 10--November 7, 1925

120 days

Objects of the Experiment

The object of this series of feeding trials was to determine, if possible, the factor, or factors, that are contained in rye which are different from those in the other grain feeds and which often seem to have a detrimental influence on the animals fed largely on rye. As noted in the review of literature, the pigs do not seem thrifty when they are consuming a light ration consisting largely of rye. On a similar light feed of other grains the pigs have a thrifty appearance as a rule even though they are making light gains.

The feed required per pound of gain, when rye fed pigs are making somewhat less than normal gains for pigs of such weight, would indicate that the ration was being well digested.

The absolute failure of some lots of pigs and of individual pigs in a lot to make even a fair gain on a ration that has given good results with other pigs would indicate there might be some factor that is not so detrimental to some pigs and yet others may not be able to tolerate it at all. The tendency of a few pigs to gain well for a short time and then suddenly go to pieces would also tend to substantiate this theory.

The experiment was planned with the idea of comparing some of the more satisfactory rations previously fed with some of those which have given good results in one case and not so good results in others. Also some other rations were included which it was thought might have some effect on the results.

Palatability no doubt deserves some consideration in the study of rations containing an appreciable percentage of rye.

Plan of Experiment

1. Tankage was compared with buttermilk as a source of protein and as an appetizing agent.
2. Linseed oilmeal was added to the rye and tankage ration to test its supplemental protein value and also any possible appetizing or conditioning values.
3. Locust bean meal was added as an appetizing agent.
4. Codliver oil was added to test any possible vitamin deficiencies and also for its lubricating value.
5. Fresh-cut green alfalfa was compared with alfalfa hay as a carrier of minerals and vitamins.
6. A fresh mixture of buttermilk and rye was compared with a similar mixture soaked twelve hours, as a palatability factor.

Since the results studied indicate that older and heavier pigs have less difficulty with rye rations than do younger pigs, it was planned to start a bunch of healthy, growthy pigs on feed soon after weaning in the spring and carry them on a full feed until they reach a marketable weight. Weights were taken regularly and a careful check kept on the condition and progress of each pig throughout the experiment.

Previous Treatment of Pigs

Three litters of late pigs had been weaned about two weeks before they were started on experiment. They had been treated for round worms with an organic iodine compound by Dr. Chandler, of the Bacteriology Department of the

Michigan State College. Previous to weaning a self feeder containing a mixture of cracked corn, ground oats, middlings and tankage had been accessible since the pigs would take the feed. All of the pigs seemed to be healthy and thrifty when the trials begun.

Alotment of Pigs

The pigs were divided into seven lots as near equal as possible according to breed, weight, sex, type and thriftiness. There were six Duroc Jersey pigs, seven Hampshires and eight Berkshires available for use from the three litters, so that there was one of each breed for each lot except one, which was composed of two Berkshires and one Hampshire.

Method of Weighing

Weights were taken at eight to nine o'clock in the morning on weigh days. The pigs were weighed for three mornings in succession at the beginning of the experiment and the average of the three weights taken as the initial weight. The first experimental feed was given at the evening feed of the second day.

Lot weights were taken every ten days and individual weights every 30 days.

A quantity of feed was mixed for each lot, or lots receiving the same grain ration, and each feed was weighed from the box and recorded on a sheet for that purpose.

All records were kept in a loose leaf note book prepared for the purpose.

Lots, Water, Etc.

Each lot of pigs was kept in a pen in the College central hog house with an adjacent outside yard for exercise and sunshine. Both the inside pen and the yard were floored with concrete. Good ventilation made the quarters very comfortable during the warm weather.

All the fresh water desired was allowed at noon in the concrete feeding trough. Slat racks were provided for the alfalfa hay or green forage. Self feeders were used for mineral mixture and salt.

Rations Fed and Method of Feeding

Lot 7 received fresh green alfalfa similar to good tender pasture once daily. All other lots were allowed good quality, bright green alfalfa hay in racks which were kept filled at all times. The rack was fastened to the partition fence and two lots ate from it.

A simple mineral mixture of ground limestone, acid phosphate and salt was allowed each lot. Very little was consumed, however, and later salt was supplied as desired.

The grain rations were fed twice daily according to the appetite and were composed as follows, all containing the same nutritive ratio as near as possible and balanced according to Morrison Standard.

Lot 1. Ground rye and tankage fed as a slop with water.

Lot 2. Ground rye, tankage and oilmeal, fed in a similar manner to Lot 1.

Lot 3. Ground rye, tankage and locust bean meal fed in similar manner to Lots 1 and 2.

Lot 4. Fed the same mixture as Lot 1 with cod liver oil added and fed in a similar manner.

Lot 5. Ground rye and buttermilk, mixed and fed as a slop.

Lot 6. Ground rye and buttermilk, mixed, soaked 12 hours, and fed as a slop.

Lot 7. Fed the same grain ration as Lot 1 and fed in a similar manner.

Treatment for Parasites

All pigs were given oil of chenopodium and castor oil for worms on the 35th day of the experiment and again on the 72nd day.

Experimental Data

The following tables will be found in the appendix:

Table I	Weights of pigs by periods.
Table II	Total gain per lot of thrifty pigs by periods.
Table III	Feed consumption by periods.
Table IV	Feed deducted for pigs removed.
Table V	Feed consumed by thrifty pigs by periods.

Gains of Pigs

Since the main object of the experiment was to find a ration that would produce satisfactory growth and gain rather than to compare the value of the rations for producing economical gains, a study of the gains made by each pig will be considered first.

Table 1
Gains of pigs by periods

Lot 1		Tankage check lot			
		B.S. 9	D.S. 15	H.B. 3	Total
		lbs.	lbs.	lbs.	lbs.
1st.	35 days	6	29	31	66
2nd.	31 "	13	31	38	82
3rd.	30 "	-2 (10 da)	35	39	72
4th.	24 "	removed	36	35	71
Total 120 days		(17)	131	143	291
Av. daily gain		(.224)	1.092	1.192	.921

Lot 2		Linseed oilmeal			
		B.S. 29	D.S. 5	H.B. 43	Total
		lbs.	lbs.	lbs.	lbs.
1st.	35 days	15	29	22	66
2nd.	31 "	25	29	32	86
3rd.	30 "	5	36	32	73
4th.	24 "	2 (10 da) removed	27	26	55
Total 120 days		(47)	121	112	280
Av. daily gain		(.443)	1.008	.933	.809

Table 1 continued
Gains of pigs by periods

Lot 3	Locust Bean Meal	B.S. 49	D.B. 15	H.B. 33	Total
		lbs.	lbs.	lbs.	lbs.
1st. 35 days		22	24	22	68
2nd. 31 "		20	34	26	80
3rd. 30 "		25	41	47	113
4th. 24 "		15	35	33	83
Total 120 days		82	134	128	344
Av. daily gain		.683	1.117	1.067	.956

Lot 4	Cod liver oil	B.S. 19	B.B. 419	H.B. 13	Total
		lbs.	lbs.	lbs.	lbs.
1st. 35 days		9	19	32	60
2nd. 31 "		6	22	42	70
3rd. 30 "		-2 (10 da)	28	51	77
4th. 24 "		removed	25	27	52
Total 120 days		(13)	94	152	259
Av. daily gain		(.171)	.783	1.267	.82

• • • • •

•
•
•
•

• • • • •

•

• • • • •

•
•
•
•

• • • • •

•

Table 1 continued
Gains of pigs by periods

Lot 5 Fresh Buttermilk

	B.S. 39	D.B. 5	H.B. 23	Total
	lbs.	lbs.	lbs.	lbs.
1st. 35 days	4 (34 da)	32	29	65
2nd. 31 "	died	45	31	76
3rd. 30 "	worms	33	41	74
4th. 24 "		3.3	35	68
Total 120 days	(4)	143	136	283
Av. daily gain	(.1180)	1.192	1.133	1.033

Lot 6 Soaked Buttermilk

	B.S. 59	D.B. 25	H.S. 3	Total
	lbs.	lbs.	lbs.	lbs.
1st. 35 days	28	30	30	88
2nd. 31 "	31	40	37	108
3rd. 30 "	37	32	46	115
4th. 24 "	23	19	31	73
Total 120 days	119	121	144	384
Av. daily gain	.992	1.008	1.2	1.067

Table 1 continued

Gains of pigs by periods

Lot 7	Fresh Alfalfa	B.B. 29	D.S. 25	H.S. 13	Total
		lbs.	lbs.	lbs.	lbs.
1st. 35 days		22	33	23	78
2nd. 31 "		36	38	27	101
3rd. 30 "		20	40	35	95
4th. 24 "		-3 (10 da) removed	17	22	36
Total 120 days		(75)	128	107	310
Av. daily gain		(.708)	1.067	.892	.896

Some Pigs Fail to Gain

It will be noticed that no pig in any lot made as fast a gain as would be expected when fed on a good ration. The majority of pigs, however, made a consistent gain throughout the feeding period. One pig in Lot 5 died on the 34th day and an autopsy showed a bad infestation of round worms in the intestines. The remaining pigs were treated for worms and a large number were expelled. All pigs received a similar treatment again on the 72nd day, but no worms were found.

One pig in Lot 2 showed a very good gain the first

66 days and then failed to make a further appreciable gain. One pig in Lot 7 made a fair gain the first two periods but began to drop off during the next period and later lost rapidly in weight. One pig in Lot 1 and one in Lot 4 never did make even a fair gain at any time.

At the time a failure to gain is noticeable, it was also noted that those pigs were not consuming their share of the ration offered the lot. They would eat very sparingly of the slop-fed grain ration and exhibit a dissatisfied, hungry and somewhat irritable attitude. After once going off feed, none of them ever improved in appetite or showed a noticeable gain in weight as long as they remained in the lots.

After being removed from the lots on the 76th day, the two pigs from Lots 1 and 4 were fed on rye and butter-milk for 44 days in an attempt to get them to take more feed. They ate a very little, however, and made only very small gains.

The pig from Lot 4 was killed at this time, and a thorough autopsy conducted by Drs. Hallman and Sholl, of the Department of Pathology. No indications whatever could be found of any physiological or pathological disturbance which might be responsible for the failure to thrive.

The pigs that had been removed from lots 1, 2 and 7 were put on a number of miscellaneous feeds in self feeders on the 120th day of the experiment. The following feeds were available: shelled corn, ground oats, ground barley,

ground rye, middlings, wheat bran, linseed oilmeal, locust bean meal, tankage, charcoal, mineral mixture and alfalfa hay. Buttermilk was also fed according to the appetite.

A ravenous appetite was manifested for shelled corn. A moderate amount of buttermilk was taken. A small amount of each of the other grains was eaten and a moderate amount of linseed oilmeal was desired but only a very little tankage. Some alfalfa hay was eaten.

The gains immediately showed the effects of the feed being eaten. There was not so great an increase in gain during the first 20 days as there was during the second twenty days, however, the pigs showed more life and vigor, and their coats took on a sleek, shiny appearance. The pigs from Lots 1 and 2 weighed 63 and 73 pounds when turned loose to the feeders and 40 days later they weighed 119 and 138 pounds, or an average gain of 1.4 and 1.6 pounds per day. The pig from Lot 7 had not been in an unthrifty condition as long as the other two, but he was slower to get under way again. Starting at a weight of 117 pounds, he weighed 160 at the end of 40 days, an average gain of 1.07 pounds.

These three pigs were put back on a ration of one part rye and two parts buttermilk after 40 days on the self feeders. Alfalfa hay was also allowed in a rack and mineral mixture and salt in a feeder. Practically no mineral was eaten but some salt was relished. Some alfalfa was also eaten.

The grain feed was consumed very readily for a period of 61 days and they were fed all they cared for.

The gains continued even better than they had been during the last part of the time on the self feeders. On February 16, the weights were 237, 259 and 272 pounds, or an average gain of 1.9, 2.0 and 1.8 pounds per day.

The barrow from Lot 7 was slaughtered and the carcass showed to be in prime condition and very firm.

The two gilts were continued on rye and an attempt made to breed them. In fact they were bred February 5. One received rye and alfalfa until March 12, and the other received rye and buttermilk. The ration was cut down considerably in order to reduce their fattened condition. On March 12 both gilts were put on rye and water and the feed continued until May 12. On that date they weighed 327 and 340 pounds, showing slightly over a pound gain per day.

One gilt was then put on a ration of rye and buttermilk and the other continued on rye and water. On July 12 they weighed 400 and 330 pounds. The one on rye and milk still continued her gain of better than a pound a day, but the other gilt did not eat her feed well and later lost quite a little that she had gained previously so that she showed a loss of 10 pounds in 61 days.

Neither gilt proved to be pregnant although they had been bred several times. Their heat periods did not occur as regularly as is commonly found in swine.



