Relation of Type of Ration to the Interior Quality of Hens' Eggs[1]

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During recent years the feeding of high-protein supplements or mashes to laying hens has increased in popularity. By using these mashes farm poultry raisers can utilize more of their home-grown grains. High-protein supplements are usually used in combination with the free-choice feeding of whole grains. The grains are fed either as a grain mixture or separately. Such feeding practices undoubtedly result in the consumption of varying proportions of available feeds due to the hen's choice. Since the interior quality of eggs is affected by the nutrition of the hens producing them, it is conceivable that varying the protein level of the supplement and the method of feeding whole grains might influence interior egg quality.

An opportunity to study the effect of the method of feeding hens on interior quality of eggs was made possible by some experiments in progress during the past two years involving six pens of Rhode Island Red pullets which were fed three supplements analyzing 22, 33 and 43 percent crude protein. The ingredients used in compounding the supplements are shown in Table 1. One of the two pens receiving each type of supplement was fed whole grains as a mixture of yellow corn, wheat, and oats (40-40-20); the other was fed the same grains unmixed and in separate compartments of the hopper. In addition all pens had free access to oyster shell and grit.

Four 25-egg samples were collected from each pen in January and May of 1945 and 1946. An attempt was made to get eggs from as many of the hens as possible during the two-or three-day collection period of each sample. Eggs were kept overnight in a cool basement egg room and were broken out and observed the following day.

Egg-yolk color was determined by comparing the yolk color of the broken-out egg with the yolk-color rotor described by Heiman and Carver (1935). Albumen quality was measured by two methods, as follows:

1. Albumen score.—The broken-out condition of the albumen was compared with the photographic standards of Heiman and Carver (1936). Eggs that were observed to have a large percent of upstanding albumen were given a score of 1. Those that appeared to have very little or no thick albumen were given

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Table 1—Compositions of Protein Supplements

Ingredients	22% supplement lbs.	33% supplement lbs.	43% supplement lbs.
Wheat bran	18.5	8.75	
Wheat middlings	18.5	8.75	
Ground yellow corn	18.5	8.75	
Ground oats	18.5	8.75	
Meat and bone scraps	10.0	25.0	40.0
Soybean meal	10.0	25.0	40.0
Alfalfa leaf meal	5.0	12.50	20.0
Salt*	1.0	2.50	4.0
Delsterol (900,000 D units per lb.)	0.12	0.30	.48

*To each pound of salt 0.046 gms. of potassium iodide was added.

a score of 5. Scores of 2, 3, and 4 were given to intermediate grades.

2. Percent of thick albumen.—The percent of thick albumen was calculated by dividing the weight of thick albumen by total albumen weight. Thick and thin albumen were separated with a sieve of 1/8" hardware cloth with holes approximately 2.7 mm. square. The procedure was similar in most respects to that described by Knox and Godfrey (1934).

Results

A wide range of egg-yolk colors was observed in all pens (Table 2). The most variation in yolk color was observed in the two pens fed the 22-percent-protein mash. In pen 1 the yolk colors ranged from 10 (yellow or lemon) to 18 (reddish orange). Such a wide variation in yolk color certainly is not desirable from the consumer's viewpoint. In all pens, except those fed the 22-percent supplement, 75 percent or more of the yolks fell within the 13-15 (medium) color range. There was a tendency toward the production of lighter colored yolks in the three pens in which the grains were fed separately.

As measured by the averages of the yolk-color indexes (Table 2) the hens fed the 33- and 43-percent supplements laid eggs with slightly darker yolks than those fed the 22-percent supplement. Average yolk color, however, is not as important a consideration as the amount variation as long as the yolks are not extremely dark in color (above index 16).

As far as egg-yolk color is concerned results from feeding the high-protein supplements were as good or better than those obtained with a 22-percent supplement. It is possible, however, that less variation in yolk color might result when whole grains mixtures are restricted or hand fed in combination with laying mashes or supplements similar to the 22-percent supplement used in these experiments.

