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

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THE EFFECT OF VARIOUS RATIONS ON THE STORAGE QUALITY OF EGGS



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†As of January 1, 1928.

**Dean, School of Veterinary Medicine.

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SYNOPSIS

Earlier work at the Texas Station showed that cottonseed meal and alfalfa leaf meal were useful feeds for the economical production of eggs. The eggs when newly laid showed no discoloration of yolk or white, but in 1926, it was found that some feeds fed laying hens caused eggs in cold-storage to show discolored yolks and in some cases discolored whites.

A study of the effect of feeding various mixtures of feeds on the storage quality of the eggs produced was begun, and from the results of the first year's work, the Station recommends not over nine per cent of 43 per cent Protein Cottonseed Meal, Prime Quality, in the mash and not over six per cent in an "all-mash ration" during the months when eggs are going into storage. So far as the first year's work shows, the possibility is not eliminated absolutely that bad effects result even from these amounts. Cottonseed meal has been proven to be an economical poultry feed and at times of the year when eggs are not going into storage larger proportions of cottonseed meal may be fed.

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THE EFFECT OF VARIOUS RATIONS ON THE STORAGE QUALITY OF EGGS

ROSS M. SHERWOOD

This Bulletin is submitted as a report of the results secured the first year in a project to determine what effect various amounts and combinations of feeds fed laying hens, had on the storage quality of the eggs produced. The work is not completed, but it is thought sufficient data were secured to warrant this publication.

Work has been carried on for a number of years to determine the value of cottonseed meal as a feed for laying hens. The Texas Station has been actively engaged on this project since 1912.

No serious discoloration of yolk or white of the eggs resulted from the combinations of feeds used at the Texas Station and, from correspondence, it was learned that this was true also at the Oklahoma, Missouri, Indiana, Ohio, and Alabama Stations. The Texas Station used 43% Protein Cottonseed Meal, Prime Quality, and did not use over thirty-two pounds of cottonseed meal in 100 pounds of mash.

In Annual Report No. 37 of the New Mexico Station, it was reported that, with the combinations of feeds used there, off-colored yolks resulted. This work is described as follows: "The pen which received 38 per cent of cottonseed meal in the mash, produced eggs which were so badly affected by the cottonseed meal spots as to be unmarketable. The yolk of these eggs turned black in color, as the eggs were kept for a few days, so that when a week old the yolk was almost entirely black." It is noted that 38 per cent of the mash was cottonseed meal. The following description of this cottonseed meal was secured by correspondence with the New Mexico Station: "The meal is prime and carries a guaranteed analysis of 43 per cent protein. It has a bright greenish-yellow color, and is different from any that I have seen elsewhere in this respect. It is practically all Acala cotton and is grown under irrigation."

In the spring of 1926, the Texas Station placed eggs from cottonseed-meal-fed hens in cold-storage and noted that the yolks and whites of the eggs did not hold their color in storage. No decomposition seemed present, and the odor was practically normal.

A large per cent of the eggs produced during the spring are normally placed in cold-storage to be consumed in the autumn and winter, and it is necessary that eggs produced for storage be of such a quality that they will store well.

For these reasons, the Texas Station undertook this experiment on the effect of feeding various feeds on the holding quality of the eggs produced.

THE EXPERIMENT

Object: The object of this experiment was to determine whether cottonseed meal, cottonseed oil, and alfalfa leaf meal, fed to laying hens in varying proportions in the mash, have any effect on the storage quality of eggs laid by these hens.

Stock Used: In this experiment the rations designated as Rations 1, 2, 3, and 4, were fed to Single Comb White Leghorn pullets. Rations designated as Rations 5, 6, 7, 8, 9, 10, 11, and 12, were fed to Single Comb White Leghorn yearling hens.

Rations: The pullets receiving Rations 1 to 4, inclusive, were fed milo and kafir for their grain and mash as given in Table 1. They were allowed liberal range. During the early spring they had winter oats for green feed. On May 1, the lots were plowed up and sowed to Sudan grass and the pullets were not allowed to range on this until May 25. During the time between these dates each pen was allowed to range on a rather poor Bermuda grass range every fourth day. Hens receiving Rations 5 to 12, inclusive, received no grain other than the ground grains in the mash, as shown in Table 1. They were not allowed

Table 1—Number pounds ingredients used in each ration.

