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G Simi
Assistant Professor, Department of Poultry Science, CVAS, Wayanad, Kerala, India

CS Madhusoodanan
Veterinary Surgeon, Veterinary Dispensary, Pallikkal, Malappuram, Kerala, India

C Sunanda
Former Assistant Professor, Department of Poultry Science, CVAS, Wayanad, Kerala, India

Correspondence Author:
G Simi
Assistant Professor, Department of Poultry Science, CVAS, Wayanad, Kerala, India

Appraisal of egg quality traits of Gramapriya layers reared under backyard system in Cherukavu panchayath of Malappuram, Kerala

G Simi, CS Madhusoodanan and C Sunanda

Abstract
In the present study, the traits of egg quality of 90 eggs of Gramapriya layer birds reared under backyard system in the rural households of Cherukavu panchayath of Malappuram district, Kerala were assessed during 46th, 47th and 48th weeks of age. 30 eggs laid during each week were appraised for the study. The internal quality traits of eggs as Albumen height as well as Albumen weight had significant positive correlations with the weight of the egg. Haugh Unit and Albumen height were positively correlated. Length of egg had significant positive correlation with Albumen weight and shell weight. Significant positive correlation was observed between shell ratio and average shell thickness. The study revealed that good quality eggs with regard to parameters of egg quality were produced from Gramapriya layer birds reared under backyard system in the rural households of Cherukavu panchayath. The farmers can augment the egg production by adopting improved health care management practices.

Keywords: Gramapriya layer, egg quality traits, backyard rearing

Introduction
Sustained efforts to enhance the poultry production in rural areas of India have been made for the past few decades with the introduction of improved varieties of chicken as Gramapriya (Kumar *et al*., 2022) [10]. It was an egg type variety developed by Directorate of Poultry Research, Hyderabad and adapts considerably well to the climatic conditions prevailing in Kerala. Introduction of improved specific chicken in backyard rearing would facilitate the simultaneous utilisation of characters of native breeds as adaptability to Indian climate, resilience to diseases and the production performance of exotic chicken. These varieties with high yields and resemblance to the indigenous birds has transformed backyard rearing into a profitable farming venture (Rajkumar *et al*., 2021) [12]. Egg quality relates to the attributes of eggs that influence their suitability for the consumers (Stadelman, 1997) [17]. For purposes as hatching and consumer acceptance, the hallmarks of quality of eggs encompass albumen thickness as well as length, yolk index, Haugh unit score, etc. The appraisal of an egg's internal as well as external quality is crucial for both incubation and consumer preference for enhanced-quality eggs (Sekeroglu and Altuntas, 2008) [16]. They are imperative in poultry breeding as these characteristics directly influence reproductive performance and progeny growth (Altinel *et al*., 1996) [1]. Given the dearth of information on the characteristics of production of Gramapriya chicken reared in the backyard system in Kerala, the current study was done to appraise the production and traits related to egg quality of these birds under low input technology in the rural households.

Materials and Methods
In the present study, the traits of egg quality of 90 eggs of Gramapriya layer birds reared under backyard system in the rural households of Cherukavu panchayath of Malappuram district, Kerala were assessed during 46th, 47th and 48th weeks of age. 30 eggs laid during each week were collected from the households and used for the study. To get the accurate weight of each egg, a digital balance was employed for measurement. To assess the width as well as length of eggs, a Vernier Caliper was employed. From the values obtained, the shape index was determined by multiplying the width to length ratio of egg by 100. The shells were dried for a day after discarding the shell membranes and then weighed in digital balance. The shell ratio was obtained by dividing weight of shell by weight of egg. Shell thickness was measured at four points (One at the broad end of egg, second at pointed end and another two

points in the egg). The average of all the four values were considered to calculate the average thickness of egg shell.
With a Vernier caliper, both the width as well as length of the eggs were assessed. From these values, the Shape index was obtained by multiplying the ratio of width (Maximum) and length with 100. The length as well as width of Albumen and yolk were measured in millimetres by using a Vernier caliper. Height of Albumen was measured at three points and average of these values were considered. The shell thickness at three points were measured using a screw Gauge. Average of the three values thus obtained was taken as the final value of shell thickness. Vernier caliper was employed to appraise the maximum length as well as width of thick Albumen, height of thick Albumen was measured between the outermost border of the thick Albumen and the yolk. With a tripod Spherometer, yolk height was measured. Yolk width was evaluated with a Vernier caliper. Then the yolk index was determined by multiplying the ratio of average yolk height and yolk width with 100.Haugh unit score was derived by employing the Raymond Haugh's formula (1937) as follows:
$HU=100 \log (H+7.57-1.7W^{0.37})$ where HU: Haugh Unit, H: Height of Albumen, W: Weight of egg.
The whole data was subjected to statistical analysis using General Linear model procedure of SPSS version 21.

