



NOV 27 1925

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

TANKAGE AND BUTTERMILK AS PROTEIN
SUPPLEMENTS FOR GROWING PIGS

E. F. FERRIN AND M. A. McCARTY
DIVISION OF ANIMAL HUSBANDRY



UNIVERSITY FARM, ST. PAUL

AGRICULTURAL EXPERIMENT STATION

ADMINISTRATIVE OFFICERS

- W. C. COFFEY, M.S., Director
ANDREW BOSS, Vice-Director
F. W. PECK, M.S., Director of Agricultural Extension and Farmers' Institutes
C. G. SELVIG, M.A., Superintendent, Northwest Substation, Crookston
P. E. MILLER, M.Agr., Superintendent, West Central Substation, Morris
O. I. BERGH, B.S.Agr., Superintendent, North Central Substation, Grand Rapids
M. J. THOMPSON, M.S., Superintendent, Northeast Substation, Duluth
R. E. HODGSON, B.S. in Agr., Superintendent, Southeast Substation, Waseca
RAPHAEL ZON, F.E., Director, Forest Experiment Station, Cloquet
F. E. HARALSON, Assistant Superintendent, Fruit Breeding Farm, Zumbra Heights,
(P. O. Excelsior)
W. P. KIRKWOOD, M.A., Editor, and Chief, Division of Publications
'ALICE McFEELY, Assistant Editor of Bulletins
HARRIET W. SEWALL, B.A., Librarian
T. J. HORTON, Photographer
R. A. GORTNER, Ph.D., Chief, Division of Agricultural Biochemistry
J. D. BLACK, Ph.D., Chief, Division of Agricultural Economics
WILLIAM BOSS, Chief, Division of Agricultural Engineering
ANDREW BOSS, Chief, Division of Agronomy and Farm Management
W. H. PETERS, M.Agr., Chief, Division of Animal Husbandry
FRANCIS JAGER, Chief, Division of Bee Culture
C. H. ECKLES, M.S., D.Sc., Chief, Division of Dairy Husbandry
R. N. CHAPMAN, Ph.D., Chief, Division of Entomology and Economic Zoology
HENRY SCHMITZ, Ph.D., Chief, Division of Forestry
W. H. ALDERMAN, B.S.A., Chief, Division of Horticulture
E. M. FREEMAN, Ph.D., Chief, Division of Plant Pathology and Botany
A. C. SMITH, B.S., Chief, Division of Poultry Husbandry
F. J. ALWAY, Ph.D., Chief, Division of Soils
C. P. FITCH, M.S., D.V.M., Chief, Division of Veterinary Medicine

DIVISION OF ANIMAL HUSBANDRY

- W. H. PETERS, M.Agr., Animal Husbandman
Section of Horse Husbandry
W. H. PETERS, M.Agr., Animal Husbandman
Section of Swine Husbandry
E. F. FERRIN, M.Agr., Assistant Animal Husbandman
M. A. McCARTY, B.S., Assistant in Swine Husbandry
Section of Beef Cattle Husbandry
H. W. VAUGHAN, M.S., Assistant Animal Husbandman
A. L. HARVEY, M.S., Assistant in Beef Cattle Husbandry
Section of Sheep Husbandry and Meats
P. A. ANDERSON, B.S., Assistant Animal Husbandman

* Absent on leave, July 1, 1925 to January 1, 1926.

TANKAGE AND BUTTERMILK AS PROTEIN SUPPLEMENTS

By E. F. FERRIN and M. A. McCARTY¹

The United States produces annually approximately 55 million hogs. Hence furnishing the growing pigs with satisfactory rations is a matter of great economic importance, as mistakes made in feeding any appreciable percentage of this large number place a heavy tax upon the pork producers. One of the chief problems of feeding is furnishing an adequate protein supply. Protein for hogs is usually obtained largely from purchased feeds, hence it is often lacking in rations or is furnished at excessive cost.

Skimmilk or buttermilk and tankage are among the most valuable high-protein feeds. Semisolid buttermilk and dried buttermilk, two forms of commercial buttermilk feeds, have appeared on the market in recent years. These two products can be stored for future use. This gives them a decided advantage over buttermilk in the natural state.