All the Pigs Gain Well on Corn

All the other pigs were changed from the rye rations on November 7 and put on slop rations of corn, tankage and linseed oilmeal, with alfalfa hay supplied. They were sorted into three lots according to size, with the large and small pigs separate. The rate of gain during the next 30 days was practically the same in all the lots, the average rate being 1.6 pounds per day. The lightest gain was made by one of the heaviest pigs and the heaviest gain by one of the lighter pigs, 1.3 and 2.2 pounds, respectively.

Conclusions

1. There seems to be little difference among these rye rations in effectiveness for producing satisfactory gains on growing fattening pigs, with the possible exceptions of the buttermilk lots. Even then Lot 5 shows only slightly faster gain than Lot 1, and Lot 6 slightly less. The one pig in Lot 6 did not do so well as the other two but it did finish the trial with a consistently steady rate of gain.

2. No ration has produced a satisfactory rate of gain at any time during the experiment.

3. No pig has produced an entirely satisfactory gain throughout the period of rye feeding although all of them made good gains on the corn ration.

4. The fact that most of the pigs in the experiment produced a fairly good and a fairly uniform gain, and that those that failed to gain on the rye rations did gain well

on the self feeders, indicates that the trouble was not in having pigs who were poor feeders but that the rye rations affected them in some adverse way.

5. The ability of the poor doing pigs to continue to gain on the rye ration after a short period on other feed again suggests the point of age as a factor.

6. A very heavy feed of alfalfa was taken by the pigs in all lots, so much so in fact that practically all the pigs looked extremely paunchy throughout the feeding period. A more restricted alfalfa ration might furnish the necessary beneficial factors in the ration and still leave more capacity for increased grain consumption.

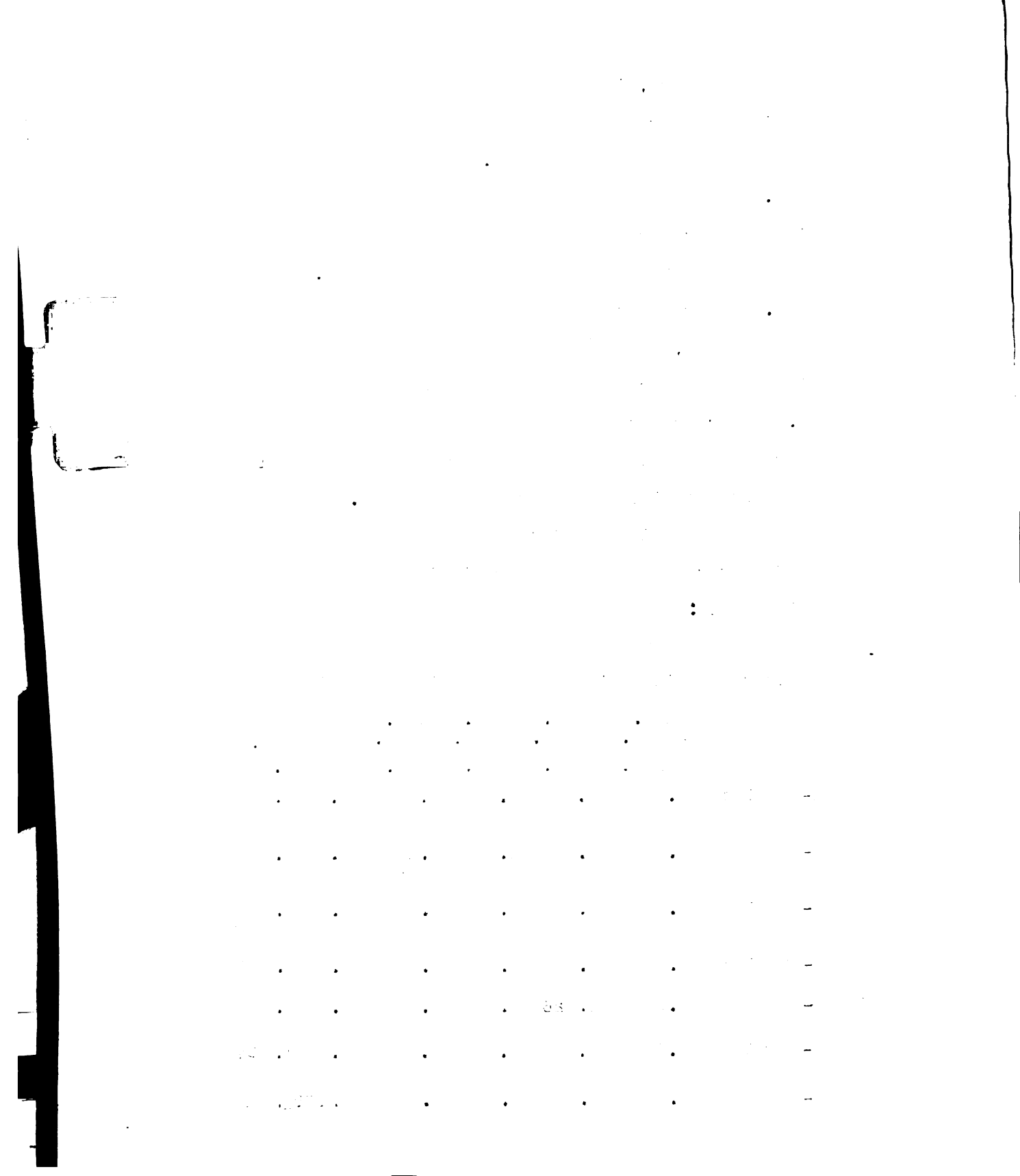
Gains of Thrifty Pigs

The average daily gain per pig is shown in the following table:

Table 2

Average daily gain of thrifty pigs by periods

	1st. 35 da. lbs.	2nd. 31 da. lbs.	3rd. 30 da. lbs.	4th. 24 da. lbs.	Total 120 da. lbs.
Lot 1- 2 pigs	.857	1.113	1.233	1.479	1.142±.023
Lot 2- 2 pigs	.728	.984	1.133	1.104	.971±.018
Lot 3- 3 pigs	.648	.86	1.255	1.153	.955±.075
Lot 4- 2 pigs	.728	1.032	1.317	1.083	1.025±.115
Lot 5- 2 pigs	.871	1.226	1.233	1.417	1.162±.014
Lot 6- 3 pigs	.838	1.161	1.278	1.014	1.066±.037
Lot 7- 2 pigs	.8	1.048	1.25	.813	.979±.042

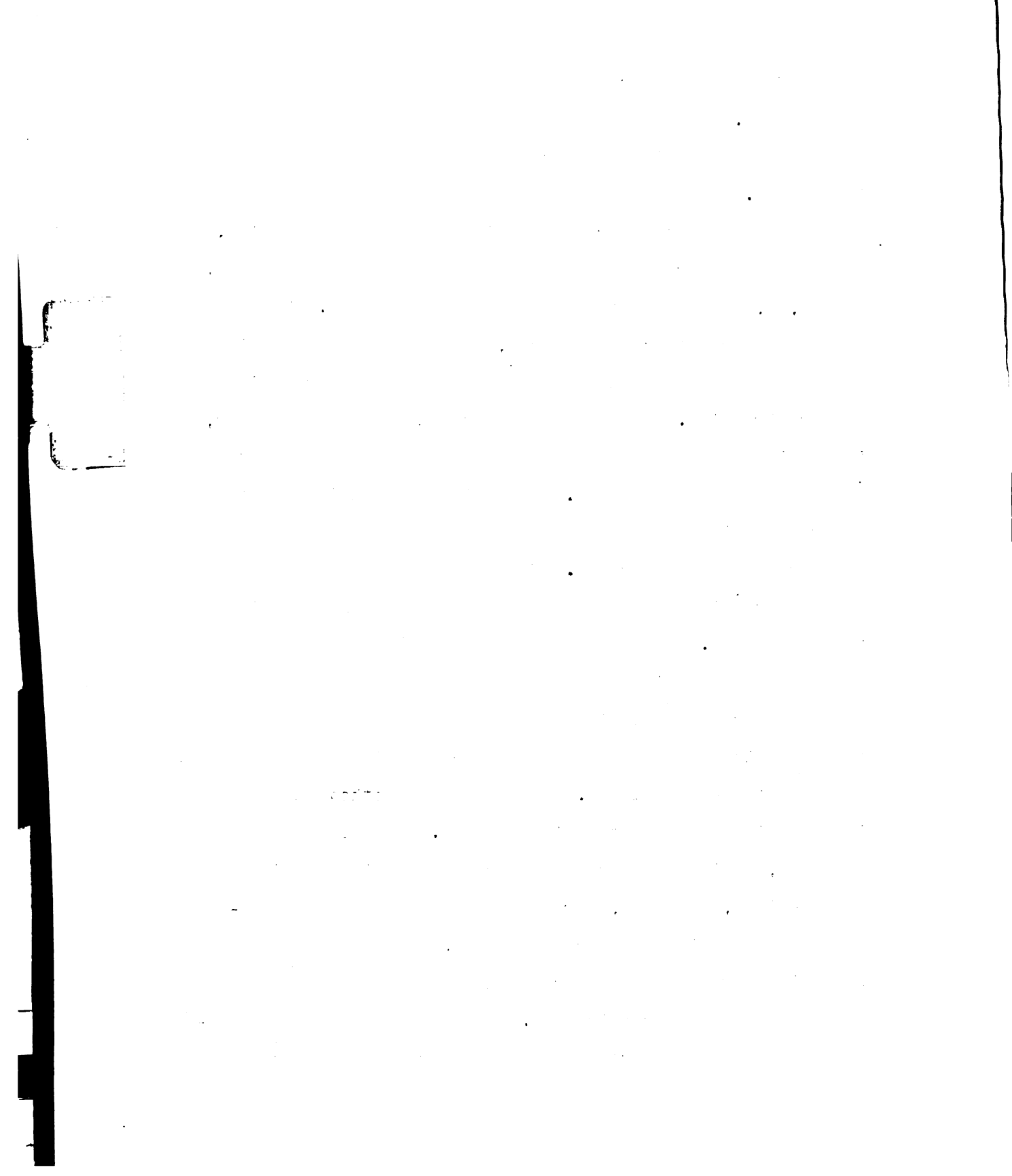


The probable error has been figured for the entire period only.

This table illustrates more clearly the data shown in Table 1. Lots 1 and 5 are the only ones which show a consistent increase in rate of gain throughout the period. Each of the others shows a decrease during the last period. Lots 2, 3, and 7 show the smallest rates of gain. Lot 4 shows the largest probable error, which indicates that in another trial the results might be somewhat different in either direction. Lot 5 shows the smallest probable error, indicating that its rate of gain is fairly representative for that set of conditions. The gain in Lot 1 is almost as great as in Lot 5 and more than one tenth of a pound greater than any other lot. The pigs in the milk lots showed more finish and looked more thrifty than those in the other lots.

Comparison of Rations

The rations fed in the different lots are compared on the basis of the thrifty pigs which continued on feed throughout the experiment. The following method was used in deducting feed for the pigs removed. The figures by Dietrich, which are given by Henry and Morrison in "Feeds and Feeding", page 606, were used as a basis for the calculations of maintenance requirements. One tenth pound digestible protein per hundred pounds live weight was used as the maintenance requirement. The total nutrient requirement was determined from the nutritive ratio of the ration



consumed. Subtraction of the maintenance requirement for the initial weight of the lot for the period, from the total nutrients consumed during the period, leaves the nutrients remaining for the gain that was made. The percentage of the nutrients required for maintenance and gain of the pig removed gives the percentage of the ration consumed by that pig. If the pig lost in weight, it was considered that only enough feed was consumed to maintain the low weight, and of course no gain was credited.

The feed analyses were obtained from Table III of the appendix to "Feeds and Feeding" by Henry and Morrison, Eighteenth Edition, except for locust bean meal which was analysed by the Experiment Station Chemistry Department of Michigan State College. The digestibility of the locust bean meal was considered to be the same as for shelled corn as given in Table II in "Feeds and Feeding".

An example of calculation is as follows:

Lot 1

First 35 day period

Final Wt. 180 lbs. Initial Wt. 114 lbs. Gain 66 lbs.

