Effect of Feeding Achiote Seed on Egg-Yolk Pigmentation

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INTRODUCTION

Various studies have repeatedly shown that the color of egg yolk is influenced mainly by the diet of laying chickens (*2*, *3*, *5*, *6*).[2] This coloring of the yolk is attributed to the carotenoid compounds contained in the feed given. Grasses and other green feeds which are high in lutein or xanthophyll (carotenoids) produce highly colored egg yolk. Laying hens fed with wheat, wheat bran, oats, barley, cottonseed-oil meal, and meat scraps lay eggs with light-colored yolks. Pimiento peppers have also been reported to produce darker colored yolk eggs when fed to laying hens (*1*).

In many United States markets eggs with light-colored yolks are preferred to those having dark-colored yolks. In Puerto Rico, however, the people prefer dark-colored-yolk eggs, and these usually sell at a higher price than those with light-colored yolks in the public markets of the Island.

"Achiote" seed (*Bixa orellana*) are used commonly in food coloring and as a spice for food preparations used by the people of Puerto Rico. These seed are produced locally. A study was undertaken to investigate whether the addition of achiote seed to a ration fed to laying hens would impart a pleasing coloring to the yolk.

EXPERIMENTAL PROCEDURE

Four trials were conducted in this study. The first three were short in duration and exploratory in nature.

In the first trial, 44 twenty-week-old White Leghorn pullets were divided into two groups. These birds were housed individually in cages. They were fed the same ration (table 1) except that the group-2 pullets received an achiote-seed supplement. The achiote seed were ground and mixed with the basal feed by hand at the level of 1 percent. Water was supplied at all times and the same feeding and management practices were employed with all groups. All eggs laid were broken to see the effect of achiote seed on the color of the yolk. This trial lasted for a month.

The same birds were used in the second trial. There was no modification in the grouping and procedure used in trial 1, except that the ground

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[2] Italic numbers in parentheses refer to Literature Cited, p. 96.

achiote seed were put in the water instead of the feed. This trial was unsuccessful and was discontinued after 2 weeks.

A third trial was also conducted using the same pullets. The same feeding and management practices used in the previous trials were employed for all groups. However, the birds that received the achiote-seed supplementation previously were now used as controls and the former control birds received the achiote-seed supplementation. The achiote seed, however, were given at the level of 2 percent, unground, and sprinkled over the feed, instead of the 1 percent previously fed. In this trial all eggs laid on Tuesdays and Fridays were broken for the yolk-color comparison between eggs from the two groups. The same number of eggs from both groups were also

TABLE 1.—*The experimental rations used in this experiment*

Constituent	Ration 1	Ration 2	Ration 3[1]
	percent	*percent*	*percent*
Soybean-oil meal	15.5	15.5	15.5
Ground yellow corn	50	50	50
Pulverized oats	20	20	20
Alfalfa leaf meal	5	5	5
Meat and bone scraps	5	5	5
Limestone	2	2	2
Trace mineralized salt	1	1	1
Bonemeal	1	1	1
Vitamin supplement[2]	.5	.5	.5
Achiote seed	—	1	2

[1] Ration 3 was used in trials 3 and 4.

[2] The vitamin supplement was supplied by the Nopco Chemical, Harrison, N. J., through the courtesy of Mr. J. Goldstein.

boiled to determine whether the color from the achiote-seed supplementation was well distributed and heat-resistant. This trial lasted for 49 days.

The fourth trial was more a control experiment than the previous three. Thirty-six laying White Leghorn hens, 6 months of age, were divided into three groups at random. Group 1 was fed a basal ration (table 1) with no achiote-seed supplementation, and served as a control. Groups 2 and 3 received the same basal ration, but with 1 and 2 percent of whole achiote-seed supplementation, respectively. These birds were housed individually in cages. Water was supplied *ad libitum.*

The cross-over experimental design was used. The 3-month experimental period was divided into three 1-month periods. The three groups of hens were rotated in the different experimental feeding treatments at the end of each 1-month period. At the end of the trial all groups have been fed with the three different experimental rations.

The eggs laid were collected and recorded daily. The same number of eggs from all groups were broken and a comparison of yolk coloring was made weekly, employing a panel which consisted of several people.

Data collected in trial 4 were analyzed statistically according to the analysis of variance recommended by Snedecor (4).

RESULTS AND DISCUSSION

THE FIRST THREE TRIALS

Trial 1 lasted only a month. It was discontinued because no difference in yolk coloring between the eggs laid by the two groups was observed.

Trial 2 was discontinued after 2 weeks. The achiote did not mix well with the water, and the reddish color produced by the addition of achiote seed prevailed for only a short time after mixing. Moreover, it was observed that the achiote did not produce or affect the color of the yolks of eggs laid by the achiote-supplemented birds.

TABLE 2.—*Egg production of 2 groups of laying hens fed a ration with and without achiote-seed supplementation*

Item	Results with Group—	
	1	2
Level of achiote seed.....percent	2	0
Birds.....number	12	12
Eggs laid.....do.	481	400
Eggs laid per bird.....do.	40.08	33.34
Egg production.....percent	81.80	68.03

In trial 3 it was observed that the sprinkling of whole achiote seed on the feed given to chickens colored the egg yolks. The coloring effect was observed as early as the third day after the first supplementation of the feed with achiote seed was given to the laying birds.

Several eggs from the control and from the achiote-fed hens were boiled twice weekly. When a comparison of yolk coloring was made results obtained showed definitely that the eggs from the achiote-fed group has deeper yolk coloring than the eggs laid by the controls. When the boiled yolks were cut into halves the coloring produced by the achiote-seed supplementation was evenly distributed.

