

## RIBOFLAVIN IN EGGS FROM HENS OF DIFFERENT BREEDS RAISED IN PUERTO RICO\*

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Previous work from this laboratory (1) has indicated a wide variation in the riboflavin content of eggs of unknown history, purchased at different market-places in San Juan, Puerto Rico. Suspecting that the breed of the hens might account at least, in part, for such variability, it was decided to determine this factor through the riboflavin assay of eggs obtained from known breeds raised and fed under the same conditions. The result of this investigation, as well as a discussion of the literature related to riboflavin in eggs, is reported in this paper.

In 1929, Roscoe (2) (3) and co-workers showed that egg yolk and egg white contained vitamin G. Roscoe (4) in 1931, found fresh egg yolk richer in vitamin G than fresh egg white; however, on dried basis he observed that egg white was the richer of the two. In 1933, Kuhn, Gyorgy, and Wagner-Jauregg (5) demonstrated that riboflavin from egg (ovoflavin) had vitamin G activity; later, it was found that riboflavin and vitamin G were the same substance.

In 1934, Von Euler, Adler, and Schlotzer (6) determined, colorimetrically, the riboflavin content of egg yolk, egg white, and whole egg reporting the following values per g. of material: yolk—5.5 ug., white—4.5, and whole egg—4.8 ug. of riboflavin, respectively. In 1939, Bauernfeind and Norris (7) assayed eggs by the fluorometric method. These eggs came from hens receiving a ration of 1 ug. of riboflavin per g. of ration and were found to contain 1.1 ug. of riboflavin per g. of fresh yolk and 0.65 ug. of riboflavin per g. of fresh egg white. Winter and Bethke assayed dried eggs biologically and reported values equivalent to 6.4 to 20.0 ug. of riboflavin per g. of whole dried egg. Using the microbiological procedure, Snell and Strong (8) in 1939, found that fresh egg yolk contained 7.6 ug. and egg white, 3.1 ug., of riboflavin per g. Lepkovsky, Taylor, Jukes, and Almquist, (9) in 1938; Hunt, Winter, and Bethke, (10) in 1939; and Engel, Phillips, and Halpin, (11) in 1940, observed that within certain limits the level of riboflavin in the ration increased the riboflavin in content of the eggs.

In 1940, Norris and Bauerfeind (12) analyzed, fluorometrically, farm eggs from hens receiving various types of egg mash and found 2.39 ug. of

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riboflavin per g. in the yolk, 1.90 ug. in the white, and 2.07 in the whole egg. These same investigators reported the following values in farm eggs from hens receiving breeding mash that generally contained more riboflavin than egg mash: egg—2.85 ug.; egg white—2.29 ug., and whole egg—2.48 ug. of riboflavin per g. In 1941, Snell and Quarles (13) recorded a value of 2.0 ug. of riboflavin per g. for fresh whole egg when assayed by the microbiological procedure. Peterson, Dearstyne, Comstock, and Weldon, (14) in 1945, separated the white and yolk of hard boiled eggs and determined the riboflavin content fluorometrically, as follows: egg yolk per g., 4.07 ug.; egg white per g., 2.67 ug.; in the whole egg the riboflavin content was 3.18 ug. per g.

The following year Jackson, Drake, Slinger, Evans, and Paddock (15) reported the riboflavin content of eggs from twelve different breeds fed a mash containing 3.1 u. of riboflavin. Riboflavin values ranged from 3.71 ug. to 2.91 ug., with an average of 3.36 ug. of riboflavin per g. Among the eggs assayed there were some from New Hampshire and White Leghorn breeds reported to contain 3.15 ug. and 3.65 ug. of riboflavin per g., respectively.

The most recent compilation of the U. S. Department of Agriculture and the National Research Council (1945) (16) gives a riboflavin value of 3.4 ug. per g. of fresh whole egg and about 173 ug. per average egg.