35 da. feed for lot		Digestible Crude Protein	Total Digestible Nutrients
	lbs.	lbs.	lbs.
Ground Rye	178.4	17.662	144.504
Tankage	19.6	11.015	13.994
Alfalfa	45.	4.77	23.220
Nutritive Ratio	1:4.43	33.447	181.718

35 da. feed for lot	Digestible Crude Protein	Total Digestible Nutrients
lbs.	lbs.	lbs.
Nutrients for daily maintenance per cwt.	.10	.543
Nutr. for 35 da. maint. per cwt.	3.5	19.005
Nutr. for 35 da. maint. of 114 lbs.	3.99	21.666
Nutr. remaining for 66 lbs. gain	29.457	160.052
Nutr. for 1 lb. gain	.4463	2.425
B. S. 9 for 35 lbs. maintenance	1.225	6.652
For 6 lbs. gain	2.678	14.55
Total	3.903	21.202
Percentage of lot total consumed by B.S. 9	11.67	11.67

Therefore

	Gr. Rye	Tank.	Alfalfa
B.S. 9 ate 11.67% of feed consumed by the lot	20.8	2.3	5.3
Total feed consumed by lot	178.4	19.6	45
With B.S. 9 out, total feed	157.6	17.3	39.7

The average daily ration consumed per pig is shown
in the following table:

Table 3

Average daily ration per pig

	1st. 35 da. lbs.	2nd. 31 da. lbs.	3rd. 30 da. lbs.	4th. 24 da. lbs.	Total 120 da. lbs.
Lot 1- 2 pigs					
Ground Rye	2.251	3.031	4.103	4.923	3.45
Tankage	.247	.267	.27	.171	.243
Alfalfa	.567	.537	.4	.312	.467
Total	3.065	3.835	4.773	5.406	4.160
Lot 2- 2 pigs					
Ground Rye	1.717	2.442	3.743	4.181	2.904
Tankage	.093	.106	.127	.125	.111
Linseed Oilmeal	.261	.279	.255	.252	.262
Alfalfa	.491	.46	.458	.362	.449
Total	2.562	3.287	4.583	4.920	3.726
Lot 3- 3 pigs					
Ground Rye	1.443	2.154	3.293	4.464	2.693
Tankage	.192	.235	.274	.347	.255
Locust Bean	.16	.24	.366	.496	.299
Alfalfa	.381	.441	.344	.285	.368
Total	2.176	3.070	4.277	5.592	3.615

Table 3 continued

Average daily ration per pig

	1st. 35 da.	2nd. 31 da.	3rd. 30 da.	4th. 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 4- 2 pigs					
Ground Rye	2.01	3.243	4.078	4.717	3.387
Tankage	.221	.287	.268	.283	.262
Alfalfa	.474	.589	.392	.281	.445
Total	2.705	4.119	4.738	5.281	4.094
Cod Liver Oil ad	15.15	20.59	20.55	21.87	19.25
Lot 5- 2 pigs					
Ground Rye	1.951	2.298	4.183	4.896	3.187
Buttermilk	4.871	4.443	5.583	5.875	5.14
Alfalfa	5.81	5.16	.533	.229	.482
Total	7.403	7.257	10.299	11.000	8.809
Lot 6- 3 pigs					
Ground Rye	1.586	2.392	3.589	4.486	2.875
Buttermilk	3.933	4.656	4.733	5.444	4.622
Alfalfa	.429	.527	.367	.236	.4
Total	5.948	7.575	8.689	10.166	7.897
Lot 7- 2 pigs					
Ground Rye	1.896	2.65	4.51	5.665	3.498
Tankage	.209	.232	.295	.34	.262
Alfalfa, fresh	1.81	2.229	3.328	3.102	2.556
Total	3.915	5.111	8.133	9.107	6.316

Some variation is noticed in the amounts of feed eaten no doubt due partly to variation in weight among the lots after the unthrifty pigs were removed. Contrary to what might be expected, neither lots 2 nor 3 showed greater feed consumption, indicating that neither linseed oilmeal nor locust bean meal were effective as appetizing agents in rye rations.

The addition of cod liver oil to the ration did not increase the feed consumption.

The fresh alfalfa lot showed no greater feed consumption than the check lot.

The soaked buttermilk lot showed a lighter feed consumption than the fresh buttermilk lot, although the average weight per pig was slightly less.

Feed Required for Gain

Table 4 shows the feed required for each hundred pounds of gain in the different lots:

Table 4

Feed per hundred pounds gain

	1st.	2nd.	3rd.	4th.	Total
	35 da.	31 da.	30 da.	24 da.	120 da.
Lot 1- 2 pigs	lbs.	lbs.	lbs.	lbs.	lbs.
Ground Rye	262.7	272.3	332.7	332.8	302.2
Tankage	28.8	24.1	21.9	11.5	21.3
Alfalfa	66.2	48.3	32.4	21.1	40.9
Total	357.7	344.7	387.0	365.4	364.4

Table 4 continued

Feed per hundred pounds gain

	1st. 35 da.	2nd. 31 da.	3rd. 30 da.	4th. 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 2- 2 pigs					
Ground Rye	235.7	248.2	330.3	378.7	299.1
Tankage	12.7	10.8	11.2	11.3	11.5
Linseed Oilmeal	35.9	28.4	22.5	22.8	27.
Alfalfa	67.4	46.7	40.4	32.8	46.3
Total	351.7	334.1	404.4	445.6	383.9
Lot 3- 3 pigs					
Ground Rye	222.8	250.4	262.3	387.1	281.8
Tankage	29.7	27.4	21.9	30.1	26.7
Locust Bean	24.7	27.9	29.1	43	31.3
Alfalfa	58.8	51.2	27.4	24.7	38.5
Total	336.0	356.9	340.7	484.9	378.3
Lot 4- 2 pigs					
Ground Rye	275.9	314.2	309.8	435.4	330.4
Tankage	30.4	27.8	20.4	26.2	25.6
Alfalfa	65.1	57	30	26	43.4
Total	371.4	399.0	360.2	487.6	399.4
Cod Liver Oil	2079.8	1994.7	1560.8	2019.2	1878.

Table 4 continued

Feed per hundred pounds gain

	1st. 35 da.	2nd. 31 da.	3rd. 30 da.	4th. 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 5- 2 pigs					
Ground Rye	223.9	187.5	339.2	345.6	274.2
Buttermilk	559.	362.5	452.7	414.7	442.1
Alfalfa	66.7	42.1	43.2	16.2	41.5
Total	849.6	592.1	835.1	776.5	757.8
Lot 6- 3 pigs					
Ground Rye	189.2	206.	280.9	442.5	269.5
Buttermilk	469.3	400.9	370.4	537.	433.3
Alfalfa	51.1	45.4	28.7	23.3	37.5
Total	709.6	652.3	680.0	1002.8	740.3
Lot 7- 2 pigs					
Ground Rye	237.	252.8	360.8	697.2	357.2
Tankage	26.1	22.2	23.6	41.8	26.8
Alfalfa, fresh	226.2	212.6	266.3	381.8	261.1
Total	489.3	487.6	650.7	1120.8	645.1

These results show a slightly different relation between the lots than was shown in feed eaten or rate of gain. A gradual increase in amount of feed required is seen as the feeding period lengthens and the pigs get heavier and older. Lots 4 and 7 show the highest feed

requirements and the greatest difference in these lots is in the last period. Lot 7 shows extremely poor results at that stage of the game. The other lots are too close together to draw any very definite conclusions. The feed per pound of gain is reasonably low in all lots except for the last period in Lot 7.

Nutrient Requirement

The following table showing the total digestible nutrients required for each hundred pounds gain in the different lots emphasizes even more the similarity of the results among the lots and the failure of any of the other rations to show materially better results than the check lot of rye, tankage and alfalfa hay.

Table 5

Total Digestible Nutrients per hundred pounds gain.

	1st. 35 da.	2nd. 31 da.	3rd. 30 da.	4th. 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 2 pigs	267.5	262.6	301.8	288.7	281
Lot 2 - 2 pigs	262.7	255	313.9	349.5	295.4
Lot 3- 3 pigs	250.8	270	264.4	380.5	291
Lot 4- 2 pigs	278.7	303.7	280.8	384.7	308.3
Lot 5- 2 pigs	262.8	204	335.1	323.1	280.7
Lot 6- 3 pigs	219.1	224	273.4	415.5	274.1
Lot 7- 2 pigs	237	245.4	348	650.3	343.4

Lot 7, the fresh alfalfa lot, shows a marked difference from the other lots and the chief variation is found there in the last period. The lot receiving cod liver oil with the rye and tankage ration shows next highest nutrient requirement. The soaked milk and rye lot made slightly the most efficient gain of the series. The check lot of rye and tankage and the fresh rye and milk lot are exactly equal. The linseed oilmeal lot and the locust bean meal lot are practically equal and slightly higher than the milk lots or the check lot in nutrients required for each pound of gain.

Cost of Gains

Table 6

Feed cost per hundred pounds gain

	1st. 35 da.	2nd. 31 da.	3rd. 30 da.	4th. 24 da.	Total 120 da.
Lot 1- 2 pigs	\$5.30	\$5.17	\$5.89	\$5.50	\$5.47
L					
Lot 2- 2 pigs	5.23	5.04	6.10	6.78	5.78
Lot 3- 3 pigs	5.60	6.01	5.89	8.50	6.49
Lot 4- 2 pigs	6.37	6.77	6.11	8.32	6.80
Lot 5- 2 pigs	6.09	4.58	7.22	6.96	6.20
Lot 6- 3 pigs	5.10	5.03	5.91	8.96	6.06
Lot 7- 2 pigs	4.76	5.86	6.62	12.43	6.65

Ground Rye \$30 per ton, tankage \$60 per ton, buttermilk 40 cents per cwt., alfalfa \$15 per ton, fresh

alfalfa \$3.75 per ton, linseed oilmeal \$45 per ton, Locust Bean Meal \$95 per ton and Cod Liver Oil 40 cents per liter.

At the prices used in calculating the feed costs the check lot of rye and tankage, with alfalfa hay self fed, is the most profitable lot in the series. Lots 4 and 7 are the least profitable lots, and Lot 3 is a close third due to the high cost of the locust bean meal. At forty cents per hundred pounds, butterilk is too high as compared with tankage at sixty dollars per ton.

Due to the small numbers of pigs in each lot and the variation among the pigs, these results are important as an indication only of the comparative value of these rations for pigs of this age.

The following table shows the differences between the lots in rate of gain with the probable error of the differences:

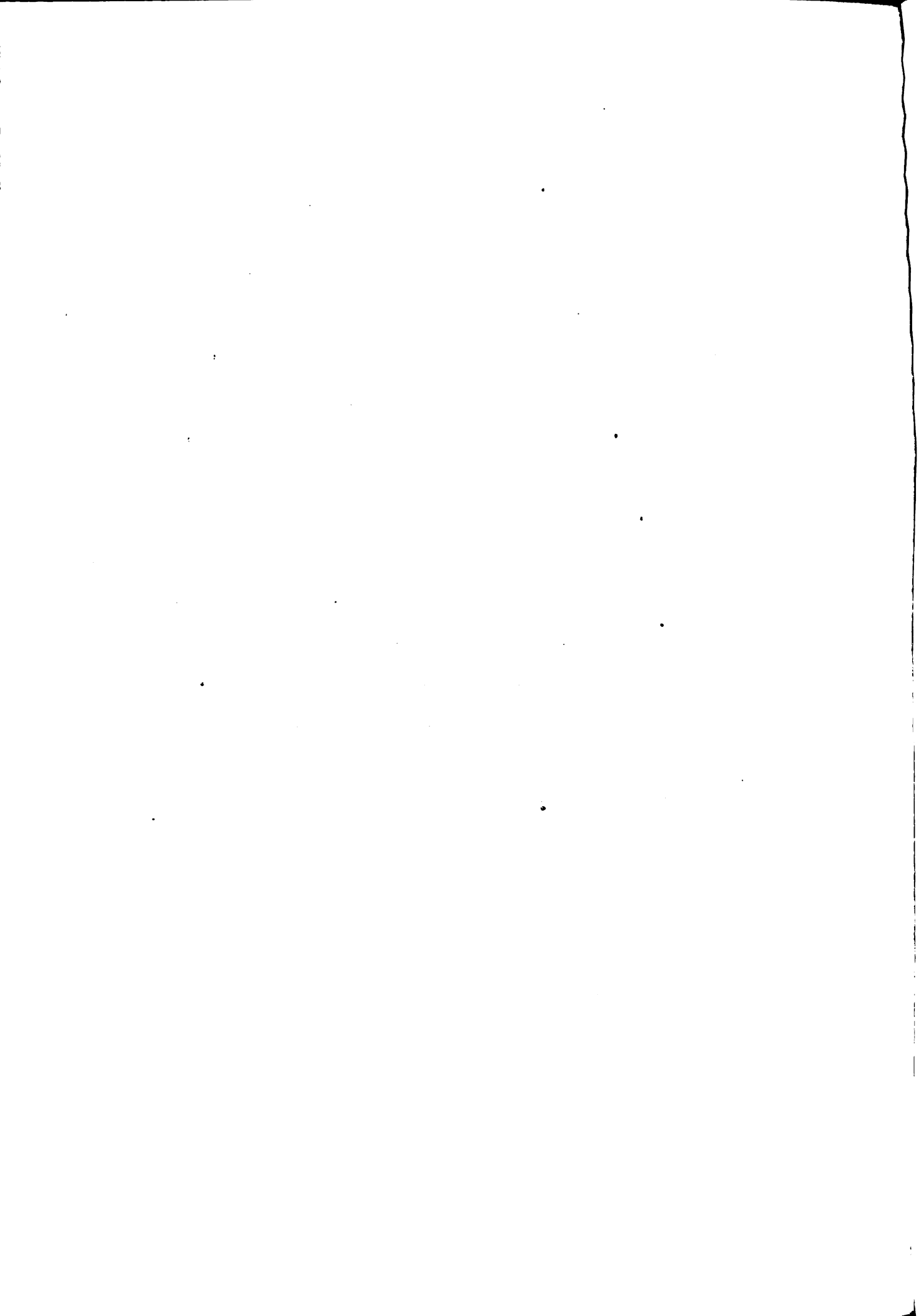


Table 7

Difference between lots in rate of gain with
Probable Error.

