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Egg Characteristics as Affected by Egg Weight in New Hampshire and White Leghorn Chickens

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AN EQUAL number of 1600 eggs was selected from each flock of New Hampshires and White Leghorns. Eggs within each breed were divided according to weight into five groups of five grams intervals. Group 1 involved extremely large eggs, while group 5 involved extremely small eggs. Breed and group of eggs differentes for egg shape index, traits of egg contents, traits of shell quality and hatch weight were statistically analyzed by least square analysis of variance and Duncan multiple range tests. Phenotypic relationships among these traits were, also, calculated.

The tabulated results indicate that breeds have nearly similar egg shape. Traits of egg contents, however, showed that breeds are significantly different in amount of yolk and shell but not in albumen weight. Breeds are, also, significantly different in most traits of egg shell quality; except those of shell thickness. percent shell thickness to egg weight and percent shell weight loss to egg weight loss. The comparable values of hatch weight and its percentage demonstrate that they are of a breed characteristic and are inherited.

There is a trend of increasing index of egg shape as the egg decreased in weight. Negative relationships are obtained between egg shape and each of egg weight, its three components and hatchability percentage.

Small eggs have higher percentage of yolk and lower percentage of albumen. Shell percentage, however, is nearly constant with different egg weights. Positive correlation coefficients are computed between each trait of egg contents and hatchability percentage.

Groups of eggs failed to show significant differences in egg specific gravity, indicating that egg weight is not responsible for the change in this trait. Percentage of shell thickness, however, is decreased with increasing egg and shell weights. The positive associations between egg specific gravity and each of shell weight, shell thickness and hatchability indicate that eggs with high specific gravity, shell weight and thickness have better chance to hatch.

There is a tendency that large eggs lose more in egg weight, shell weight and shell thickness during the first two weeks of incubation than small eggs. The negative relationships between percentage of shell thickness and each weight loss of egg and shell demonstrate that these losses are increased with decreasing percentage of shell thickness.

Percent hatch weight is not found to be in direct proportion to its respective egg weight. Negative associations are estimated between percent hatch weight and percent albumen weight. Positive relationships, however, are evaluated between percent hatch weight and each percent of yolk weight, shell thickness and losses of egg and shell weights. These direct proportions indicate a better efficiency of embryonic utilization of the nutrients of the egg.

There have been several studies of possible relationships between shape of eggs and percent hatchability of fertile egg, while others have shown no statistically significant association between the two have shown no statistically significant association between the two traits. Jull and Haynes (1925), Hays and Sumbardo (1927) and Hutt (1938) stated that egg shape did not affect hatching quality. Olsen and Haynes (1949), Skoglund (1951), Brunson and Godfrey (1952), however, found that extreme shapes did not hatch as well as those with intermediate indexes.

The importance of the amount of albumen on the hatching quality of eggs, on the other hand, was studied by several investigators who found a low, but significant, negative correlation between weight of total albumen per egg and hatchability .This relationship is closely similar to that between egg weight and hatchability (Godfrey, 1936 and Scott and Warren, 1941). Little evidence is available tending to demonstrate that yolk qualities play a role in hatchability. No relationship was found between yolk weight and hatchability (Rudy and Marble, 1939).

Godfrey and Olsen (1937) and Quinn *et al.* (1945) studied egg shell characters and concluded that egg shell quality, as expressed by the loss of weight of eggs during the first two weeks of incubation, is a genetic trait. The incomplete dominance of small to higher weight loss involves at least one sex linked and one autosomal factors.

Some publications indicated that eggs with lower specific gravity and shell thickness lose more weight and hatch less than eggs with higher specific gravity and shell thickness. Godfrey and Jaap (1949) found negative correlation between 14-day weight loss both specific gravity and shell thickness. Perek and Snapir (1970), Philip and Washburn (1974) and Malik *et al.* (1976) reported positive correlation coefficients between specific gravity and shell thickness and between shell thickness and egg weight.

In the earlier phases of research concerning selection for growth rate the possibility of utilizing egg weight as an index of growth rate was intensively studied. Halbersleben and Mussehl (1922), Jull and Quinn (1925) and Upp (1928) reported that egg weight and chick weight at hatching time were highly correlated and that hatch weight from either large or small eggs ranged from 64-68% of the unincubated egg weight. They, also, emphasized that subsequent growth rate was independent of egg size and chick size at hatching. Bray and Iton (1962), however, found no difference in percent hatch weight (71%) between strains which differed drastically in egg size and growth rate.