#### MATERIAL AND METHODS

The eggs utilized in this study came from the La Plata Animal Production Sub-station of the Agricultural Experiment Station of the University of Puerto Rico, near Cayey, a town located in the center of the Island at an altitude of 1,233 feet above sea level. Eggs from three different breeds were studied: New Hampshire, White Leghorn, and native. The pollorum reaction of the three breeds were 27.70, 21.07 and 6.84 per cent, respectively. These fowl were kept under identical conditions in the standard chicken house, with mesh wire floors so that there was little access to the feces. The hens received a laying mash having an average of 2.63 (range, 2.60—2.65 ug.) ug. of riboflavin per g. Ration samples were analyzed by the same procedure used for the eggs, which had been collected during an interval of a year by alternating the three breeds.

Analysis was performed within the same week that the eggs were laid, at which time the weight of the whole edible part, as well as the individual weight of both white and yolk, was recorded. Samples were prepared in a Waring blender adding a known amount of water and portions of this mixture used for riboflavin determinations by the microbiological procedure of Snell and Strong (8). Each sample was tested at four different levels (using duplicate tubes at each level). Those results falling outside the

range 0.05 to 0.25 ug. of riboflavin per tube were discarded. If the maximal variation of the remaining values was not over 10 per cent, all values were averaged to give the final result for that particular sample. The results obtained are presented in table 1.

TABLE 1  
*Result of analysis*

Item	Breed		
	New Hampshire	White Leghorn	Native
1. Weight of edible part of egg, g. (ave. 12 eggs)	49.4 (2.0)*	53.2 (1.9)	40.3 (1.8)
2. Per cent yolk (ave. 12 eggs)	36.1 (2.2)	38.3 (1.6)	42.9 (2.2)
3. Per cent white (ave. 12 eggs)	63.9 (2.2)	61.7 (1.6)	57.1 (2.2)
4. ug. riboflavin in yolk (ave. 36, 24 and 24 eggs, respectively)	6.96 (1.13)	6.30 (1.10)	4.96 (0.91)
5. ug. riboflavin in white (ave. 36, 24 and 24 eggs, respectively)	4.20 (0.89)	3.70 (0.85)	2.68 (0.74)
6. ug. riboflavin per g. of whole egg edible portion calculated from 2, 3, 4, and 5	5.19	4.69	3.65
7. ug. riboflavin per g. of whole egg edible portion determined directly (ave. 12 eggs)	5.17 (0.72)	4.70 (0.63)	4.13 (0.63)
8. Average of 6 and 7	5.18	4.70	3.89
9. ug. riboflavin per egg using the average of 6 and 7	256	250	157

\* Numbers in parenthesis are standard deviation.

#### DISCUSSION

The results appearing in table 1 indicate that eggs from native hens contain 3.89 ug. per g. of edible portion. This is less riboflavin than in eggs from New Hampshire and White Leghorn hens kept under the same conditions and fed the same ration. The difference between native eggs and those of hens from other breeds is more pronounced when the total riboflavin

content per egg is compared. This is due to the fact that native eggs contain a considerably less amount of edible matter.

The per gram content of riboflavin for fresh yolk, white, and whole eggs, found in the three breeds studied, was considerably higher than the average reported by other investigators for eggs from continental breeds raised in northern latitudes. Jackson *et al.* (15) found that the riboflavin content of eggs from New Hampshire and White Leghorn hens, raised in Canada and fed mash containing 3.1 ug. of riboflavin per g., was 3.15 and 3.65 ug. per g. of whole fresh egg, respectively, as determined by a modification of the fluorometric procedure of Hudson and Norris (17). These values were more than a microgram below those found for eggs from hens of the same breeds but raised in Puerto Rico. While the values are not strictly comparable, since they were obtained by two different methods of analysis, it may be noted that even the native eggs exhibited a higher content of riboflavin per g. of fresh whole egg than any of those reported by the Canadian investigators.

It is noteworthy that Snell and Strong (15), using the same procedure employed in this laboratory, found that eggs from continental breeds averaged values of 7.1 ug. and 3.1 ug. per g. for fresh yolk and white, respectively. These values are more or less like the ones found by the writers.

#### SUMMARY

The riboflavin content of eggs from New Hampshire, White Leghorn and native hens, raised in Puerto Rico, was found to be 5.18 ug., 4.70 ug., and 3.89 ug. per g. of whole fresh egg, respectively. The hens all received a mash containing an average of 2.63 ug. of riboflavin per g.

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