Greater Gain	Lesser Gain	Differences in Gain	Probable Error
Lot No.	Lot No.	lbs.	lbs.
1	2	.171	.029
1	3	.187	.079
1	4	.117	.117
1	6	.076	.044
1	7	.163	.048
5	1	.02	.028
5	2	.191	.022
5	3	.206	.076
5	4	.137	.116
5	6	.096	.039
5	7	.183	.044
6	2	.095	.041
6	3	.111	.084
6	4	.041	.121
6	7	.087	.055
4	2	.054	.076
4	3	.07	.137
4	7	.046	.122
7	2	.008	.045
7	3	.024	.086
2	3	.016	.094

The following lots only show a significant difference in rate of gain: 1 and 2, 1 and 7, 5 and 2, 5 and 7. Their differences in rate of gain are more than three times the probable error, which indicates that a similar lot will show the greater rate of gain in a majority of further trials.

Summary of Results

1. The palatability of the ration was not materially increased by adding linseed oilmeal or locust bean meal .
2. The vitamins contained in cod liver oil were of no apparent benefit.
3. The vitamins and other factors carried by fresh green alfalfa were no better than those in well cured alfalfa hay of good color.
4. The rye and buttermilk ration was slightly more palatable than the rye and tankage ration. The pigs also showed a more thrifty appearance and better finish.
5. It was not possible to put a desirable market finish on the pigs in a reasonable length of time when fed on a full feed.
6. The vital factors necessary for proper nutrition are evidently not in proper balance.
7. The feed required for each hundred pounds of gain was not exceedingly high.
8. All pigs gained much faster on a similarly supplemented corn ration.

Experiment II

February 11 - June 1, 1926

110 days

Object of the Experiment

This second series of trials on feeding rye to growing fattening pigs was planned with much the same purpose as the previous experiment. Some of the conclusions from the study of earlier trials have been strengthened by the results of the previous experiment.

1. Pigs consuming a relatively light ration consisting chiefly of rye as the grain feed do not show a normal thrifty appearance.

2. Good digestion is indicated by the feed requirement per pound of gain.

3. Some factor in the rye ration seems to be responsible for the failure of certain pigs to use such a ration to advantage, while other similar pigs may do acceptable well on it.

4. Palatability is probably one factor in securing good results with rye rations although it is likely not the greatest factor.

The new angles developed from the preceding experiment were also included in this trial. The question of limiting the alfalfa seemed to be an outstanding one. The possibility that a liberal supply of buttermilk throughout the period might exert some beneficial effect also looked favorable. Since the buttermilk pigs, especially those in Lot 5, made the most consistent gains throughout the period considering the one pig which failed to gain in

Lot 1, it seemed worth while to make a more detailed study of the properties inherent in the buttermilk.

Plan of Experiment

1. A limited ration of alfalfa was compared with one self fed in a rack.
2. Soaking the rye in buttermilk was compared with feeding the mixture fresh.
3. A liberal feed of buttermilk was compared with a more restricted feed in which the ration was balanced according to the Morrison standard.
4. The acid properties of creamery buttermilk were studied by feeding one lot on sweet skimmilk.
5. Tankage was compared with buttermilk as a protein supplement to rye.
6. The younger pigs of the September pig crop were used in order to have pigs which did not possess too much possible advantage of age and weight. It was planned to feed them to a market weight of approximately 200 pounds as quickly as possible.

Previous Treatment of Pigs

The pigs received a grain mixture in a creep while nursing and were weaned when about eight weeks old. A short time after weaning they were treated with oil of chenopodium and castor oil for ascaris infestation. Only a very few worms were expelled. A grain mixture of corn, oats, middlings and tankage with a small amount of buttermilk was fed and alfalfa hay was supplied in racks. All

the pigs were apparently in thrifty growing condition when put on experimental feed.

Allotment of Pigs

The pigs were divided into six lots as nearly uniform as possible according to breed, type, weight, sex and thriftiness. Four pigs were available for each lot.

Method of Weighing

Three weights were taken on successive days at the beginning and at the close of the experiment and the average of these three weights was considered as the initial and final weights respectively. Individual weights were taken every ten days throughout the experiment. The feed for each lot was weighed and recorded at each feeding. The first experimental feed was given in the evening after the second initial weight and the last feed was given in the morning of the second day of the final weight.

Lots, Water, etc.

The same lots and yards were used in this experiment as in Experiment I. No water was allowed except what was necessary to make the proper consistency of the slop feed. Alfalfa hay was fed in slat racks to all lots except Lot 1. Self feeders were used for mineral mixtures and salt.

Rations Fed and Method of Feeding

The alfalfa hay for Lot 1 was ground and mixed with the grain ration. All other lots were self fed alfalfa hay in racks with two lots eating from each rack except in case of Lot 6 which had a rack alone.

A mineral mixture of ground limestone 20 lbs., salt 30 lbs., and steamed bonemeal 45 lbs. was kept in one compartment of a self feeder and common salt in another compartment.

The grain rations were fed twice daily according to the appetite and were composed as follows:

Lot 1. Ground rye, ground alfalfa (5% to 7% of the grain ration), buttermilk, the ration balanced according to the Morrison Standard for pigs of corresponding weights.

Lot 2. Ground rye and buttermilk, the same nutritive ratio as Lot 1, allowing a similar amount of alfalfa hay in the calculations.

Lot 3. Ground rye and buttermilk soaked twelve hours and balanced in the same manner as Lot 2.

Lot 4. Ground rye 1 part, buttermilk 2 parts.

Lot 5. Ground rye 1 part, sweet skim milk 2 parts.

Lot 6. Ground rye and tankage balanced in the same manner as Lots 2 and 3.

Experimental Data

The following tables will be found in the appendix:

Table VI Weights of pigs by 10 day periods.

Table VII Total gain per lot of thrifty pigs by 30 day periods.

Table VIII Feed consumption by periods.

Table IX Feed deducted for pigs removed.

Table X Feed consumed by thrifty pigs by periods.

Table 8

Gains of pigs by periods

Lot 1 - 4 pigs Limited Alfalfa

	Y.B. 7	C.B. 36	P.S. 3	H.S. 15	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days	2	16	11	6	35
2nd. eleven "	14	20	-8	7	33
3rd. ten "	16	15	3	4	38
Total 30 days	32	51	6	17	106
4th. ten days	14	16	*C.S. 26 7	2	39
5th. " "	14	22	22	4	62
6th. " "	12	15	22	4	53
Total 30 days	40	53	51	10	154
7th. ten days	16	20	18	Removed	54
8th. " "	16	21	22	April 12	59
9th. " "	14	13	17		44
Total 30 days	46	54	57		157
10th. ten days	12	23	24		59
11th " "	20	24	23		67
Total 20 days	32	47	47		126
Total 110 days	150	205	161	(27)	543
Average daily gain	1.364	1.864	1.464	(.45)	1.392

*C.S. 26 substituted for P.S. 3 at the end of 30 days.

Table 8 continued
Gains of pigs by periods

Lot 2- 4 pigs Fresh Buttermilk		B.S. 2	C.S. 5	P.B. 3	H.S. 5	Total
		lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days		3	9	11	5	28
2nd. eleven "		13	12	17	12	54
3rd. ten "		11	10	11	11	43
Total 30 days		27	31	39	28	125
4th. ten days		15	19	12	13	59
5th. " "		16	15	20	14	65
6th. " "		11	4	9	8	32
Total 30 days		42	38	41	35	156
7th. ten days		14	13	16	18	61
8th. " "		16	9	12	9	46
9th. " "		10	15	13	19	57
Total 30 days		40	37	41	46	164
10th. ten days		14	13	23	6	56
11th. " "		10	12	13	16	51
Total 20 days		24	25	36	22	107
Total 110 days		133	131	157	131	552
Average daily gain		1.209	1.191	1.427	1.191	1.255

Introduction

1. The purpose of this document is to provide a comprehensive overview of the project's objectives, scope, and timeline.

2. The project is designed to address the following key areas:

3. The project is expected to be completed by the end of the year.

4. The project is expected to be completed by the end of the year.

5. The project is expected to be completed by the end of the year.

6. The project is expected to be completed by the end of the year.

7. The project is expected to be completed by the end of the year.

8. The project is expected to be completed by the end of the year.

9. The project is expected to be completed by the end of the year.

10. The project is expected to be completed by the end of the year.

11. The project is expected to be completed by the end of the year.

12. The project is expected to be completed by the end of the year.

13. The project is expected to be completed by the end of the year.

14. The project is expected to be completed by the end of the year.

15. The project is expected to be completed by the end of the year.

16. The project is expected to be completed by the end of the year.

17. The project is expected to be completed by the end of the year.

18. The project is expected to be completed by the end of the year.

19. The project is expected to be completed by the end of the year.

20. The project is expected to be completed by the end of the year.

Table 8 continued

Gains of pigs by periods

Lot 3- 4 pigs Soaked Buttermilk

	Y.S. 3	C.B. 26	D.B. 4	H.S. 4	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days	12	12	11	12	47
2nd. eleven "	14	9	14	9	46
3rd. ten "	11	13	9	12	45
Total 30 days	37	34	34	34	138
4th. ten days	20	19	16	11	66
5th. " "	15	18	6	11	50
6th. " "	12	14	3	0	29
Total 30 days	47	51	25	22	145
7th. ten days	19	19	-5	-4	29
8th. " "	15	25	7	Removed	47
9th. " "	11	20	3	April 22	34
Total 30 days	45	64	5	-4	110
10th. ten days	19	20	2		41
11th. " "	6	21	9		36
Total 20 days	25	41	11		77
Total 110 days	154	190	75	(51)	470
Average daily gain	1.4	1.727	.682	(.729)	1.175

Table 8 continued

Gains of pigs by periods

Lot 4- 4 pigs Liberal Buttermilk

	Y.S.2	C.B.6	D.B.1	H.B.2	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days	9	11	9	8	37
2nd. eleven "	16	13	15	15	59
3rd. ten "	12	15	12	8	47
Total 30 days	37	39	36	31	143
4th. ten days	20	14	13	14	61
5th. " "	22	32	-10	19	63
6th. " "	11	6	3	4	24
Total 30 days	53	52	6	37	148
7th. ten days	19	23	4	10	56
8th. " "	26	18	Removed	8	52
9th. " "	15	23	April 22	10	48
Total 30 days	60	64	4	28	156
10th. ten days	16	22		15	53
11th. " "	24	16		14	54
Total 30 days	40	38		29	107
Total 110 days	190	193	(46)	125	554
Average daily gain	1.727	1.755	(.657)	1.136	1.385

Table 8 continued
Gains of pigs by periods

Lot 5- 4 pigs Liberal Skimmilk

	B.S. 5	C.B. 33	D.S. 6	H.B. 4	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days	14	12	15	2	43
2nd. eleven "	16	8	13	11	48
3rd. ten "	9	19	14	4	46
Total 30 days	39	39	42	17	137
4th. ten days	14	23	14	*H.S. 5 13	64
5th. " "	14	18	18	9	59
6th. " "	15	23	8	9	55
Total 30 days	43	64	40	31	178
7th. ten days	9	16	12	8	45
8th. " "	9	19	17	13	58
9th. " "	14	14	11	15	54
Total 30 days	32	49	40	36	157
10th. ten days	15	16	12	8	51
11th. " "	13	11	16	16	56
Total 20 days	28	27	28	24	107
Total 110 days	142	179	150	108	579
Average daily gain	1.291	1.627	1.364	.982	1.316

*H.S. 5 substituted for H.B. 4 at the end of 30 days.

Table 8 continued

Gains of pigs by periods

Lot 6- 4 pigs		Tankage				Total
		Y.B. 8	C.S. 3	P.B. 5	H.S. 3	
		lbs.	lbs.	lbs.	lbs.	lbs.
1st. nine days		9	4	9	6	28
2nd. eleven "		11	16	11	4	42
3rd. ten "		11	6	6	11	34
Total 30 days		31	26	26	21	104
4th. ten days		8	19	7	16	50
5th. " "		8	11	7	8	34
6th. " "		16	15	4	12	47
Total 30 days		32	45	18	36	131
7th. ten days		13	22	removed	14	49
8th. " "		19	10	April 12	16	45
9th. " "		10	27		19	56
Total 30 days		42	59		49	150
10th. ten days		15	19		10	44
11th. " "		16	15		9	40
Total 20 days		31	34		19	84
Total 110 days		136	164	(44)	125	469
Average daily gain		1.236	1.491	(.733)	1.136	1.203

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

• • • • •

It will be noticed immediately that those pigs made considerably larger gains than those in the first experiment. A part of this difference might be explainable on the basis of age and weight since these pigs averaged approximately 70 pounds in weight and those in the other trials averaged slightly less than 40 pounds.

