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Research Article

PHENOTYPIC CORRELATIONS BETWEEN SOME EXTERNAL AND INTERNAL EGG QUALITY TRAITS IN GRAMAPRIYA LAYERS

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ABSTRACT: In a study, 360 nos of eggs were randomly collected from 80 birds from a flock of Gramapriya layers for a period of twelve weeks and assessed individually for the evaluation of the egg quality traits and to study the phenotypic correlations between some external and internal egg quality traits. The average values of egg weight, shape index, shell ratio, and average shell thickness were found to be 56.34g, 83.92%, 10.13% and 0.39 mm, respectively. The values related to albumen index , albumen height , albumen weight , albumen ratio , yolk diameter , yolk height , yolk index , yolk ratio and average values related to Haugh Unit (HU) were 0.33 %, 8.28 mm, 34.16g, 61.81%, 26.23 mm, 18.13 mm, 15.24g, 64.01% , 8.05% and 88.24% respectively. All the internal quality traits of the eggs, except the yolk ratio, were found to have significant positive correlations with the weight of the egg. The study indicates that as the albumen height improved the Haugh Unit also improved and as the egg weight increased heights of both the albumen and yolk also increased. Results achieved in the study in relation with external and internal quality traits of Gramapriya layer eggs may assist the breeders for further improvement of the breed.

Key words: Gramapriya layer poultry, egg characteristics, phenotypic correlations.

INTRODUCTION

Poultry is generally acceptable to people all over the world as excellent sources of protein. Poultry is good converter of feed into good quality protein in forms of meat and egg. The poultry production cost is also low as compared to other livestock and the return on investment is high; thus farmers need just a small amount of capital to start with poultry (Ojo 2000). In a fast developing country like India, egg is more preferable and affordable by the common man than other sources of animal protein and this gives poultry more advantage over other livestock. Hence, Low Input Technology (LIT) poultry birds like Gramapriya are being propagated in rural areas of India for production of eggs and meat. Gramapriya is a multi-coloured cross breed, produced by breeding the Rhode Island and the Plymouth Rock breed. This dual purpose chicken variety was

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developed at Directorate of Poultry Research, Hyderabad, for free range and rural backyard rearing. This bird has better adaptability to adverse conditions and better immunocompetence. This bird lays more number of eggs than native chickens and eggs are tinted brown in colour and heavier than native chicken eggs. These hybrid LIT birds usually start laying at about 24 weeks of age and peak egg production is attained during the first production cycle. In areas of tropical climate like India, commercial hybrids produce an average of 180-200 eggs per year. The weight of eggs of layers may be influenced by many factors of internal (albumin weight, yolk weight, albumin diameter, yolk diameter, albumin height, yolk height, HU, etc.) or external (egg shell thickness, shell ratio, shape index, etc.) or both the parameters of egg. Secondly, the external and internal egg quality traits of any particular breed affect the future generations and their performance (Islam *et al.*, 2001). Hence, external and internal egg quality traits may be helpful in getting a future idea regarding their egg weight, production and hatching potentiality. Meagre research work has been conducted in India to exploit the internal and external egg parameters of LIT layers. Therefore, this study was designed to find some external and internal egg quality traits and correlations among them in Gramapriya layers.

MATERIALS AND METHODS

Freshly laid eggs were collected from 80 birds from a flock of Gramapriya layers housed in deep litter system at the poultry unit of Department of Animal Nutrition, WBUAFS, Kolkata. Although the birds started laying at the age of twenty four weeks, the eggs laid between thirty two and forty four weeks of age were used for the study. This was because egg production reached its peak at thirty two weeks which ensured that that eggs collected during the period were quite uniform in size. A total of 360 nos. of eggs were randomly selected (30 from each week's egg collection) for a period of twelve weeks and assessed individually for the evaluation of the egg quality traits.

The birds were fed with commercial ration having 18.04 % crude protein, 2613 Kcal ME/kg, 4.02 % crude fibre, 3.01 % calcium and 0.7 % available phosphorus contents at the rate of 110g/day/bird throughout the study period. All the birds were maintained under the same management condition with litter house temperature and relative humidity maintained at about 32-35°C and 50 - 60% respectively. The birds were provided light for 16 hours a day.

