

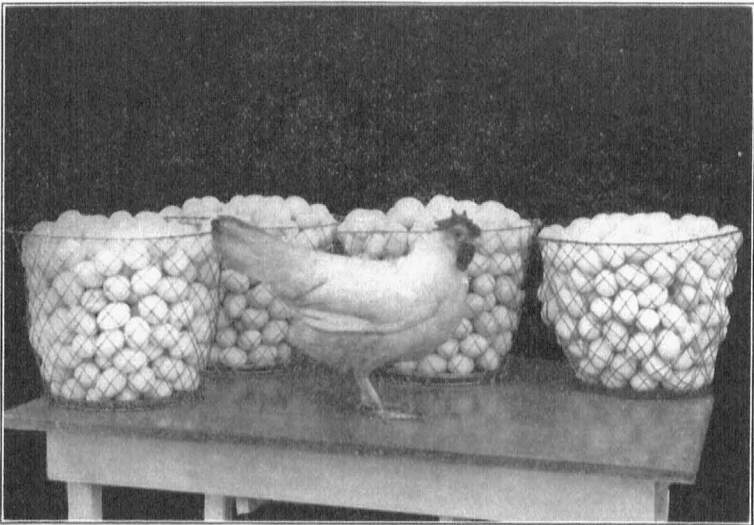
UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

BULLETIN 225

# The Influence of Animal and Vegetable Proteins on Egg Production



Missouri Ann, a White Leghorn hen bred and owned by the department of poultry husbandry at the Missouri College of Agriculture. This hen at 7 years and 3 months of age laid her 1000th egg—and is still laying. She has had approximately 20 % meat scrap or tankage in her dry mash all her life.

COLUMBIA, MISSOURI

NOVEMBER, 1924

## GENERAL CONCLUSIONS

The experiments reported in this bulletin have given results justifying the following general conclusions:

1. The use of meat scrap, tankage, sour skimmilk, and dried buttermilk resulted in an egg production per hen of 117, 120, 125, and 112 eggs respectively as compared to 61 eggs in the check pen receiving no animal protein.

2. Cost is the chief factor to consider in selecting one of the above protein concentrates for feeding for egg production.

3. Mashers containing 15 per cent or more of meat scrap or tankage gave uniformly more satisfactory results than when smaller amounts were used.

4. The addition of cottonseed meal to poultry mashes did not increase production when fed as the only protein concentrate in the mash or in combination with meat scrap or tankage.

5. It is suggested that a mineral deficiency exists in cottonseed meal which may be the cause of the unsatisfactory results.

6. The optimum amount of meat scrap or tankage for White Leghorn hens is around 6 pounds per hen per year.

7. White Leghorn hens ate from 67 to 82 pounds of feed per hen per year.

8. Feeding meat scrap, tankage, or milk products reduced the amount of feed required to produce a pound of eggs nearly one-half.

# The Influence of Animal and Vegetable Proteins on Egg Production

H. L. KEMPSTER\*

**Abstract.**—Ten years of feeding experiments are reported in this bulletin. The report covers seventy separate tests involving four distinct phases of the relationship between protein feeds and egg production, namely; proteins of animal origin, various amounts of such proteins, proteins of vegetable origin, and the correlation between the consumption of meat scrap or tankage and egg production. The tests reported indicate that animal proteins are far superior to vegetable proteins in egg laying rations and that the mash containing 15 to 20 per cent of meat scrap or tankage is more economical and efficient than any of the other proteins or amounts used in this particular investigation.

Feeding experiments at the Missouri Agricultural Experiment Station have demonstrated that hens cannot produce eggs profitably on rations made up of grains and grain by-products commonly produced on the farm. These investigations show that the ration must be supplemented with protein concentrates. Further it is shown that different protein concentrates differ in ability to stimulate egg production. In general protein concentrates from animal origin, such as meat scrap or tankage and milk products are superior to vegetable protein concentrates such as cottonseed meal, oil meal, and gluten meal. A series of tests have been made to determine the relative efficiency of various protein concentrates. These experiments began in 1914 and have been continued to date. From time to time various changes have been made as experience dictated.

