

✓

TEXAS AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

W. B. BIZZELL, President

BULLETIN NO. 317

FEBRUARY, 1924

DIVISION OF ANIMAL INDUSTRY

COMPARATIVE INFLUENCES OF VARIOUS PROTEIN FEEDS ON LAYING HENS



AGRICULTURAL & MECHANICAL
COLLEGE OF TEXAS LIBRARY

B. YOUNGBLOOD, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

TEXAS AGRICULTURAL EXPERIMENT STATION SYSTEM

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

COLLEGE STATION, TEXAS

STAFF: (As of February 15, 1924)

ADMINISTRATION:

B. YOUNGBLOOD, M. S., Ph. D., *Director*
 A. B. CONNER, M. S., *Vice Director*
 A. H. LEIDIGH, M. S., *Assistant Director*
 C. A. FELKER, *Chief Clerk*
 A. S. WARE, *Secretary*
 M. P. HOLLEMAN, JR., *Ass't. Chief Clerk*
 J. M. SCHAEDEL, *Executive Assistant*
 C. J. GORZYCKI, *Technical Assistant*

VETERINARY SCIENCE:

*M. FRANCIS, D. V. M., *Chief*
 H. SCHMIDT, D. V. S., *Veterinarian*
 V. J. BRAUNER, D. V. M., *Veterinarian*

CHEMISTRY:

G. S. FRAPS, Ph. D., *Chief; State Chemist*
 S. E. ASBURY, M. S., *Assistant Chemist*
 W. H. WALKER, *Assistant Chemist*
 A. G. PETERSON, B. S., *Assistant Chemist*
 J. E. TEAGUE, B. S., *Assistant Chemist*
 J. K. BLUM, B. S., *Assistant Chemist*

HORTICULTURE:

A. T. POTTS, M. S., *Chief*

ANIMAL INDUSTRY:

J. M. JONES, A. M., *Chief*
 J. L. LUSH, Ph. D., *Animal Husbandman, Breeding*
 G. R. WARREN, B. S., *Swine Husbandman*
 R. M. SHERWOOD, B. S., *Poultry Husbandman*
 J. J. HUNT, *Wool Grader*

ENTOMOLOGY:

M. C. TANQUARY, Ph. D., *Chief; State Entomologist*
 H. J. REINHARD, B. S., *Entomologist*
 C. S. RUDE, B. S., *Entomologist*
 W. O. VICTOR, JR., *Apiary Inspector*
 W. R. JORDAN, B. S., *Apiary Inspector*

AGRONOMY:

E. B. REYNOLDS, M. S., *Chief*
 G. N. STROMAN, Ph. D., *Cotton Breeder*
 C. H. MAHONEY, B. S., *Ass't. in Cotton Breeding*

PLANT PATHOLOGY AND PHYSIOLOGY:

J. J. TAUBENHAUS, Ph. D., *Chief*

FARM AND RANCH ECONOMICS:

L. P. GABBARD, M. S., *Chief*
 V. L. CORY, M. S., *Grazing Research Botanist*
 H. E. REA, B. S., *Assistant*

SOIL SURVEY:

**W. T. CARTER, B. S., *Chief*
 H. W. HAWKER, *Soil Surveyor*
 EDWARD TEMPLIN, B. S., *Soil Surveyor*

BOTANY:

H. NESS, M. S., *Chief*

PUBLICATIONS:

A. D. JACKSON, *Chief*

STATE APICULTURAL RESEARCH

LABORATORY:

H. B. PARKS, B. S., *Apiculturist in Charge*
 A. H. ALEX, B. S., *Queen Breeder*

MAIN STATION FARM:

D. T. KILLOUGH, B. S., *Superintendent*

FEED CONTROL SERVICE:

B. YOUNGBLOOD, M. S., Ph. D., *Director*
 F. D. FULLER, M. S., *Chief*
 S. D. PEARCE, *Secretary*
 J. H. ROGERS, *Inspector*
 W. H. WOOD, *Inspector*
 J. J. KELLY, *Inspector*
 J. D. PREWIT, B. S., *Inspector*
 T. C. DAVIS, B. S., *Inspector*

SUBSTATIONS:

No. 1, Beeville, Bee County:

R. A. HALL, B. S., *Superintendent*

No. 2, Troup, Smith County:

W. S. HOTCHKISS, *Superintendent*

No. 3, Angleton, Brazoria County:

V. E. HAFNER, B. S., *Superintendent*

No. 4, Beaumont, Jefferson County:

R. H. WYCHE, B. S., *Superintendent*

No. 5, Temple, Bell County:

A. B. CRON, B. S., *Superintendent*

No. 6, Denton, Denton County:

P. B. DUNKLE, B. S., *Superintendent*

No. 7, Spur, Dickens County:

R. E. DICKSON, B. S., *Superintendent*

No. 8, Lubbock, Lubbock County:

R. E. KARPER, B. S., *Superintendent*

No. 9, Balmorhea, Reeves County:

J. J. BAYLES, B. S., *Superintendent*

No. 10, College Station, Brazos County:

(Feeding and Breeding substation)

L. J. McCALL, *Superintendent*

No. 11, Nacogdoches, Nacogdoches County:

G. T. McNESS, *Superintendent*

**No. 12, Chillicothe, Hardeman County:

D. L. JONES, *Superintendent*

No. 14, Sonora, Sutton-Edwards Counties:

E. M. PETERS, B. S., *Superintendent*

D. H. BENNETT, V. M. D., *Veterinarian*

O. L. CARPENTER, B. S., *Shepherd*

No. 15, Llano Grande, Hidalgo County:

W. H. FRIEND, B. S., *Superintendent*

Teachers in the School of Agriculture carrying cooperative projects on the Station:

‡S. W. BILSING, *Professor of Entomology*
 W. L. STANGEL, *Professor of Animal Husbandry, Hogs*
 F. A. BUECHEL, *Professor of Agricultural Economics*
 G. W. ADRIANCE, *Associate Professor of Horticulture*

W. E. GARNETT, *Professor of Rural Sociology*
 G. P. GROUT, *Professor of Dairy Husbandry*
 R. C. WHITE, *Associate Professor of Rural Sociology*

*In cooperation with School of Veterinary Medicine, A. and M. College of Texas.

**In cooperation with United States Department of Agriculture.

‡On leave.

CONTENTS

	Page
Synopsis	4
Introduction	5
Experiment 1—Comparative Value of Meat Scrap, Tankage and Cottonseed Meal for Laying Hens	6
Time, Objects, Stock Used, Feeds Used.....	6
Prices of Feeds	7
Results of the Test	7
Mortality	7
Feeds Consumed and Eggs Produced	8
Discussion	9
Experiment 2—Comparison of Fish Meal and Tankage with Cottonseed Meal for Laying Hens	10
Time, Object, Stock Used, Feeds Used.....	10
Prices of Feeds	11
Results of the Test	11
Mortality	11
Feeds Consumed and Eggs Produced	11
Discussion	13
Experiment 3—Comparison of Tankage with Cottonseed Meal for Laying Hens	14
Time, Object, Stock Used, Feeds Used, Prices of Feeds.....	14
Results of the Test.....	15
Mortality	15
Feeds Consumed and Eggs Produced	15
Discussion	15
Experiment 4—Comparison of Meat Scrap with Cottonseed Meal For Laying Hens	16
Time, Object, Stock Used, Feeds Used.....	16
Prices of Feeds	17
Results of the Test	17
Mortality	17
Feeds Consumed and Eggs Produced	18
Experiment 5—Value of Meat Scrap, Cottonseed Meal, and Alfalfa Meal for Laying Hens	19
Time, Objects, Stock Used, Feeds Used.....	19
Prices of Feeds	20
Results of the Test	20
Health of Fowls and Mortality	20
Hatchability of Eggs	22
Egg Production	23
Feed Consumed and Cost of Eggs.....	23
Discussion	24
Summary	24

This bulletin embodies the data secured in the experiment of using cottonseed meal instead of animal products as a source of protein for laying hens. The results warrant the recommendation of freshly ground cottonseed meal as a substitute for meat-scrap and tankage in rations for laying hens.

The ration in which cottonseed meal gave the best results was: wheat bran 125 pounds, gray wheat shorts 75 pounds, corn meal 75 pounds, and cottonseed meal 120 pounds.

Data are also given showing that with hens given feeds containing only limited quantities of fat-soluble A for a period of seven months and three weeks, the mortality was very high and the egg production was low. The greatest mortality and the lowest egg production occurred during the last seven weeks of the experiment.

COMPARATIVE INFLUENCES OF VARIOUS PROTEIN FEEDS ON LAYING HENS

By

R. M. SHERWOOD

Poultry raisers have, for some time, been aware of the necessity of feeding protein feeds to laying hens. Experiment Stations have proved that milk, meat scrap, tankage, and fish meal are valuable feeds for egg-production. Early experiments showed that protein feeds from animal sources gave better results than those from vegetable sources. Later experiments showed that if certain deficiencies in some of the vegetable rations were corrected they gave good results. In the studies with cottonseed meal, the New Mexico Station¹ and the Texas Station² found that cottonseed meal gave satisfactory results. The Mississippi Station,³ (in the case of the lots which were comparable), reports similar results. The Oklahoma Station⁴ did not find cottonseed meal as satisfactory as the other stations named.

In the tests at Northern stations, cottonseed meal gave poor results. Conditions are somewhat different in these different sections. In the South, fresh cottonseed meal is readily available, while in the North, the supply will have been milled several months, and in some cases it may have been milled over a year before it reaches the feeder. The condition of freshness alone may have its effect upon the palatability, which, in turn, affects the amount consumed and eggs produced.

In the South, green feed is available at all times. This is not always true in the North. Possibly, green feed may correct the deficiencies in the cottonseed meal and this may account for the discrepancies in results in the different sections of the country.

The series of experiments reported in this bulletin were started at this Station in January, 1920, and have been carried on continuously since then. Experiments 1 to 4 deal with various quantities of cottonseed meal as substituted for meat scrap, tankage, and fish meal. In these experiments, the hens were allowed range at all times. The experiment reported in part 5 of this publication was carried on with the fowls in a building, without access to the ground at any time. In half of the lots, screened alfalfa meal was fed in the mash ration; in the other two lots, none was given.

¹New Mexico Experiment Station Bulletin No. 117.

²Texas Experiment Station Bulletins No. 206 and No. 220.

³Mississippi Experiment Station Bulletins No. 162 and No. 175.

⁴Oklahoma Experiment Station Bulletin No. 112.

EXPERIMENT 1

Comparative Value of Meat Scrap, Tankage, and Cottonseed Meal for Laying Hens

Time of test—This experiment started January 6, 1920 and continued 244 days, ending August 31, 1920.