Purpose of the Experiment

Information regarding the relative desirability and economy of these four protein supplements should be of considerable value to swine feeders. Accordingly an experiment was planned to learn the relative merits of these feeds. Four lots of pigs, each consisting of ten head with an average weight of approximately 73 pounds per pig, were started on feed August 4, 1922. They were carried on the same rations until the pigs in each lot averaged 175 pounds in weight.

As this was a comparison of protein carrying substances and the other factors in correct feeding were to be held uniform, the pigs were all allowed access to a high-class pasture crop; rape being the crop used. There was always more green growth than the pigs could eat. A mineral mixture was fed regularly. The nutritive ratios of the feed combinations were kept the same for all four lots and equal quantities of dry matter in each of the three kinds of milk were fed daily.

The Rations Fed

The pigs were all hand fed. Shelled corn was fed dry, while red dog flour and the protein supplement were mixed and fed as slop. The rations were as follows:

- Ration I. Shelled corn, red dog flour, tankage.
- Ration II. Shelled corn, red dog flour, dried buttermilk.
- Ration III. Shelled corn, red dog flour, semisolid buttermilk.
- Ration IV. Shelled corn, red dog flour, creamery buttermilk.

¹ The feeding was in charge of O. A. Morris, herdsman.

Composition of the Feeds

The analysis of the feeds as made by the Division of Agricultural Biochemistry were:

	Dry Basis				
	Moisture	Protein	Ash	Ether extract	Nitrogen-free extract
	Per cent	Per cent	Per cent	Per cent	Per cent
Corn	13.69	10.68	1.30	5.03	81.47
Red dog flour.....	11.62	17.02	2.79	6.09	71.10
Tankage	11.01	64.81	22.59	9.80	
Dried buttermilk	11.71	30.56	14.05	6.10	
Semisolid buttermilk	68.81	36.56	15.00	6.02	
Creamery buttermilk	91.62	38.02	9.90	1.17	

The Pigs Used

The pigs used for this trial were farrowed and raised in the University herd. The average dates of farrowing varied but five days among all the four lots, ranging from April 10 to April 15. The pigs averaged accordingly about 115 days of age and 73 pounds in

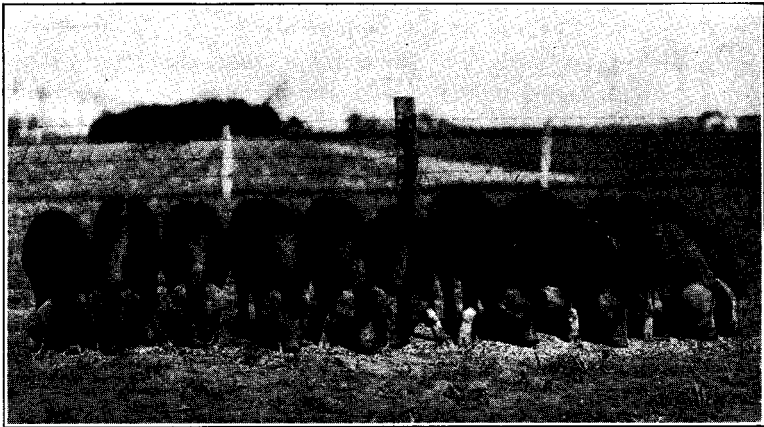


Fig. 1. Pigs Typical of Lots Fed in This Experiment

weight when the trial was started. Each of the forty pigs gained satisfactorily throughout the experiment, the aim being to cause the pigs to grow well but not to fatten them, hence a market finish was not obtained at the final average weight of 175 pounds per pig. This weight was considered the most suitable measure for determining the effect of the protein supplements upon the growing pigs. Table I presents a summary of the results obtained.