## GENERAL CONDITIONS

**Housing.**—The birds have been housed in a long laying house 12 feet deep. The pens are 6 feet wide and fitted with the usual equipment, including trapnests.

**Stock.**—The first year White Leghorn pullets were used, but after the first year hens which have passed through at least one laying season have been selected. The selection has been based on trapnest records. It was felt that in this way more uniform pens could be provided and errors due to heredity could be largely eliminated. A criticism of the number of birds used in each pen, from 10 to 14 (25 the first year) might be made, but this is compensated for by the large number of trials.

**The Ration.**—Throughout the experiments it has been the practice to so feed that approximately two-thirds of the ration consisted of

\*Acknowledgment is made of valuable assistance rendered by G. W. Hervey who did a great deal of work on this investigation while a graduate student at the Missouri College of Agriculture.

scratch food. In the earlier work the scratch food consisted of two pounds of corn and one pound of wheat. Sometimes the scratch food consisted of corn alone and later oats were used in place of wheat. The rest of the food given each pen consisted of a mixture of ground feeds designated by the term mash. The basal mash consisted of equal parts of bran, shorts, or middlings, and cornmeal. To this basal mash various protein concentrates have been added in various amounts. These differences will be noted in the discussion of the various mashes.

**Methods of Feeding.**—The usual method of feeding for egg production was followed. In the morning a little scratch food was fed in a heavy straw litter so as to encourage exercise. Water was kept before the hens. The hens had access to mash at all times. Moist crumbly mashes were fed at noon during the cold and extremely hot weather. At night the hens were given all the grain they would eat. The purpose of this method of feeding was to keep the hens busy, to keep their appetite keen, and to encourage the greatest food consumption possible. Grit and shell was kept before the hens all the time. It should be noted that during the nine years that these experiments have been conducted, feeders have changed—a factor which materially influences the results. However, the general conclusions will not be influenced to any extent, especially where general averages are made.

## I. EXPERIMENTS WITH PROTEIN CONCENTRATES OF ANIMAL ORIGIN

In this classification are included meat scrap, tankage, sour milk, and dried buttermilk. The figures given are on basis of one hen. They include the amount of grain and mash consumed and the eggs laid.

**Meat Scrap.**—In this pen, 25 per cent of the mash was meat scrap. In other words the mash consisted of equal parts by weight of bran, shorts, cornmeal, and meat scrap. Based on five tests, a hen consumed 50 pounds of grain and 26.6 pounds of mash, and laid 117 eggs. She produced a dozen eggs for 7.75 pounds of feed or one pound of eggs for 5.2 pounds of feed.

TABLE 1.—FEED CONSUMED AND EGGS LAID PER HEN PER YEAR WHEN USING MEAT SCRAP.

Year	Grain per hen	Mash per hen	Eggs per hen
1914-15	44	17	107
1915-16	49	21	133.6
1917-18	46	23	105.
1918-19	47	32	119.6
1919-20	64	40	121.1
5-Year Average	50	26.6	117

**Sour Milk.**—The mash used was the basal mash of bran shorts and cornmeal. Sour skimmilk was kept before the hens as a drink in addition to the water. The average consumption of milk per year per hen was 88 pounds.

TABLE 2.—FEED CONSUMED AND EGGS LAID PER HEN PER YEAR WHEN USING SOUR MILK.

Year	Grain per hen	Mash per hen	Eggs per hen
1914-15	38	18	131
1915-16	46	20	127
1918-19	58	20	116
1920-21	52	15	128
1921-22	48	34	130
1922-23	53	35	120
6-Year Average	49	23.3	125

**Check Pen.**—The check pen was fed the same ration as the meat scrap and sour milk pens except that no meat scrap or milk was fed. It will be observed that the addition of meat scrap or milk to the ration resulted in an increased egg production per bird of from 56 to 65 eggs or was approximately one-half as great. When one considers that the addition of 6.6 pounds of meat scrap or 88 pounds of milk to the ration of a hen for one year results in such apparent increase in egg production he can readily appreciate the value of incorporating some such material in rations for laying hens.