Objects—The principal object of this work was to test the value of varying quantities of cottonseed meal as a substitute for either meat scrap or tankage in a ration for laying hens. Another object was to test the value of tankage as compared with meat scrap, when fed with varying amounts of cottonseed meal.

Stock Used—Eight pens of nineteen S. C. White Leghorn pullets, each, were used in this work. They were of similar age and breeding and had received similar feed and care up to the time they were started on this experiment. When the pullets were divided to make up the various pens, customary precautions were taken to make all pens alike.

Feeds Used—Pens 1, 3, 5, and 7 received meat scrap, while Pens 2, 4, 6, and 8, received tankage. Pens 1 and 2 received no cottonseed meal; Pens 3 and 4 received enough cottonseed meal to supply the protein removed by the omission of 15 per cent. of the meat scrap and tankage from the mash rations fed Pens 1 and 2. Pens 5 and 6 received enough cottonseed meal to supply the protein removed by the omission of 30 per cent. of the meat scrap and tankage from the mash rations fed Pens 1 and 2. Pens 7 and 8 received enough cottonseed meal to supply the protein removed by the omission of 45 per cent. of the meat scrap and tankage from the mash rations fed pens 1 and 2.

The meat scrap used in this test was purchased from one of the packers and was guaranteed to contain 50 per cent. protein. The tankage was secured from the same source and was guaranteed to contain 60 per cent. protein. The cottonseed meal was purchased from a local oil mill and was guaranteed to contain 43 per cent. protein.

All pens received milo for their grain feed. This was fed in litter twice a day. Oyster shell and water were before the fowls at all times. Growing oats were available for green feed during the winter and early spring; the balance of the year Sudan grass was used. All of these mash rations contain more bran than is usually fed with meat scrap, at this Station. This is used to improve the physical condition of the cottonseed meal rations and thus make them more palatable.* Their mash rations were made up as shown in Table 1.

*In other rations where meat scrap is used, at this Station, the proportion of the various feeds in the mash is as follows: wheat bran 100 lbs.; shorts 200 lbs.; corn meal 100 lbs.; or milo meal 100 lbs.; and meat scrap 100 lbs.

TABLE 1
Composition of Mash Rations

Feeds Used in Pounds	Pen 1	Pen 2	Pen 3	Pen 4	Pen 5	Pen 6	Pen 7	Pen 8
Wheat Bran	125	125	125	125	125	125	125	125
Wheat Shorts	75	75	75	75	75	75	75	75
Milo Meal	100	100	100	100	100	100	100	100
Meat Scrap	100	0	85	0	70	0	55	0
Tankage	0	83	0	71	0	58	0	46
Cottonseed Meal	0	0	20	20	40	40	60	60

Prices of Feeds. This experiment was carried on during the year 1920, when feed prices were very high. The prices, per 100 pounds, used in figuring the results of the experiments are as follows:

Milo	\$2.50
Milo meal	2.75
Wheat bran	3.25
Gray wheat shorts	3.50
Meat scrap	6.50
Tankage	6.00
Cottonseed meal	3.50

It is not uncommon, on the local market, for meat scrap and tankage to cost more than twice as much as cottonseed meal. In such cases, the rations for Pens 1 and 2 would cost more as compared with the others than is shown in this table. At these prices the mash mixtures for the different pens cost per 100 pounds as follows:

Pen 1	\$3.99
Pen 2	3.77
Pen 3	3.87
Pen 4	3.69
Pen 5	3.75
Pen 6	3.60
Pen 7	3.67
Pen 8	3.52

Results of the Test

Mortality—Five hens died during this experiment. Two died from Pen 2 that received tankage and no cottonseed meal. One died from Pen 7 that received meat scrap and cottonseed meal, while two died from Pen 8 that received tankage and cottonseed meal. This death rate is no greater than could be expected, and it is not thought that it was caused from the feeds used.

Feeds Consumed and Eggs Produced—Table 2 gives the amounts of the feeds consumed and the eggs produced during this experiment; it also gives the value of the feed and costs of the eggs produced.

TABLE 2

Feeds Consumed and Eggs Produced, January 6, 1920, to August 31, 1920—244 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 125 lbs., Gray Wheat Shorts 75 lbs., Milo Meal 100 lbs.	Pounds of Feed per Hen for Period			Value of feed per Hen	Doz. Eggs per Hen	Lbs. of Feed Consumed per Doz Eggs	Cost of Feed to Produce 1 Doz Eggs
		Grain	Mash	Total				
1	Meat scrap 100 lbs.	25.4	22.2	47.6	\$1.52	10.7	4.4	\$.14
2	Tankage 83 lbs.	25.0	17.8	42.8	1.30	8.6	5.0	.15
3	Meat scrap 85 lbs. Cottonseed Meal 20 lbs.	25.0	18.5	43.5	1.34	8.6	5.1	.16
4	Tankage 71 lbs. Cottonseed Meal 20 lbs.	25.4	18.9	44.3	1.33	10.2	4.3	.13
5	Meat Scrap 70 lbs. Cottonseed Meal 40 lbs.	24.8	17.3	42.1	1.27	8.8	4.8	.14
6	Tankage 58 lbs. Cottonseed Meal 40 lbs.	25.5	16.4	41.9	1.23	8.4	5.0	.15
7	Meat Scrap 55 lbs. Cottonseed Meal 60 lbs.	25.4	16.7	42.1	1.25	8.6	4.9	.15
8	Tankage 46 lbs. Cottonseed Meal 60 lbs.	25.2	16.4	41.6	1.21	8.6	4.8	.14

From table 2 it is seen that the different pens ate approximately the same amount of grain. They vary in the amount of mash eaten from 16.4 to 22.2 pounds. They vary in the total feed consumed per hen from 41.6 to 47.6. The egg-production varied from 8.4 dozen to 10.7 dozen per hen with the amount of feed consumed to produce one dozen eggs varying from 4.3 pounds to 5.1 pounds at a cost per dozen of \$.13 to \$.16. These differences are all small and there is no regular graduation in these figures as the per cent. of cottonseed meal increases or decreases.

