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Comparative study of egg quality traits in chicken varieties for backyard farming in Jharkhand

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Abstract
Present study was carried out on four chicken varieties i.e. Delham Red (DR), Red Cornish (RC) one Vanaraja (VR) and Gramapriya (GP) to assess the effect of genetic groups on equality traits. A total of 87 eggs were collected from the above four genetic groups at 20 weeks of age to study the various external, internal and derived egg equality traits. The external characters like egg weight, length and width were measured. Thereafter, the egg was broken and the internal traits like weight, height and width of albumin and yolk, shell weight and their thickness were recorded using standard procedure. The derived traits egg Haugh unit, shape index, albumin index and yolk index were estimated for study. Least square analysis of variance showed significant effect genetic group on all the traits (external, internal and derived traits) under study except on shell weight and shape index. Significantly higher external egg traits were recorded in DR followed by RC, VR and GP. Exactly similar trend was noticed with albumin weight. However, there was no any definite trend with respect to other internal and derived traits. Overall egg weight, egg length and egg width were found to be 53.77±0.273 g, 5.56±0.02 cm and 4.15±0.008 cm, respectively.

Keywords: Delham red, egg quality traits, gramapriya, red cornish and vanaraja

1. Introduction

Backyard poultry is one of the viable alternative systems for improving the livelihood and nutritional security of rural people. Vanaraja is a multi-colored, medium sized dual-purpose bird. It is a cross strain of chicken suitable for backyard farming in rural and tribal areas with high immune status (Sahu *et al.* 2016) [19]. Red Cornish and Vanaraja are mostly reared in both intensive and backyard system of management in tropical climate like India. Such breeds are popular and well accepted by the small, marginal and landless farmers across the country (Debata *et al.* 2014) [5]. The rural varieties Gramapriya developed earlier are popular and well accepted by the small landless farmers and tribal folks of the country. These birds are popular among the rural/ tribal women as one of the incomes generating activity especially for rural women. The knowledge and information on the structure of egg and its various parameters are essential for an understanding of egg quality, fertility, embryo development and diseases of the poultry Islam and Dutta (2010) [9]. The egg quality is the most important factors for popularization of the backyard farming. The success of poultry farming largely depends on the total number of good quality eggs produced especially in layers and dual-purpose birds. Though lot of work has been carried out on egg quality traits, the information on varieties developed and being popularized for backyard farming in rural and tribal areas are limited. The evaluation of external and internal quality of the egg is essential as consumer prefer better quality eggs. Eggs quality is the characteristics of an egg that affect its acceptability to consumer. Hence, the present study was aimed at assessing the effect of genetic group and age on egg quality traits in rural varieties developed for backyard farming.

2. Materials and Methods

2.1 Treatment details

The present study was carried out on backyard poultry belonging to four genetic groups *viz.* Delham Red (23), Red Cornish (19), Vanaraja (25) and Gramapriya (20) maintained under AICRP on backyard poultry at Ranchi Veterinary College, Birsa Agricultural University, Ranchi (Jharkhand). Birds of all the genetic groups were maintained uniformly on similar rations computed by mixing different feed ingredients. A total of 87 eggs were collected from the above four genetic groups at 20 weeks of ages and various external, internal and derived egg quality traits were studied.

2.2 Measurements of traits

2.2.1 Egg weight
The egg weight was measured in gram (g) with the help of electronic balance with 0.1g accuracy.

2.2.2 Egg Length
The egg length was measured in centimeter (cm) with the help of Vernier caliper.

2.2.3 Egg Width
The egg width was measured in centimeter (cm) with the help of Vernier caliper.

2.2.4 Shell weight
The shell weight was measured in gram (g) with the help of electronic balance with 0.1g accuracy.

2.2.5 Shell thickness
Shell thickness was measured after removing the shell membrane from the shell. It was measured with the help of screw gauze at four places *viz*., one from each end and two from center and then the average value was recorded. The values were expressed in millimeter (mm).