TABLE J
TANKAGE AND BUTTERMILK AS PROTEIN SUPPLEMENTS AUGUST 4 TO NOVEMBER 5, 1922

	Lot I	Lot II	Lot III	Lot IV
	Shelled corn red dog flour tankage rape pasture	Shelled corn red dog flour dried buttermilk rape pasture	Shelled corn red dog flour semisolid buttermilk rape pasture	Shelled corn red dog flour creamery buttermilk rape pasture
Days on feed.....	93	87	88	86
Average initial weight, lbs.....	73.40	73.40	73.50	73.10
Average final weight, lbs.....	174.20	174.40	174.90	174.30
Average daily gain, lbs.....	1.08	1.16	1.15	1.18
Feed for 100 lbs. gain				
Shelled corn (14 per cent moisture)	265.77	244.28	240.21	239.75
Red dog flour.....	76.98	70.87	70.44	69.71
Tankage	23.86			
Dried buttermilk		35.53		
Semisolid buttermilk			113.64	
Creamery buttermilk				390.84
Total feed for 100 lbs. gain, lbs....	366.61	350.68	424.29	700.30
Feed cost of 100 lbs. gain*.....	\$4.74	\$6.31	\$7.57	\$4.75

* Not including pasture charge.

Feed prices—Average Minneapolis quotations during the time of the experiment:

Shelled corn	60 cents per bushel
Red dog flour	\$29.00 per ton
Tankage	\$65.00 per ton
Dried buttermilk	\$ 7.50 per 100 pounds
Semisolid buttermilk	\$ 3.50 per 100 pounds
Creamery buttermilk	30 cents per 100 pounds

The feeding of any one of the buttermilk products increased the daily gains made by the pigs above those of the lot receiving tankage and accordingly reduced the time necessary to make 100 pounds gain. Taking the average of the three lots this saving in time amounted to 6 days. It cannot be said that the lot receiving tankage as the protein supplement failed to make satisfactory gains, but the more rapid increase in the weights of the other three lots is a considerable item in their favor. The added pork produced, amounted to approximately 70 pounds for each lot of ten pigs in the 87 days' feeding period.

A saving of 25 pounds of corn for each 100 pounds increase in the weight of the pigs resulted from using any form of buttermilk as the protein supplement, as contrasted with tankage. As the ten pigs in each lot gained a total of almost 1000 pounds in weight, very nearly 5 bushels less of corn was fed to the lots receiving buttermilk.

Costs of gains in Lots I and IV are practically the same, using the prices of feeds current at the time of the experiment. Enough difference is shown between these costs and the figures for Lots II and III to rank dried buttermilk third and semisolid buttermilk fourth in economy. The advantage of storing for future use either of the two commercial buttermilk feeds seems to be obtained at a high cost. As a substitute for tankage or creamery buttermilk, dried buttermilk increased the cost of producing 100 pounds of pork \$1.56, and semisolid buttermilk \$2.82 under the conditions of this experiment.

Results in 1923

To determine whether or not the differences resulting in the first comparison were constant and to check the results, the trial was repeated and four lots of pigs were fed during the summer and fall of 1923. Exactly the same rations were given under conditions similar to those of the preceding year. The feeding was begun on August 21 and the slowest gaining lot was weighed out on November 18. The pigs averaged almost the same in initial weight as those fed during the corresponding season of 1922. The average age was practically the same for each lot, being approximately 106 days. Six Duroc-Jersey and four Poland-China pigs constituted each lot. This season, as well as the summer of 1922, was rather dry. During both years the pigs always had rape to eat tho at times the crop was dry and somewhat yellow because of infrequent rains.

ANALYSIS OF FEEDS USED IN 1923

	Dry basis				
	Moisture	Protein	Ash	Ether extract	Nitrogen-free extract
	Per cent	Per cent	Per cent	Per cent	Per cent
Corn	13.27	11.51	1.56	4.50	80.59
Red dog flour.....	11.88	17.16	2.38	4.56	74.06
Tankage	9.34	66.11	22.44	7.79	
Dried buttermilk	12.87	35.51	15.55	6.15	
Semisolid buttermilk	66.37	37.58	13.64	11.02	
Creamery buttermilk	91.05	36.89	9.23	5.33	

The results from the 1923 trial are summarized in Table II.