Table 3 shows that the tankage-fed hens gave as good results as those fed meat scrap. This is in agreement with the results of similar experiments at the Indiana Experiment Station.¹

¹Indiana Experiment Station Bulletin No. 227.

TABLE 3
Meat Scrap and Tankage Compared for 244 Day Period.

Pens	Cost of Feed per Hen	No. Dozen Eggs per Hen	Cost of Eggs per Dozen
Meat Scrap	\$1.35	9.2	\$.148
Tankage	1.27	9.0	.143

Table 4 seems to show that hens fed cottonseed meal do not lay as well as those not receiving it. By turning back to table 2, however, one will notice that Pens 5 and 6, also 7 and 8, which received cottonseed meal, laid as well as Pen 2, which did not receive cottonseed meal. It will also be noted that Pen 4, which received some cottonseed meal, laid much better than Pen 2, which received no cottonseed meal.

TABLE 4
Value of Varying Quantities of Cottonseed Meal for 244 Day Period.

Amt. cottonseed meal substituted for meat scrap or tankage in the mash ration	Cost of Feed per Hen	No. Dozen Eggs per Hen	Cost per Dozen
No cottonseed meal	\$1.41	9.7	\$.145
15 per cent. cottonseed meal	1.34	9.4	.145
30 per cent. cottonseed meal	1.25	8.6	.145
45 per cent. cottonseed meal	1.23	8.6	.145

DISCUSSION

1. Tankage gave as satisfactory results as meat scrap when fed in the proportion of 83 pounds tankage to 100 pounds meat scrap.

2. Rations with tankage and meat scrap and no cottonseed meal did not give uniformly better results than similar rations with varying quantities of cottonseed meal replacing part of the meat scrap or tankage in the rations.

EXPERIMENT 2

Comparison of Fish Meal and Tankage With Cottonseed Meal for Laying Hens

Time of Test—This experiment started November 2, 1920 and continued 334 days, ending October 1, 1921.

Object—The object of this experiment was to test the value of varying quantities of cottonseed meal in rations for laying hens. The rations contained fish meal from November 2, 1920 to February 4, 1921 and tankage from February 4, 1921 to October 1, 1921.

Stock used—Four pens of forty S. C. White Leghorn pullets, each, were used in this work. They were of similar breeding and had received similar feed and care up to the time they were started in this experiment.

In dividing the pullets to make up the various pens, customary precautions were taken to make all pens alike.

Feeds Used—All pens received milo for their grain feed. This was fed in litter twice a day. Oyster shell and water were before the fowls at all times. Growing oats were available for green feed during the winter and early spring; for the remainder of the year Sudan grass was used. Their mash rations were as shown in Table 5.

TABLE 5
Composition of Mash Rations.

Feeds Used in Pounds	Pen 1	Pen 2	Pen 3	Pen 4
Wheat Bran	100	100	100	100
Gray Wheat Shorts	100	100	100	100
Milo Meal	200	200	200	200
Fish Meal or Tankage*	100	85	70	50
Cottonseed Meal	0	19	38	63

*Fish meal was fed before February 4, 1921, and tankage after that date.

It will be noticed that Pen 1 was fed fish meal the first part of the test and tankage the last part, but at no time was cottonseed meal given. Pen 2 received enough cottonseed meal to supply the protein removed by the omission of 15 per cent. of the fish meal and tankage from the mash as fed Pen 1. Pen 3 received enough cottonseed meal to supply the protein removed by the omission of 30 per cent of the fish meal and tankage from the

mash as fed Pen 1, and Pen 4 received enough cottonseed meal to supply the protein removed by the omission of 50 per cent. of the fish meal and tankage from the mash as fed Pen 1.

The fish meal used in this test was manufactured in Texas and was guaranteed to contain 55 per cent. protein. The tankage was secured from one of the packers and was guaranteed to contain 60 per cent. protein. The cottonseed meal was purchased from a local mill and was guaranteed to contain 43 per cent. protein.

Prices of Feeds—The prices of feed per 100 pounds used in figuring the results of this experiment are as follows:

Milo	\$1.25
Milo Meal	1.35
Wheat bran	1.35
Gray wheat shorts	1.50
Fish meal	5.25
*Cottonseed meal	3.00
**Cottonseed meal	2.00
Tankage	3.50
*Before February 4.	
**After February 4.	

At these prices the mash mixtures for the different pens cost per 100 pounds as follows: From November 2, to February 3, Pen 1, \$2.16; Pen 2, \$2.10; Pen 3, \$2.04, and Pen 4, \$1.96. From February 4, to October 1, the cost was for Pen 1, \$1.81; Pen 2, \$1.77; Pen 3, \$1.72, and Pen 4, \$1.67.