The collected eggs used for this research were numbered at first. The eggs were weighed; the width and length of the eggs were then measured. After external measurements, the eggs were broken on a table with a glass cover in order to measure the yolk height, yolk diameter, albumen length and albumen height. The yolk separated from the albumen part was weighed together with the membrane and the yolk weight was obtained. The shells were washed under low flowing water so that albumen remains are removed. The washed shells were left to dry in the open air for 24 hours. Then they were weighed together with the shell membrane. Finally samples taken from sharp, blunt and equatorial parts were measured and the average shell thickness was obtained from the average values of these three parts An electronic weighing balance of 0.001g sensitivity was used for weighing the eggs; a compass sensitive to 0.01mm was used for

measuring the length, width, yolk diameter, albumen length and width of the eggs; a table with flat glass on it was used on which the eggs are broken; a 3-legged micrometer sensitive to 0.01 mm was used for measuring the height of the yolk and albumen; a micrometer sensitive to 0.01 mm was used for measuring the shell thickness. Some internal and external quality traits of the eggs were estimated using following formula:

Shape Index (%)=[Width (cm)/Height (cm)]×100

Shell ratio (%) =(Shell weight/Egg weight) ×100

Albumen index (%) (=Albumen height (mm)/[Albumen length (mm)+Albumen width (mm)]/2 ×100

Albumen ratio (%)=(Albumin weight/Egg weight) ×100

Yolk index (%)=(Yolk height/Yolk diameter)×100

Yolk ratio (%)=(Yolk weight/Egg weight) ×100

Albumen weight (G) = Egg weight-(Yolk height +Shell weight)

Haugh Unit (HU) =100 log (H+7.57-1.7 $W^{0.37}$), H=albumin height (mm), W= Egg weight (g)

The data were subjected to analysis of variance using complete randomized design (Snedecor and Cochran 1980).

RESULTS AND DISCUSSION

The descriptive statistics related to the quality traits of the examined egg in the study are shown in table 1. The average values related to egg weight (g), shape index (%), shell shell ratio (%), and average shell thickness (mm) were found to be 56.34g, 83.92%, 10.13% and 0.39 mm, respectively. The average values related to albumen index (%), albumen height (mm), albumen weight (g), albumen ratio (%), yolk diameter (mm), yolk height (mm), yolk index (%), yolk ratio (%) and average values related to HU were found respectively, as 0.33, 8.28 mm, 34.16g, 61.81%, 26.23 mm, 18.13 mm, 15.24g, 64.01% , 8.05% and 88.24%.

Table. 1. External and internal quality parameters of egg of Gramapriya layer.

Parameters	Mean± SE
Egg weight (g)	56.34±1.01
Shape Index (%)	83.92±0.17
Shell wt. %	10.13±0.19
Yolk Index (%)	64.01±0.03
Yolk wt. %	28.05±0.45
Albumin Index (%)	32.7±0.03
Albumin weight %	61.81±0.38
Avg. Shell thickness (mm)	0.39±0.01
Shell membrane thickness (mm)	0.03±0.01
Yolk height (mm)	18.13±0.20
Albumin height (mm)	8.28±0.23
Yolk diameter (mm)	26.23±0.08
Albumin diameter (mm)	28.77±0.11
Yolk weight (g)	15.24±0.54
Albumin weight (g)	34.16±0.83
HU	88.24±0.64

Internal egg quality traits

Among the internal egg quality parameters, yolk weight, albumen weight and their ratios respectively are very important in terms of nutrients and cholesterol contents (Olawumi and Ogunlade 2008). The results indicated a greater proportion of albumen (61.81%) compared to yolk (28.05%) and shell (10.14%) of the total egg, which is similar to the findings of Sezer (2007) who recorded the total

Table.2. Phenotypic correlations among external egg quality traits.

External egg traits	Shape index	Average shell thickness	Shell ratio
Egg weight	-0.24**	0.52**	0.42
Shape index		0.52**	0.56**
Average shell thickness			0.51**

**P‹0.01

summation value of both yolk and albumen as over 91% of the total egg weight. The yolk height (18.13mm) was greater than the albumen height (8.28mm). The Haugh unit recorded (88.24) was similar, but the yolk index (64.10%) differed from the findings of Sezer (2008). The composition of the egg with regards to percentages of yolk weight, albumen weight and shell weight respectively, varies as a result of differences in the genetic makeup of the birds and their management or even the age of the hen.