Results

Means of characteristics of external egg quality and the standard error at 46, 47 and 48 weeks of age are given in Table 1. Means for external parameters of Gramapriya eggs as egg weight, breadth of egg, length of egg, shape index, shell weight, thickness and shell % at week 46 of age were 51.86 g, 4.04 cm, 5.66 cm, 71.47, 6.05 g, 0.40 mm and 11.70%. The corresponding values were 54.10 g, 4.14 g, 5.57 cm, 74.50, 6.02 g, 0.35 mm and 11.12% at 47 weeks of age and 56.22 g, 4.16 cm, 5.73 cm, 72.76, 6.59, 0.35 mm and 11.80% at 48 weeks of age respectively.

Table 1: External traits of egg quality of Gramapriya chicken under low input backyard system of rearing

Egg quality traits	Week 46	Week 47	Week 48
Egg weight (g)	51.86±0.96	54.10±1.03	56.22±1.54
Breadth of egg (cm)	4.04±0.06	4.14±0.04	4.16±0.04
Length of egg (cm)	5.66±0.05	5.57±0.07	5.73±0.06
Shape index	71.47±1.22	74.50±0.88	72.76±0.64
Shell weight (g)	6.05±0.17	6.02±0.18	6.59±0.21
Shell thickness (mm)	0.40±0.01	0.35±0.01	0.35±0.01
Shell %	11.70±0.30	11.12±0.25	11.80±0.33

Internal traits of egg quality of Gramapriya eggs at the age of 46, 47 and 48 are given in Table 2. The average values for Albumen width, Albumen width, Albumen Index, Albumen weight, yolk width, yolk height, yolk Index, yolk weight, Haugh unit, Yolk %, Albumen % and Yolk: Albumen ratio were 7.27 cm, 5.34 cm, 0.074, 28.56 g, 4.30 cm, 1.54 cm, 0.36, 17.13 g, 74.64, 33.39, 55.34 and 0.61. The corresponding values for week 47 were 7.43 cm, 5.55 cm, 0.075, 29.23 g, 4.37 cm, 1.33 cm, 0.31, 18.70 g, 75.37, 34.76, 54.14 and week 48 were 7.70 cm, 5.73 cm, 0.075, 29.02 g, 4.35 cm, 1.40 cm, 0.32, 19.36 g, 75.94, 34.99, 51.41 and 0.70 respectively. Table 3 depicts phenotypic correlations of parameters of egg quality with regard to egg weight, breadth and length. Table 4 depicts phenotypic correlations with regard to traits of external egg quality. Table 5 elaborates on phenotypic correlations with regard to parameters of internal egg quality and Albumen traits. Albumen width was positively correlated with Albumen weight. Albumen height was correlated with Albumen index, Albumen weight, shell weight and Haugh unit. Albumen index was correlated with Albumen height as well as Haugh unit. Albumen weight was correlated with Albumen width and height and also with shell weight. Phenotypic correlations with regard to parameters of internal egg quality and yolk traits are given in table 6. Yolk height was correlated with yolk index, shell thickness as well as shell percentage. Yolk index was correlated with yolk height and shell percentage. Yolk weight was correlated with yolk percentage. Phenotypic correlations with regard to internal as well as external egg quality characteristics are given in table 7. Shell weight was correlated with Albumen height, Albumen weight, shell thickness as well as shell percentage. Shell thickness was correlated with yolk height, shell weight as well as shell percentage. Haugh unit was correlated with Albumen height and Albumen index, yolk percentage and shell percentage. Yolk percentage was correlated with yolk weight, Haugh unit and Yolk: Albumen ratio. Yolk: Albumen ratio was correlated with yolk weight, yolk percentage. The percentage of shell was correlated with yolk height, shell weight, and shell thickness. Albumen weight was negatively correlated with yolk ratio and yolk: Albumen ratio.

Table 2: Traits of internal egg quality of Gramapriya chicken under low input backyard system of rearing

Egg quality traits	Week 46	Week 47	Week 48
Albumen width(cm)	7.27±0.10	7.43±0.12	7.70±0.15
Albumen height(cm)	5.34±0.05	5.55±0.06	5.73±0.08
Albumen Index	0.074±0.01	0.075±0.02	0.075±0.02
Albumen weight(g)	28.56±0.65	29.23±0.62	29.02±1.12
Yolk width(cm)	4.30±0.06	4.37±0.06	4.35±0.06
Yolk height(cm)	1.54±0.02	1.33±0.03	1.40±0.04
Yolk Index	0.36±0.01	0.31±0.01	0.32±0.01
Yolk weight(g)	17.13±0.19	18.70±0.36	19.36±0.51
Haugh Unit	74.64±0.53	75.37±0.47	75.94±0.74
Yolk %	33.39±0.75	34.76±0.72	34.99±1.20
Albumen %	55.34±1.24	54.14±0.86	51.41±1.17
Yolk: Albumen ratio	0.61±0,02	0.65±0.02	0.70±0.04