TABLE 3.—FEED CONSUMED AND EGGS LAID PER HEN PER YEAR WITH NO PROTEIN CONCENTRATE.

Year	Grain per hen	Mash per hen	Eggs per hen
1914-15	44	17	55
1915-16	47	21	60
1916-17	45	18	64
1917-18	34	25	59
1918-19	50	23	88
1919-20	57	21	39
6-Year Average	49	21	61

**Tankage.**—In some later work tankage as a source of animal protein has been used with the results shown in Table 4. From these results it would appear that tankage may be used in rations for egg production in place of meat scrap. In the above rations the mash consisted of 20 per cent tankage as compared to a mash of 25 per cent meat scrap in the experiments summarized in Table 1.

TABLE 4.—FEED CONSUMED AND EGGS LAID PER HEN PER YEAR WHEN USING TANKAGE

Year	Grain per hen	Mash per hen	Eggs per hen
1920-21	58	27	113
1920-21	51	24	114
1921-22	48	37	132
1922-23	50	33	122
Average	51	30	120

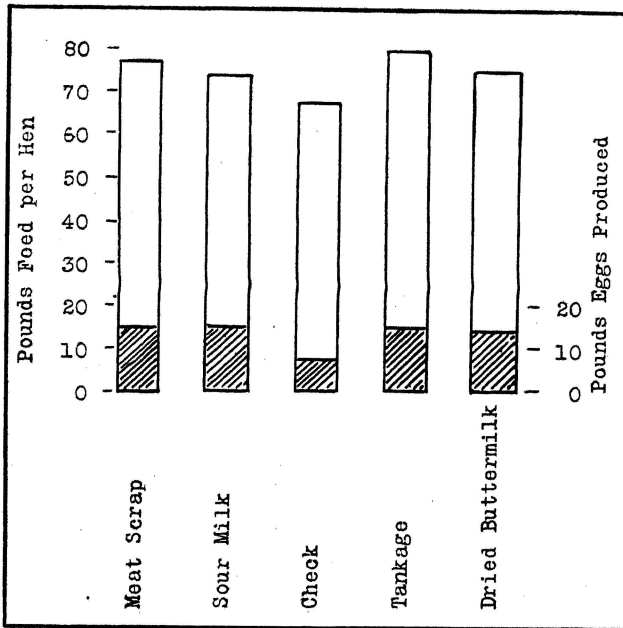


Fig. 2.—Comparison of meat scrap, tankage, sour milk, no meat scrap or milk, and dried buttermilk in rations for egg production.

**Dried Buttermilk.**—Two years' work has been completed using dried buttermilk as a substitute for meat scrap or tankage. In these tests a mash of 35 per cent dried buttermilk was used with the following results:

TABLE 5.—FEED CONSUMED AND EGGS LAID PER HEN PER YEAR WHEN USING DRIED BUTTERMILK.

Year	Grain per hen	Mash per hen	Eggs per hen
1921-22	42	34	129
1922-23	45	33	96
2-Year average	43.5	33.5	112.

**Summary.**—The following table shows the comparison of the various animal protein concentrates:

TABLE 6.—SUMMARY OF RESULTS FROM ANIMAL PROTEINS.—PER HEN PER YEAR.

Kind of Supplement	No. of tests	Av. grain per hen	Av. mash per hen	Eggs per hen	Pounds feed to produce 1 lb. of eggs
Meat Scrap	5	50	26.6	117	5.2
Sour Milk	6	49	24.0	125	*4.7
Check Pen	6	49	21.	61	9.3
Tankage	4	51	30.0	120.	5.4
Dried Buttermilk	2	43.5	33.5	112.	5.5

\*Does not include the milk.

It would appear that there is very little choice in the efficiency of the various protein concentrates of animal origin. The cost, however, would be a factor to consider. It is evident that it is poor economy not to use one of them in rations for egg production. It will be observed that the feed required to produce a pound of eggs ranges from 5.2 to 5.5 pounds for those pens in which meat scrap, tankage, or dried buttermilk was used as compared to 9.3 pounds in the check pen receiving no animal food.

TABLE 7.—SUMMARY OF AMOUNTS OF FEED PER HEN PER YEAR.