Correlation analysis

Phenotypic correlation between external quality traits:

There was a statistically significant (P<0.01) but negative correlation (-0.24) between egg weight and shape index. This is in agreement with the findings of Olawumi and Ogunlade (2008) for ISA Brown Layer Breeders and Zhang *et al*. (2005) for Brown-Egg Dwarf Layers. The value obtained in both the earlier studies also revealed a negative correlation among shape index and egg weight (-0.09). The negative correlation value between egg weight and shape index obtained in this study was also found similar as reported by Choprakarn *et al.* (1998) on chickens. Thus implies that the increase in egg width as a result of increase in the weight the egg weight is more than the increase in egg length association with increase in egg weight. It is generally noted that weight of the egg increases as the shape index decreases

Table. 3. Phenotypic correlations among internal egg quality traits.

Int. egg traits	Alb. index	Alb. weight	Albumen ratio	HU	Yolk diameter	Yolk height	Yolk weight	Yolk index	Yolk ratio
Alb. height	0.09	0.52**	0.24	0.90**	0.06	0.54**	0.09	0.06	0.15
Alb. index	-	0.01	0.19	0.64**	0.1	0.22	-0.02	0.88**	-0.06
Alb. weight	-	-	0.36	0.52**	0.4	0.51**	0.71**	0.10	0.19
Alb. ratio	-	-	-	0.47**	0.27	0.26	-0.33	0.07	-0.91**
HU	-	-	-	-	0.1	0.42**	-0.05	0.30	-0.34
Yolk width	-	-	-	-	-	0.05	0.55**	0.10	0.16
Yolk height	-	-	-	-	-	-	0.31	0.03	0.21
Yolk weight	-	-	-	-	-	-	-	0.06	0.20
Yolk index	-	-	-	-	-	-	-	-	-0.11

*P‹0.05, **P‹0.01

Table.4. Phenotypic correlations among external and internal egg quality traits.

Int. Egg traits	Egg weight	Shape index	Avg. Shell thickness	Shell ratio
Alb. index	0.30	0.23	-0.24	0.30
Alb. height	0.40**	-0.34	0.32	0.20
Alb. weight	0.42**	-0.42**	0.30	0.40*
Alb. ratio	0.42**	-0.48**	0.14	-0.21
HU	0.19	0.05	-0.28	-0.19
Yolk diameter	0.33**	-0.50	0.26	0.25
Yolk height	0.28**	-0.16	-0.02	0.11
Yolk weight	0.35**	-0.40*	0.15	0.32
Yolk ratio	-0.32	-0.24	-0.08	0.22

*P‹0.05, **P‹0.01

(Pandey *et al.*, 1986).

The positive correlation between the egg weight and the shell thickness was statistically significant (P<0.01) indicating that heavier eggs are expected to have higher shell weight compared to lighter eggs. Similar findings were also observed by Zhang *et al.* (2005), Olawumi and Ogunlade (2008) and Kul and Seker (2004).

Shell ratio is a much more reflective value of shell quality than absolute shell weight. The shell ratio was found to have a statistically correlated positively (0.42) with egg weight suggesting that selection for increased egg weight may result in increased shell quality, though it requires further study on genetic correlation to make such a l conclusion. The results of this work are in agreement with the findings of Olawumi and Ogunlade (2008) who also reported a positive but insignificant phenotypic correlation between the egg weight and the shell ratio. On the contrary, Kul and Seker (2004) reported a statistically significant negative correlation (-0.22) between egg weight and the shell ratio.

In this study, a significant positive phenotypic correlation (P<0.01) was observed between the shape index and shell ratio indicating the possibility of improving shell quality with rounder eggs and this explains the evolutionary consequence of egg shape. Richards and Staley (1967) reported that shape index had a significant effect on the variation of crushing strength. Therefore shape index becomes an important factor in the determination of eggshell quality in Gramapriya layer eggs.

A significantly positive correlation (P<0.01) was observed between the average shell thickness and the shell ratio referring to the traits that determined the shape index and shell quality. In this study, the results that the shape index might give an idea about the shell weight due to the highly significant correlation value between the shape index and the shell weight ratio. This is in accordance with the results of Ogundipe (1990)

Phenotypic correlation between internal quality traits:

As summarized in Table 3 a statistically significant ($p<0.01$) positive correlation was found between yolk weight and yolk diameter and this agrees with the findings of Kul and Seker (2004) and Olawumi and Ogunlade (2008). These observations indicated that greater diameter of yolk leads to increased yolk weight.