This study is carried out to determine the effect of egg weight on egg shape, traits of egg contents, traits of shell quality and on hatch weight; as well as to estimate the phenotypic relationships between these traits in New Hampshire and White Leghorn chickens.

Material and Methods

An equal number of 1600 eggs with non-cracked clean shells was selected on day of lay from each flock of New Hampshires and White Leghorns. The pullets were in their initial year of production.

The day after laying, all of the selected eggs within each breed were individually weighed to the nearest gram and divided into five groups of five grams intervals ranging from 74 to 50 g. Groups of eggs were designated in numbers where group 1 involved extremely large eggs while group 5 involved extremely small eggs. Eggs were then incubated at one time in a forced incubator.

Prior to incubation, a sample of 20 eggs from each group within each breed was randomly taken to measure the chosen traits of egg contents and shell quality.

Index of egg shape, estimated as the maximum width of the egg x 100/length of the egg, was determined. The measurements were taken with a vernier caliper to the nearest millimeter.

Specific gravity of the whole egg was estimated at room temperature by immersing each egg in a series of salt solutions ranging in concentration from 1.055 to 1.120 degrees with a difference of 0.005 degrees between successive solutions. The value was taken from the concentration in which the egg barely floated beneath the surface (Philip *et al.*, 1974 and Roland and Harms, 1974).

After breaking the egg, the albumen and yolk were placed in a small beaker. The albumen was carefully poured from the beaker leaving the yolk, then each was weighed separately to the nearest tenth of a gram. Albumen to yolk ratio was, also, estimated. Shell of each broken egg with adhering white was weighed wet. Shell thickness with shell membranes was measured with a vice caliper to the nearest 0.01 mm at the equatorial plane (Bayfield, 1966 and Malik *et al.*, 1976).

At the first 14 days of incubation a sample of 12 eggs from each group within each breed was randomly taken to evaluate each loss in egg weight, shell weight and shell thickness. Shell thickness was also recorded to ascertain its loss at hatching.

Hatchability percentage was estimated for each group of eggs. To facilitate testing significance of differences between groups of eggs for this trait; each group within each breed was randomly divided, prior to incubation, into 12 subgroups of 24 eggs each.

1074 New Hampshire and 938 White Leghorn hatched chicks were individually weighed to the nearest gram. The subgroup averages of hatch weight were utilized in the statistical analysis.

The methods of Least Square Analysis of Variance (Harvey, 1960) and Duncan Multiple Range Tests (Duncan, 1955) were used for testing significance of breed and group differences of the studied traits. Phenotypic correlation coefficients between these traits were, also, computed. Symbols and description of the studied traits are presented in Table 1.

Table 1 : Symbols and description of the studied traits.

Symbols	Description of the traits
	Traits of egg contents
EW	Egg weight in grams.
ESI	Egg shape index in percent.
AW	Albumen weight in grams.
YW	yolk weight in grams.
SW	Shell weight in grams.
AW/EW	Albumen weight to egg weight in percent.
YW/EW	Yolk weight to egg weight in percent.
SW/EW	Shell weight to egg weight in percent.
AW/YW	Albumen weight to yolk weight ratio.
	Traits of shell quality
ESG	Egg specific gravity.
ST	Shell thickness in millimeter.
ST/EW	Shell thickness to egg weight in percent.
ST/SW	Shell thickness to shell weight in percent.
EWL	Egg weight loss in grams.
EWL/EW	Egg weight loss to egg weight ir percent.
SWL	Shell weight loss in grams.
SWL/EW	Shell weight loss to egg weight in percent.
SWL/SW	Shell weight loss to shell weight in percent.
SWL/EWL	Shell weight loss to egg weight loss in percent.
STL(1)	Shell thickness loss at 14 days of incubation in percent.
STL(2)	Shell thickness loss at hatching in percent.
	Traits related to egg contents and shell quality
H %	Hatchability percentage.
HW	Hatch weight in grams.
HW/EW	Hatch weight to egg weight in percent.

Results and Discussion

Least square means along with their standard error (Tables 2 and 5) and mean square values (Tables 3 and 6) are presented for egg shape index, trains of egg contents, traits of egg shell quality and hatch weight for different groups of New Hampshire and White Leghorn eggs. Tables 4, 7 and 8 present the phenotypic correlation coefficients between these traits.