Feed Ingredients	Ration Number											
	1	2	3	4	5	6	7	8	9	10	11	12
Ground Milo and Kafir.....	36.5	27.8	22.5	31.5	70.0	70.0	70.0	70.0	70.0			
Ground Feterita.....										70.0		
Ground Yellow Corn.....											70.0	70.0
Wheat Gray Shorts.....	20.0	25.0	25.0	16.0	14.5	14.5	14.5	14.5	14.5	14.5	13.5	18.5
Wheat Bran.....	15.0	15.0	15.0	12.0								
Alfalfa Leaf Meal.....	8.0	8.0	8.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Meat Scrap.....	20.0	14.0	7.5		10.0	8.5	7.0	5.5	4.0	10.0	10.0	10.0
43 Per Cent Protein Cottonseed Meal, Prime Quality.....		9.0	20.0	32.0		3.0	6.0	9.0	12.0			
Crude Cottonseed Oil.....											1.0	1.0
Salt.....	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
Finely Ground Oyster Shells.....		.7	1.5	2.0		.5	1.0	1.5	2.0			
Total.....	100	100	100	100	100	102	104	106	108	100	100	100
Grain.....	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Range.....	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No

to range, but were held in houses 10x10 feet in size with yards 6x10 feet in size which were floored with cement. It will be noted from Table 1 that the chief differences in the Rations 1 to 4, inclusive, are the amounts of meat scrap and cottonseed meal they contain. Ration 10 is a duplicate of Ration 5 except that feterita is used in Ration 10 and milo and kafir are used in Ration 5. Rations 11 and 12 are meat-scrap rations with one per cent crude cottonseed oil added. In the case of Ration 11,

alfalfa leaf meal is added, and in Ration 12, no alfalfa leaf meal is given. Crushed oyster shell was available to all the hens in shell hoppers.

Storage of the Eggs: Beginning March 12, 1927, eggs were collected and beginning on March 15, 1927, they were shipped to a commercial cold-storage house* in Houston, Texas. A case was placed in storage every second Thursday following this date until nine cases were in storage. Each case contained eggs from each of the rations, the exact number depending on the eggs laid by the hens receiving the various rations. None of the eggs had been laid longer than four days when they were placed in storage.

Candling of Eggs and Grades

These eggs were candled on July 1st, July 27th, September 9th, and October 5th, by a commercial egg candler. He graded them as firsts, seconds, and discards. Eggs graded as seconds showed a slight discoloration of the yolk. In some cases, this appeared slightly red and in other cases, the yolk showed a green tint.

The eggs graded as discards contained discolored yolks, whites, or both. In some cases the color of the yolks was a mottled yellow; in others the yolks appeared more red than the seconds; and in other cases they were of a greenish brown, sometimes called black. The white varied from normal color to a light pink. The yolks were spongy in consistency and in some cases when cut with a knife, they resembled gelatin.

It is very probable that a number of the eggs would have graded poorer if broken, due to the consistency of the yolk and colors that did not show up to the candle. More work will be done on this subject later. Notes were taken of the number of eggs in each grade from each lot at each candling.

Tables 2 to 10, inclusive, give the final candling of the nine cases, and Table 11 gives a summary of the final candling of all of these cases.

Table 2—Candling record of Case A in storage from March 24 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	51	47	1	3	92.1	2.0	5.9
2	9% cottonseed meal mash	53	52	1		98.1	1.9	
3	20% cottonseed meal mash	53	40	2	11	75.5	3.8	20.7
4	32% cottonseed meal mash	52	21	1	30	40.4	1.9	57.7
5	Meat scrap, no cottonseed meal	11	10		1	90.9		9.1
6	3% cottonseed meal, all-mash	30	30			100.0		
7	6% cottonseed meal, all-mash	31	31			100.0		
8	9% cottonseed meal, all-mash	27	10	2	15	37.0	7.4	55.6
9	12% cottonseed meal, all-mash	23	10	6	7	43.5	26.1	30.4
10	Meat scrap, no cottonseed meal	12	12			100.0		

*The author wishes to acknowledge the assistance rendered by the Morning Glory Creameries of Houston, Texas, in placing their facilities at our disposal and in furnishing an expert candler to grade these eggs whenever desired.