Results of the Test

Mortality—The mortality in this experiment was not high. One hen died from Pen 2 and two died from each of Pens 3 and 4.

Feeds Consumed and Eggs Produced—Tables 6a, 6b, and 6c show the amount of feed consumed, the value of the feed, the number of eggs laid, the number of pounds of feed consumed to produce one dozen eggs, and the cost of feed to produce one dozen eggs. It will be noted in Table 6c that the feed consumption of the different pens is very close, the difference being only .8 of a pound, or less than 2 per cent. The difference in the cost of feed was only \$.04 per hen. The difference in egg-production shown in this table is only .9 of a dozen or less than 8 per cent. The feed consumed per dozen eggs produced shows a variation of .4 of a pound or less than 9 per cent. None of these differences is large and there is no regular graduation from one pen to the other except in the case of pounds of feed consumed per dozen eggs produced. Here the differences are not in proportion to the differences in the ration. The cost of feed to produce one dozen eggs varied from 7.4 to 7.8 cents. This difference amounts to only about 6 per cent.

Feed Consumed and Eggs Produced

TABLE 6A

November 2, 1920 to February 3, 1921—94 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 100 lbs., Gray Wheat Shorts 100 lbs., Milo Meal 200 lbs.	Feed in Pounds per Hen			Value of Feed per Hen	Doz. Eggs Produced per Hen	Lbs. of Feed Consumed per Doz.	Cost of Feed to Produce 1 Doz. Eggs
		Grain	Mash	Total				
1	Fish Meal.....100 lbs. Cottonseed Mealnone	11.3	5.9	17.2	\$.27	1.4	12.3	\$.19
2	Fish Meal..... 85 lbs. Cottonseed Meal 19 lbs.	11.3	5.6	16.9	.26	1.4	12.0	.19
3	Fish Meal..... 70 lbs. Cottonseed Meal 38 lbs.	11.3	5.8	17.1	.26	1.2	14.3	.22
4	Fish Meal..... 50 lbs. Cottonseed Meal 63 lbs.	11.3	5.3	16.6	.25	1.1	15.1	.23

TABLE 6B

February 4, 1921, to October 1, 1921—240 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 100 lbs., Gray Wheat Shorts 100 lbs., Milo Meal 200 lbs.	Feed in Pounds per Hen			Value of Feed per Hen	Doz. Eggs Produced per Hen	Lbs. of Feed Consumed per Doz.	Cost of Feed to Produce 1 Doz. Eggs
		Grain	Mash	Total				
1	Tankage100 lbs. Cottonseed Mealnone	18.4	19.3	37.7	\$.58	10.0	3.8	\$.058
2	Tankage 85 lbs. Cottonseed Meal 19 lbs.	18.8	18.6	37.4	.56	9.7	3.9	.058
3	Tankage 70 lbs. Cottonseed Meal 38 lbs.	19.5	18.5	38.0	.56	9.3	4.1	.060
4	Tankage 50 lbs. Cottonseed Meal 63 lbs.	19.7	18.6	38.3	.55	9.5	4.0	.059

Table 6C
November 2, 1920, to October 1, 1921—334 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 100 lbs., Gray Wheat Shorts 100 lbs., Corn Meal 200 lbs.	Pounds of Feed per Hen			Value of Feed per Hen	Doz. Eggs Produced per Hen	Lbs. of Feed Consumed per Doz.	Cost of Feed to Produce 1 Doz. Eggs
		Grain	Mash	Total				
1	Fish Meal or Tankage . . . 100 lbs. Cottonseed Meal none	29.7	25.2	54.9	\$.85	11.4	4.8	\$.075
2	Fish Meal or Tankage . . . 85 lbs. Cottonseed Meal 19 lbs.	30.1	24.2	54.3	.82	11.1	4.9	.074
3	Fish Meal or Tankage . . . 70 lbs. Cottonseed Meal 38 lbs.	30.8	24.3	55.1	.82	10.5	5.2	.078
4	Fish Meal or Tankage . . . 50 lbs. Cottonseed Meal 63 lbs.	31.0	23.9	54.9	.81	10.6	5.2	.076

Observations were taken on the earliness of the molt of the hens in each of the pens and there seemed to be no difference in the molt of the fowls getting the different amounts of cottonseed meal.

DISCUSSION

1. Rations containing either fish meal or tankage, with varying quantities of cottonseed meal were practically as good as the rations containing fish meal or tankage without cottonseed meal.

EXPERIMENT 3

Comparison of Tankage With Cottonseed Meal for Laying Hens

Time of Test—This experiment started November 1, 1921 and continued 325 days, ending September 21, 1922.

Object of Test—The object of this test, as of that reported in part two of this Bulletin, was to study how much cottonseed meal could be substituted for tankage in rations for laying hens.

Stock Used—Three pens of forty S. C. White Leghorn pullets, each, were used in this work. They were all of similar breeding and had received similar feed and care up to the time they were started on this experiment. When the pullets were divided to make up the various pens, customary precautions were taken to make all pens alike.

Feed Used—All pens received milo fed in litter twice a day for their grain feed and had growing oats for green feed during the winter and early spring. Sudan grass furnished the green feed for the remainder of the year. Oyster shell and water were kept before the fowls at all times. The mash rations of the different lots were as shown in Table 7.

TABLE 7
Composition of Mash Rations.