I. *Egg shape index*

The tests of significance for mean and mean square values (Tables 2 and 3) showed that the two breeds are not different from each other in egg shape. Group 1 of extremely large eggs is the only group to show significant differences comparable to the other groups of eggs. Though, there is a trend of increasing index of egg shape as the egg decreased in weight. Large eggs are, therefore, relatively long and narrow, small eggs are more spherical. This trend is confirmed by the highly significant negative relationships between egg shape and each of egg weight, albumen weight, yolk weight and shell weight (Table 4). Egg shape is, also, negatively correlated with hatchability percentage (— 0.576). Thus, eggs with high amounts of egg contents tend to be elongated and hatch less compared to ones that are more spherical. The ratio of egg surface to egg volume as related to heat transfer in the incubator may have a relationship in the physical conditions of incubation which influence hatchability. Egg shape may, therefore, be considered in selection programme to obtain an optimal shape for higher hatchability percentage. These results are in agreement with those of Singh and Dsai (1962), Varadarajulu *et al.* (1966), Kumar and Kapri (1967) and Maclaury *et al* .(1973).

II. *Traits of egg contents*

Breeds showed to be significantly different in amounts of yolk and shell but not in albumen weight. New Hampshire eggs have relatively more yolk and less albumen and shell. This criterium is nearly reversed with eggs of White Leghorn (Tables 2 and 3).

The highly significant differences between groups of eggs indicate that large eggs have more amounts of albumen, yolk and

TABLE 2. Least means (± S.E.) of traits of egg contents in different groups of New Hampshire (NH) and White Leghorn (WL) eggs.

Classification	N	EW	ESI	AW	YW	SW	AW/EW	YW/EW	SW/EW	AW/YW
Overall mean	200	61.90 ± 0.11	73.38 ±0.25	34.76 ±0.16	20.27 ±0.12	6.86 ±0.04	56.15 ±0.21	32.86 ±0.20	11.04 ±0.06	1.74 ±0.02
Breeds										
NH	100	61.88 ±0.15a	73.45 ±0.36a	34.57 ±0.23a	20.59 ±0.17a	6.78 ±0.05a	55.77 ±0.30a	33.39 ±0.28a	10.94 ±0.08a	1.69 ±0.02a
WL	100	62.09 ±0.15a	73.31 ±0.36a	34.95 ±0.23a	19.94 ±0.17b	6.93 ±0.05b	56.53 ±0.30a	32.32 ±0.28b	11.14 ±0.08a	1.78 ±0.02b
Groups of eggs										
1	40	71.55 ±0.24a	71.70 ±0.57a	41.33 ±0.37a	22.30 ±0.27a	7.93 ±0.08a	57.72 ±0.47a	31.20 ±0.45a	11.08 ±0.13a	1.87 ±0.04a
2	40	66.80 ±0.24b	73.37 ±0.57b	37.88 ±0.37b	21.38 ±0.27b	7.60 ±0.08b	56.65 ±0.47a	31.98 ±0.45a	11.37 ±0.13a	1.79 ±0.04a
3	40	61.35 ±0.24c	73.23 ±0.57b	34.60 ±0.37c	19.40 ±0.27c	6.78 ±0.08c	57.57 ±0.47a	31.63 ±0.45a	11.05 ±0.13a	1.84 ±0.04a
4	40	57.55 ±0.24d	74.49 ±0.57b	31.48 ±0.37d	19.68 ±0.27c	6.40 ±0.08d	54.66 ±0.47b	34.21 ±0.45b	11.12 ±0.13a	1.62 ±0.04b
5	40	52.68 ±0.24e	74.12 ±0.57b	28.53 ±0.37e	18.58 ±0.27d	5.58 ±0.08e	54.16 ±0.47b	35.27 ±0.45b	10.57 ±0.13b	1.55 ±0.04b

Means within a trait within a classification followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at $P < 0.05$.

shell. Significant positive correlation coefficients are, therefore, found between egg weight and each weight of albumen, yolk and shell (Table 4). However, when these contents are expressed at percentages to egg weight, small eggs have higher percentage of yolk (r = — 0.501) and lower percentage of albumen (r = 0.442) than large eggs. Albumen to yolk ratio is, therefore, lowered with decreasing egg weight (r = 0.484). Shell percentage is nearly constant (about 11%) with different egg weights.

Table 3 : Mean square values of traits of egg contents in different groups of New Hampshire and White Leghorn eggs.