Egg-albumen quality as measured by the appearance (albumen score) and percentage of thick albumen did not vary a great deal between pens (Table 3). On the basis of albumen scores the eggs from the pen which was fed grains separately with the 22-percent supplement (A-2) were best and those from the pen which was fed grains separately with the 43-percent

Table 2—Relation of type of ration to egg-yolk color
Measured by the percentage distribution of yolk-color indexes
Combined data for two trials—100 eggs from each pen

Pen	Percent protein in supplement	Method of feeding grains	Yolk-color indexes: Light 10 %	11 %	12 %	13 %	Medium 14 %	15 %	16 %	Dark 17 %	18 %	13 to 15 %	Avg.
A-1	22	Mixture	1	3	13	37	21	14	9	1	1	72	13.6
A-2	22	Separate	0	10	23	24	20	18	3	2	0	62	13.3
A-3	33	Mixture	0	0	4	20	28	31	14	3	0	79	14.4
A-4	33	Separate	0	5	11	28	32	19	5	0	0	79	13.6
A-5	43	Mixture	0	3	6	16	33	26	15	1	0	75	14.2
A-6	43	Separate	0	3	7	31	28	21	9	1	0	80	13.9

Table 3—Relation of type of ration to quality of egg albumen.
Measured by percentage distribution of albumen scores and percentage of thick albumen
Combined data for two years—100 eggs from each pen

Pen	Percent protein in supplement	Method of feeding grain	Albumen score: 1 %	2 %	3 %	4 %	5 %	Avg.	Thick albumen %
A-1	22	Mixture	12	43	34	7	4	2.5	61
A-2	22	Separate	22	34	40	3	1	2.3	61
A-3	33	Mixture	13	35	40	11	1	2.5	61
A-4	33	Separate	17	39	35	7	2	2.4	63
A-5	43	Mixture	21	31	36	12	0	2.4	63
A-6	43	Separate	11	32	41	14	2	2.6	61

Table 4—Influence of pasture on egg-yolk color index

Pen	Percent protein in supplement	Method of feeding grain	January (confined) Range	January (confined) Average	May (green feed) Range	May (green feed) Average
A-1	22	Mixture	11-16	13.4	10*-18*	13.8
A-2	22	Separate	11-16	13.2	11 -17	13.4
A-3	33	Mixture	12-16	14.1	13 -17	14.7
A-4	33	Separate	11-15	13.8	11 -16	13.4
A-5	43	Mixture	12-16	14.3	11 -17*	14.1
A-6	43	Separate	11-17*	13.6	12 -16	14.2
All pens			11-17*	13.7	10*-18*	13.9

*One egg only

supplement (A-6) least desirable. However, the albumen quality of eggs from these two pens was the same as measured by the actual weight of thick and thin albumen. Varying the protein level of the mash and the method of feeding the grains had little or no influence on albumen quality of eggs.

As the pullets were confined to the laying house until May 1, after which date they had access to green feed in yards in the afternoons, it might be expected that the yolk color of eggs produced in late May was darker than that of eggs laid in January. Several investigators including Wilhelm and Heiman (1938), Parker, Gossman and Lippincott (1926), and Hunter, Van Wagenen and Hall (1936) have shown that there is no seasonal variation in yolk color of eggs when hens are fed a constant ration. The results in Table 4 show that there was a tendency for the eggs examined in the May samples to have slightly darker yolks than those of eggs in the January samples. All eggs with yolk color indexes of 17 and 18 shown in Table 2, except the one egg in pen A-6, were produced after the hens had access to green feed.

Summary

Investigations over a two-year period were conducted on yolk color and albumen quality of 1-day-old eggs from 6 pens of Rhode Island Red pullets which were fed ad libitum mashes or supplements with 22, 33 and 43 percent crude protein and the whole grains yellow corn, wheat, and oats as a mixture (40-40-20) and separately.

The results show that a rather wide range of egg yolk color was observed in all pens. Yolk color of eggs from the pens on the 33- and 43-percent supplements was slightly darker but less variable than that of eggs from the pen on the 22-percent supplement. The feeding of the whole grains separately resulted in lighter colored yolks. Albumen quality was not influenced appreciably by either the protein level of the supplement or the method of feeding the whole grains. There was a tendency for the egg-yolk colors to be darker when the birds had access to pasture in the afternoons.

Literature Cited

Heiman, Victor and Carver, J. S. The yolk color index. U.S. Egg and Poultry Magazine 41:40-41. 1935.

Heiman, Victor and Carver, J.S. The albumen index as a physical measurement of observed egg quality. Poultry Science 15:141-148. 1936.

Hunter, J. A., Van Wagenen, A. and Hall, G. O. Seasonal changes in interior egg quality of Single Comb White Leghorn Hens. Poultry Science 15: 115-118. 1936.

Knox, C. W. and Godfrey, A. B. Variability of thick albumen in fresh-laid eggs. Poultry Science 13:18-22. 1934.

Parker, Sylvia, Gossman, S. S. and Lippincott, W. A. Studies in egg quality. I Variations in yolk color. Poultry Science 5: 131-145. 1926.

Wilhelm, L. A. and Heiman, Victor. The seasonal variations in interior egg quality of new laid eggs. Wash. Tech. Paper 358. 1938.

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