Some of the boiled eggs, unshelled and marked for identification, were distributed to a panel consisting of students and women secretaries of the College of Agriculture. They were asked which they preferred. All who participated in this panel preferred the deep-color-yolk eggs, the eggs laid by the achiote-fed hens.

The egg production was recorded and summarized in table 2. The addi-

tion of whole achiote seed to the feed given to laying hens not only colored the egg yolks, but also increased egg production tremendously. Egg production was increased 20 to 26 percent in favor of the achiote-fed hens over the control group. The achiote-fed birds were also more consistant in laying eggs. The egg-production percentage was 68.03 for the control group as compared to 81.80 for the experimental group.

TRIAL 4

The fourth trial was conducted to investigate further the egg-stimulatory effect of achiote seed which had been observed during the third trial. Results obtained in trial 4 are summarized in tables 3 and 4. The addition of achiote seed to the ration fed to laying hens resulted in an increased egg

TABLE 3.—*Egg production of laying hens fed a ration without and with 2 levels of achiote seed added as a supplement in trial 4*

Item	Results at level of achiote indicated in percentage		
	0	1	2
Birds.....number	12	12	12
Eggs laid.....do.	632	693	705
Eggs laid.....do.	52.67	57.75	58.75
Egg production.....percent	58.52	64.17	65.28
Defective eggs.....do.	1.10	1.99	1.57
Egg production for:			
Period 1.....number	184	226	236
Period 2.....do.	216	232	233
Period 3.....do.	232	235	236
Total	632	693	705

production. When the analysis of variance was made (table 5), the difference was statistically significant ($P = 0.01$).

Statistical analysis revealed no significant difference in egg production as between periods. No statistical interaction was observed between treatments and periods.

Egg production was consistently higher for the achiote-fed hens, regardless of groupings or periods. An increase in egg production was observed whenever the control birds were shifted to the achiote-supplemented ration. Likewise, changing the feeding regime from the achiote supplemented to a basal ration decreased egg production (table 4).

There was no additive effect of achiote supplementation upon egg production. No difference in egg production was observed between the birds fed the two levels of achiote seed.

The yolk-coloring effect of achiote which was observed in previous trials

was substantiated in this trial. Eggs from the achiote-fed chickens had a deeper yolk color than those from groups receiving a ration with no achiote-seed supplementation. The yolk-coloring effect has been demonstrated in both fresh and boiled eggs.

TABLE 4.—*Egg production of laying hens by treatments and periods in trial 4*

Treatments and periods	Results for hen group—			
	1	2	3	Total
Treatments				
0	184	232	216	632
1-percent achiote	232	226	235	693
2-percent achiote	236	233	236	705
Total	652	691	687	2030
Periods				
1	184	226	236	646
2	232	233	216	697
3	236	232	235	687
Total	652	691	687	2030

TABLE 5.—*Analysis of variance of the egg production of laying hens fed rations without and with 2 levels of achiote-seed supplementation in trial 4*[1]

Variance of source	Degrees of freedom	Sums of squares	Mean square	F value[2]
Total	269	931.41		
Treatments	2	34.05	17.03	5.19**
Periods	2	18.37	9.19	2.80
Treatments × periods	4	23.05	5.76	1.76
Error	261	855.94	3.28	

[1] The daily egg production per group was used in the analysis of variance rather than the individual hen production. Egg production was recorded by groups instead by individual hens.

[2]** Significant at P = 0.01.

SUMMARY AND CONCLUSIONS

The yolk-coloring effect of "achiote" seed was investigated. Hens fed a ration supplemented with whole achiote seed laid eggs with deep-colored yolks. The red-orange color that was observed in the egg yolks of the achiote group persisted in both fresh and boiled eggs.

Ground achiote seed fed to laying hens did not impart color to the egg

yolks when added to the basal ration or when mixed with the drinking water given.

The addition of whole achiote seed to the ration fed to laying hens not only colored the egg yolks more deeply, but also increased egg production. Since Puerto Rican consumers prefer eggs with deeper colored yolks this finding has potential commercial significance.

RESUMEN

Se investigó el efecto de las semillas del achiote *Bixa Crellana* en cuanto a intensificar et color de la yema del huevo. Las gallinas que se alimentaron con una ración complementada con semillas enteras de achiote pusieron huevos cuyas yemas tenían un color más intenso. El color rojo-anaranjado de las yemas de los huevos producidos por el grupo que consumió achiote persistió tanto en los huevos frescos como en los cocinados.

El achiote molido y añadido a la ración, cuando se mezcló con el agua suplida a las gallinas ponedoras, no impartió más color a las yemas.

La adición de semillas enteras de achiote a la ración de las gallinas ponedoras no sólo intensificó el color de las yemas, también aumentó la producción de huevos.

LITERATURE CITED

1. Brown, W. L., The influence of pimiento pigment on the color of the egg yolk of fowls, *J. Biol. Chem.* **122** 655, 1938.
2. Henderson, E. W., and Wilcke, H. L., The effect of ration on yolk colors, *Poultry Sci.* **12**, 266, 273, 1933.
3. Payne, L. F., and Wilhelm, L. A., Egg yolk color as affected by certain xanthopyll-bearing feeds, *Poultry Sci.* **12** 330, 331, 1933.
4. Snedecor, G. W., Statistical Methods, 4th ed., Iowa State College Press, Ames, Iowa, 1950.
5. Titus, H. W., The Scientific Feeding of Chickens, 2nd. ed. Interstate Press, Danville, Ill., 1947.
6. Wilhelm, L. A., and Herman, A., The effect on yolk color of various ingredients of poultry feeds, *Poultry Sci.* **16** 416, 418, 1937.