	Meat scrap pen	Sour milk pen	Check pen	Tankage pen	Dried butter-milk pen
Corn	34	32	33	34	28
Oats or Wheat	17	16	16	17	14
Bran	6.6	5.5	7.	7.8	7.3
Shorts	6.6	5.5	7.	7.8	7.3
Cornmeal	6.6	5.5	7.	7.8	7.3
Total	70.8	64.5	70.	73.4	63.9
Meat Scrap	6.6				
Sour Milk		88.			
Tankage			----	5.8	
Dried Buttermilk					11.5
Total	77.4	142.5	70.	79.2	75.4
Eggs Per Hen	117	125	61	120	112

From the foregoing data one may conclude that the addition of 6.6 pounds of meat scrap, 5.8 pounds of tankage or 11.5 pounds of dried buttermilk to the ration fed the check pen resulted in the production of approximately twice as many eggs. Using local prices these products one can readily realize the necessity of using protein concentrates of animal origin in ration for laying hens. When it is realized that for each pound of tankage or meat scrap a dozen extra eggs were produced the value of such concentrates is appreciated.

## II. THE INFLUENCE OF VARIOUS AMOUNTS OF MEAT SCRAP OR TANKAGE IN POULTRY MASHES ON EGG PRODUCTION

In the preceding report the percentages of meat scrap contained in the mash was 25 per cent and for tankage 20 per cent. The following experiments were designed to determine the optimum amount of animal protein concentrate a poultry mash should contain. In these experiments mashes containing 5, 10, 15, 20, 25, and 33 per cent of either meat scrap or tankage were used, the general plan of the experiments being similar to that of the preceding report.

**Using 34% Meat Scrap.**—The egg production is slightly higher with 34% meat scrap than when a mash containing 25% meat scrap was used. The production per bird was slightly higher while the food required to produce a pound of eggs remained unchanged.

TABLE 8.—SUMMARY OF RESULTS WITH MASH CONTAINING 34% MEAT SCRAP.

Year	Grain per hen per year	Mash per hen per year	Average egg pro- duction per year
1916-17	47	25	135
1917-18	51	32	113
1918-19	38	36	119
1918-19	54	34	134.6
1919-20	62	26	125.5
1919-20	62	30	130
6-Year Average	52	30	126

**Using 15% Meat Scrap or Tankage.**—With the exception of 1920-21 when the consumption and production was low and 1922 when the consumption and production was correspondingly high the results compared favorably with the results obtained with a larger amount of animal food in the mash.

TABLE 9.—SUMMARY OF RESULTS WITH MASH CONTAINING 15% MEAT SCRAP OR TANKAGE.

Year	Grain per hen per year	Mash per hen per year	Average egg pro- duction per year
1917-18	48	25	104
1918-19	51	31	118
1919-20	62	38	118
1920-21	48	17	84
1921-22	50	38	163
1922-23	50	40	123
6-Year Average	51	31	118



**Using 10% Meat Scrap or Tankage.**—In this case the results are variable, but the general average is slightly less than reported in mashes containing larger amounts.

TABLE 10.—SUMMARY OF RESULTS WITH MASH CONTAINING 10% MEAT SCRAP OR TANKAGE.

Year	Grain per hen per year	Mash per hen per year	Average egg pro- duction per year
1919-20	59	34	104
1920-21	59	19	86
1921-22	42	34	147
1922-23	50	23	112
4-Year Average	52	27	112

**Using 5% Meat Scrap or Tankage.**—These results demonstrate that even the addition of a small amount of animal protein results in an enormous increase in the number of eggs laid.

TABLE 11.—SUMMARY OF RESULTS WITH MASH CONTAINING 5% MEAT SCRAP OR TANKAGE.

Year	Grain per hen per year	Mash per hen per year	Average egg pro- duction per year
1920-21	55	21	100
1921-22	44	31	130
1922-23	43	34	85
3-Year Average	47	29	105

TABLE 12.—GENERAL SUMMARY OF RESULTS FROM DIFFERENT PERCENTAGES OF MEAT SCRAP OR TANKAGE.