2.2.6 Yolk weight
The yolk weight was measured in gram (g) with the help of electronic balance with 0.1g accuracy.

2.2.7 Yolk height
The yolk height was measured in millimeter (mm) with the help of Spherometer.

2.2.8 Yolk width
The yolk width was measured in centimeter (cm) with the help of Vernier caliper.

2.2.9 Albumin weight
The albumin weight was measured in gram (g) with the help of electronic balance with 0.1g accuracy.

2.2.10 Albumin height
The albumin height was measured between the yolk and outer edge of the thick albumin in millimeter (mm) with the help of Spherometer.

2.2.11 Albumin width
The albumin width was measured in centimeter (cm) with the help of Vernier caliper. The width of thick albumin from two different places were taken and average width of thick albumin was estimated.

2.2.12 Egg Shape Index
The shape index of egg was obtained by dividing the maximum width by maximum length of egg and multiplied the quantity by 100.

2.2.14 Haugh unit (HU)
The most widely used method of assessing albumin quality is by its Haugh Unit. This method is an expression relating to egg weight and thick albumin height measured between the yolk and outer edge of the thick albumin by using Haugh meter. The HU calculated by using the following formula.

$HU = 100\ _{log}\ (H + 7.57 - 1.7\ W^{0.37})$

Where,

H = Height of dense albumin in mm.

W = Weight of egg (g).

2.2.14 Yolk Index
Yolk index is the ratio between height and width of yolk of egg.

2.2.15 Albumin index
Albumin index is the ratio between height and average width of thick albumin of egg.

2.3 Statistical analysis
Data were analyzed by mixed model least-square and maximum likelihood computer program pc-2 in the Department of Animal Genetics and Breeding, Ranchi Veterinary College, Ranchi. The least squares mean and standard error were calculated through least squares models (Harvey, 1990) [7] and some of the minor calculations were carried out by a programmable scientific calculator CASIOfx-100s as per standard statistical method (Snedecor and Cochran,1994) [22]. Significant differences between means were tested by Duncan (1955) [6] multiple range test and modified by Kramer (1957) [12]. The following mathematical model was used to see the effect of genetic groups on the foresaid traits:

$Y_{ij} = \mu + G_i + e_{ij}$

Where,

Y_{ij} is the measurement of a trait on the j^{th} bird of i^{th} genetic group

μ is the overall population mean

G_i is the effect of i^{th} genetic group

e_{ij} is the random error assumed to be normally and independently distributed with mean 0 and variance σ_e^2.

3. Results and Discussion

3.1 External Egg Quality Traits
Least square analysis of variance revealed significant effect of genetic group on all the external egg quality traits. The overall egg weight, egg length and egg width were 53.77±0.273 g, 5.26±0.020 cm and 4.15±0.008 cm, respectively. The external egg quality traits were superior in DR than those of RC followed by VR and GP (Table 1). Significant superior and inferior egg quality traits were noticed in DR and GP, respectively. However, RC and VR lies in between these two and the difference between these two did not differ significantly. Bharambe and Garud (2012) [2] also reported higher average weight at 1st lay egg in DR than the improved crossbred birds. Our finding was also supported by Johari and Singh (1968) [11], Chand *et al.* (1972) [3] and Mahanta and Sapcota (2007) [14] who found superior egg quality traits in DR as compared to crossbred birds. On the contrary, Tomar *et al.* (2009) [24] reported higher egg weight which might be due to the fact that the birds were meat type lines. However, our finding was supported by Niranjan *et al.* (2008) who got higher egg weight, egg length and egg width in VR than GP. Significantly higher egg weight in RC (58.30 ± 0.80 g) was also reported by Debata *et al.* (2014) [5].

3.2 Internal Egg Quality Traits
The average estimate of internal egg quality traits and their comparative study are presented in Table 1. The overall albumin weight, albumin height and albumin width were found to be 31.05±0.255 g, 9.45±0.066 mm and 66.83±1.488