One pig in Lot 1 and one in Lot 5 was removed at the end of the first 30 days on account of an extremely unthrifty appearance evidently not due to the ration being fed. Other pigs were substituted for them. One pig was removed from Lot 6 at the end of 60 days for the same reason.

The Hampshire sow number 15 in Lot 1 shows a very light gain from the beginning of the feeding period. She did not seem to relish the ration offered and ate only enough feed to keep from starving. Her tail hung straight and she seemed dull and stupid. At the end of 60 days she was removed from the lot.

The Hampshire sow and the Duroc barrow in Lot 3 showed very good gains for the first part of the period. It will be noticed that their gains suddenly dropped off after 40 to 50 days feeding. The Hampshire was removed from the lot soon after ceasing to gain and the Duroc was continued on the original ration throughout the experiment.

The Duroc barrow in Lot 4 showed the same tendencies as the two pigs in Lot 3. He was also removed at the end of 70 days.

These three pigs showed exactly the same symptoms at the time they failed to gain. A very laxative condition was noticeable, and they ate very little feed. This condition continued in the pig left in Lot 3 until the close of the experiment.

The other two pigs and the one from Lot 1 were put on a ration of rye and buttermilk in the proportion of one to two, with alfalfa hay in the rack. They were also given an organic iodide preparation recommended by Dr. Chandler, of the Bacteriology Department. A rather heavy dose was given at two day intervals for a week for the purpose of an intestinal antiseptic. The pig left in Lot 3 was also given two of these treatments and a liberal dose of castor oil. A few drops of the preparation were given in the ration of the three pigs once daily for a period of 71 days.

The pig from Lot 1 which had never eaten the former ration well at any time, began to eat greedily and her gains increased proportionately. She gained 86 pounds in the 71 days, an average of 1.21 pounds per day.

The pig from Lot 3, which had been off feed and losing weight for only a few days, was more slow to get started on feed. The tendency to scouring gradually disappeared, however, and she showed a very good rate of gain later in the period. During the last 41 days she made an average gain of 1.27 pounds per day.

The pig from Lot 4, however, which had been losing weight for some time before being changed and had gained

it all back before the change, did not show much improvement with the addition of the iodine to the ration. He gained a total of only 30 pounds during the 71 days on this ration.

The Duroc pig from Lot 3 was also put on the iodized ration at the close of the original experiment. At the end of 32 days he had lost six pounds in weight.

Evidently the addition of iodine did not make the ration satisfactory for all pigs although it may have had some influence on two of the pigs.

Table 9

Average daily gain of thrifty pigs by 30 day periods

	1st 30 da.	2nd 30 da.	3rd 30 da.	4th 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1 - 3 pigs	.989	1.6	1.744	2.1	1.564 \pm .084
Lot 2 - 4 pigs	1.042	1.3	1.367	1.337	1.255 \pm .034
Lot 3 - 2 pigs	1.183	1.633	1.813	1.65	1.564 \pm .078
Lot 4 - 3 pigs	1.189	1.578	1.689	1.783	1.539 \pm .111
Lot 5 - 4 pigs	1.142	1.483	1.308	1.337	1.316 \pm .078
Lot 6 - 3 pigs	.867	1.256	1.667	1.4	1.288 \pm .058

The average daily gain by periods of the pigs that finished with steady gains throughout the experiment shows some variation. Quite a bit of this variation is probably due to individuality of the different pigs. The initial weights varied somewhat in the beginning so that the lack of uniformity among the lots after some pigs were removed may have been partly responsible. The pig substituted in Lot 1 developed into a very growthy pig that gained very well. Lots 2 and 5 did not contain pigs that were as good individuals as some pigs in the other lots. This situation was evident soon after the beginning of the experiment.

However, the milk-fed lots as a whole showed faster gains than the tankage lot, Lot 6, and yet the pigs in the tankage lot seemed to be equally as good individuals as those in any other lot, except possibly Lot 1.

The outstanding point of the experiment as shown by the rates of gain is that some pigs in various lots failed entirely to utilize to good advantage the rations offered, while all the other pigs made gains that would be considered good average results with other rations of recognized value for growing and fattening pigs.

Comparison of Rations

The comparative value of the rations fed is made on the basis of the pigs which finished the entire trial with continuous gains. The deduction of feed for the pigs removed from the lots is made in the same manner as in Experiment I.

Table 10

Average daily ration per pig

	1st 30 da. lbs.	2nd 30 da. lbs.	3rd 30 da. lbs.	4th 20 da. lbs.	Total 110 da lbs.
Lot 1 - 3 pigs					
Ground Rye	3.024	3.983	5.221	6.266	4.475
Ground Alfalfa	.159	.373	.446	.4	.339
Buttermilk	5.051	5.141	6.478	7.333	5.88
Minerals					.0076
Salt					.0076
Total	8.234	9.497	12.145	13.999	10.7092
Lot 2 - 4 pigs					
Ground Rye	2.858	3.779	4.759	5.65	4.135
Buttermilk	4.829	4.958	5.717	6.725	5.451
Alfalfa	.5	.425	.438	.257	.418
Minerals					.0068
Salt					.0068
Total	8.187	9.162	10.914	12.632	10.0176
Lot 3 - 2 pigs					
Ground Rye	2.848	4.82	6.375	5.717	4.87
Buttermilk	4.785	6.428	7.77	6.992	6.449
Alfalfa	.513	.548	.661	.307	.526
Minerals					.0073
Salt					.0073
Total	8.146	11.796	14.806	13.016	11.8596

Table 10 continued

	1st 30 da.	2nd 30 da.	3rd 30 da.	4th 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 4 - 3 pigs					
Ground Rye	2.858	4.708	5.37	5.333	4.498
Buttermilk	5.716	9.168	10.74	10.667	8.928
Alfalfa	.541	.588	.39	.3	.468
Minerals					.0073
Salt					.0073
Total	9.115	14.464	16.5	16.3	13.9086
Lot 5 - 4 pigs					
Ground Rye	2.517	3.5	4.2	5.	3.695
Skim Milk	5.034	6.783	8.4	10.	7.332
Alfalfa	.542	.483	.363	.3	.433
Minerals					.0068
Salt					.0068
Total	8.095	10.766	12.963	15.3	11.4736
Lot 6 - 3 pigs					
Ground Rye	2.908	4.6	5.416	5.7	4.561
Tankage	.218	.272	.284	.3	.266
Alfalfa	.336	.346	.167	.117	.252
Minerals					.0076
Salt					.0076
Total	3.462	5.218	5.867	6.117	5.0942

These pigs ate quite a little lighter percentage of alfalfa than did the smaller pigs of Experiment I. They did not show a paunchy appearance at any time. In fact, the amount of alfalfa in the ration of the limited alfalfa lot was increased after a short time when it was evident that the others were not consuming an excessive amount. The tankage lot, Lot 6, shows a considerably lighter alfalfa consumption than any of the other lots. Of the other lots, two were eating from the same rack so that the amount taken by each lot was considered to be in proportion to the number of pigs in the lots after some were removed. There was no doubt some error there on account of the pigs which were going off feed. A small amount of mineral mixture was eaten and an equal amount of salt.

The daily ration probably was governed somewhat by the individuality of the pigs in the same manner as the gains produced. It seems reasonable that pigs consuming so large a ration and making greater gains per day would show a greater individual variation in the daily ration and in the rate of gain than should pigs which are taking only a light ration and gaining more slowly, as in the case of Experiment I. The possible inaccuracy in deducting feed consumed by pigs removed may account for some of the variations among the lots. This is especially true for Lots 3 and 4 when they show a decreased feed consumption during the last period.

Table 11

Feed per hundred pounds gain

	1st 30 da.	2nd 30 da.	3rd 30 da.	4th 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 3 pigs					
Ground Rye	305.8	249	299.3	298.4	286.2
Ground Alfalfa	16.1	23.3	25.5	19	21.7
Buttermilk	510.8	321.3	371.3	349.2	375.
Minerals					.48
Salt					.48
Total	832.7	593.6	696.1	666.6	684.86
Lot 2 - 4 pigs					
Ground Rye	274.4	290.7	348.2	422.4	329.6
Buttermilk	463.6	381.4	418.3	502.8	434.5
Alfalfa	48	32.7	32.1	19.2	33.4
Minerals					.54
Salt					.54
Total	786.0	704.8	798.6	944.4	798.58
Lot 3 - 2 pigs					
Ground Rye	240.7	295.1	350.9	346.5	311.4
Buttermilk	404.4	393.6	427.7	423.8	412.4
Alfalfa	43.4	33.6	36.4	18.6	33.6
Minerals					.47
Salt					.47
Total	688.5	722.3	815.0	788.9	758.34

Table 11 continued

Feed per hundred pounds gain

	1st 30 da. lbs.	2nd 30 da. lbs.	3rd 30 da. lbs.	4th 20 da. lbs.	Total 110 da lbs.
Lot 4 - 8 pigs					
Ground Rye	240.4	298.4	318	299.1	292.2
Buttermilk	480.8	581.1	635.9	598.2	579.9
Alfalfa	45.5	37.3	23	16.8	30.4
Minerals					.47
Salt					.47
Total	766.7	916.8	976.9	914.1	903.44
Lot 5 - 4 pigs					
Ground Rye	220.4	236	321	373.8	280.8
Skim Milk	440.8	457.3	642	747.7	557.2
Alfalfa	47.4	32.6	27.8	22.4	32.9
Minerals					.52
Salt					.52
Total	708.6	725.9	990.8	1143.9	871.94
Lot 6 - 3 pigs					
Ground Rye	335.5	366.4	324.9	407.1	354.1
Tankage	25.1	21.7	17.	21.4	20.6
Alfalfa	38.7	27.5	10.	8.3	19.6
Minerals					.59
Salt					.59
Total	399.3	415.6	351.9	436.8	395.48

There is doubtless more or less error in the deduction of feed for the pigs removed since it is absolutely impossible to tell how much feed was consumed by the individual pigs. Although they were eating very lightly, more feed probably is required for each pound of gain, and more especially for maintenance, than is given in the standards used in the computations. A single weight between 30 day periods is also a likely source of error since a pig or a lot may vary in fill at different times.

A moderate increase in feed required per pound of gain is seen in all lots except Lot 1 as the feeding period progressed, and in Lots 2 and 6 a sharp increase is noted in the last period. The two pigs removed from Lot 1 early in the feeding period and the extra good pig substituted no doubt account for the more economical gains later in the period.

Taking the lots individually and as a whole, the amount of feed required for each unit of gain is no higher than would be expected for any good ration under similar conditions.

Milk Lots compared with Check Lots.

A comparison of the milk fed lots with the tankage check lot shows the following differences between each milk lot and the check lot in feed required to produce one hundred pounds gain.

Table 12

Differences in feed requirements per cwt. gain

	Milk Lots			Check Lot:	
	Milk	Alfalfa hay		Ground rye	Tamrage
	lbs.	lbs.		lbs.	lbs.
Lot 1	376	2.1	replaced	67.9	20.6
Lot 2	434.5	13.8	"	24.5	20.6
Lot 3	412.4	14	"	42.7	20.6
Lot 4	579.9	10.8	"	61.9	20.6
Lot 5	557.2	13.3	"	73.3	20.6

Nutrient Requirement

The total digestible nutrients used in producing each hundred pounds of gain in the various lots shows again the similar results obtained from the different rations.

Table 13

Total Digestible Nutrients per hundred pounds gain

	1st. 30 da.	2nd. 30 da.	3rd. 30 da.	4th. 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 3 pigs	298.9	240.7	286.9	280.9	274.6
Lot 2- 4 pigs	285.9	284.4	333.7	394.3	320.7
Lot 3- 2 pigs	251.3	289.3	339	326.2	304.3
Lot 4- 3 pigs	258.6	309.7	322.8	301.2	301
Lot 5- 4 pigs	243.2	249.5	332.7	382.4	295.1
Lot 6- 3 pigs	305.7	326.4	280.5	349.4	310.9

As mentioned before, the individuality of the pigs doubtless was responsible for some of the differences shown.

The good pigs in Lot 1 show the best results and the common pigs in Lot 2 show the poorest results. The check lot of rye and tankage, Lot 6, is slightly higher than the other three milk lots, which are quite close together in nutrients required. No lot shows a material advantage over the check lot of rye, tankage and alfalfa hay.

Table 14

Feed cost per hundred pounds gain

	1st. 30 da.	2nd. 30 da.	3rd. 30 da.	4th. 20 da.	Total 110 da.
Lot 1- 3 pigs	\$6.75	\$5.19	\$6.16	\$6.01	\$5.97
Lot 2- 4 pigs	6.33	6.13	7.14	8.49	6.95
Lot 3- 2 pigs	5.55	6.25	7.24	7.03	6.59
Lot 4- 3 pigs	5.87	7.08	7.49	7.00	6.94
Lot 5- 4 pigs	5.42	5.61	7.59	8.76	6.70
Lot 6- 3 pigs	6.08	6.35	5.46	6.81	6.09

Ground Rye \$30 per ton, tankage \$60 per ton, milk 40 cents per cwt., alfalfa \$15 per ton, mineral and salt \$30 per ton.

