Physical Characteristics of Araucana Chicken Eggs[1,2]

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ABSTRACT The physical characteristics of whole egg, yolk, albumen, and shell-membrane weights, as well as total dry matter and moisture content, were compared between Araucana and White Leghorn eggs at 1, 3, and 5 months into production. These characteristics were also regressed against their respective whole egg weights in order to make comparisons at equal egg size.

When comparisons were made between eggs from hens of the same reproductive ages, albumen and shell-membrane weights were significantly heavier for the White Leghorns, but there were no differences in whole egg or yolk weights. All weights increased significantly in both breeds with reproductive age except for shell-membrane weights, which showed no change over the 5-month study.

Whole egg dry matter was significantly greater for the Araucana eggs, but there were no differences in whole egg moisture content and in yolk or albumen dry matter. All of these characteristics increased significantly in both breeds with reproductive age except albumen dry matter, which decreased significantly.

On an equal egg weight basis, typical Araucana eggs had 23% more yolk, 9% less albumen, 9% less shell-membrane, 10% more whole egg dry matter, and .6% less moisture than the White Leghorn eggs.

(Key words: Araucana, blue eggs, yolk size, albumen, egg solids, yolk solids, albumen solids)

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INTRODUCTION

With the increase in public concern over nutrition and health, there has been a continuous influx of supposed health foods. One of these claimed health foods is the blue-shelled Araucana egg (Hickman, 1974). Some of the more commonly claimed advantages for use of these eggs are such things as less cholesterol, more protein, and more iron. Hickman (1974) also claimed that Araucana eggs had larger yolks, and in several studies of the nutritive value of these eggs a similar yolk size difference has been observed (Peterson *et al.*, 1978; Somes *et al.*, 1977).

Peterson *et al.* (1978) made comparisons between Araucana eggs collected from numerous farms and commercial white eggs from supermarkets. These eggs, from hens of unknown ages and raised in different environments, were classified by weight, and analysis showed that yolks of Araucana eggs were larger than those from the commercial white eggs of the same weight class.

Somes *et al.* (1977) collected yolk:albumen ratio data over a 2-year period and showed similar yolk:albumen ratios for brown-shelled New Hampshire and white-shelled White Leghorn eggs and significantly higher ratios for blue-shelled Araucana eggs. Unlike the work done by Peterson *et al.* (1978), Somes *et al.* (1977) analyzed eggs from hens of the same reproductive age and raised under the same conditions. Neither Somes *et al.* (1977) nor Peterson *et al.* (1978) controlled for age of hen and egg size.

The purpose of this study was to compare the physical characteristics of Araucana and White Leghorn eggs. Although previous studies compared some physical characteristics of the Araucana and White Leghorn eggs, none have made this comparison controlling both egg size and hen's reproductive age. Characteristics studied were weights of whole egg, yolk, albumen, and shell membrane, percent dry matter of whole egg, yolk, and albumen, and moisture of egg. Comparisons were made between breeds and within breeds over time.

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MATERIALS AND METHODS

The chickens used in this study were White Leghorns and Araucanas from the University of Connecticut farm. The Araucana population was originally obtained from a fancier source and maintained for several years at the university. All birds were hatched and raised on the University of Connecticut farm. Both breeds were housed together and received the same ration. At maturity, three eggs were collected from each of 18 Araucana and 17 White Leghorn hens at each of three time intervals, 30, 90, and 160 days into production. Eggs were collected the day of lay and stored for no longer than 24 hr before being weighed and boiled.

Eggs were hard cooked prior to separation of yolk and albumen in order to facilitate the separation and drying procedure and to have them in a form suitable for future chemical analyses. Eggs were covered with water at room temperature, slowly brought to a boil (approximately 20 min) and boiled for 8 min. They were then promptly removed from the boiling water and allowed to cool at room temperature. Once cooled, they were then refrigerated for not more than 3 days before being shelled. Yolks and albumens were separated, and special attention was given to complete removal of albumen from the shells. Both components were weighed, sliced, and oven dried at 77 C to a constant weight (approximately 18 hr) and then reweighed. Shell plus membrane weights were obtained by difference.