Feeds Used in Pounds	Pen 1	Pen 2	Pen 3
Wheat Bran	125	125	125
Gray Wheat Shorts	75	75	75
Milo Meal	75	75	75
Tankage	60	30	0
Cottonseed Meal	0	60	120

The tankage used in this test was secured from one of the packers and was guaranteed to contain 60 per cent. protein. The cottonseed meal was purchased from a local oil mill and was guaranteed to contain 43 per cent. protein.

Prices of Feeds—The following prices per 100 pounds represent the average prices during the time of this experiment:

Milo	\$1.25
Milo Meal	1.35
Wheat bran	1.30
Gray wheat shorts	1.60
Cottonseed meal	2.00
Tankage	3.50

With these prices as a basis, the mash for the various pens cost per 100 pounds as follows:

Pen 1	\$1.77
Pen 2	1.67
Pen 3	1.59

Results of the Test

Mortality—Seven hens died during this experiment. Two died from Pen 1 and five from Pen 3.

TABLE 8

Feed Consumed and Eggs Produced, November 1, 1921, to September 21, 1922—325 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 125 lbs., Gray Wheat Shorts 75 lbs., Milo Meal 75 lbs.	Pounds of Feed per Hen			Value of Feed per Hen	Doz. Eggs Produced Per Hen	Lbs. of Feed Consumed per Doz.	Cost of Feed to Produce 1 Doz. Eggs
		Grain	Mash	Total				
1	Tankage 60 lbs. Cottonseed Meal none	33.5	28.5	62.0	\$.92	10.6	5.8	\$.087
2	Tankage 30 lbs. Cottonseed Meal 60 lbs.	33.2	20.5	53.7	.76	10.0	5.4	.076
3	Tankage none Cottonseed Meal 120 lbs.	30.4	27.4	61.8	.82	12.0	5.2	.068

Feed Consumed and Eggs Produced—Table 8 shows that Pen 1 ate slightly more feed than Pen 3 and about eight pounds or 13 per cent. more than Pen 2. Pen 2 laid nearly as many eggs as Pen 1 but two dozen less than Pen 3. The pounds of feed required to produce one dozen eggs and the cost of feed to produce one dozen eggs are in favor of Pen 3 with Pen 1 most expensive.

Observations were taken on the earliness of molt in the different pens, but there seemed to be no difference in the molt of the pullets getting the different amounts of cottonseed meal.

DISCUSSION

1. Under the conditions of this test, the chickens receiving cottonseed meal and no tankage produced more eggs at a cheaper price per dozen than those receiving tankage and no cottonseed meal.

2. The mortality was slightly higher in the cottonseed meal pen than in the tankage pens, but was higher in the tankage-fed pen than in the pen receiving the 50 per cent. cottonseed meal.

EXPERIMENT 4

Comparison of Meat Scrap With Cottonseed Meal for Laying Hens

Time of Test—This experiment started October 1, 1922 and continued 335 days, ending August 31, 1923.

Object—The object of this test was to secure more data on the value of cottonseed meal for laying hens, when used to replace part or all of the meat scrap in the ration.

Stock Used—Three pens of twenty-four S. C. White Leghorns, each, were used in this test. They were of similar age and breeding and had received similar feed and care up to the time they were started on the experiment. When the pullets were divided to make up the various pens customary precautions were taken to make all pens alike.

Feeds Used—All pens received corn for their grain ration, fed twice a day in a straw litter. Oyster shell and water were before the fowls at all times. Growing oats furnished green feed during the winter and early spring; for the remainder of the year Sudan grass was used. The mash rations for the different pens were as shown in Table 9.

TABLE 9
Composition of Mash Rations.

Feeds Used in Pounds	Pen 1	Pen 2	Pen 3
Wheat Bran	125	125	125
Gray Wheat Shorts	75	75	75
Corn Meal	75	75	75
Meat Scrap	60	30	0
Cottonseed Meal	0	60	120

The cottonseed meal used was of good quality during the first seven months of the experiment but became slightly rancid during the last four months. No data are available to show that rancid cottonseed meal is less digestible than fresh meal but it is certainly less palatable and it is not possible to induce the hens to eat enough of this rancid meal to give good results. It may be that the meal that has been milled for some time is less palatable than the fresh meal even though it may not be noticeably rancid. In Bulletin 227 of the Indiana Station, results are given to show that cottonseed meal is of little value. In this experiment enough meal was purchased to last two years. No mention is made as

to how long this meal had been milled before it was purchased. If the freshness of the meal is one of the limiting factors, it may be found that it can be recommended only in sections where it can be secured soon after being milled.

The meat scrap used was richer in protein than that usually fed to poultry. Table 10 shows the percentage composition of meat scrap and cottonseed meal as analysed by Dr. G. S. Fraps, Station Chemist.

TABLE 10
Percentage Composition of Protein Feeds Compared

	Protein	Fat	Crude Fiber	Nitrogen-Free Extr.	Water	Ash
Cottonseed meal	40.95	6.08	11.59	27.15	9.05	5.18
Meat scrap	74.41	7.36	2.17	2.06	6.92	7.08

Prices of Feeds—The prices of feeds per 100 pounds represent the average prices during the time of the experiment.