The cost of the rations was figured on the same basis as in Experiment I. Lot 1, the limited alfalfa lot, again shows an advantage, part of which may be due to the ration and part to the individuality of the pigs. With the

exception of Lot 1, Lot 6, fed Ground Rye, Tankage and Alfalfa hay shows the cheapest cost per pound of gain. However, they did not show as good finish as the pigs in the milk lots.

The differences among the other lots receiving milk with the rye are entirely within the possibility of experimental error.

Table 15
Differences between lots in rate of gain
with Probable Error.

Greater Gain	Lesser Gain	Differences in gain	Probable Error
Lot No.	Lot No.	lbs.	lbs.
1	2	.31	.09
1	3	.0	.115
1	4	.025	.139
1	5	.248	.114
1	6	.276	.102
3	2	.309	.085
3	4	.025	.136
3	5	.248	.11
3	6	.276	.077
4	2	.284	.116
4	5	.223	.136
4	6	.251	.125
5	2	.061	.084
5	6	.028	.097
6	2	.033	.067

In only three cases is the difference in rate of gain between two lots greater than three times the probable error. The probable error of many of the differences is practically as great and in some cases even greater than the difference in gain. This table emphasizes the conclusion mentioned previously, that with the small number of pigs and the individual differences among the pigs there is little significant difference among the lots.

Summary of Results

1. A ration containing ground rye as the chief source of grain feed can not be used efficiently by many pigs.
2. Older and heavier pigs seem to utilize rye to better advantage.
3. Limiting the alfalfa in the ration may be of some advantage.
4. There is little if any benefit from soaking the ration of rye and buttermilk before feeding.
5. Increasing the amount of buttermilk beyond the amounts necessary to balance the ration properly is of little or no advantage.
6. Buttermilk and sweet skim milk are apparently equal as supplements to rye.
7. Buttermilk or skimmilk seems to be superior to 60% meat meal tankage in producing gains and finish on pigs with rye as the source of grain.

8. Iodine does not seem to be efficient in all cases, if any, in completing the deficiencies in a ration of ground rye and buttermilk, with alfalfa self-fed.

9. Ground rye produces economical gains if the pigs will consume enough feed to gain consistently.

10. Palatability is probably not the only limiting factor.

Bibliography

1. Hays, F. A.
Delaware Station Bulletin 124, 1919.
2. Henry and Morrison.
"Feeds and Feeding".
3. Ferrin, E. F. and McCarty, M. A.
Mimeograph Sheets.
Paper delivered at the American Society of Animal
Production, Nov. 27, 1925 by E. F. Ferrin.
Personal information from Ferrin and McCarty.
University of Minnesota.
4. Morgan, George, Supt., North Montana Branch Station,
University of Montana Agricultural Experiment Station,
Thirtieth annual report, February, 1924.
5. Fieldsted, E. J. and Potter, E. L.
Oregon Agricultural College Station
Bulletin 165
6. Eastwood
Ohio Station Bulletin 268, pages 147-164.
7. Kennedy, Evvard, Kildee and Robbins
Iowa Agricultural Station
Bulletin 136

8. Mumford, F. B. and Weaver, L. A.
Missouri Agricultural Experiment Station
Bulletin 110.
9. Brown, G. A. and Edwards, W. E. J.
Unpublished data from Experiment Station
Michigan State College.
10. Brown, G. A. and Edwards, W. E. J.
Quarterly Bulletin, Vol. 8, No. 2, Nov. 1925.
Michigan Experiment Station.
11. Brown, G. A.
Quarterly Bulletin, Vol. 4, No. 1, Aug. 1921.
Michigan Experiment Station.
12. Ferrin, E. F. and Winchester, H. B.
Kansas State Agricultural College
Circular 89.
13. Gibson, W. H.
Dominion of Canada Experiment Farm, Indian Head, Sask.
Report of Supt., 1925.
14. Matthews, Victor
Agricultural Experiment Station, Scott, Sask.
Report of Supt., 1924.
15. Snyder, W. P.
Supt. North Platte Substation
Nebraska Agricultural Experiment Station Bulletin 147
North Platte Substation Bulletin 16.

16. Faville, A. D.
Wyoming Experiment Station Bulletin 114, 1917.
17. Hultz, Fred S.
Wyo. Annual Report, Experiment Station 1924-5.
18. Freeman, V. A.
Extension Specialist in Animal Husbandry
Michigan State College
Personal Information.
19. Osborne, T. B. and Mendel, L. B.
Carnegie Institute
Chemical Abstracts, Vol. 16, page 4255.
20. McCollum et al
John Hopkins University
Journal of Biological Chemistry, 1919, pp. 155-178
21. McCollum, Simmonds and Parsons
J. B. C. 47, 1921, pp. 235-42.
22. Osborne and Mendel
J. B. C. 41, 1920, pp. 275-95.
Chemical Abstract, Vol. 14, page 2365.
23. Ostwald, Wo
Colloidal Chemistry of Bread
Kolloid Zeit., Liepzig.
Chemical Abstract, Vol. 14, page 1167.

24. Groh, J. and Friedl, G.
University of Budapest
Biochemical Zeitung, 66, pp. 154-64.
Chemical Abstract, Vol. 1, page 5446.
25. McCollum, Simmonds and Parsons
J.B.C. 47, 1921, Page 215.
26. Hart and Bentley
University of Wisconsin
J.B.C. 22, 1915, pp. 479 and 483.
27. Turner, J. D. and Spears, H. D.
Kentucky Station Bulletin 203
Experiment Station Record, Vol. 36, page 269.
28. Osborne and Mendel
Connecticut Agricultural College and
Carnegie Institute
J.B.C. 20, 1915, page 352.
29. HonCamp, F. and Nolte, O.
Landwerts Vers. Stat. 96, 1920.
Experiment Station Record, Vol. 44, page 867.
30. HonCamp, Neumann and Mullner
Landwerts Vers, Stat. 81, 1913
Experiment Station Record, Vol. 30, 1914, page 565.

APPENDIX

Table I
Weights of pigs by periods

Lot 1 - 3 pigs	Tankage check lot.			Total
	B.S. 9	D.S. 15	H.B. 3	
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	35	34	43	112
" 10	36	36	45	117
" 11	33	34	43	110
Average Initial Wt.				
July 10	35	35	44	114
" 25				140
Aug. 5				169
" 14	41	64	75	180
" 25				209
Sept. 4				236
" 14	54	95	113	262
" 24	*52			289
Oct. 3				*258
" 14		130	152	282
" 24		146	164	310
Nov. 7		166	187	353

* B.S. 9 removed Sept. 24

Table I continued
Weights of pigs by periods

Lot 2- 3 pigs	Linseed meal			Total
	B.S. 29	D.S. 5	H.B. 43	
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	32	39	40	111
" 10	33	39	42	114
" 11	33	38	40	111
Average Initial Wt.				
July 10	33	39	41	113
" 25				136
Aug. 5				158
" 14	48	68	63	179
" 25				205
Sept. 4				235
" 14	73	97	95	265
" 24				294
Oct. 3				318
" 14	78	133	127	338
" 24	*80	146	139	365
Nov. 7		160	153	*313

***B.S. 29 removed Oct. 24**

Table I continued
Weights of pigs by periods

Lot 3- 3 pigs	Locust Bean Meal			Total
	B.S. 49	D.B. 15	H.B. 33	
	lbs.	lbs.	lbs.	
July 9, 1925	31	30	48	109
" 10	30	29	48	107
" 11	30	30	49	109
Average Initial Wt.				
July 10	30	30	48	108
" 25				132
Aug. 5				158
" 14	52	54	70	176
" 25				199
Sept. 4				228
" 14	72	88	96	256
" 24				286
Oct. 3				337
" 14	97	129	143	369
" 24	103	144	158	405
Nov. 7	112	164	176	452

Table I continued
Weights of pigs by periods

Lot 4- 3 pigs	Cod liver oil			Total
	B.S. 19	B.B. 419	H.B. 13	
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	36	35	41	112
" 10	36	35	43	114
" 11	36	33	41	110
Average Initial Wt.				
July 10	36	34	42	112
" 25				135
Aug. 5				154
" 14	45	53	74	172
" 25				190
Sept. 4				221
" 14	51	75	116	242
" 24	*49			271
Oct. 3				*245
" 14		103	167	270
" 24		112	176	288
Nov. 7		128	194	322

* B.S. 19 removed Sept. 24

Table I continued
Weights of pigs by periods

Lot 5- 3 pigs	Fresh Buttermilk			Total
	B.S. 39	D.B. 5	H.B. 23	
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	37	40	30	107
" 10	39	40	31	110
" 11	37	43	31	111
Average Initial Wt.				
July 10	38	41	31	110
" 25				136
Aug. 5				165
" 14	*42	73	60	175
" 25				*155
Sept. 4				179
" 14		118	91	209
" 24				232
Oct. 3				269
" 14		151	132	283
" 24		165	152	317
Nov. 7		184	167	351

* B.S. 39 died August 13.

Table I continued
Weights of pigs by periods

Lot 6- 3 pigs	Soaked Buttermilk			Total
	B.S. 59	D.B. 25	H.S. 3	
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	34	39	37	110
" 10	35	41	38	114
" 11	33	40	40	113
Average Initial Wt.				
July 10	34	40	38	112
" 25				149
Aug. 5				190
" 14	62	70	68	200
" 25				232
Sept. 4				269
" 14	93	110	105	308
" 24				345
Oct. 3				394
" 14	130	142	151	423
" 24	140	156	168	464
Nov. 7	153	161	182	496

Table I continued
Weights of pigs by periods

Lot 7- 3 pigs		Fresh Alfalfa		
	B.B. 29	D.S. 25	H.S. 13	Total
	lbs.	lbs.	lbs.	lbs.
July 9, 1925	37	40	32	109
" 10	36	41	31	108
" 11	37	40	30	107
Average Initial Wt.				
July 10	37	40	31	108
" 25				135
Aug. 5				162
" 14	59	73	54	186
" 25				209
Sept. 4				247
" 14	95	111	81	287
" 24				314
Oct. 3				348
" 14	115	151	116	382
" 24	*112	170	126	408
Nov. 7		168	138	*306

* B.B. 29 removed Oct. 24th.

Table II

Total gain per lot of thrifty pigs by 30 day periods

	1st 35 da.	2nd 31 da.	3rd 30 da.	4th 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 2 pigs	60	69	74	71	274
Lot 2- 2 pigs	51	61	68	53	233
Lot 3- 3 pigs	68	80	113	83	344
Lot 4- 2 pigs	51	64	79	52	246
Lot 5- 2 pigs	61	76	74	68	279
Lot 6- 3 pigs	88	108	115	73	384
Lot 7- 2 pigs	56	65	75	39	235

Table III

Feed Consumption by periods

Lot 1	Tankage check lot	Ground	Tankage	Alfalfa
		Rye		
		lbs.	lbs.	lbs.
1st 15 da.	(rye 50-Tank. 5½)	.....69.....	.	14
2nd 11 "	" "	.....66.....		24
3rd 9 "	" "	.....63.....		15
Total 35 days		178.4	19.6	*45
4th 11 da.	(rye 50-Tank. 5½)	.....71.5...		18
5th 10 "	(rye 50-Tank. 4)	.....84.5...		15
6th 10 "	(rye 50-Tank. 4)	.....90.....		15
Total 31 days		226	20	*40
7th 10 da.	(rye 50-Tank. 4)	.....89.5...		12
8th 9 "	(rye 50-Tank. 3)	.....77.5...		9.6
9th 11 "	" "	.....99.....		7.2
Total 30 days		249.5	16.5	*24.5
10th 10 da.	(rye 50-Tank. 3)	....103.....		9.6
11th 14 "	" "	....141.5...		8
Total 24 days		236.3	8.2	*15
Total 120 days		890.2	64.3	*124.5

* Approximately 15% alfalfa deducted for waste from racks.