It is noted that no firsts were left in Ration 4 in case E at the close of the period. This case of eggs was collected during the time that very little green feed was available. More data will be secured to learn whether green feed is a factor which affects quality.

Table 3—Candling record of Case B in storage from April 7 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	50	49		1	98.0		2.0
2	9% cottonseed meal mash	53	51		2	96.2		3.8
3	20% cottonseed meal mash	58	39	10	9	67.2	17.2	15.5
4	32% cottonseed meal mash	59	13	4	42	22.0	6.8	71.2
5	Meat scrap, no cottonseed meal	12	12			100.0		
6	3% cottonseed meal, all-mash	31	31			100.0		
7	6% cottonseed meal, all-mash	26	26			100.0		
8	9% cottonseed meal, all-mash	27	15	4	8	55.6	14.8	29.6
9	12% cottonseed meal, all-mash	29	14	8	7	48.3	27.6	24.1
10	Meat scrap, no cottonseed meal	12	12			100.0		

Table 4—Candling record of Case C in storage from April 21 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	58	55	3		94.8	5.2	
2	9% cottonseed meal mash	62	59	2	1	95.2	3.2	1.6
3	20% cottonseed meal mash	63	47	9	7	74.6	14.3	11.1
4	32% cottonseed meal mash	59	11	8	40	18.6	13.6	67.8
5	Meat scrap, no cottonseed meal	11	11			100.0		
6	3% cottonseed meal, all-mash	30	30			100.0		
7	6% cottonseed meal, all-mash	21	21			100.0		
8	9% cottonseed meal, all-mash	14	7	5	2	50.0	35.7	14.3
9	12% cottonseed meal, all-mash	21	10	7	4	47.6	33.3	19.0
10	Meat scrap, no cottonseed meal	17	17			100.0		

Table 5—Candling record of Case D in storage from May 5 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	54	54			100.0		
2	9% cottonseed meal mash	60	58			96.6		3.3
3	20% cottonseed meal mash	52	42	8	2	80.8	15.4	3.8
4	32% cottonseed meal mash	59	6	16	37	10.2	27.1	62.7
5	Meat scrap, no cottonseed meal	11	11			100.0		
6	3% cottonseed meal, all-mash	21	20	1		95.2	4.8	
7	6% cottonseed meal, all-mash	13	12		1	92.3		7.7
8	9% cottonseed meal, all-mash	13	11	1	1	84.6	7.7	7.7
9	12% cottonseed meal, all-mash	12	10	2		83.3	16.6	
10	Meat scrap, no cottonseed meal	10	10			100.0		

Table 6—Candling record of Case E in storage from May 19 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	57	56	1		98.2	1.8	
2	9% cottonseed meal mash	68	65		3	95.6		4.4
3	20% cottonseed meal mash	77	20	21	36	26.0	27.3	46.8
4	32% cottonseed meal mash	68		2	66		2.9	97.1
5	Meat scrap, no cottonseed meal	9	9			100.0		
6	3% cottonseed meal, all-mash	4	4			100.0		
7	6% cottonseed meal, all-mash	3	3			100.0		
8	9% cottonseed meal, all-mash	1	1			100.0		
9	12% cottonseed meal, all-mash	9	5	2	2	55.6	22.2	22.2
10	Meat scrap, no cottonseed meal	13	12		1	92.3		7.7
11	1% crude cottonseed oil, alfalfa and meat scrap	27	26	1		96.3	3.7	
12	1% crude cottonseed oil and meat scrap, no alfalfa	24	24			100.0		