S.O.V.	D.F.	EW	ESI	AW	YW	SW	AW/EW	YW/EW	SW/EW	AW/YW
Breeds	1	2.21	1.01	7.22	21.13++	1.13+	28.98	56.79++	2.14	0.41++
Groups of eggs	4	2214.22++	46.25++	1024.95++	93.26++	35.52++	109.03++	126.58++	3.35++	0.77++
Residual	194	2.30	13.00	5.34	2.93	0.27	8.79	8.07	0.69	0.05

+ : Significant at the 5 % level.

++ : Significant at the 1 % level.

Table 4 : Phenotypic correlation coefficients between traits of egg contents.

	EW	ESI	AW	YW	SW	AW/EW	YW/EW	SW/EW	AW/YW
ESI	-0.226++								
AW	0.940++	-0.180++							
YW	0.627++	-0.174+	0.351++						
SW	0.879++	-0.190++	0.610++	0.508++					
AW/EW	0.442++	-0.043	0.704++	-0.378++	0.335++				
YW/EW	-0.501++	0.071	-0.735++	0.356++	-0.490++	-0.954++			
SW/EW	0.221++	-0.014	0.169+	0.058	0.657++	-0.019	-0.458++		
AW/YW	0.484++	-0.059	0.729++	-0.367++	0.443++	0.972++	-0.987++	0.135	
H %	-0.177+	-0.576++	0.337++	0.537++	0.405++			0.233++	0.106

+ : Significant at the 5 % level.

++ : Significant at the 1 % level.

The significant positive relationship between traits of egg contents indicate that an increase in amount of one component is associated with simultaneous increase in each amount of the other components (Table 4). However, the percentage of a component to egg weight is negatively correlated with each percentage of the other components. Thus, the increase in yolk percentage will be on the expense of each of albumen percentage (r = — 0.954), shell percentage (r = — 0.458) and albumen to yolk ratio (r = — 0.987). An optimal ratio for each trait of egg contents is, therefore, needed so that an egg will have a better chance to produce a hatched chick. The estimated correlation coefficients between hatchability percentage and each weight of albumen (0.357), yolk (0.537) and shell (0.405) indicate that hatchability percentage is increased when large amounts of nutrients are deposited in the egg.

II. *Traits of egg shell quality*

Breeds showed highly significant differences in most traits of shell quality except those of shell thickness, percentage of shell thickness to egg weight and percentage of shell weight loss to egg weight loss (Tables 5 and 6). Erasmus (1954), Fikry Amer (1972) and Philip and Washburn (1974) reported significant differences among their breeds regarding the studied traits of egg shell quality.

Groups of eggs failed to show significant differences in whole egg specific gravity. Non significant relationship is obtained between egg weight and egg specific gravity (Table 7), indicating that egg weight is not responsible for the change in this trait. Similar results are found by Roland and Harms (1974).

Large eggs have more shell weight and thickness than small eggs (Tables 2, 5 and 6). Highly significant positive associations are, therefore, found between egg weight and shell weight (0.900), between egg weight and shell thickness (0.777) and between shell weight and shell thickness (0.736). However, when shell thickness is expressed as percentage to each weight of egg and shell, shell thickness is found to decrease with increasing egg and shell weights. Negative correlation coefficients are, therefore, found among these traits (Table 7).

Table 5 : Least square means (± S.E.) of traits of egg shell quality in different groups of New Hampshire (NH) and White Leghorn (WL) eggs.

Classification	N	ESG	ST	ST/EW	ST/SW	N	EWL	EWL/EW	SWL
Overall mean	200	1.097 ±0.001	36.40 ±0.20	0.591 ±0.003	5.38 ±0.03	120	5.21 ±0.08	[illegible] ±0.12	1.01 ±0.03
Breeds									
NH	100	1.089 ±0.001a	36.63 ±0.29a	0.595 ±0.005a	5.47 ±0.05a	60	5.72 ±0.11a	9.00 ±0.18a	1.14 ±0.04a
WL	100	1.104 ±0.001b	36.17 ±0.29a	0.587 ±0.005a	5.28 ±0.05b	60	4.70 ±0.11b	7.37 ±0.18b	0.88 ±0.04b
Groups of eggs									
1	40	1.096 ±0.002a	40.03 ±0.45a	0.560 ±0.008a	5.07 ±0.08a	24	7.71 ±0.17a	10.73 ±0.28a	1.75 ±0.06a
2	40	1.099 ±0.002ab	37.80 ±0.45b	0.568 ±0.008a	4.99 ±0.08ad	24	6.38 ±0.17b	9.54 ±0.28b	1.38 ±0.06b
3	40	1.098 ±0.002a	35.25 ±0.45c	0.575 ±0.008a	5.22 ±0.08ac	24	5.58 ±0.17c	8.98 ±0.28b	0.90 ±0.06c
4	40	1.097 ±0.002a	34.95 ±0.45cd	0.607 ±0.008b	5.47 ±0.08b	24	3.42 ±0.17d	6.02 ±0.28c	0.58 ±0.06d
5	40	1.094 ±0.002ac	33.98 ±0.45d	0.645 ±0.008c	6.14 ±0.08c	24	2.96 ±0.17e	5.66 ±0.28c	0.46 ±0.06d