Table III continued

Feed consumption by periods

Lot 2 Linseed Oilmeal

	Ground rye	Tankage	Linseed Oilmeal	Alfalfa
	lbs.	lbs.	lbs.	lbs.
1st 15 da.(rye 46-L.O.M. 7) tankage 2.5 )	.....	69	.....	14
2nd 11 " " "	.....	57.5	.....	24
3rd 9 " " "	.....	63	.....	15
Total 35 days	157.1	8.5	23.9	*45
4th 11 da.(rye 46-L.O.M. 7) tankage 2.5 )	.....	71.5	.....	18
5th 10 " (rye 50-L.O.M. 5) tankage 2 )	.....	84.5	.....	15
6th 10 " " "	.....	90	.....	15
Total 31 days	212.4	9.3	24.3	*40
7th 10 da.(rye 50-L.O.M. 5) tankage 2 )	.....	89.5	.....	12
8th 9 " (rye 50-L.O.M. 3) tankage 1.5 )	.....	80	.....	14.4
9th 11 da. " "	.....	110	.....	10.8
Total 30 days	252.8	8.5	17.2	*31
10th 10 da.(rye 50-L.O.M. 3) tankage 1.5 )	.....	100	.....	14.4
11th 14 " " "	.....	130	.....	8
Total 24 days	211	6.3	12.7	*19
Total 120 days	833.3	32.6	78.1	*135

* Approximately 15% alfalfa was deducted for waste from racks

Table III continued

Feed consumption by periods

Lot 3_ Locust Bean Meal

	Ground rye	Tankage	Locust Bean Meal	Alfalfa
	lbs.	lbs.	lbs.	lbs.
1st 15 da.(rye 45,L.B.M. 5) tankage 6 )	.....	69	.....	14
2nd 11 " " "	.....	66	.....	21
3rd 9 " " "	.....	53.5	.....	12
Total 35 days	151.5	20.2	16.8	*40
4th 11 da.(rye 45-L.B.M. 5) tankage 6 )	.....	71.5	....	18
5th 10 da.(rye 45-L.B.M. 5) tankage 3.5 )	.....	84.5	....	15
6th 10 " " "	.....	88.5	....	15
Total 31 days	200.3	21.9	22.3	*41
7th 10 da.(rye 45-L.B.M. 5) tankage 3.5 )	.....	89.5	....	12
8th 9 da.(rye 45-L.B.M. 5) tankage 3.5 )	.....	110.5	....	14.4
9th 11 da. " "	.....	154	....	10.8
Total 30 days	296.4	24.7	32.9	*31
10th 10 da.(rye 45-L.B.M. 5) tankage 3.5 )	.....	150	....	14.4
11th 14 " " "	.....	232	....	9.6
Total 24 days	321.3	25	35.7	*20.5
Total 120 days	969.5	91.8	107.7	*132.5

* Approximately 15% alfalfa deducted for waste from racks

Table III continued

Feed consumption by periods

Lot 4 Cod Liver Oil

	Ground rye	Tankage	Alfalfa	Cod Liver Oil
	lbs.	lbs.	lbs.	c.c.
1st 15 da.(rye 50-Tank. 5.5)	69	....	14	500
2nd 11 " "	66	....	21	440
3rd 9 " "	53.5	..	12	340
Total 35 days	169.8	18.7	*40	1280
4th 11 da.(rye 50-Tank. 5.5)	71.5	..	18	435
5th 10 " (rye 50-Tank. 4)	84.5	..	15	500
6th 10 " "	90	...	15	1500
Total 31 days	226	20	*41	1435
7th 10 da.(rye 50-Tank. 4)	87.5	..	12	450
8th 9 " (rye 50-Tank. 3)	77.5	..	9.6	500
9th 11 " "	99	...	7.2	300
Total 30 days	247.4	16.3	*24	1250
10th 10 da.(rye 50-Tank. 3) ...	100	...	9.6	400
11th 14 " " ...	140	...	6.4	650
Total 24 days	226.4	13.6	*13.5	1050
Total 120 days	869.9	68.6	*118.5	5015

* Approximately 15% deducted for waste from racks.

Table III continued

Feed consumption by periods

Lot 5 Fresh Buttermilk		Ground rye	Tankage	Alfalfa
		lbs.	lbs.	lbs.
1st 15 days		56.5	140.5	16
2nd 11 "		43.5	108.8	24
3rd 9 "		51	127.5	12
Total 35 days		151	376.8	*45
4th 11 days		43.5	108.7	13.6
5th 10 "		41.5	71.5	12
6th 10 "		57.5	95	12
Total 31 days		142.5	275.5	*32
7th 10 days		72	117	9.6
8th 9 "		79	98	9.6
9th 11 "		100	220	7.2
Total 30 days		251	335	*22
10th 10 days		95	114	7.2
11th 14 "		140	168	6.4
Total 24 days		235	282	*11
Total 120 days		779.5	1269.3	*110

* Approximately 15% alfalfa deducted for waste from racks.

Table III continued

Feed consumption by periods

Lot 6	Soaked Buttermilk	Ground rye	Buttermilk	Alfalfa
		Soaked 12 hours.		
		lbs.	lbs.	lbs.
1st 15 days		65.5	160.5	16
2nd 11 "		54	135	24
3rd 9 "		47	117.5	12
Total 35 days		166.5	413	*45
4th 11 days		62.5	154.5	20.4
5th 10 "		73	131.5	18
6th 10 "		87	147	18
Total 31 days		222.5	433	*49
7th 10 days		90	153	14.4
8th 9 "		101	119	14.4
9th 11 "		132	154	10.8
Total 30 days		323	426	*33
10th 10 days		127	154	10.8
11th 14 "		196	238	9.6
Total 24 days		323	392	*17
Total 120 days		1035	1664	*144

* Approximately 15% alfalfa deducted for waste from racks.

Table III continued

Feed consumption by periods

Lot 7		Fresh Alfalfa		
		Ground rye	Tankage	Fresh Alfalfa
		lbs.	lbs.	lbs.
1st 15 da.	(rye 50-tank. 5.5)	..... 78	.....	83
2nd 11 "	"	..... 66	.....	48
3rd 9 "	"	..... 63	.....	47
Total 35 days		186.5	20.5	178
4th 11 da.	(rye 50-tank. 5.5)	..... 71.5	...	68
5th 10 "	(rye 50-tank. 4 )	..... 94.5	...	64
6th 10 "	"	.....109.5	.....	81
Total 31 days		253.3	22.2	213
7th 10 da.	(rye 50-tank. 4)	.....108	.....	94
8th 9 "	(rye 50-tank 3 )	..... 115	.....	83
9th 11 "	"	..... 151	.....	82
Total 30 days		351	23	259
10th 10 days	(rye 50-tank. 3)	..... 140	.....	73
11th 14 "	"	..... 156	.....	80
Total 24 days		279.3	16.7	153
Total 120 days		1070.1	82.4	803

Table IV
Feed deducted for pigs removed

	1st 35 da. lbs.	2nd 31 da. lbs.	3rd 30 da. lbs.	4th 24da. lbs.	Total 120 da. lbs.
Lot 1					
B.S. 9	*11.67%	16.87%	10 da. 3.93%		
Ground Rye	20.8	38.1	3.3		62.2
Tankage	2.3	3.4	.3		6.
Alfalfa	5.3	6.7	.5		12.5
Lot 2					
B.S. 29	*23.52%	28.74%	11.15%	10 da. 11.23	
Ground rye	36.9	61	28.2	10.3	136.4
Tankage	2.	2.7	.9	.3	5.9
Linseed Meal	5.6	7.	1.9	.6	15.1
Alfalfa	10.6	11.5	3.5	1.6	27.2
Lot 4					
B.S. 19	*17.13%	11.04%	10 da. 3.78%		
Ground Rye	29.1	24.9	3.		57.
Tankage	3.2	2.2	.2		5.6
Alfalfa	6.8	4.5	.5		11.8
Cod Liver Oil	219.3 c.c.	158.4c.c.	17c.c.		394.7c.c.

* Percentage of total feed of the lot consumed by pig later removed.

Table IV continued

Feed deducted for pigs removed

	1st 35 da.	2nd 31 da.	3rd 30, da.	4th 24 da.	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 5					
B.S. 39	* 9.51%				
Ground Rye	14.4				14.4
Buttermilk	35.8				35.8
Alfalfa	4.3				4.3
Lot 7					
B.B. 29	* 28.84%	35.14%	22.9%	10 da. 5.62%	
Ground Rye	53.8	89	80.4	7.4	230.6
Tankage	5.9	7.9	5.3	.4	19.5
Alfalfa fresh	51.3	74.8	59.3	4.1	189.5

* Percentage of total feed of the lot consumed by pig later removed.

Table V

Feed consumed by thrifty pigs by periods

	1st 35 da	2nd 31 da	3rd 30 da	4th 24 da	Total 120 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 2 pigs					
Ground Rye	157.6	187.9	246.2	236.3	828
Tankage	17.3	16.6	16.2	8.2	58.3
Alfalfa	30.7	33.3	24	15	112
Lot 2- 2 pigs					
Ground Rye	120.2	151.4	224.6	200.7	696.9
Tankage	6.5	6.6	7.6	6.	26.7
Linseed	18.3	17.3	15.3	12.1	63.
Oilmeal					
Alfalfa	34.4	28.5	27.5	17.4	107.8
Lot 3- 3 pigs					
Ground Rye	151.5	200.3	296.4	321.3	969.5
Tankage	20.2	21.9	24.7	25	91.8
Locust Bean	16.8	22.3	32.9	35.7	107.7
Alfalfa	40	41	31	20.5	132.5
Lot 4- 2 pigs					
Ground Rye	140.7	201.1	244.7	226.4	812.9
Tankage	15.5	17.8	16.1	13.6	63
Alfalfa	33.2	36.5	23.5	13.5	106.7
Cod liver oil	1060.7cc	1276.6cc	1233 cc	1050cc	4620.3cc

Table V continued

Feed consumed by thrifty pigs by periods

	1st 35 da	2nd 31 da	3rd 30 da	4th 24 da	Total 120 da
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 5- 2 pigs					
Ground Rye	136.6	142.5	251	235	765.1
Buttermilk	341	275.5	335	282	1233.5
Alfalfa	40.7	32	32	11	115.7
Lot 6- 3 pigs					
Ground Rye	166.5	222.5	323	323	1035
Buttermilk	413	433	426	392	1664
Alfalfa	45	49	33	17	144
Lot 7- 2 pigs					
Ground Rye	132.7	164.3	270.6	271.9	839.5
Tankage	14.6	14.4	17.7	16.3	63
Alfalfa fresh	126.7	138.2	199.7	148.9	613.5

Table VI

Weights of pigs by 10 day periods

Lot 1- 4 pigs		Limited Alfalfa				
		Y.B. 7	C.B. 36	P.S. 3	H.S. 15	Total
		lbs.	lbs.	lbs.	lbs.	lbs.
Feb. 10,1926		66	77	57	74	274
Feb. 11		65	80	57	74	276
" 12		66	82	58	72	278
Average Initial Wt.						
Feb. 11		66	80	57	73	276
" 20		68	96	68	79	311
Mar. 3		82	116	60	86	344
" 13		98	131	63	90	382
" 23		112	147	*124	92	*475
Apr. 2		126	169	146	96	537
" 12		138	184	168	**100	590
" 22		154	204	186		**544
May 2		170	225	208		603
" 12		184	238	225		647
" 22		196	261	249		706
" 31		217	281	269		767
June 1		214	284	273		771
" 2		217	290	276		783
Average Final Wt.						
June 1		216	285	272		773

* P.S. 3 removed Mar. 13th. C.S. 26 put in the same date,
weight 117 lbs. Gain in weight by change 54 lbs.

** H.S. 15 removed April 12th.

Table VI continued

Weights of pigs by 10 day periods

Lot 2- 4 pigs		Fresh Buttermilk				
		B.S. 2	C.S. 5	P.B. 3	H.S. 5	Total
		lbs.	lbs.	lbs.	lbs.	lbs.
Feb.	10,1926	79	60	80	73	292
"	11	77	61	79	76	293
"	12	75	59	82	*67	283
Average Initial Wt.						
Feb.	11	77	60	80	73	290
"	20	80	69	91	78	318
Mar.	3	93	81	108	90	372
"	13	104	91	119	101	415
"	23	119	110	131	114	474
Apr.	2	135	125	151	128	539
"	12	146	129	160	136	571
"	22	160	142	176	154	632
May	2	176	151	188	163	678
"	12	186	166	201	182	735
"	22	200	179	224	188	791
"	31	210	191	239	207	847
June	1	210	193	237	205	845
"	2	210	190	234	200	834
Average Final Wt.						
June	1	210	191	237	204	842

* H.S. 5 not eating Feb. 12, weighed empty.

Table VI continued

Weights of pigs by 10 day periods

Lot 3- 4 pigs

Soaked Buttermilk

	Y.S. 3	C.B. 26	D.B. 4	H.S. 4	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
Feb. 10.1926	82	61	73	68	284
" 11	82	63	74	66	285
" 12	81	62	77	67	287
Average Initial Wt.					
Feb. 11	82	62	74	67	285
" 20	94	74	85	79	332
Mar. 3	108	83	99	88	378
" 13	119	96	108	100	423
" 23	139	115	124	111	489
Apr. 2	154	133	130	122	539
" 12	166	147	133	122	568
" 22	185	166	128	*118	597
May 2	200	191	135		*526
" 12	211	211	139		560
" 22	230	231	140		601
" 31	234	250	151		635
June 1	236	252	146		634
" 2	240	253	149		642
Average Final Wt.					
June 1	236	252	149		637

* H.S. 4 removed April 22nd.

