UNIVERSITY OF MISSOURI

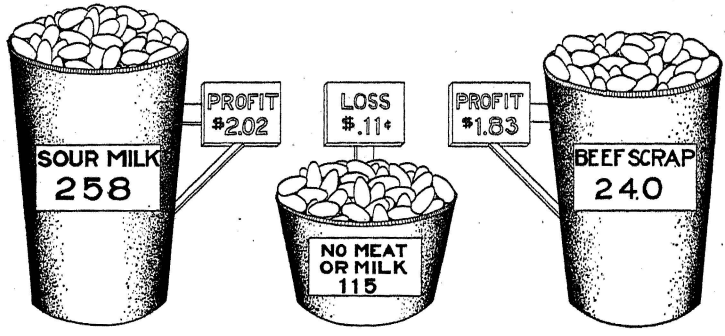
COLLEGE OF AGRICULTURE

Agricultural Experiment Station

COLUMBIA, MISSOURI, JUNE, 1917

CIRCULAR 82

RESULTS PER HEN FOR TWO-YEAR PERIOD



Scratch Food	85 lbs.	Scratch Food	91 lbs.	Scratch Food	94 lbs.
Mash	37	Mash	38	Mash	28
Total Grain	122	Total Grain	129	Total Grain	122
Milk	177			Beef Scrap	10

Protein Feeds For Laying Hens

H. L. KEMPSTER

TESTS TO DETERMINE THE VALUE OF BEEF SCRAP AND SOUR MILK

Feeding tests conducted at the Missouri Agricultural Experiment Station have shown that sour milk or beef scrap added to the poultry ration materially increases egg production. Results of these tests, which were published in Circular 79 of this station, confirmed similar results obtained by Graham[1] and Phillips[2]. These tests extended from November 1, 1914 to October 31, 1915. A second experiment was con-

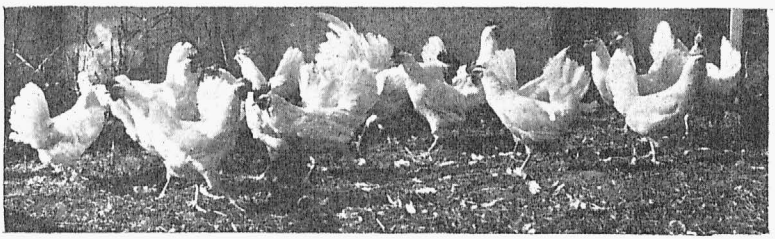
[1]Graham, W. R. Report of poultry husbandman. Thirty-eighth Rept. Ont. Agr. Col. 1912. 106-109.

[2]Phillips, A. G. The value of meat scrap and skim milk in rations for laying pullets. Purdue Agr. Exp. Sta. Bull. 182.

ducted from November 1, 1915 to October 31, 1916. Results of these tests together with results from feeding protein concentrates of vegetable origin are presented herewith.

THE RATION

About two-thirds of the ration given to each pen consisted of a scratch food made by mixing two parts of corn and one part of wheat. The rest of the feed given to each pen was a mash made by mixing bran, middlings or shorts and corn meal for the no-meat pen, or the



A Part of the Experimental Flock

pen which received no animal food whatever. The sour milk pen received the same mash and all the sour milk the fowls wanted, while the beef scrap pen received the same mash with the addition of beef scrap mixed with the mash. The exact number of pounds fed during the year to each of these pens of fowls is indicated in Tables 1 and 2.

METHODS OF FEEDING

The usual poultry yard method of feeding was followed. Practically the only difference in the method of feeding the various pens was in the protein concentrate or the animal food given to the hens. In the morning a little scratch feed was sprinkled in the straw litter deep enough to make the fowls scratch and take exercise. Water was placed in clean pails and a pan of sour milk was given to the sour milk pen. At noon the proper amount of dry mash was measured into a trough, and during winter green feed was frequently given at the same time. Two or three times a week the fowls were induced to eat more of the mash by mixing the dry mash with water or with milk in case of the sour milk pen. This wet mash was fed at the rate of a handful for every four birds. At night the scratch feed was given again and the birds were allowed to eat all they would so that they might go to roost with full crops. The purpose of this method of feeding was to keep

the hens busy all day, to keep their appetites keen, and yet to give them all the feed they would use. Feeding a small amount of the scratch feed in the morning encouraged the hens to eat more of the mash. An attempt was made to get them to consume about half as much of the mash as they did of the grain or scratch feed. Grit and oyster shell were kept before the hens at all times.