TABLE II

TANKAGE AND BUTTERMILK AS PROTEIN SUPPLEMENTS AUGUST 21 TO NOVEMBER 18, 1923

	Lot V	Lot VI	Lot VII	Lot VIII
	Shelled corn red dog flour tankage rape pasture	Shelled corn red dog flour dried buttermilk rape pasture	Shelled corn red dog flour semisolid buttermilk rape pasture	Shelled corn red dog flour creamery buttermilk rape pasture
Days on feed.....	89	82	83	85
Average initial weight, lbs.....	72.80	73.00	72.50	73.20
Average final weight, lbs.....	176.20	177.00	178.10	178.90
Average daily gain, lbs.....	1.16	1.26	1.27	1.24
Feed for 100 lbs. gain				
Shelled corn (14 per cent moisture)	280.01	249.82	240.38	256.46
Red dog flour.....	71.47	66.13	63.63	66.63
Tankage	22.02			
Dried buttermilk		33.07		
Semisolid buttermilk			102.70	
Creamery buttermilk				372.37
Total feed for 100 lbs. gain, lbs....	373.50	349.02	406.71	695.46
Feed cost of 100 lbs. gain*.....	\$6.14	\$7.41	\$8.33	\$6.34

* Not including pasture charge.

Feed prices—Average Minneapolis quotations during the time of the experiment:

Shelled corn	86 cents per bushel
Red dog flour.....	\$33.00 per ton
Tankage	\$60.00 per ton
Dried buttermilk	\$ 7.50 per 100 pounds
Semisolid buttermilk	\$ 3.50 per 100 pounds
Creamery buttermilk	35 cents per 100 pounds

A greater rate of gain again resulted from feeding buttermilk feeds as compared with tankage. This increased gain amounted to 1 pound daily per lot for each lot of ten pigs and was obtained without any considerable increase in the feed consumed. The average daily ration per pig fed in Lot V was 4.3 pounds per day while each pig in Lot VI ate 4.4 pounds. The time necessary to reach an average weight of approximately 175 pounds per head was less in 1923 than in 1922 but there was very little difference in the relative rates of gain of the lots on similar rations. The gains made on each of the four rations approximated the normal average to be expected from pigs of these weights.

To make a fair comparison of the quantities of each protein supplement used to produce 100 pounds of pork, it is necessary to list the dry matter rather than the total amounts fed. The amounts of dry matter in the several supplemental feeds for each 100 pounds of gain made are as follows:

Tankage, lbs.....	19.96
Dried buttermilk, lbs.....	28.81
Semisolid buttermilk, lbs.....	34.54
Creamery buttermilk, lbs.....	33.33

A smaller amount of tankage than of any kind of buttermilk was needed because of the greater percentage of protein in tankage. There are no significant differences in the amount of dry matter in the three kinds of buttermilk used to make 100 pounds of pork.

The saving of corn in the lots receiving a buttermilk feed indicates a lower value for each unit of protein in the tankage. That is, while tankage contains a higher percentage of protein than buttermilk it probably is not so high in quality as the protein of buttermilk. Milk protein more nearly fills all the demands of the body for this nutrient than similar compounds contained in other feeds. The actual saving of corn based on each 100 pounds of pork produced in the lots receiving a buttermilk feed as compared to the lot receiving tankage, was 30 pounds. On the basis of ten pigs to a lot this amounts to 5½ bushels of corn for the feeding period.

The costs of gains made by the lots receiving tankage and creamery buttermilk are, as in 1922, nearly the same. Any small shift in the

relative prices of these two feeds might throw the advantage in favor of the creamery buttermilk. Dried buttermilk again ranks third in economy and semisolid buttermilk, fourth.

The 1922 and 1923 Data Averaged

As the results check closely in all particulars for the two trials, an accurate picture can be presented by averaging the figures obtained during 1922 and 1923. This information is contained in Table III.

Identical daily gains were made by pigs fed each kind of buttermilk when the data of the two trials are averaged. This result indicates that for feeding pigs under conditions such as those of this experiment the processes of producing either dried buttermilk or semisolid buttermilk do not damage the feeding value of the product. In fact, slightly less corn was required for a 100-pound gain in the lots receiving the commercial milk feeds. This difference in corn consumption is so small that it scarcely can be considered significant. For dry-lot feeding the results might have been very different.