Table 3: Phenotypic correlations of parameters of egg quality with regard to egg weight, breadth and length

Egg quality traits	Egg weight	Egg breadth	Length
Alb. width	0.154	0.098	0.189
Alb. height	.292**	0.136	.253*
Albumen index	0.06	0.006	-0.004
Alb. weight	.678**	.477**	.498**
Yolk width	0.152	.217*	-0.008
Yolk height	-0.153	-0.041	-0.011
Yolk index	-.222*	-0.16	-0.022
Yolk weight	0.155	0.189	0.055
Shell weight	.542**	.453**	.363**
Shell thickness	-0.018	-0.064	0.013
Haugh unit	-.501**	-.318**	-.231*
Yolk %	-.560**	-.258*	-.355**
Albumen %	-0.138	0.035	0.033
Yolk: Albumen ratio	-.312**	-0.172	-.257*
Shell %	-0.156	0.077	-0.043

** shows that correlation is significant at the 0.01 level (2-tailed), * correlation is significant at the 0.05 level (2-tailed) in all the tables

Table 4: Phenotypic correlations with regard to traits of external egg quality

Egg quality trait	Shell thickness	Shell %
Shell weight	.348**	.736**

Table 5: Phenotypic correlations with regard to parameters of internal egg quality and Albumen traits

Internal egg quality traits	Alb. width	Alb. height	Alb. index	Alb. weight	Haugh unit	Albumen %	Yolk:Albumen ratio
Alb. width	1	0.1	-.760**	.248*	-0.032	0.157	-0.153
Alb. height	0.1	1	.560**	.223*	.680**	-0.03	-0.124
Alb. index	-.760**	.560**	1	-0.07	.463**	-0.159	0.052
Alb. weight	.248*	.223*	-0.07	1	-.316**	.630**	-.732**
Yolk width	0.173	0.187	-0.025	0.158	0.044	0.03	-0.161
Yolk height	-0.095	-0.026	0.067	0.011	0.082	0.169	-0.183
Yolk index	-0.187	-0.142	0.069	-0.076	0.036	0.138	-0.183
Yolk weight	0.081	0.064	-0.032	-0.09	-0.063	-.317**	.709**
Haugh unit	-0.032	.680**	.463**	-.316**	1	0.083	0.126
Yolk %	-0.091	-0.157	-0.032	-.558**	.289**	-0.184	.829**
Albumen %	0.157	-0.03	-0.159	.630**	0.083	1	-.679**
Yolk: Albumen ratio	-0.153	-0.124	0.052	-.732**	0.126	-.679**	1

Table 6: Phenotypic correlations with regard to parameters of internal egg quality and yolk traits

Internal egg quality traits	Yolk width	Yolk height	Yolk index	Yolk weight	Yolk ratio
Alb. width	0.173	-0.095	-0.187	0.081	-0.091
Alb. height	0.187	-0.026	-0.142	0.064	-0.157
Alb. index	-0.025	0.067	0.069	-0.032	-0.032
Alb. weight	0.158	0.011	-0.076	-0.09	-.558**
Yolk width	1	0.055	-.489**	0.052	-0.125
Yolk height	0.055	1	.839**	-.260*	-0.136
Yolk index	-.489**	.839**	1	-.259*	-0.054
Yolk weight	0.052	-.260*	-.259*	1	.713**
Haugh unit	0.044	0.082	0.036	-0.063	.289**
Yolk %	-0.125	-0.136	-0.054	.713**	1
Albumen %	0.03	0.169	0.138	-.317**	-0.184
Yolk: Albumen ratio	-0.161	-0.183	-0.078	.709**	.829**

Table 7: Phenotypic correlations with regard to traits of internal and external egg quality

Internal egg quality traits	Shell thickness	Shell ratio
Alb. width	-0.103	-0.004
Alb. height	-0.132	0.111
Alb. index	0.005	0.085
Alb. weight	-0.001	0.079
Yolk width	0.141	0.016
Yolk height	.274**	.235*
Yolk index	0.178	.215*
Yolk weight	-0.107	-0.163
Haugh unit	-0.141	.218*
Yolk %	-.421**	-0.053
Albumen %	0.126	.257*
Yolk: Albumen ratio	-.324**	-0.133