Corn	\$1.75
Corn meal	1.85
Wheat bran	1.80
Gray wheat shorts	2.00
Cottonseed meal	2.25
Meat scrap	3.50

With these prices as a basis, the mash rations for the various pens cost per hundred pounds as follows:

Pen 1	\$2.16
Pen 2	2.07
Pen 3	1.98

Results of Test

Mortality—Six hens died during this experiment. One died from Pen 1, which received meat scrap; two from Pen 2, which received meat scrap and cottonseed meal; and three from Pen 3, which received cottonseed meal. The loss was not high in any of the pens, and the difference in loss of the different pens is not considered significant.

TABLE 11

Feed Consumed and Eggs Produced, October 1, 1922, to August 31, 1923—335 Days

Pen	Amt. protein supplement added basal mash consisting of Wheat Bran 125 lbs., Gray Wheat Shorts 75 lbs., Corn Meal 75 lbs.	Pounds of Feed per Hen			Value of Feed per Hen	Doz. Eggs Produced per Hen	Lbs. of Feed Consumed per Doz.	Cost of Feed to Produce 1 Doz. Eggs
		Grain	Mash	Total				
1	Meat Scrap..... 60 lbs.	41.6	15.3	56.9	\$1.06	12.3	4.63	\$.086
2	Meat scrap..... 30 lbs.	43.1	12.0	55.1	1.00	10.8	5.10	.093
	Cottonseed Meal 60 lbs.							
3	Cottonseed Meal 120 lbs.	41.7	12.3	54.0	.97	10.9	4.95	.089

Feed Consumed and Eggs Produced—The results of this test, as shown in Table 11, were slightly in favor of the meat-scrap pen. In this test the cottonseed meal used the last four months of the feeding period was not as palatable as was that used earlier and the fowls did not eat it as well. This may have caused the poorer results toward the close of the test.

EXPERIMENT 5

Value of Meat Scrap, Cottonseed Meal, and Alfalfa Meal for Laying Hens

Time of Test—This experiment started October 1, 1922 and continued 233 days, ending May 21, 1923.

Objects—The objects of this test were to determine the value of cottonseed meal as compared with meat scrap and to determine the effect of the substitution of a small quantity of alfalfa meal for an equal quantity of wheat bran in rations for laying hens when not supplied with other green feed.

Stock Used—Four pens of 12 yearling S. C. White Leghorn hens, each, were used in this test. Four hens in each pen had been fed a meat-scrap ration the preceding year, four had been fed cottonseed meal ration without any meat scrap, and four had been fed a ration with both meat scrap and cottonseed meal. The average egg-production of all pens for the first year was the same.

Feeds Used—All hens were kept in pens 10 feet square, with concrete floors. They were given no green feed except the alfalfa meal given Pens 3 and 4. The rations without alfalfa meal were lacking in the vitamin, fat-soluble A. All pens received cracked white corn fed twice a day in litter. Oyster shell and water were before the fowls at all times. The mash rations for the various pens were as shown in Table 12.

TABLE 12
Composition of Mash Rations.

Feeds Used in Pounds	Pen 1	Pen 2	Pen 3	Pen 4
Wheat Bran	125	125	100	100
Gray Wheat Shorts	75	75	75	75
White Corn Meal	75	75	75	75
Meat Scrap	60	0	60	0
Cottonseed Meal	0	120	0	120
Alfalfa Meal	0	0	25	25
Salt (ozs.)	26	32	26	32

The meat scrap used in this test was richer in protein than that usually fed to poultry. It was secured from a Texas pack-

ing house. The cottonseed used was of good quality. It was secured from a local oil mill. The alfalfa meal was bright green but was screened to remove some of the stems, because of their high fiber content. Table 13 gives the analysis of the meat scrap, cottonseed meal, and screened alfalfa meal, as analyzed by Dr. G. S. Fraps, Station Chemist. All other feeds were the same in each pen; therefore they were not analyzed.

TABLE 13
Percentage of Composition of Protein Feeds

	Protein	Fat	Crude Fiber	Nitrogen Free Extr.	Water	Ash
Meat scrap.....	74.41	7.36	2.17	2.06	6.92	7.08
Cottonseed meal	40.95	6.08	11.59	27.15	9.05	5.18
Alfalfa meal	15.51	1.95	24.48	38.18	11.01	7.87

Prices of Feeds—The following prices per 100 pounds represent the average local prices for the various feeds during the time of this experiment:

Cracked corn	\$1.85
Corn meal	1.85
Wheat bran	1.80
Gray wheat shorts	2.00
Alfalfa meal	2.50
Meat scrap	3.50
Cottonseed meal	2.25

Using these prices, the value of the mash per 100 pounds for the various pens was as follows:

Pen 1	\$2.16
Pen 2	1.98
Pen 3	2.21
Pen 4	2.03

Results of the Test

Health of the Fowls and Mortality—Seventeen hens died during this experiment and one was killed. Seven died from Pen 1 and seven from Pen 2, one was killed from Pen 3, and three died from Pen 4. Those that died from Pens 1 and 2 all showed nasal discharge and throat lesions; one that died from Pen 4 also showed these lesions but the other two which died from Pen 4 died because of a broken egg in the oviduct. The hen killed from Pen 3 had canker and would not yield to treatment.

On April 26, observations were taken on the health of the hens as shown in table 14.

TABLE 14
Health Observations, April 26, 1923.

	Pen 1	Pen 2	Pen 3	Pen 4
Total hens	10	8	12	11
No. showing throat lesions or nasal discharge	7	6	3	3

On May 21 observations were again taken on the health of the hens. The results are shown in Table 15.

TABLE 15
Health Observations May 21, 1923.