TABLE III
TANKAGE AND BUTTERMILK AS PROTEIN SUPPLEMENTS

	Lots I and V	Lots II and VI	Lots III and VII	Lots IV and VIII
	Shelled corn red dog flour tankage rape pasture	Shelled corn red dog flour dried buttermilk rape pasture	Shelled corn red dog flour semisolid buttermilk rape pasture	Shelled corn red dog flour creamery buttermilk rape pasture
Days on feed.....	91	84.5	85.5	85.5
Average initial weight, lbs.....	73.10	73.20	73.00	73.20
Average final weight, lbs.....	175.20	175.70	176.50	176.60
Average daily gain.....	1.12	1.21	1.21	1.21
Feed for 100 lbs. gain				
Shelled corn	272.89	247.05	240.30	248.11
Red dog flour.....	74.23	68.50	67.04	68.17
Tankage	22.94			
Dried buttermilk		34.30		
Semisolid buttermilk			108.17	
Creamery buttermilk				381.61
Total feed for 100 lbs. gain, lbs....	370.06	349.85	415.51	697.89
Feed cost of 100 lbs. gain*.....	\$5.53	\$6.98	\$8.08	\$5.75

* Not including pasture charge.

Feed prices used in calculating the cost of 100 pounds gain.

Shelled corn	75 cents per bushel
Red dog flour.....	\$32.00 per ton
Tankage	\$60.00 per ton
Dried buttermilk	\$ 7.50 per 100 pounds
Semisolid buttermilk	\$ 3.50 per 100 pounds
Creamery buttermilk	35 cents per 100 pounds

It is probable that when good pasture is available for pigs the very bulky nature of the creamery buttermilk is a disadvantage. The pig has a small stomach and the consumption of $91\frac{1}{2}$ pounds of water in order to get $8\frac{1}{2}$ pounds of dry matter, as is necessary when ordinary buttermilk is fed, no doubt is a considerable disadvantage. By adding only a small amount of water the dried and semisolid buttermilk could be fed in more concentrated form.

The ten pigs in any one of the three buttermilk lots made total gains in 85 days of $76\frac{1}{2}$ pounds more than the tankage-fed pigs. These gains were produced with slightly less feed when the differences in the moisture contents of the protein supplements are considered. It can be said that tankage was inferior to any one of the buttermilk feeds in two points, (1) daily rate of gain and (2) consumption of feed to produce 100 pounds of gain.

But where the cost of gains are computed, tankage possibly has a slight advantage over any of the other supplements. The difference between tankage and creamery buttermilk is too small to be given much weight. Both tankage and creamery buttermilk produced gains at a much cheaper cost than dried buttermilk and this feed in turn was more economical than semisolid buttermilk. On the basis of the cost of creamery buttermilk, for each 100 pounds of pork made, a feeder could have paid \$3.91 per hundredweight for dried buttermilk and \$1.24 per hundredweight for semisolid buttermilk to have made an equal expenditure for each of the three kinds of milk feeds.

The advantage of storing commercial buttermilk feeds for future use seems to be obtained at a decided increase in cost over creamery buttermilk. There are, of course, many situations preventing the feeding of creamery buttermilk and in these cases the commercial feeds may be found satisfactory altho probably it will be desirable to use smaller amounts than were fed in these trials. Tankage can be kept for a long time if properly stored and as indicated here, will produce gains nearly on a par in cost with creamery buttermilk if good pasture is a part of the ration. As more pork is made on creamery buttermilk than on tankage in the same length of time, economy of production is greater when the protein supplement is ordinary buttermilk than when tankage is used to balance the ration.

Conclusions

1. The feeding of dried, semisolid, or creamery buttermilk as a protein supplement in rations for growing pigs increased slightly the daily gains and the total amount of pork produced as contrasted with tankage.

2. The saving in the time necessary to increase the weight of a growing pig by 100 pounds was 6 days when either kind of buttermilk was fed instead of tankage.

3. Not considering the cost, the use of any one of the four protein supplemental feeds resulted in satisfactory rations.

4. Creamery buttermilk or tankage produced the most economical gains, with dried buttermilk third, and semisolid buttermilk fourth.

5. For feeding growing pigs on good pasture, the commercial buttermilk feeds, with relative prices current during these trials are not as cheap sources of protein as either tankage or creamery buttermilk.