TABLE 1.—SUMMARY OF EXPERIMENT WITH THREE TWENTY-FIVE BIRD PENS OF WHITE LEGHORN PULLETS.
November 1, 1914—October 31, 1915.

	Beef scrap	No meat	Sour milk
Grain, pounds	1095	1095	956
Mash, pounds	422	429	446
Total pounds (meat foods excluded)	1410	1524	1402
Total pounds meat foods	105	.....	2200
Average pounds of food per hen per year	56.4	60.9	56.08
Pounds meat foods per hen per year	4.2	.....	88
Average cost per hen per year, dollars	1.026	.956	1.05
Eggs per hen	107	55	131
Profit per hen, dollars	.79	—.04[1]	1.13
Eggs laid	2669	1373	3275
Cost (total), dollars	25.68	23.90	26.32
Corn, pounds	730	730	638
Cost, dollars[2]	11.68	11.68	10.21
Wheat, pounds	365	365	318
Cost, dollars[2]	6.08	6.08	5.30
Bran, pounds	105	143	149
Cost, dollars[2]	1.26	1.71	1.79
Shorts, pounds	105	143	149
Cost, dollars[2]	1.47	2.00	2.09
Corn meal, pounds	105	143	149
Cost, dollars[2]	1.78	2.43	2.53
Beef scrap, pounds	105	.....	.....
Cost, dollars[2]	3.41	.....	.....
Sour milk, pounds	.....	.....	2200
Cost, dollars[2]	.....	.....	4.40
Value of eggs (20c. a doz.), dollars	44.46	22.90	54.58
Profit in dollars	19.78	—1.00[1]	28.26
Feed to produce a pound of eggs, pounds	4.55	8.88	3.42
Food cost of a dozen eggs, dollars	.122	.222	.10

[1]The minus sign (—) indicates a loss.

[2]The cost of the feed is based on the quotations of a local mill at the following rates: Wheat, $1.66 per 100 pounds; corn, $1.60 per 100 pounds; bran, $1.20 per 100 pounds; corn meal, $1.70 per 100 pounds; shorts, $1.40 per 100 pounds; beef scrap, $3.25 per 100 pounds; sour milk, $0.20 per 100 pounds.

TABLE 2.—SUMMARY OF EXPERIMENT WITH THREE TEN-BIRD PENS OF WHITE LEGHORN HENS.

November 1, 1915—October 31, 1916.

	Beef scrap	No meat or milk	Sour milk
Grain, pounds	491	470	458
Mash, pounds	207	209	197
Total pounds (meat excluded)	646	679	655
Total pounds meat or milk	52	.....	880
Average pounds food per hen per year	65.5[1]	64.6	62.4[2]
Pounds meat food per hen per year	5	.....	83.8
Average feed cost per hen per year	1.13	1.00	1.14
Eggs per hen	133.6	59.7	126.9
Profit per hen, dollars	1.04	—.05	.924
Eggs laid	1336	597	1269
Cost (total) dollars	11.84	10.56	11.91
Corn, pounds	328	314	305
Cost, dollars	5.25	5.02	4.88
Wheat, pounds	164	157	153
Cost, dollars	2.72	2.60	2.54
Bran, pounds	52	70	66
Cost, dollars	.62	.84	.79
Shorts, pounds	52	70	66
Cost, dollars	.73	.98	.92
Corn meal, pounds	52	70	66
Cost, dollars	.83	1.12	1.02
Beef scrap, pounds	52	.....	.....
Cost, dollars	1.69	.....	.....
Sour milk, pounds	.....	.....	880
Cost, dollars	.....	.....	1.76
Value of eggs, (20c. a doz.), dollars	22.27	9.95	21.15
Pounds of feed to produce a pound of eggs	4[1]	9	4.1[2]
Food cost of dozen eggs, dollars	.106	.21	.112