	Pen 1	Pen 2	Pen 3	Pen 4
Total hens	6*	6*	11	9
No. showing throat lesions or nasal discharge	5	4	3	3

*One hen died from Pen 1 and Pen 2 on May 21, but after these observations were taken.

It is noted that very few of the hens in Pens 1 and 2, those which received no alfalfa meal, were healthy either on April 26, or May 21, while most of those in Pens 3 and 4, those receiving alfalfa meal, were normal. The unhealthy condition of the eye, so often found when rations are deficient in fat-soluble A, was not as pronounced as were the throat lesions and the nasal discharge.

Table 16 shows the mortality for the different pens.

TABLE 16
Mortality.

	Pen 1	Pen 2	Pen 3	Pen 4
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	1	1	0	0
February	0	0	0	0
March	1	0	0	1*
April	2	3	0	2**
May	3	3	1***	0

*Caused by broken egg.

**One caused by broken egg, other by nutritional troubles.

***Killed because of canker.

It is noted from this table that no deaths resulted until after the hens had been on the experimental feed for over three months. This could be due to the small quantity of the fat-soluble A present in the rations for Pens 1 and 2.

Hatchability of Eggs

All eggs laid by these hens for three consecutive weeks were incubated. Table 17 gives the summary of the three hatches. The variation of the hatchability of the eggs from the various pens was not very great. This may be due to the fact that the hens in the poorest health were not laying; therefore, eggs for the healthiest hens were set. The rations of Pens 1 and 2 were not absolutely free of fat-soluble A, which may have helped in the hatch.

TABLE 17
Hatching Record.

Pen	Eggs Incubated	No. Infertile	No. Dead In Shell	No. Hatched	Per Cent of To- tal Which Were Hatched
1	27	2	11	14	52
2	36	0	10	26	72
3	104	11	25	68	65
4	98	0	33	65	66

Egg-Production

Table 18 gives the egg-production for the pens for the entire time. It is noted that the egg-production for Pens 1 and 2 held up for five months and then dropped rapidly. It is also noted that, except for the first three months, the cottonseed meal pens laid practically as well as the meat-scrap pens. During certain months the cottonseed meal pens laid more than the meat scrap pens.

TABLE 18
Egg-Production by Months.

Month	Pen 1	Pen 2	Pen 3	Pen 4
Total	928	772	1213	1124
October	40	40	76	55
November	129	73	150	103
December	155	98	169	139
January	146	136	157	145
February	152	148	160	156
March	153	156	194	204
April	115	95	209	211
May, 3 weeks	38	26	98	111

Feed Consumed and Cost of Eggs

Table 19 gives the feed consumed and its value together with the eggs produced per hen and the cost of feed to produce one dozen eggs. In both cases the results are in favor of the pens receiving alfalfa meal. The loss was too great to compare Pen 1 with Pen 2, but it will be seen that Pens 3 and 4 are almost alike. Here, Pen 4, the cottonseed meal pen, laid about as many and produced them cheaper per dozen than did Pen 3, which received meat scrap.

TABLE 19
Feeds Consumed and Eggs Produced

Pen	Feed in Pounds per Hen			Value of Feed per Hen	Doz. Eggs per Hen	Pounds Feed to Produce 1 Doz. Eggs	Cost of Feed to Produce 1 Doz. Eggs.
	Grain	Mash	Total				
1	25.6	16.5	42.1	\$.83	7.3	5.77	\$.11
2	25.6	14.9	41.5	.77	6.0	6.92	.13
3	26.7	18.8	45.5	.91	8.5	5.35	.11
4	24.4	17.8	43.3	.83	8.1	5.33	.10

DISCUSSION

1. Under the conditions of this experiment, the pens receiving screened alfalfa meal* gave satisfactory results, while those that did not receive it gave unsatisfactory results.

2. The pens receiving cottonseed meal gave results nearly equal to the pens that received meat scrap.

SUMMARY

Rations containing tankage were as palatable as those containing meat scrap. There was no high mortality from the tankage-fed pens and the egg-production was as good as in the meat scrap pens.

Rations containing cottonseed meal were palatable in all cases when the cottonseed meal was fresh. One ration containing cottonseed meal which had become slightly rancid was not palatable.

With fowls fed rations in which varying quantities of cottonseed meal replaced part of the meat scrap, tankage, or fish meal the egg-production was slightly lower and the mortality was slightly higher in the lots receiving cottonseed meal, but these differences were not in proportion to the quantities of cottonseed meal in the rations.

Hens receiving cottonseed meal and no tankage, in Experiment 3, laid more eggs than those receiving tankage and no cottonseed meal. In Experiment 4, the hens fed meat scrap and no cottonseed meal laid more eggs than those receiving cottonseed meal and no meat scrap. The average egg-production for the cottonseed meal pens in these two experiments taken together was practically the same as that for pens receiving meat scrap or tankage.

The pens receiving cottonseed meal and either meat scrap or tankage laid fewer eggs than did those getting either cottonseed meal, meat scrap, or tankage alone.

In Experiment 5, hens receiving alfalfa meal laid well and few of them died. The mortality from nutritional troubles was only 4 per cent. With hens receiving the same treatment, except that no alfalfa meal was fed, the mortality was 58 per cent. No check was available to show the effect of green feed on range upon the mortality.

*Fat-soluble A, which is found in choice alfalfa meal, is also found in such feeds as grasses, lettuce, clover, egg yolks, and milk.