Means within a trait within a classification followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at $P < 0.05$.

The significant relationships between specific gravity and each of shell weight 0.237, shell thickness 0.266 and hatchability percentage 0.182 indicate that eggs with high specific gravity, shell weight and shell thickness have better chance to hatch. In addition, it seems that egg specific gravity is a characteristic of both shell weight and shell thickness. Similar results are reported by Perek and Snapir (1970), Cooper and Johnston (1974), Philip and Washburn (1974) and Malik *et al.* (1976).

Table 5 cont.: Least square means (±S.E.) of traits of egg shell quality in different groups of New Hampshire (NH) and White Leghorn (WL) eggs.

Classification	N	SWL/EW	SWL/SW	SWL/IWL	STL(1)	STL(2)	H %	HW	HW/EW
Overall mean	120	1.57 ±0.04	14.04 ±0.34	18.97 ±0.49	2.65 ±0.07	6.91 ±0.10	69.61 ±1.03	40.70 ±0.06	65.77 ±0.11
Breeds									
NH	60	1.77 ±0.06a	15.98 ±0.48a	19.45 ±0.70a	3.08 ±0.10a	6.65 ±0.14a	74.59 ±1.46a	41.76 ±0.08a	67.09 ±0.15a
WL	60	1.37 ±0.06b	12.11 ±0.48b	18.50 ±0.70a	2.22 ±0.10b	7.17 ±0.14b	64.63 ±1.46b	39.65 ±0.08b	64.46 ±0.15b
Groups of eggs									
1	24	2.44 ±0.09a	21.79 ±0.75a	22.72 ±1.10a	4.63 ±0.16a	8.54 ±0.22a	61.12 ±2.31a	47.23 ±0.13a	65.73 ±0.24a
2	24	2.06 ±0.09b	18.11 ±0.75b	21.63 ±1.10d	3.21 ±0.16b	7.17 ±0.22b	71.70 ±2.31b	43.72 ±0.13b	65.49 ±0.24a
3	24	1.44 ±0.09c	12.90 ±0.75c	15.74 ±1.10b	2.13 ±0.16c	6.25 ±0.22c	72.39 ±2.31b	40.58 ±0.13c	65.32 ±0.24a
4	24	1.02 ±0.09d	9.05 ±0.75d	18.15 ±1.10b	1.50 ±0.16d	5.71 ±0.22e	74.76 ±2.31bc	37.27 ±0.13d	65.75 ±0.24a
5	24	0.89 ±0.09d	8.38 ±0.75d	16.63 ±1.10b	1.79 ±0.16cd	6.88 ±0.22b	68.07 ±2.31bd	34.73 ±0.13e	66.58 ±0.24b

Means within a trait within a classification followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at $P < 0.05$.

There is a trend that large eggs lose more egg weight, shell weight and shell thickness during the first 14 days of incubation than small eggs (Tables 5 and 6). The comparable loss percentages of extremely large eggs with extremely small eggs are 10.73 vs. 5.66% in egg weight, 21.79 vs. 8.38% in shell weight and 4.63 vs. 1.79% in shell thickness. The rate of loss in shell thickness is largely increased during the last week of incubation to reach, on average, between 8.54 to 5.71% at hatching time. Negative correlation coefficients are estimated between percentages of shell thickness and each loss of egg weight and shell weight

Table 6 : Mean square values of traits of egg shell quality in different groups of New Hampshire and White Leghorn eggs.