Table 7—Candling record of Case F in storage from June 2 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	67	66		1	98.5		1.5
2	9% cottonseed meal mash	68	61	5	2	89.7	7.4	2.9
3	20% cottonseed meal mash	70	36	23	11	51.4	32.9	15.7
4	32% cottonseed meal mash	62	8	13	41	12.9	21.0	66.1
5	Meat scrap, no cottonseed meal	8	8			100.0		
6	3% cottonseed meal, all-mash	4	4			100.0		
7	6% cottonseed meal, all-mash	1	1			100.0		
8	9% cottonseed meal, all-mash	5	3	2		60.0	40.0	
9	12% cottonseed meal all-mash	10	7	2	1	70.0	20.0	10.0
10	Meat scrap, no cottonseed meal	11	11			100.0		
11	1% crude cottonseed oil, alfalfa and meat scrap	15	15			100.0		
12	1% crude cottonseed oil and meat scrap, no alfalfa	27	27			100.0		

Table 8—Candling record of Case G in storage from June 16 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	68	67	1		98.5	1.5	
2	9% cottonseed meal mash	85	83	2		97.6	2.4	
3	20% cottonseed meal mash	85	49	31	5	57.6	36.5	5.9
4	32% cottonseed meal mash	66	21	18	27	31.8	27.3	40.9
5	Meat scrap, no cottonseed meal	6	6			100.0		
6	3% cottonseed meal, all-mash	8	8			100.0		
7	6% cottonseed meal, all-mash	0	0					
8	9% cottonseed meal, all-mash	1	0	1			100.0	
9	12% cottonseed meal, all-mash	8	1	3	4	12.5	37.5	50.0
10	Meat scrap, no cottonseed meal	5	5			100.0		
11	1% crude cottonseed oil, alfalfa and meat scrap	11	8	3		72.7	27.3	
12	1% crude cottonseed oil and meat scrap, no alfalfa	9	9			100.0		

Table 9—Candling record of Case H in storage from June 30 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	99	94	3	2	94.9	3.0	2.0
2	9% cottonseed meal mash	93	90	2	1	96.8	2.2	1.1
3	20% cottonseed meal mash	44	35	7	2	79.5	15.9	4.5
4	32% cottonseed meal mash	37	15	4	18	40.5	10.8	48.6
5	Meat scrap, no cottonseed meal	2	2			100.0		
6	3% cottonseed meal, all-mash	15	15			100.0		
7	6% cottonseed meal, all-mash	1	1			100.0		
8	9% cottonseed meal, all-mash	3	2	1		66.7	33.3	
9	12% cottonseed meal, all-mash	5	1	2	2	20.0	40.0	40.0
10	Meat scrap, no cottonseed meal	5	5			100.0		
11	1% crude cottonseed oil, alfalfa and meat scrap	29	29			100.0		
12	1% crude cottonseed oil and meat scrap, no alfalfa	12	12			100.0		

Table 10—Candling record of Case I in storage from July 14 to October 5, 1927.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	77	76	1		98.7	1.3	
2	9% cottonseed meal mash	68	67	1		98.5	1.5	
3	20% cottonseed meal mash	64	51	13		79.7	20.3	
4	32% cottonseed meal mash	56	19	19	18	33.9	33.9	32.1
5	Meat scrap, no cottonseed meal	6	6			100.0		
6	3% cottonseed meal, all-mash	9	9			100.0		
7	6% cottonseed meal, all-mash	2	2			100.0		
8	9% cottonseed meal, all-mash	4	3	1		75.0	25.0	
9	12% cottonseed meal, all-mash	8	6	1	1	75.0	12.5	12.5
10	Meat scrap, no cottonseed meal	9	9			100.0		
11	1% crude cottonseed oil, alfalfa and meat scrap	18	18			100.0		
12	1% crude cottonseed oil and meat scrap, no alfalfa	24	24			100.0		

Table 11—Summary of candling records of nine cases of eggs.