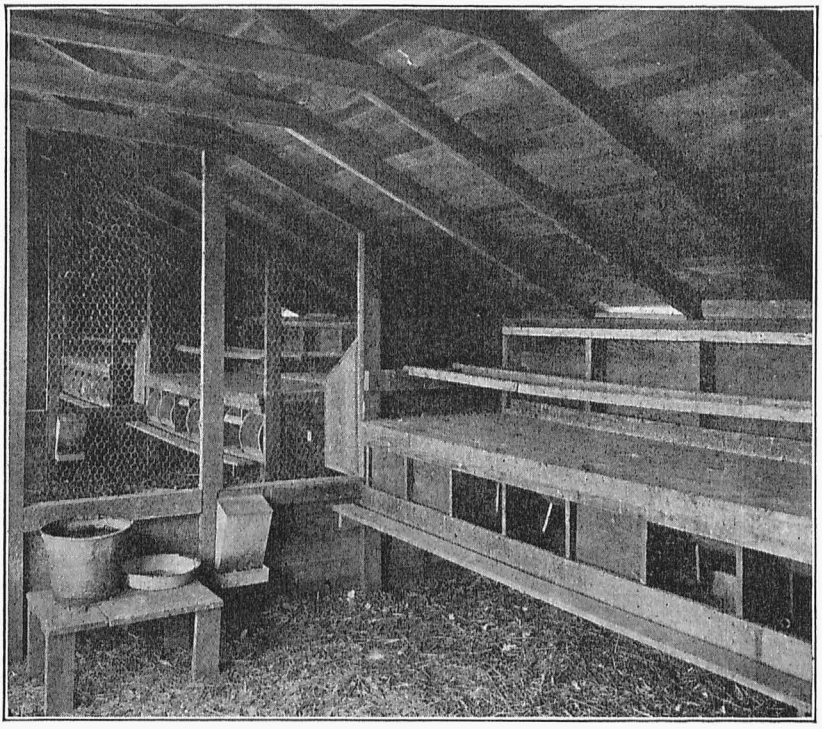
[1]Includes beef scrap.
[2]Does not include milk.

COST, RESULTS, AND PROFIT

Cost of feed.—The prices paid for feed will vary, of course, in different counties, in different states and from year to year, but the prices quoted by a local mill are probably fairly representative of Missouri for 1915. Even if they should be a little too high or a little too low to show the profitable cost in the reader's locality, they will enable

him to compare the cost of egg production on no meat, beef scrap, and sour milk rations.

Eggs laid.—During the first test, the twenty-five hens in the no-meat pen laid 1373 eggs or an average of 55 per hen for the year. The hens fed beef laid an average of 107 eggs apiece or almost twice as many as the no-meat hens; and the sour milk hens averaged 131 eggs apiece, or almost two and a half as many as the no-meat hens.



Interior of the Feeding Pens

During the second test the ten hens in the no-meat or milk pen laid 597 eggs, or an average of 59.7 eggs, per hen for the year. The hens fed beef scrap laid 1336 eggs, or almost two and one-fourth times as many, while those fed milk laid 1269 or 126.9 eggs apiece.

Profits.—Examination of profits returned shows that it is poor economy not to feed either beef scrap or sour milk to laying hens. Table 1 shows that the fowls fed no meat or milk laid only 55 eggs per hen at a food cost of $0.956. With eggs at twenty cents a dozen they returned $0.916. In other words, the poultryman gave his work for nothing and paid four cents more for the feed than the eggs re-

turned in cash. The hens fed beef scrap laid 107 eggs per hen and returned a profit per bird of $0.79 altho the feed they ate cost $0.07 more per hen. The hens fed sour milk laid 131 eggs per hen; and with milk at $0.20 a hundred pounds, they returned a profit of $1.13 per bird or a profit of more than 100 per cent.

Table 2 shows that the no meat or milk pen laid 59.7 eggs per hen at a food cost per hen of $1.00. In other words, the eggs cost $0.21 a dozen. If the eggs had sold at $0.20 a dozen the loss per hen would have been $0.05. The hens fed beef scrap laid 133.6 eggs at a food cost of $0.106 per dozen. In other words, the hens returned a profit of $1.04 per bird. The hens fed milk averaged 126.9 eggs at a food cost of $0.112 a dozen. They returned a profit of $0.924 per hen. There is no doubt that the meat scrap and sour milk are responsible for the great increase in the number of eggs laid.

TABLE 3.—SUMMARY OF EXPERIMENTS WITH BEEF SCRAP AND SOUR MILK.