There was negative correlation between yolk weight and the albumen ratio, similar to the findings of Kul and Seker (2004) and Olawumi and Ogunlade (2008) indicating that weight of the yolk decreases as the albumen ratio increases. A statistically positive significant ($p<0.01$) correlation existed between yolk height and Haugh unit. It can be assumed that with an improvement in Haugh unit (a function of the height of the inner thick albumen) improves the yolk height. However, it may be suggested a genetic correlation analysis in this regard is also suggested.

Statistically significant ($p<0.01$) negative correlations was obtained for yolk ratio and albumen ratio; whereas positive correlations ($p<0.01$) were found between yolk height and albumen height & weight. These results indicated that as the yolk height and diameter increased the albumen height also increased. However, the albumen ratio has an inverse relationship to the yolk ratio so that if albumin ratio increases the yolk ratio decreases.

Statistically significant ($P<0.0l$) correlation was found between the albumen height and the Haugh unit which also supports the findings of Oluwami and Ogunlade (2008) and Kul and Sekar (2004), indicating that as the albumen height improves the Haugh unit also improved.

Statistically significant ($P<0.0l$) correlation was found between albumen height and albumen weight. It indicates that as the weight of the albumen increases, the albumen height also gets increased. The significant positive ($p<0.01$) correlation found between albumen weight and albumen height, which are the parameters associated with albumen quality (Ogundipe 1990) and with estimating the Haugh unit implies that as these parameters increase the Haugh unit increases as well.

Phenotypic correlations among internal and external quality traits

The phenotypic correlations among various internal and external quality traits of eggs are shown in Table 4 which indicates an insignificant but negative phenotypic correlation between egg weight and the yolk ratio.

There was negative phenotypic correlation between shape index and all the internal quality traits except with the albumin index (0.23) and HU (0.05) which correlated positively but not significant with the shape index. However, there were significant ($P<0.01$) positive correlations between egg weight and albumen weight, albumen height, albumen ratio, yolk diameter, yolk height and yolk weight. These were in agreement with the findings of Isam and Dutta (2010). Wolanski *et al.* (2006) also observed a strong and positive correlation between egg weight and albumen weight, and between egg weight and yolk weights in broiler breeder eggs. The present study indicates that as the weight of the egg increases, the albumen weight, albumin height, yolk weight and yolk height also increase. However the increase in weight of the albumen overshadows that of the weight of the yolk, the yolk ratio then decreases with an increase in the weight of the egg. There is

also an indication that as the egg weight increases the heights of both the albumen and yolk also increase.

A statistical non-significant positive correlation was observed between the shell thickness and some of the internal quality traits like albumin height, albumin weight, albumin ratio, yolk diameter and yolk weight. Kul and Seker (2004) also found positive correlation between the shell thickness and some of the internal quality traits like, albumin weight, yolk diameter and yolk weight. A statistical non-significant but negative correlations were observed between the shell thickness and some internal quality traits like albumin index, HU, yolk height and yolk ratio. Similarly, a statistically non-significant positive correlations were observed between the shell ratio and all the internal quality traits except, with albumen weight which had a positive significant ($p<0.05$) correlation. However, a negative and non-significant correlation was found between shell ratio and, internal quality traits like albumen ratio (-0.21) and HU (- 0.19), However, Kul and Seker (2004) and Olawumi and Ogunlade (2008) found a negative correlation between the shell ratio and all the internal quality traits.

There was significant ($p<0.01$) but negative phenotypic correlation between shape index and internal quality traits like albumin ratio and albumin weight. Significant ($p<0.05$) but negative phenotypic correlation was also noted between shape index and yolk weight. However, there was negative and non-significant correlation between the shape index and internal traits like yolk ratio, yolk height, yolk diameter, and albumin height. Kul and Seker (2004) and Olawumi and Ogunlade (2008) also found a phenotypically negative and non-significant correlation between shape index and some of internal traits like yolk ratio, yolk height, yolk diameter, and albumin height.

CONCLUSION

The results in Gramapriya birds suggest correlations and inter-linking among various egg quality traits. The findings may be useful for the researchers and breeders for further improvements in egg quality and selection of better performing birds.

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