mm, respectively. Higher albumin weight was recorded in DR (35.14±0.479 g) followed by RC (33.07±0.536 g), VR (29.10±0.479 g) and GP (26.88±0.514 g). The difference being significant among the entire four genetic groups. Albumin height was significantly higher in DR (10.02±0.123 cm) and GP (9.72±0.132 cm) in comparison to other two genetic groups, the difference between former two was non-significant. As regard albumin width, higher value was observed in RC (71.73±3.125 mm) which differs significantly only from DR (60.95±2.795 mm). Bharambe and Garud (2012) [2] recorded that albumen weight in purebreds was significantly higher than that of crossbreds. Parmar *et al.* (2006) [18] reported 20.74g albumin weight in Kadaknath birds which was much lower than the present findings. Lower albumin weights (23.46 to 26.67g) than the present study was also recorded by Chatterjee *et al* (2007) [4] in indigenous fowls of Andaman. The values of albumen height obtained in the present study are also in close agreement to the findings of Sinha *et al.* (2018) [21] and Niranjan *et al.* (2008) [16] in Vanaraja and Gramapriya .The results obtained in the present study are in agreement with the findings of Alewi *et al.* (2012) [1], Sarica *et al.* (2012) [20] and Kumar *et al.* (2014) [13] who reported significant effect of breed and strain on albumen height.

Table 1: Least-square means of external and internal egg quality traits

Groups	DR	RC	VR	GP	Overall (μ)
Egg weight (g)	56.97±0.512[a]	56.15±0.572[a]	52.23±0.512[b]	49.75±0.548[c]	53.77±0.273
Egg length (cm)	5.70±0.038[a]	5.63±0.043[ab]	5.53±0.038[b]	5.39±0.041[c]	5.56±0.020
Egg width (cm)	4.25±0.015[a]	4.18±0.017[b]	4.16±0.015[b]	4.01±0.016[c]	4.15±0.008
Albumin weight (g)	35.14±0.479[a]	33.07±0.536[b]	29.10±0.479[c]	26.88±0.514[d]	31.05±0.255
Albumin height (mm)	10.02±0.123[a]	8.81±0.138[c]	9.23±0.123[b]	9.73±0.132[a]	9.45±0.066
Albumin width (mm)	60.95±2.795[b]	71.37±3.125[a]	68.48±2.794[ab]	66.50±2.996[ab]	66.83±1.488
Yolk weight (g)	15.52±0.163[b]	16.71±0.182[a]	16.57±0.163[a]	16.85±0.174[a]	16.41±0.087
Yolk height (mm)	16.15±0.092[c]	16.40±0.103[c]	16.89±0.092[b]	17.26±0.099[a]	16.67±0.049
Yolk width (mm)	39.23±0.239[b]	40.48±0.268[a]	40.12±0.239[a]	40.03±0.257[a]	39.96±0.128
Shell weight (g)	6.31±0.088	6.36±0.098	6.55±0.088	6.01±0.094	6.31±0.047
Shell thickness (mm)	0.31±0.0076[c]	0.32±0.0085[bc]	0.40±0.0076[a]	0.33±0.0081[b]	0.34±0.004

a-c; values bearing same superscript in a row did not differ significantly.

There was significant effect of genetic groups on yolk weight, yolk height and yolk width. The overall yolk weight, yolk height and yolk width were 16.41±0.087 g, 16.67±0.049mm and 39.96±0.128mm, respectively. Higher yolk weight was recorded in GP (16.85±0.174 g) followed by RC (16.71±0.182 g), VR (16.57±0.163 g) and DR (15.52±0.163 g). Significantly lower yolk weight was observed in DR than those of other three genetic groups. Yolk height of GP was significantly more than the three genetic groups. The difference between RC and DR was not significant, though they differed significantly from VR. Yolk width of DR (39.23±0.239 mm) was significantly lesser than that of RC (40.48±0.268 mm), VR (40.12±0.239 mm) and GP (40.03±0.257 mm), which did not differ significantly among themselves. Significant effect of genetic groups observed in yolk weight in the present study have also been reported by various scientists (Islam and Dutta, 2010, Mohanty and Nayak, 2011 and Sreenivas *et al.* 2013) [9, 15, 23]. The values found in the present study were comparable to the values of Sinha *et al.*, (2018) [21] and Niranjan *et al.* (2008) [16] in VR and GP, Padhi *et al.* (2013) [17] and Mohanty and Nayak (2011) [15] in VR. Significant effect of genetic groups on yolk height have also been reported by many scientists such as Alewi *et al.* (2012) [1], Sarica *et al.* (2012) [20] and Kumar *et al.* (2014) [13]. The values of yolk height found in present study are in close agreement to the values obtained by Alewi *et al.* (2012) [1] in RIR and their crosses and Kumar *et al.* (2014) [13] in RIR. However, higher value has been reported by Sarica *et al.* (2012) [20] than the values observed in the present study.