Mash	No. of tests	Av. grain per hen per year	Av. mash per hen per year	Av. eggs per hen per year	Pounds feed to produce 1 lb. eggs	Relative value %
34% Meat Scrap	6	52	30.	126	5.2	100
25% Meat Scrap	5	50	26.6	117	5.2	100
20% Tankage	4	51	30.	120	5.4	96.3
15% Tankage or Meat Scrap	6	51	31.	118	5.5	94.5
10% Tankage or Meat Scrap	4	52	27.	112	5.6	93.9
5% Tankage or Meat Scrap	3	47	29.	105	5.8	89.9
Check	6	49	21.	61	9.3	55.9

**Summary.**—From the above figures it is seen that the higher the percentage of meat scrap or tankage in the mash the lower the amount of feed required to produce a pound of eggs. The most efficient mashes were those containing 25 to 33 per cent of animal protein. Using these as a basis of 100 per cent, the relative value of the other mashes is readily seen. The mash containing 5% meat scrap or tankage is 90 per cent as efficient while the check pen is only 55.9. It is true that meat scrap or

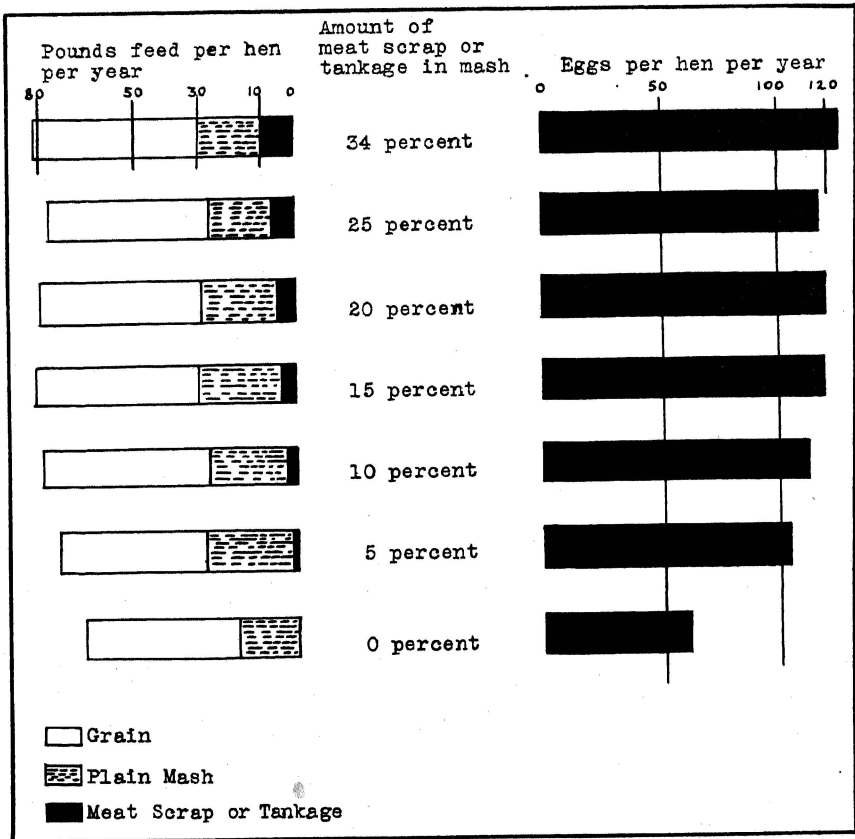


Fig. 3.—Results with various amounts of meat scrap or tankage in the dry mash.

tankage are higher in price than other poultry feed stuffs, but these foods constitute a comparatively small proportion of the ration and their addition to the reaction does not materially increase the average cost of a pound of feed. It is safe to state that the general practice of feeding mashes containing 20 to 25 per cent of tankage or similar product is an economical one and that using mashes containing smaller amounts will tend to decrease egg production and affect profits.

From Table 13 (below) it is observed that food consumption is fairly constant and that the chief differences in the various rations is due to the amount of meat scrap or tankage used. The importance of using

TABLE 13.—SUMMARY OF AMOUNTS OF FEED PER HEN PER YEAR (IN POUNDS).