	Beef Scrap			No Meat or Milk			Sour Milk		
	1st yr	2nd yr	Aver.	1st yr	2nd yr	Aver.	1st yr	2nd yr	Aver.
Total pounds, meat foods excluded	56.1	60.5	58.4	60.9	64.6	62.7	56	62.4	59.2
Total pounds, meat or milk	4.2	5	4.6				88	83	86
Av. cost per hen per year, dollars	1.026	1.13	1.078	.956	1.00	.978	1.05	1.14	1.095
Eggs per hen	107	133.6	120.3	55	59.7	57.3	131	126.9	129
Profit per hen, dollars	.79	1.04	.915	—.04[1]	—.05[1]	—.045[1]	1.13	.092	1.024
Feed to produce a pound of eggs, pounds	4.5	4	4.25[2]	8.88[2]	9	8.94	3.42	4.1	3.76[2]
Food cost of dozen of eggs, dollars	.122	.106	.114	.222	.21	.215	.10	.112	.106

[1]Loss, no meat or milk pens.

[2]The foregoing table shows that it required an average of 4.25 pounds of feed to produce a pound of eggs in the beef scrap pen; 8.94 in the no-meat or milk pen, and 3.76 in the sour milk pen. The computations are unfair to the beef scrap pen because the beef scrap is included and the sour milk is not included. By excluding the beef scrap the amount of feed required to produce a pound of eggs in the beef scrap pen would be 3.9 pounds. The feed cost per dozen eggs also gives a fair comparison.

TESTS TO DETERMINE THE VALUE OF OIL MEAL, GLUTEN MEAL AND COTTONSEED MEAL

Different stations have compared the value of protein concentrates of vegetable origin with protein concentrates of animal origin. Results of these comparisons, together with similar tests by the Missouri Station, are given.

In Bulletin 171 of the New York Experiment Station on "What Grains Lack as Poultry Food," Wheeler shows that rations made up of "grains alone, (even with the same nutritive ratio) required more dry matter in the food for each pound of gain, than did one corresponding lot fed on a ration composed in part of animal meal. The same held true with the four lots of laying hens compared. The average for hens was nearly one-fourth (23%) more food for each pound of eggs than on an animal meal ration."

"Laying hens, upon a ration made equal in mineral matter, produced as great weight of eggs as upon the animal meal ration for most of the time but began to show a slight advantage for the animal food toward the end of the thirty weeks."

Conclusions point "toward the superiority of rations containing animal food over those made up of grain alone. When a bone ash supplement is used, the advantage disappears."

Morrison in Mississippi Experiment Station Bulletin 162 concluded "that so far as can be determined, the general condition of the cottonseed meal fed fowls seems just as good as the condition of those fed beef scrap, and that hens fed cottonseed meal will produce eggs when eggs are highest in price."

The general tone of the bulletin is to show the superiority of cottonseed meal over beef scrap.

Two tests out of three were in favor of cottonseed meal:

Pen A—Mash 10% cottonseed meal..	114 dozen.....	$0.1059	cost	per	doz.
Pen B—Mash 5% beef scrap	90 7/12 dozen..	.13	"	"	"
Pen C—Mash 22% cottonseed meal..	111 5/6 "	.088	"	"	"
Pen D—Mash 11% beef scrap	168 7/12 "	.067	"	"	"
Pen E—Mash 15% cottonseed meal..	121 1/2 "	.083	"	"	"
Pen F—Mash 7.5% beef scrap	98 2/3 "	.114	"	"	"

All cottonseed meal .....346 11/12 dozen
All beef scrap .....347 10/12 "

No record is given of the number of hens used so that it is impossible to judge the production. The experiment ran from January 1 to June 30. The cheapest eggs came from the pen which was fed a mash consisting of 11% beef scrap.

Bulletin 112 Oklahoma Experiment Station reports feeding rations containing cottonseed meal. The authors conclude: "As a feed for egg production and not considering the effect on hatchability, beef scrap is superior to cottonseed meal and more than makes up the greater cost by apparently causing greater production." There appeared to be a slight advantage in hatchability (3.7%) in favor of the cottonseed meal fed hens.