Discussions

Haunshi *et al.* (2009) [5] have reported the egg quality traits of Gramapriya layers at 40 weeks of age as having an average value of 0.0714 for Albumen Index, 0.37 for yolk index, 69.10 for Haugh unit and 57.22 for egg weight. In the present study, positive correlation (Statistically significant, $p<0.01$) existed between weight of egg and shell thickness. Kul and Seker (2004) [8], Zhang *et al.* (2005) [19], Olawumi and Ogunlade (2008) [15] and Debnath and Ghosh (2015) [3] have reported similar results in egg quality parameters.It is expected that the shell of larger eggs will weigh more in comparison to smaller eggs. Our study suggests that as egg weight increases Albumen height, Albumen weight, yolk width and yolk weight also increases correspondingly. Similar to the report by Markos *et al* (2017) [11] and Hussen *et al* (2019) [6] egg weight was positively correlated with shell weight, Albumen height, yolk weight.

Albumen weight was negatively correlated with yolk ratio and yolk: Albumen ratio and was in accordance with Bekele (2024) [2] who has observed similar results in eggs of Sasso breed of chicken. The study also reported positive correlation between Albumen height and Haugh unit and negative correlation between Albumen height and Yolk: Albumen ratio. These were in line with the findings of the current study. Mube *et al.* (2014) [14] have suggested that as quality of egg is higher, the Haugh unit will be having value of 70 and above. Haugh unit score of Gramapriya eggs in the current study can be categorized as high quality eggs as the mean Haugh units were reported to be 74.64, 75.37 and 75.94 at 46, 47 and 48 weeks of age.

Shell thickness and shell ratio were positively correlated ($p<0.01$) and agreed with findings of Debnath and Ghosh (2015) [3] who observed similar results in Gramapriya eggs at an age of 32-44 weeks. The positive correlation that existed between yolk weight and yolk width (0.052) is similar to observations of Kul and Seker (2004) [8], Olawumi and Ogunlade (2008) [15] and Debnath and Ghosh (2015) [3]. Yolk weight and Albumen ratio were negatively correlated ($p<0.01$) which supports the observations made by Kul and Seker (2004) [8], Olawumi and Ogunlade (2008) [15] and Debnath and Ghosh (2015) [3]. The results denote the fact that weight of yolk increases as Albumen ratio decreases. Yolk index had negative correlation with yolk width which agreed with findings of Sinha *et al.* (2017) [13] in Gramapriya and Vanaraja eggs. This is suggestive of the

fact that yolk quality may be compromised as yolk width increases and eggs with lower yolk width corresponds to higher yolk quality. Albumen ratio and Yolk ratio manifested negative correlation but positive correlation was seen between yolk height and Albumen weight as well as Haugh unit and yolk height as suggested by Debnath and Ghosh (2015) [3]. As Haugh unit reflects the quality of egg Albumen, an enhanced Haugh unit may result in improvement in height of yolk. Egg width was negatively correlated with Haugh unit, which was similar to the observation made by Markos *et al* (2017) [11] in lowland Ethiopian chicken isotypes. Similar to the observations made by Kul and Seker (2004) [8], Olawumi and Ogunlade (2008) [15], Mube *et al.* (2014) [14] and Debnath and Ghosh (2015) [3], Markos *et al.* (2017) [11], Hussen *et al.* (2019) [6] a positive correlation (Statistically significant) was obtained between Albumen height and Haugh unit ($p<0.01$). Albumen height and weight evidenced positive correlation ($p<0.05$). An improvement in Albumen height and weight simultaneously results in an enhanced Haugh unit. Positive correlation (Non-significant) was manifested between shell thickness and Albumen weight and Albumen width as suggested by Kul and Seker (2004) [8] and Debnath and Ghosh (2015) [3]. Negative correlation (statistically non-significant) was observed between shell thickness and Haugh unit score as well as shell thickness and yolk ratio. Shell thickness was positively correlated to yolk height and yolk index which followed a similar trend of the study by Hussen *et al.* (2019) [6] in Horro ecotype and red bared D922 exotic chicken eggs. Shell ratio was positively correlated to all Albumen traits except Albumen width. With regard to yolk quality traits, shell ratio was positively correlated to yolk width and height and yolk index. These results pertinent to shell ratio resembled the observations made by Debnath and Ghosh (2015) [3].

Conclusions

The study revealed that good quality eggs in terms of parameters of egg quality were produced from Gramapriya layer birds reared in rural households under low input backyard system in Cherukavu panchayath of Kerala. Egg shell thickness was strong in Gramapriya eggs which makes it preferable for enhanced rural poultry production. Many of the parameters of external egg quality had significant correlation between the characteristics of internal egg quality studied. The farmers can augment the egg production by adopting improved health care management practices with regard to Gramapriya layers.

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