	Percentage Meat Scrap Or Tankage Used						
	34%	25%	20%	15%	10%	5%	0
Corn	34.6	34.0	34.	34	34.6	31.6	33.
Oats or Wheat	17.3	17.0	17.	17	17.3	15.3	16.
Bran	6.6	6.6	7.8	8.8	8.1	9.1	7.
Shorts	6.6	6.6	7.8	8.8	8.1	9.1	7.
Cornmeal	6.6	6.6	7.8	8.8	8.1	9.1	7.
Meat Scrap or tankage	10.0	6.6	5.8	4.5	2.7	1.5	
Total pounds feed	81.7	77.4	79.9	81.6	78.9	75.7	70.
Eggs per hen	126	117	120	118	112	105	61.

animal protein in some form is readily appreciated when it is realized when 4.5 to 10 pounds per hen are added to the check ration the production is from 56 to 61 eggs greater. For each pound of meat scrap or tankage approximately 9 extra eggs were produced. Mashers containing 20 per cent or more of these products gave uniformly good results, and for this reason it is recommended that the mash contain from 15 to 25 per cent meat scrap or tankage or its equivalent.

### III. INFLUENCE OF VEGETABLE PROTEINS ON EGG PRODUCTION

In Bulletin 155, Missouri Agricultural Experiment Station, some experiments using oil meal, cottonseed meal and gluten meal to the extent of 25 per cent of the mash were reported. These results indicated that vegetable protein concentrates appeared to be of little if any value in influencing the egg yield. In fact the results were similar to those obtained in the check pen which was fed similar rations containing no protein concentrate of any kind. The results were as follows:

TABLE 14.—RESULTS OBTAINED IN FORMER EXPERIMENT WITH OIL MEAL, COTTONSEED MEAL AND GLUTEN MEAL.

Ration	Pounds feed per hen per year	Eggs per hen	Feed to produce one pound of eggs
Oil Meal	59.9	64.9	7.6
Gluten Meal	62.6	63.8	8.25
Cottonseed Meal	59.6	66.0	7.6
Check	70.0	61.3	9.3

**Cottonseed Meal 50%.**—Due to the fact that the results were not satisfactory the work with oil meal was discontinued and later the work was confined to cottonseed meal which has been used to some extent in poultry feeding. Two later tests with cottonseed meal to the extent of 50 per cent of the mash were made with equally unsatisfactory results:

TABLE 15.—RESULTS IN LATER TESTS WITH COTTONSEED MEAL 50%.

Years	Grain	Mash	Eggs
1916-17	43	20	59.6
1917-18	49	17	38.0
2-Year Average	46	18.5	48.4

**Gluten Meal or Cottonseed Meal Plus Bone Meal.**—One test with gluten meal produced results similar to the results reported in table 15. It was found, however, that when similar rations were fed, but to which 5 per cent bone meal was added to the mash, better results were obtained. These results were as follows:

TABLE 16.—RESULTS WITH GLUTEN MEAL OR COTTONSEED MEAL PLUS BONE MEAL.

Year	Grain	Mash	Eggs
1916-17	44	23	83.4
1916-17	38	25	93.0*
1917-18	47	20	67.6
3-Year Average	43	22.6	81.0

The addition of bone meal resulted in an increased egg production of 32 eggs per hen as compared with results shown in Table 15 and suggests that by the use of suitable mineral supplements these vegetable protein concentrates may be used. The work at this Station here reported does not warrant any recommendation.

**Combinations of Animal and Vegetable Proteins.**—Since these results indicated that these vegetable protein concentrates were not efficient substitutes for those of animal origin various combinations using

TABLE 17.—RESULTS WITH MASH CONTAINING 20 PER CENT MEAT SCRAP OR TANKAGE AND 20 PER CENT COTTONSEED MEAL

Year	Grain	Mash	Eggs
1916-17	43	24	127.5
1916-17	44	22	107.0*
1917-18	47	20	110.
1918-19	48	32	115.
1919-20	60	41	87.
Average	48	28	109.3

\*Gluten meal.

both vegetable and animal protein concentrates were tried. It was hoped that a partial substitution of vegetable protein might be made which would result in a more economical and efficient ration. The accompanying tables show the results of the various combinations:

TABLE 18.—RESULTS WITH MASH CONTAINING 10 PER CENT TANKAGE AND 30 PER CENT COTTONSEED MEAL

Year	Grain	Mash	Eggs
1916-17	44	20	97.9
1916-17	45	22	115.2*
1917-18	46	24	106.
1917-18	47	22	100.
1918-19	50	46	119.
1919-20	59	36	81.
Average	48	28	103.