Clayton of the Mississippi Experiment Station in Bulletin 175, "Cottonseed Meal a Good Feed for Laying Hens" shows the following:

Pen A—Mash	11% Cottonseed meal	249 eggs	27.6 eggs	per hen
Pen 5—Mash	5½% Beef scrap	174 eggs	17 "	" "
Pen K—Mash	22% Cottonseed meal	396 eggs	30.5 "	" "
Pen D—Mash	11% Beef scrap	200 eggs	29 "	" "

In pen D there were only seven hens while pen K had twice that number. In pen D it is noted that during the first three months only 7 eggs were produced, or only 3½ per cent of the entire production. In the corresponding pen K, 25 per cent were laid during the first three months. During the last three months when the beef scrap pen had started to lay, the seven hens laid 193 eggs or an average of 27.6 eggs while in the cottonseed meal pen thirteen hens laid 281 eggs or 21.6 eggs apiece. The experiment ran from October 1 to March 31, or six months. The egg production per hen was correspondingly low. It is regretted that the experiment did not continue over a longer period. The bulletin recommends that the mash contain 25 per cent cottonseed meal.

Hare in Agricultural Extension Bulletin 16, Clemson College, South Carolina, suggests using a mash containing one-sixth cottonseed meal and one-sixth cowpea meal.

All experiment stations do not report favorably on the use of cottonseed meal.

Waite of the Maryland Experiment Station in the Journal of the American Association of Instructors and Investigators in Poultry Husbandry reports using three different rations:

Pen 3—	10.67% cottonseed meal	214 eggs
Pen 4—	18.00% gluten feed	370 "
Pen 7—	2.67% cottonseed meal 1.78% beef scrap 3.56% soybean meal 4.45% gluten meal	605 "

There were 40 hens in each lot. The test ran from December 1 to February 28.

During February every bird in Pen 3, if not actually sick, was in such bad condition that it was deemed necessary to change the ration.

Lewis in Vol. III No. 4 Journal of the American Association of Instructors and Investigators in Poultry Husbandry reports feeding five pens of fowls over a period of two years. In this experiment, various protein concentrates of vegetable origin were compared with beef scrap; this was the only difference in the rations.

	Per cent production 1st year	Per cent production 2nd year	Per cent Mortality
Pen 43—Beef Scrap	32.3	24.17	12
Pen 43—Soybean Meal	12.3	21.68	26
Pen 46—Gluten Meal	10.7	17.67	24
Pen 47—Oil Meal	6.54	17.05	32
Pen 48—Cottonseed Meal	9.4	14.55	32

In conclusion, Mr. Lewis states that meat scrap proved to be the most efficient, nearly doubling the next highest pen, the soybean meal. The mortality was less in the beef pens and highest in the oil meal and cottonseed meal pens.

Concerning oil meal, Payne in Vol. III No. 3, Journal of the American Association of Instructors and Investigators in Poultry Husbandry says that linseed meal was not palatable, but that gluten feed was palatable.

AT THE UNIVERSITY OF MISSOURI

Similar tests were made in which the method of feeding was similar to that already described under the beef scrap and sour milk experiments. The grain rations were the same. The only difference in the feed was the kind of protein concentrate used. The three mashes were composed of equal parts by weight of the following ingredients:

Bran 1	Bran 1	Bran 1
Shorts 1	Shorts 1	Shorts 1
Corn meal 1	Corn meal 1	Corn meal 1
Oil meal 1	Gluten meal 1	Cottonseed meal .. 1

Table 4 shows the results of the test.

TABLE 4.—RESULTS OF THREE TEN-HEN PENS OF WHITE LEGHORN HENS
November 1, 1915 to October 31, 1916