This procedure resulted in whole egg, yolk, albumen, and shell plus membrane weights, as well as the dry matter content of yolk and albumen. The yolk, albumen, and shell plus membrane weights from each breed were regressed against their respective whole egg weights, and these regression lines were tested for significant differences by analysis of covariance. Dry matter content and moisture were treated in the same manner. The weights of component parts and dry matter were also analyzed for significant changes associated with time in production. This analysis was done using a one-way, two-staged nested analysis of variance and New-

TABLE 1. *Comparisons of mean weights of Araucana and White Leghorn whole eggs and their cooked component parts*

Characteristics	Breeds	Age of production[1] Month 1	Month 3	Month 5
		(g)		
Whole egg weights	Araucana	$46.14^{a,x}$ (3.37)	$49.99^{b,x}$ (3.09)	$52.96^{c,x}$ (2.79)
	White Leghorn	$52.78^{a,x}$ (4.32)	$57.63^{b,x}$ (3.83)	$60.61^{b,x}$ (3.27)
Wet yolk weights	Araucana	$13.86^{a,x}$ (1.52)	$16.06^{b,x}$ (1.31)	$17.78^{c,x}$ (1.02)
	White Leghorn	$13.18^{a,x}$ (1.81)	$16.39^{b,x}$ (1.59)	$17.54^{c,x}$ (1.81)
Wet albumen weights	Araucana	$26.04^{a,x}$ (2.09)	$27.85^{b,x}$ (2.15)	$29.22^{c,x}$ (2.20)
	White Leghorn	$32.43^{a,y}$ (2.53)	$34.06^{b,y}$ (3.51)	$36.25^{c,y}$ (2.48)
Shell + membrane weights	Araucana	$6.23^{a,x}$ (.64)	$6.08^{a,x}$ (1.23)	$5.94^{a,x}$ (.77)
	White Leghorn	$7.17^{a,y}$ (1.15)	$7.17^{a,y}$ (1.25)	$6.77^{a,y}$ (1.17)

^{a,b,c}Within breeds, unlike superscript letters denote significant differences (P<.05).

^{x,y}Between breeds within months within characteristics, unlike superscript letters denote a significant difference (P<.05).

[1] Means ± SD.

FIG. 1. Regressions of wet yolk weight on whole egg weight. Araucana b = .35, r = .84 (P<.01); White Leghorn b = .37, r = .84 (P<.01).

man-Keuls pair comparisons (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

A comparison of whole egg weights between Araucanas and White Leghorns at 1, 3, and 5 months into production showed that White Leghorn hens tended to lay an overall heavier egg than that laid by Araucana hens (Table 1). This difference, however, was only significant at the 10% level. As might have been expected, there was an increase in egg weight of both Araucana and White Leghorn eggs with time into lay (P<.01).

A comparison of cooked yolk weights between eggs from the two populations showed no differences between breeds over the three time intervals, demonstrating that these hens, when of the same reproductive age and regardless of whether White Leghorn or Araucana, laid eggs with equal size yolks. While egg weight data showed that the White Leghorn hens tended to lay heavier eggs than the Araucana hens at each of the three reproductive ages, the increased egg weight was not due to increased yolk weight. Thus, when comparing eggs of equal size from Araucana and White Leghorn hens of the same reproductive age, the yolk: whole egg ratio is higher for the Araucana egg, thus confirming one of the popularized attributes of the Araucana egg, that they have larger yolks. Comparisons of mean wet yolk weights within breeds demonstrate a significant (P<.01) increase in yolk weights for eggs of both breeds over time, which accounts for approximately 50% of the increase in whole egg weight (Table 1). Regressions of wet yolk weights against whole egg weights for Araucana and White Leghorn eggs are shown in Figure 1. The slopes of the two regression lines are equal, and the Araucana eggs have significantly (P<.01) larger yolks at any given egg weight. At an egg weight of 50 g, the typical Araucana egg had an average of 23% more yolk than White Leghorn eggs of the same size.