\*Gluten Meal.

TABLE 19.—RESULTS WITH MASH CONTAINING 15 PER CENT TANKAGE AND 5 PER CENT COTTONSEED MEAL

Year	Grain	Mash	Eggs
1920-21	53	24	88
1921-22	43	30	128
1922-23	44	35	121
Average	47	29	112

TABLE 20.—RESULTS WITH MASH CONTAINING 10% TANKAGE AND 10% COTTONSEED MEAL

Year	Grain	Mash	Eggs
1920-21	58	22	46
1921-22	42	34	124
1922-23	53	37	102
Average	51	31	91

TABLE 21.—RESULTS WITH MASH CONTAINING 5% TANKAGE AND 15% COTTONSEED MEAL

Year	Grain	Mash	Eggs
1920-21	49	16	68
1921-22	44	36	126
1922-23	44	27	93
Average	45	26	95.6

**Summary.**—In consideration of the foregoing results one might conclude that the cottonseed meal might be used as a partial substitute for meat scrap or tankage. Where the mash contained 20 per cent each of tankage and cottonseed meal the egg production was 109 eggs. A similar mash containing no cottonseed meal produced 120 eggs. The mash containing 10 per cent tankage and 30 per cent cottonseed meal resulted in an average production of 103 eggs while a similar mash including no cottonseed meal produced 112 eggs. Similarly the mash containing 15 per cent tankage and 5 per cent cottonseed meal produced 112 eggs while a similar mash containing 15 per cent tankage produced 118.

In the case of the mash containing 10 per cent of tankage and 10 per cent cottonseed meal 91 eggs were obtained while a mash containing 10 per cent of tankage but with no cottonseed meal produced 112.

TABLE 22.—GENERAL SUMMARY OF AMOUNTS EATEN PER HEN PER YEAR OF VARIOUS MASHES CONTAINING COTTONSEED MEAL AND TANKAGE OR MEAT SCRAP

	C. S. M. 50%	C. S. M. 50%	Tank. 20%	Tank. 10%	Tank. 15%	Tank. 10%	Tank. 5%
			C. S. M. 20%	C. S. M. 30%	C. S. M. 5%	C. S. M. 10%	C. S. M. 15%
Corn (lbs.)	30	29	32	32	32	34	30
Oats or wheat (lbs.)	15	14	16	16	16	17	15
Bran (lbs.)	3.2	3.7	5.6	5.6	7.7	8.3	7
Shorts (lbs.)	3.2	3.7	5.6	5.6	7.7	8.3	7
Cornmeal (lbs.)	3.2	3.7	5.6	5.6	7.7	8.3	7
Tankage (lbs.)	--	--	5.6	2.8	4.3	3.1	1.3
Cottonseed Meal (lbs.)	9.2	11.6	5.6	8.4	1.4	3.1	3.9
Bone Meal (lbs.)	--	1.1	--	--	--	--	--
Number of Eggs	48	81	109	103	112	91	95.6

Also the mash containing 5 per cent tankage and 15 per cent cottonseed meal produced 95 eggs as compared to 105 eggs for the mash containing 5 per cent meat scrap or tankage only.

In each case it will be observed that the mash containing cottonseed meal produced a smaller number of eggs than did mashes made up in similar manner but to which no cottonseed meal was added. From these tests one would conclude that it is poor economy to attempt to substitute cottonseed meal for tankage or meat scrap in the rations for laying hens.

When one compares the protein analysis of cottonseed meal with tankage or meat scrap the cost of a pound of protein is practically the same and since there is some question as to its practicability it will be wise for the poultryman to await the results of further investigation.