S.O.V.	D.F.	ESI	ST	ST/EW	ST/SW	D.F.	EWL	EWL/EW	SWL
Breeds	1	0.0116 ++	10.58	0.0026	1.846 ++	1	31.01 ++	0.797 ++	2.002 ++
Groups of eggs	4	0.0002	244.06 ++	0.0497 ++	8.538 ++	4	96.15 ++	1.199 ++	7.075 ++
Residual	194	0.0001	8.15	0.0023	0.236	114	0.69	0.018	0.092

Table 6 cont. :

S.O.V.	D.F.	SWL/EW	SWL/SW	SWL/EWL	EWL(1)	SWL(2)	H %	HE	HW/EW
Breeds	1	0.0049 ++	44.83 ++	2.70	0.0225 ++	0.0080 +	2975.05 ++	134.20 ++	206.34 ++
Groups of eggs	4	0.0107 ++	80.97 ++	22.61 ++	0.0393 ++	0.0277 ++	678.72 ++	594.77 ++	5.60 ++
Residual	114	0.0002	1.35	2.92	0.0007	0.0012	127.69	0.42	1.39

+ : Significant at the 5 % level.

++ : Significant at the 1 % level.

(Table 7). Thus, as the percentage of shell thickness is decreased, losses in both egg and shell weights are increased. More loss in egg weight due to excessive rate of evaporation is, therefore, expected as the shell becomes more thinner and porous. However, the relation of shell porosity to moisture loss by evaporation tends to disappear at optimal humidity levels, and egg weight loss will, therefore, become less variable (Mueller and Scott, 1940, Quinn *et al.*, 1945 and Godfrey and Jaap, 1949).

The estimates of relationship among the different traits of shell quality and those between them and hatchability (Table 7), indicate that these traits are interdependent and play an important role on hatchability.

Table 7 : Phenotypic correlation coefficients between traits of egg shell quality.

	EW	SW	ESG	ST	ST/EW	ST/SW	EWL	SWL	STL(1)	STL(2)
SW	0.900++									
ESG	0.091	0.237++								
ST	0.777++	0.736++	0.266++							
ST/EW	-0.577++	-0.405++	0.176+	0.256++						
ST/SW	-0.623++	-0.762++	-0.111	-0.033	0.749++					
EWL	0.890++	0.767++	0.388++	0.738++	-0.741++	-0.698++				
SWL	0.855++	0.799++	0.319++	0.770++	-0.563++	-0.635++	0.857++			
STL(1)	0.748++	0.608++	-0.577++	0.779++	0.606++	0.580++	0.753++	0.796++		
STL(2)	0.471++	0.501++	-0.208++	0.658++	0.676++	0.680++	0.371++	0.456++	0.540++	
H %	-0.177+	0.405++	0.182++	-0.077	-0.690++	-0.675++	-0.065	-0.047	-0.783++	-0.795++

+ : Significant at the 5 % level.

++ : Significant at the 1 % level.

It seems that factors related to specific gravity such as shell weight, thickness, porosity, matrix structure and the rate of absorption of shell minerals may be more important in determining the chance of the egg to hatch. Also, eggs will hatch if the moisture loss is within a certain range provided all other factors are equal, but if the range of moisture loss is exceeded at either extreme the chances of the egg to hatch are greatly lessened.

IV. *Hatch weight*

Results presented in Tables 5 and 6 indicate that New Hampshire's hatch weight and its percent of the unincubated egg weight are significantly higher than those of White Leghorn (41.76 vs. 39.65 g and 67.09 vs. 64.09%, respectively). This demonstrates that these two traits are of a breed characteristic and are inherited.

TABLE 8. Phenotypic correlation coefficients between hatch weight and different traits of egg contents and shell quality.

	HW	HW/EW
EW	0.881++	- 0.162
AW	0.942++	
YW	0.910++	
SW	0.956++	
AW/EW		- 0.327++
YW/EW		0.415++
SW/EW		- 0.303++
ST/EW		0.207+
ST/SW		0.347++
EWL/EW		0.201+
SWL/EW		0.179+
SWL/SW		0.217+

+ : Significant at the 5 % level.

++ : Significant at the 1 % level.

The effect of egg weight on hatch weight is shown to be highly significant (Tables 5 and 6). The estimated relationships between hatch weight and each weight of egg (0.881), albumen (0.942), yolk (0.910) and shell (0.956) indicate that egg size and each part of egg components have a positive effect on hatch weight. The size of the egg can be regarded as a temporary environmental factor which influences embryo weight and hatch weight. This effect begins after 11 days of incubation, increases gradually to a maximum at hatching time when egg size almost completely determines chick size (Bray and Iron, 1962).