Ration No.	Variable Feeds	Number of Eggs				Per Cent		
		Total	Firsts	Seconds	Discards	Firsts	Seconds	Discards
1	Meat scrap, no cottonseed meal	581	564	10	7	97.1	1.7	1.2
2	9% cottonseed meal mash	610	586	13	11	96.1	2.1	1.8
3	20% cottonseed meal mash	566	359	124	83	63.4	21.9	14.7
4	32% cottonseed meal mash	518	114	85	319	22.0	16.4	61.6
5	Meat scrap, no cottonseed meal	76	75		1	98.7		1.3
6	3% cottonseed meal, all-mash	152	151	1		99.3	.7	
7	6% cottonseed meal, all-mash	98	97		1	99.0		1.0
8	9% cottonseed meal, all-mash	95	52	17	26	54.7	17.9	27.4
9	12% cottonseed meal, all-mash	125	64	33	28	51.2	26.4	22.4
10	Meat scrap, no cottonseed meal	94	93		1	98.9		1.1
11	1% crude cottonseed oil, alfalfa and meat scrap	100	96	4		96.0	4.0	
12	1% crude cottonseed oil and meat scrap, no alfalfa	96	96			100.0		

Two chemical analyses were made from Ration 1 and Ration 4, these containing meat scrap and cottonseed meal, respectively. The eggs in analysis 1 were cold storage eggs. Those in analysis 2 for Ration 4 were

cold-storage eggs, while those for Ration 1 in this case were freshly laid eggs. Dr. Fraps reported greater difficulty in separating yolks from whites in the case of the cottonseed meal eggs than from the meat scrap eggs, due to the fact that the yolks ruptured more readily. He stated that, for that reason, the proportion of white to yolk in the cottonseed meal eggs may have been reported slightly greater than it really was.

Table 12.—Analysis of eggs.*

	Eggs from Ration 1. Containing Meat Scrap.		Eggs from Ration 4. Containing Cottonseed Meal.	
	Analysis 1	Analysis 2	Analysis 1	Analysis 2
Per cent yolk in egg.....	32.4	34.7	38.4	40.0
Per cent white in egg.....	56.4	54.0	48.7	48.8
Per cent shell in egg.....	11.1	11.3	12.9	11.2
Per cent protein in yolk.....	15.7	16.0	13.4	15.6
Per cent fat in yolk.....	30.9	29.5	24.8	22.7
Per cent water in yolk.....	50.2	53.0	57.2	57.5
Per cent ash in yolk.....	1.4	1.5	1.6	1.6

*Analyses made by Dr. G. S. Fraps, State Chemist.

From Table 12 it would seem that these rations have an influence on the proportion of yolk and white as well as the chemical composition of these parts of the egg. More analyses of eggs from hens fed these rations will be made to supply more data on this point.

CONCLUSIONS

1. None of the eggs in this experiment showed any serious discoloration of yolk or white when they were first laid.
2. Little or no change in color of yolk or white was noted with any of the rations used until eggs had been held in cold-storage as long as four weeks.
3. Eggs laid by hens receiving a mash containing 20 or 32 per cent of 43% Protein Cottonseed Meal, Prime Quality, began to deteriorate in color at the end of four weeks in cold-storage.
4. Hens receiving a mash containing 9 per cent of 43% Protein Cottonseed Meal, Prime Quality, laid eggs that seemed to keep a good color as long as twenty-eight weeks in cold-storage, as determined by candling. More work should be done on this ration since candling will not always detect all the undesirable eggs.
5. Hens receiving an "all-mash ration" containing approximately 9 or 12 per cent of 43% Protein Cottonseed Meal, laid eggs that began to deteriorate in color after being held four weeks in cold-storage.
6. Hens receiving an "all-mash ration" containing approximately 3 or 6 per cent of 43% Protein Cottonseed Meal, Prime Quality, laid eggs that seemed to keep a good color, as shown by candling, as long as twenty-eight weeks in storage, but more work should be done on these rations, as candling will not always detect all the undesirable eggs.

7. Eggs produced by hens receiving 1 per cent of crude cottonseed oil seemed to hold their color as long as twenty weeks in cold-storage as determined by candling.

8. The data seem to show that the feeding of a liberal supply of fresh, succulent green feed will improve the storage quality of the eggs, but more work is necessary to determine this point conclusively.

9. Egg producers in Texas should be careful of the feeds their hens receive during the season when eggs are being stored so that the eggs will retain their color and texture in cold-storage.