A comparison of cooked albumen weights from eggs of the two breeds showed that the overall differences between breeds was significant (P<.05) and that the difference within breeds over time was significant (P<.01) (Table 1). This difference in albumen weight between breeds reflects the difference in whole egg weights between breeds. For the purpose of comparison at a single egg weight, wet albumen was regressed against whole egg weight (Fig. 2). At an egg weight of 50 g, typical Araucana eggs were shown to have 9% less albumen than White Leghorn eggs of the same weight.

The larger White Leghorn eggs were shown to have significantly (P<.01) more shell plus membrane than Araucana eggs (Table 1). The

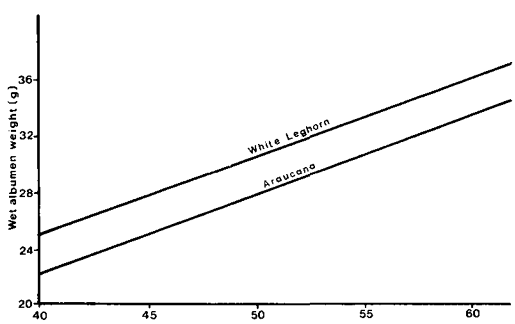

FIG. 2. Regressions of wet albumen weight on whole egg weight. Araucana b = .54, r = .90 (P<.01); White Leghorn b = .53, r = .82 (P<.01).

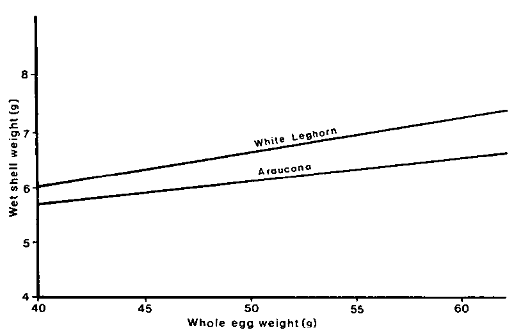

FIG. 3. Regressions of wet shell plus membrane weight on whole egg weight. Araucana b = .04, r = .19 (P<.05); White Leghorn b = .07, r = .29 (P<.01).

two regression lines (shell plus membrane/ whole egg weight) had equal slopes and the White Leghorn regression line was significantly ($P<.01$) higher than that of the Araucana (Fig. 3). At an egg weight of 50 g, typical Araucana eggs averaged 9% less shell plus membrane. Despite the fact that whole egg weights were found to increase significantly with reproductive age, shell plus membrane weights within breeds did not change significantly over the 5-month period. A significant increase in whole egg weight over time was not accompanied by a significant increase in shell plus membrane weight, thus resulting in heavier eggs with presumably thinner shells.

The whole egg dry matter content between breeds varied significantly. A comparison of the percent of whole egg dry matter (yolk and albumen) over the three time periods showed Araucana eggs to contain a significantly ($P<.05$) higher percent dry matter than eggs from White Leghorn hens (Table 2). Although the analysis showed a significant within-breed increase in the percent whole egg dry matter, this increase is only between the first and third months of collection (Table 2). The regression of whole egg dry matter on whole egg weight showed that the slopes of the regression lines were equal, and the Araucana eggs had a significantly ($P<.05$) higher dry matter content than White Leghorn eggs of a similar weight. At an egg weight of 50 g, typical Araucana eggs had 10.4% more dry matter than the White Leghorn eggs of the same weight (Fig. 4).

Despite the fact that at each of the three collection periods Araucana eggs tended to have less moisture, an analysis of the percent whole egg moisture over the three time periods showed no overall differences between breeds (Table 2). The analysis did show a significant increase in whole egg moisture with the increases of the hen's age, which was primarily due to an increase from the 3rd to the 5th months. A comparison of linear regressions of total egg moisture and whole egg weight showed White Leghorn eggs to be significantly higher ($P<.01$) in total egg moisture than Araucana eggs of a similar weight (Fig. 5). At

TABLE 2. *Comparisons of percent moisture and dry matter of cooked Araucana and White Leghorn eggs*