Differences in hatch weight as percentage of egg weight are found to be highly significant, though, no consistant variations are observed between groups of eggs of different weights (Tables 5 and 6). Percent hatch weight is, therefore, not in direct proportion to its respective egg weight. Negative relationships are estimated between percent hatch weight and each of egg weight, percent albumen weight and percent shell weight. Positive associations, however, are calculated between percent hatch weight and each percentage of yolk weight, shell thickness, egg weight loss and shell weight loss (Table 3). It seems that albumen is important for embryonic development at early stages, while yolk and shell are more important for the growing embryo than the albumen at later stages since a large part of the yolk and shell are not utilized by the embryo until fairly late in development (Landaur, 1967). In addition, the direct proportion of percent hatch weight to each percent of yolk weight, shell thickness and losses of egg and shell weights may indicate a better efficiency of embryonic utilization of the nutrients in the egg which may be correlated with subsequent efficiency as the chick becomes older. If so, this provides a valuable tool in selection programmes for feed efficiency (Guill and Washburn, 1973).

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تاثير وزن البيضة على صفاتها فى دجاج النيوهامشير ودجاج اللجهورن الابيض

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اجرى هذا البحث على ١٦٠٠ بيضة من كل من دجاج النيوهامبشير ودجاج اللجهورن الابيض وقد قسم هذا العدد من البيض داخل كل نوع حسب وزن البيضة الى خمسة مجاميع بفارق خمسة جرامات بين كل مجموعة واخرى . وتمت دراسة تأثير وزن البيضة على كل من دليل شكل البيضة وصفات مكونات البيضة وصفات القشرة ووزن الكتكوت عند الفقس . كما قدرت معاملات الارتباط المظهرى بين هذه الصفات . ودلت نتائج هذا البحث على ما يأتى :–

١ – ظهرت فروق معنوية بين نوعى الدجاج فى كل من وزن الصفار ووزن القشرة ، معظم صفات القشرة ، وزن الفقس ونسبته الى وزن البيضة الا ان الاختلافات فى كل من دليل شكل البيضة ووزن البياض ، وسمك القشرة ونسبة الفقد فى وزن القشرة الى كمية الفقد فى وزن البيضة لم تكن معنوية .

٢ – يزداد دليل شكل البيضة كلما صغرت البيضة فى الوزن . وظهرت لذلك معاملات ارتباط سالبة بين شكل البيضة وكل من وزن البيضة واوزان مكونات البيضة الثلاث ونسبة الفقس .

٣ – يحتوى البيض الصغير على نسبة اعلى من الصفار ونسبة اقل من البياض ، بينما كانت نسبة القشرة متساوية تقريبا فى مجاميع البيض المختلفة . قدرت معاملات ارتباط موجبة بين نسبة الفقس وكل من اوزان مكونات البيضة .

٤ – لم يظهر لوزن البيضة تاثير على كثافتها النوعية . كما ظهر ان نسبة سمك القشرة يتناقص بزيادة كل من وزن البيضة ووزن القشرة . وقد دلت معاملات الارتباط الموجبة على ان البيض ذات القيمة العالية فى كل من الكثافة النوعية ، وزن القشرة وسمك القشرة يكون له فرصة اكبر فى ان يعطى نسبة فقس مرتفعة .

٥ – البيض الكبير فى الحجم (بمقارنته بالبيض الصغير فى الحجم) يفقد كمية اكبر فى كل من وزن البيضة ، وزن القشرة وسمك القشرة خلال الاسبوعين الاولين من مدة التفريخ . وقد دلت معاملات الارتباط السالبة على ارتفاع معدل الفقد فى كل من وزن البيضة ووزن القشرة كلما قلت قشرة البيضة فى السمك .

٦ – ينتج كتكوت كبير فى الوزن من البيضة الكبيرة فى الحجم الا ان نسبة وزن الكتكوت عند الفقس الى وزن البيضة لا يتناسب مع وزن البيضة المقابل . ودلت معاملات الارتباط الموجبة بين نسبة وزن الكتكوت عند الفقس وكل من نسبة الصفار وسمك القشرة والفقد فى وزن البيضة والقشرة على زيادة معاملات استفادة الجنين للغذاء المخزن فى البيضة .