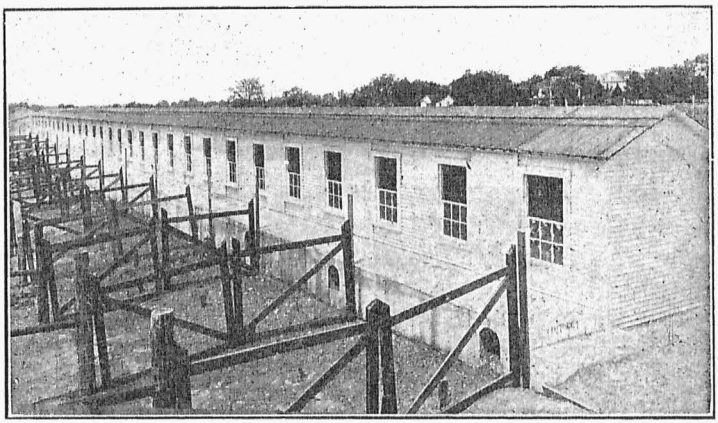
	Oil Meal	Gluten Meal	Cottonseed Meal
Grain, pounds	460	464	446
Mash, pounds	169	194	180
Total pounds	629	658	626
Average pounds food per hen per year	59.9	62.6	59.6
Average cost per hen per year, dollars	.96	1.00	.958
Eggs per hen	64.9	63.8	66
Profit per hen, dollars	.12	.06	.14
Eggs	649	638	660
Cost (total) dollars	10.11	10.49	10.24
Corn, pounds	306	309	297
Cost, dollars	4.90	4.94	4.75
Wheat, pounds	153	155	149
Cost, dollars	2.54	2.57	2.47
Bran, pounds	42.25	48.50	45
Cost, dollars	.51	.58	.54
Shorts, pounds	42.25	48.50	45
Costs, dollars	.59	.68	.63
Corn meal, pounds	42.25	48.50	45
Cost, dollars	.72	.82	.77
Oil meal, pounds	42.25		
Cost, dollars	.85		
Gluten meal, pounds		48.5	
Cost, dollars		.90	
Cottonseed meal, pounds			45
Cost, dollars			1.08
Food to produce a pound of eggs, pounds	7 2/3	8 1/4	7 2/3
Value of eggs, (20c. a doz.), dollars	10.82	10.63	11.00
Food cost of a dozen eggs, dollars	.18	.19	.196

TABLE 5.—SUMMARY OF COMPARISON OF SOUR MILK AND BEEF SCRAP WITH OIL MEAL, GLUTEN MEAL AND COTTONSEED MEAL. BASIS OF ONE HEN PER YEAR.

Ration	Pounds Feed	Feed Cost Per Hen	Eggs	Profit	Food to Produce 1 Pound of Eggs
Beef scrap	58.4	$1.078	120.3	$0.915	4.25[1]
Sour milk	59	1.095	129	1.02	3.76[2]
Oil meal	59.9	0.96	64.9	0.12	7.6
Gluten meal	62.6	1.00	63.8	0.06	8.25
Cottonseed meal	59.6	0.958	66	0.14	7.6
No basal protein	62.7	1.00	57.3	—0.045	8.94

[1]Includes meat.
[2]Does not include milk.

From the tests it appears that the addition of protein concentrates of vegetable origin, such as oil meal, gluten meal and cottonseed meal, to a ration has but little influence on egg production. Where sour milk or beef scrap was used the production was very nearly double and while the cost of the ration was increased from 9 to 13 cents per hen per year the extra profit paid for this ten fold. The oil meal mash was not consumed in as large quantities as the other mashes, indicating that the hens did not relish this as much as they did the other mashes.



Pens Where Hens Were Fed

CONCLUSIONS

1. So far as could be observed the hens in all pens were in perfect health thruout the entire experiment with vegetable proteins. No deleterious effects were observed in the use of the cottonseed meal.

2. Beef scrap and sour milk are the most economical methods of supplying protein to laying hens.

3. Protein concentrates of vegetable origin alone did not materially increase egg production.

4. It is poor economy not to furnish the laying hen a protein concentrate of animal origin.

5. One pound of eggs can be produced with every four pounds of feed if the proper ration is fed.

6. The beef scrap ration and the sour milk ration appeared to give the same egg production.

7. According to these tests, 100 pounds of sour milk is worth 5.4 pounds of beef scrap.

HOW PROTEIN FEEDS AFFECT EGG PRODUCTION

These protein feeds	plus grain and mash	produced these eggs
Sour Milk	Grain and Mash	129 per hen per year
Beef Scrap	Grain and Mash	120 per hen per year
Cottonseed Meal	Grain and Mash	66 per hen per year
Linseed Oil Meal	Grain and Mash	64 per hen per year
Gluten Meal	Grain and Mash	63 per hen per year
No Protein Feed	Grain and Mash	57 per hen per year

In each case the protein feed constituted approximately one-twelfth, the mash (bran 1, corn meal 1, shorts 1) three-twelfths, and the grain (corn 2, wheat 1) eight-twelfths, of the ration by weight.