Characteristics	Breeds	Age of production[1]		
		Month 1	Month 3	Month 5
		(%)		
Whole egg dry matter (yolk + albumen)	Araucana	$25.81^{a,x}$ (.92)	$26.64^{b,x}$ (.83)	$26.58^{b,x}$ (.59)
	White Leghorn	$24.45^{a,y}$ (1.74)	$25.38^{b,y}$ (1.35)	$25.13^{b,y}$ (1.00)
Moisture (yolk + albumen)	Araucana	$64.11^{a,x}$ (1.30)	$64.41^{ab,x}$ (2.13)	$65.12^{b,x}$ (1.34)
	White Leghorn	$65.49^{a,x}$ (2.19)	$65.48^{ab,x}$ (2.17)	$66.59^{b,x}$ (2.12)
Yolk dry matter	Araucana	$46.93^{a,x}$ (5.08)	$49.45^{b,x}$ (1.37)	$48.93^{b,x}$ (.63)
	White Leghorn	$47.74^{a,x}$ (2.84)	$47.99^{a,x}$ (1.07)	$48.56^{a,x}$ (.67)
Albumen dry matter	Araucana	$14.24^{a,x}$ (1.14)	$13.48^{b,x}$ (.88)	$12.98^{c,x}$ (.92)
	White Leghorn	$14.73^{a,x}$ (1.18)	$14.49^{a,x}$ (.18)	$13.82^{b,x}$ (.71)

[a,b,c]Within breeds, unlike superscript letters denote significant differences ($P<.05$).

[x,y]Between breeds within months within characteristics, unlike superscript letters denote a significant difference ($P<.05$).

[1]Means ± SD.

FIG. 4. Regressions of whole egg dry matter (yolk and albumen) on whole egg weight. Araucana b = .28, r = .95 (P<.01); White Leghorn b = .26, r = .90 (P<.01).

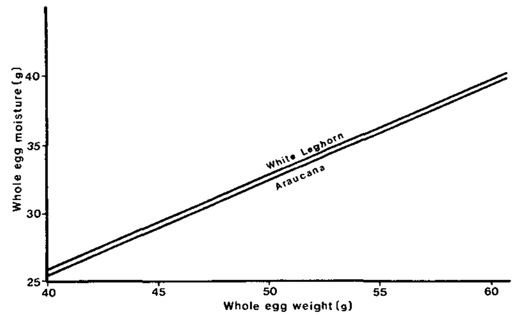

FIG. 5. Regressions of whole egg moisture (yolk and albumen) on whole egg weight. Araucana b = .68, r = .96 (P<.01); White Leghorn b = .68, r = .94 (P<.01).

an egg weight of 50 g, the typical Araucana egg had approximately .6% less moisture than a White Leghorn egg of the same weight.

Linear regressions of percent dry matter of yolk on whole egg weight for Araucana and White Leghorn eggs had unequal variances, and therefore, could not be tested. A one-way analysis of variance showed no overall breed difference but did show a significant increase in the percent dry matter of yolk with age of hen (Table 2).

As was the case with yolk percent dry matter, the linear regression lines of albumen dry matter on whole egg weight could not be tested due to unequal variances; however, an analysis of variance showed no overall significant differences in albumen dry matter between breeds. The analysis did show a significant (P<.05) overall decrease in albumen dry matter with age of the hen.

These data show that the physical characteristics of the Araucana eggs that were measured follow the same change trends as those of the White Leghorn over the five month test period. However, there is a distinct breed difference relative to the proportion of component parts of the egg. This difference appears to be due to reduced albumen secretion associated with the Araucana breed in as much as there were no yolk size differences. A similar difference has also been reported by others when Araucana eggs were compared with sex-link eggs (Somes *et al.*, 1977) and commercial white eggs (Peterson *et al.*, 1978). This difference in egg construction would appear to be characteristic of the Araucana breed as it now has been reported in several different sources of the breed and was mentioned by Hickman (1974). When compared on an equal egg weight basis, as in this study, the Araucana egg had 23% more yolk, 9% less albumen, 9% less shell plus membrane, and 10% more whole egg dry matter. These differences, although apparent in other studies, did not reveal their true magnitude.

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