#### IV. THE COMPARISON BETWEEN THE CONSUMPTION OF MEAT SCRAP OR TANKAGE AND EGG PRODUCTION

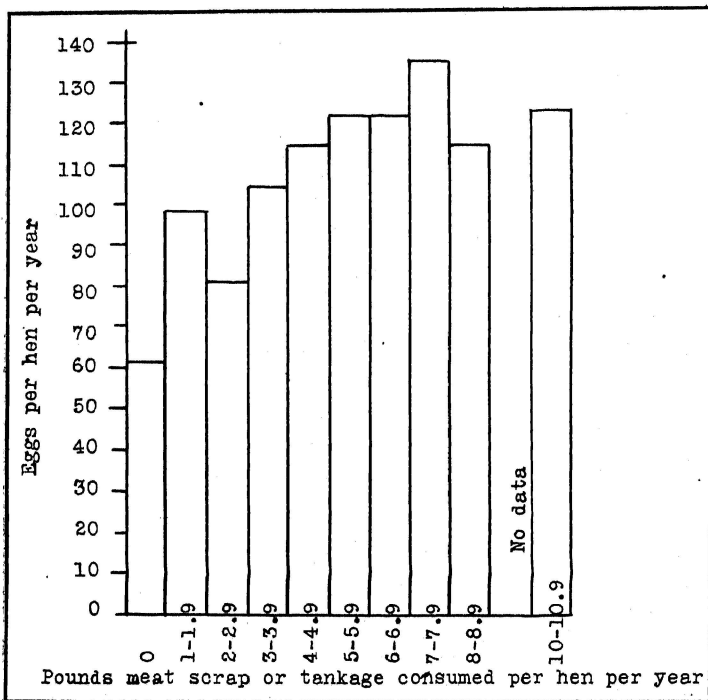


Fig. 4.—The relation between the consumption of meat scrap or tankage and egg production.

From the preceding reports it is evident that egg production is closely related to the consumption of meat scrap or tankage. A criticism might be offered to the various mashes reported that uniform results were not obtained. This criticism is not justified when the general averages are considered, but in an effort to arrive at more definite conclusions the data have been considered from a statistical standpoint. There are involved in these data 48 tests, not including the check pen, in which no animal protein concentrate was used.

Figure 5 shows the correlation existing between the amount of meat scrap or tankage consumed per hen per year and the annual egg yield

As one would expect there is a strong correlation between the amount of animal protein concentrate and the egg production. This is shown also in the following table:

TABLE 23.—RELATION BETWEEN AMOUNT OF TANKAGE OR MEAT SCRAP EATEN AND EGGS LAID PER HEN PER YEAR

	Pounds of tankage or meat scrap per hen									
	0	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	10-10.9
Eggs per Hen	61	98	81	105	114	122	122	135	115	123

		Eggs Produced per Hen per Year													
		40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	Total
Meat Scrap or Tankage per Hen (Per Year)	1 to 1.9			1		2	1	1		2					7
	2 to 2.9	1				1	1	2	2						7
	3 to 3.9					2		2				1			7
	4 to 4.9							3	3	2					8
	5 to 5.9							2	2	2	1		1		8
	6 to 6.9								1	2					3
	7 to 7.9										1				1
	8 to 8.9					1			1	1	1				4
	9 to 9.9														0
	10 to 10.9								3		2				5
Total		1	0	1	0	6	2	10	12	9	5	1	1	0	48

Fig. 5.—Correlation between the consumption of meat scrap or tankage and egg production is  $.5179 \pm .071$ . Opposite the number of pounds of meat scrap or tankage consumed in the respective tests are figures indicating the number of tests so fed in which the egg production reached the figures heading the vertical columns.

It is thus seen that as the consumption of meat scrap or tankage increased the number of eggs produced increased. The rate of increase is fairly constant until a consumption of 5 to 7 pounds per hen was reached, after which no increase was noted. It would appear from these data that the optimum amount of meat scrap or tankage per hen per year lies around these points. If a hen consumes 30 pounds of mash in one year, 6 pounds or 20 per cent of the mash would satisfy the requirement. If the mash consumed is less, the amount of animal protein would necessarily be increased and vice versa.