Table VI continued

Weights of pigs by 10 day periods

Lot 4- 4 pigs		Liberal Buttermilk				
		Y.S. 2	C.B. 6	D.B. 1	H.B. 2	Total
		lbs.	lbs.	lbs.	lbs.	lbs.
Feb. 10,1926		83	76	66	53	278
"	11	82	77	66	51	276
"	12	81	77	67	50	275
Average Initial Wt.						
Feb. 11		82	77	66	51	276
"	20	91	88	75	59	313
Mar. 3		107	101	90	74	372
"	13	119	116	102	82	419
"	23	139	130	115	96	480
Apr. 2		161	162	105	115	543
"	12	172	168	108	119	567
"	22	191	191	*112	129	623
May 2		217	209		137	*563
"	12	232	232		147	611
"	22	248	254		162	664
"	31	272	266		178	716
June 1		271	273		175	719
"	2	271	273		176	720
Average Final Wt.						
June 1		272	270		176	718

* D.B. 1 removed April 22nd.

Table VI continued

Weights of pigs by 10 day periods

Lot 5- 4 pigs

Liberal Skim milk

	B.S. 5	C.B. 33	D.S. 6	H.B. 4	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
Feb. 10, 1926	79	72	71	61	283
" 11	77	71	74	62	284
" 12	76	71	*63	63	273
Average Initial Wt.					
Feb 11	77	71	72	62	282
" 20	91	83	87	64	325
Mar. 3	107	91	100	75	373
" 13	116	110	114	79	419
" 23	130	133	128	101 ***101	**492
Apr. 2	144	151	146	110	551
" 12	159	174	154	119	606
" 22	168	190	166	127	651
May 2	177	209	283	140	709
" 12	191	223	194	155	763
" 22	206	239	206	163	814
" 31	220	251	222	179	872
June 1	220	249	225	178	872
" 2	217	251	219	179	866
Average Final Wt.					
June 1	219	250	222	179	870

* D.S. 6 not eating Feb. 12, weighed empty.

** H.B. 4 removed Mar. 13. H.S. 5 put in same date,
weight 88 lbs. Gain in weight by change 9 lbs.

Table VI continued
Weights of pigs by 10 day periods

Lot 6- 4 pigs	Tankage				Total
	Y.B. 8	C.S. 3	P.B. 5	H.S. 3	
	lbs.	lbs.	lbs.	lbs.	lbs.
Feb. 10, 1926	67	60	75	67	269
" 11	72	60	74	70	276
" 12	68	62	73	68	271
Average Initial Wt.					
Feb. 11	69	61	74	68	272
" 20	78	65	83	74	300
Mar. 3	89	81	94	78	342
" 13	100	87	100	89	376
" 23	108	106	107	105	426
Apr. 2	116	117	114	113	460
" 12	132	132	*118	125	507
" 22	145	154		139	*438
May 2	164	164		155	483
" 12	174	191		174	539
" 22	189	210		184	583
" 31	200	222		192	614
June 1	205	225		193	623
" 2	210	228		193	631
Average Final Wt.					
June 1	205	225		193	623

* P.B. 5 removed April 12th.

Table VII

Total gain per lot of thrifty pigs by 30 day periods

	1st 30 da	2nd 30 da	3rd 30 da	4th 20 da	Total 110 da
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 3 pigs	89	144	157	126	516
Lot 2- 4 pigs	125	156	164	107	552
Lot 3- 2 pigs	71	98	109	66	344
Lot 4- 3 pigs	107	142	152	107	508
Lot 5- 4 pigs	137	178	157	107	579
Lot 6- 3 pigs	78	113	150	84	425

Table VIII

Feed consumption by periods

Lot 1- Limited Alfalfa

	Ground Rye	Ground Alfalfa	Buttermilk	Mineral	Salt
	lbs.	lbs.	lbs.	lbs.	lbs.
1st 10 days	102.6	5.4	172	1	1
2nd " "	114	6	190		
3rd " "	114	6	190		
Total 30 da.	330.6	17.4	552	1	1
4th 10 days	119.2	6.3	189.5	1	1
5th " "	140.4	15.6	152		
6th " "	136.8	15.2	170		
Total 30 da.	396.4	37.1	511.5	1	1
7th 10 days	132.3	14.7	163.5	1	1
8th " "	160.9	12.1	199.5		
9th " "	176.7	13.3	220		
Total 30 days	469.9	40.1	583	1	1
10th 10 days	186	14	220		
11th " "	190	10	220		
Total 20 da.	376	24	440		
Total 110 days	1572.9	118.6	2086.5	3	3

Table VIII continued

Feed consumption by periods

Lot 2- Fresh Buttermilk

	Ground Rye	Buttermilk	Self fed Alfalfa	Mineral	Salt
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. 10 days	100	170	20	1	1
2nd. " "	113	189.5	20		
3rd " "	130	220	20		
Total 30 da.	343	579.5	60	1	1
4th. 10 days	143.5	234	23	1	1
5th " "	158	171	13		
6th " "	152	190	15		
Total 30 da.	453.5	595	51	1	1
7th 10 days	160	190	24	1	1
8th " "	193	238	11.4		
9th " "	218	258	17.2		
Total 30 da.	571	686	52.6	1	1
10th 10 days	220	260	11.4		
11th " "	232	278	9.2		
Total 20 da.	452	538	20.6		
Total 110 days	1819.5	2398.5	184.2	3	3

Table VIII continued

Feed consumption by periods

Lot 3- Soaked Buttermilk		Ground Rye	Buttermilk	Self fed Alfalfa	Mineral	Salt
		lbs.	lbs.	lbs.	lbs.	lbs.
1st.	10 days	100	170	20	1	1
2nd	" "	113	189.5	20		
3rd	" "	120	200	20		
Total 30 days		333	559.5	60	1	1
4th	10 days	140	240	23	1	1
5th	" "	156	167.5	13		
6th	" "	152	190	15		
Total 30 days		448	597.5	51	1	1
7th	10 days	160	190	24	1	1
8th	" "	140	170	8.6		
9th	" "	131	165	12.8		
Total 30 days		431	525	45.4	1	1
10th	10 days	124	150	8.6		
11th	" "	152	187.5	6.8		
Total 20 days		276	337.5	15.4		
Total 110 days		1488	2019.5	171.8	3	3

Table VIII continued

Feed consumption by periods

Lot 4- Liberal Buttermilk

	Ground Rye	Buttermilk	Self fed Alfalfa	Mineral	Salt
	lbs.	lbs.	lbs.	lbs.	lbs.
1st 10 days	100	200	20	1	1
2nd " "	113	226	20		
3rd " "	130	260	25		
Total 30 da.	343	686	65	1	1
4th 10 days	126	238	24	1	1
5th " "	159.5	291	16		
6th " "	171	360	17		
Total 30 da.	456.5	889	57	1	1
7th 10 days	180	360	15	1	1
8th " "	160	320	8.6		
9th " "	160	320	12.8		
Total 30 da.	500	1000	36.4	1	1
10th 10 days	160	320	8.6		
11th " "	160	320	9.4		
Total 20 da.	320	640	18		
Total 110 days	1619.5	3215	176.4	3	3

Table VIII continued

Feed consumption by periods

Lot 5 Liberal Skim milk

	Ground Rye	Skimmilk	Self fed Alfalfa	Mineral	Salt
	lbs.	lbs.	lbs.	lbs.	lbs.
1st. 10 days	100	200	20	1	1
2nd " "	102	204	20		
3rd " "	100	200	25		
Total 30 da.	302	604	65	1	1
4th 10 days	112	210	25	1	1
5th " "	156	284	16		
6th " "	152	320	17		
Total 30 da.	420	814	58	1	1
7th 10 days	160	320	15	1	1
8th " "	160	320	11.4		
9th " "	184	368	17.2		
Total 30 da.	504	1008	43.6	1	1
10th 10 days	200	400	11.4		
11th " "	200	400	12.6		
Total 20 da.	400	800	24		
Total 110 days	1626	3226	190.6	3	3

Table VIII continued
Feed consumption by periods

Lot 6	Tankage	Ground	Tankage	Self-fed	Mineral	Salt
		Rye		Alfalfa		
		lbs.	lbs.	lbs.	lbs.	lbs.
1st 10 days		93	7	10	1	1
2nd " "		120	9	25		
3rd " "		134	10	5		
Total 30 da.		347	26	40	1	1
4th 10 days		142.3	10.7	22	1	1
5th " "		169.1	8.9	5	1	
6th " "		180.5	9.5	10		
Total 30 da		491.9	29.1	37	1	1
7th 10 days		152	8	10	1	1
8th " "		164.4	8.6	5		
9th " "		171	8.1	0		
Total 30 da		487.4	25.6	15	1	1
10th 10 days		171	9	0		
11th " "		171	9	7		
Total 20 da		342	18	7		
Total 110 days		1668.3	98.7	99	3	3

Table IX

Feed deducted for pigs removed

	1st 30 da. lbs.	2nd 30 da. lbs.	3rd 30 da. lbs.	4th 20 da. lbs.	Total 110 da. lbs.
Lot 1					
H.S. 15	*17.65%	9.55%			
Ground Rye	58.4	37.9			96.3
Alfalfa	3.1	3.5			6.6
Buttermilk	97.4	48.8			146.2
Mineral	.25	.25			.5
Salt	.25	.25			.5
Lot 3					
D.B. 4	*24.83%	18.74%	9.68%	17.16%	
Ground Rye	82.7	84	40.9	47.3	254.9
Buttermilk	138.9	112	49.8	57.8	358.5
Alfalfa	14.9	9.6	4.6	3.1	32.2
Mineral	.25	.25	.3		.8
Salt	.25	.25	.3		.8
H.S. 4	*23.85%	16.70%	10 da 4.75%		
Ground Rye	79.4	74.8	7.6		161.8
Buttermilk	133.4	99.8	9.		242.2
Alfalfa	14.3	8.5	1.1		23.9
Mineral	.25	.25	.1		.6
Salt	.25	.25	.1		.6

* Percentage of total feed of the lot consumed by pig later removed.



Table IX continued

Feed deducted for pigs removed.

	1st 30 da. lbs.	2nd 30 da. lbs.	3rd 30 da. lbs.	4th 20 da. lbs.	Total 110 da. lbs.
Lot4					
D.B. 1	*25.01%	7.19%	10 da. 9.28%		
Ground Rye	85.8	32.8	16.7		135.3
Buttermilk	171.6	63.9	33.4		268.9
Alfalfa	16.3	4.1	1.4		21.8
Mineral	.25	.25	.1		.6
Salt	.25	.25	.1		.6
Lot 6					
P.B. 5	*24.58%	15.84%			
Ground Rye	85.3	77.9			163.2
Tankage	6.4	4.6			11
Alfalfa	9.8	5.9			15.7
Mineral	.25	.25			.5
Salt	.25	.25			.5

* Percentage of total feed of the lot consumed by pig later removed.

Table X

Feed consumed by thrifty pigs by periods

	1st 30 da.	2nd 30 da.	3rd 30 da.	4th 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 1- 3 pigs					
Ground Rye	272.2	358.5	469.9	376	1476.6
" Alfalfa	14.3	33.6	40.1	24	112
Buttermilk	454.6	462.7	583	440	1940.3
Mineral	.75	.75	1		2.5
Salt	.75	.75	1		2.5
Lot 2- 4 pigs					
Ground Rye	343	453.5	571	452	1819.5
Buttermilk	579.5	595	686	538	2398.5
Alfalfa	60	51	52.6	20.6	184.2
Mineral	1	1	1		3
Salt	1	1	1		3
Lot 3- 2 pigs					
Ground Rye	170.9	289.2	382.5	228.7	1071.3
Buttermilk	287.1	385.7	466.2	279.7	1418.8
Alfalfa	30.8	32.9	39.7	12.3	115.7
Mineral	.5	.5	.6		1.6
Salt	.5	.5	.6		1.6

Table X continued

Feed consumed by thrifty pigs by periods

	1st 30 da.	2nd 30 da.	3rd 30, da.	4th 20 da.	Total 110 da.
	lbs.	lbs.	lbs.	lbs.	lbs.
Lot 4- 3 pigs					
Ground Rye	257.2	423.7	483.3	320	1484.2
Buttermilk	514.4	825.1	966.6	640	2946.1
Alfalfa	48.7	52.9	35	18	154.6
Mineral	.75	.75	.9		2.4
Salt	.75	.75	.9		2.4
Lot 5. 4 pigs					
Ground Rye	302	420	504	400	1626
Skimmilk	604	814	1008	800	3226
Alfalfa	65	58	43.6	24	190.6
Mineral	1	1	1		3
Salt	1	1	1		3
Lot 6. 3 pigs					
Ground Rye	261.7	414	487.4	342	1505.1
Tankage	19.6	24.5	25.6	18	87.7
Alfalfa	30.2	31.1	15	7	83.3
Mineral	.75	.75	1		2.5
Salt	.75	.75	1		2.5

ROOM USE ONLY

ROOM USE ONLY

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03196 4723