Genetic group had non-significant influence on shell weight ranging from 6.01 to 6.55 g (table-1). The estimates of mean shell weight reported by Niranjan *et al.* (2008) in VR and GP, Zita *et al.* (2009) in brown egg layer strain and Sarica *et al.* (2012) [20] in Brown and white egg laying strains were in close agreement with the findings of the present investigation. Shell thickness of Vanaraja (0.40±0.0076 mm) was significantly higher than all the rest three genetic groups. On the contrary, significantly lowest value was recorded in DR (0.31±0.0076 mm). However, RC did not-differ significantly neither from DR nor from GP. Significant effect of genetic group on shell thickness was also reported by Niranjan *et al.* (2008) [16]. However, Mohanty and Nayak (2011) [15] found non-significant effect of genetic group on shell thickness. Almost similar shell thickness was also reported by Mohanty and Nayak (2011) [15], Alewi *et al.* (2012) [1], Jha and Prasad (2013) [10] and Kumar *et al.* (2014) [13] in RIR, VR, indigenous and other exotic fowls. On the contrary Niranjan *et al.* (2008) [16] and Sinha *et al.*, (2018) [21] in Gramapriya, Zita *et al.* (2009) [25] in brown egg layer strain and Sarica *et al.* (2012) [20] in brown and white egg laying strains were noticed higher estimates of shell thickness. Significantly higher shell thickness in purebreds than those of crossbreds, was also reported by Bharambe and Garud (2012) [2].

3.3 Egg Derived Traits

List squares analysis of variance reveled significant effect on genetic groups on various egg derived traits under study excerpt shape index. Significantly higher Haugh unit was found in GP and DR however, lowest value was recorded in RC followed by VR, the difference between later two was significant statistically. On the contrary, Haunshi (2009) [8] observed non-significant effect of genetic group on Haugh unit score in VR and White Leghorn breeds of chickens. However, Niranjan *et al.* (2008) [16], Padhi *et al.* (2013) [17] and Sinha *et al.* (2018) [21] observed lower value of Haugh unit in comparison to the present study. The higher Haugh unit in present study indicated the superior quality of the albumin in improved varieties under studied.

Although the shape index was not significantly influenced by genetic groups, but higher value was observed in VR than those of DR followed by GP and RC (Table-2). Almost similar shape index was also reported by Niranjan *et al.*, (2008) in GP (78.0) and VR (76.2) By Bharambe and Garud (2012) [2] in DR (75.57). Table-2 showed significantly higher albumin index in DR in comparison to rest of three genetic groups which did not differ significantly among themselves. Significant effect of genetic group on albumen index had also been reported by various group of workers (Mohanty and Nayak 2011, Alewi *et al.* 2012, Sarica *et al.* 2012; Sreenivas *et al.* 2013) [15, 1, 20, 23]. However, Sarica *et al.* (2012) [20], Bharambe and Garud (2012) [2] and Jha and Prasad (2013) [10] obtained lower albumin index value in comparison to our values. Yolk index was significantly higher in GP (0.43) than those of other three genetic groups. The difference between among latter three genetic groups were non-significant statistically. Our findings were in close agreement to those of Padhi *et al.* (2013) [17] in VR and Sinha *et al.* (2018) [21] in VR and GP. However, Bharambe and Garud (2012) [2] in DR and VR obtained lower yolk index value and Niranjan *et al.*, (2008) [16] recorded higher yolk index value in GP and VR than the present study. It is reported that changes in interior quality traits could be expected during egg production period.

Table 2: Least-square means of various egg derived traits

Groups	DR	RC	VR	GP	Overall (μ)
Haugh unit	98.92±0.558^a	93.59±0.624^c	96.62±0.558^b	99.50±0.598^a	97.16±0.297
Shape index	74.67±0.501	74.44±0.560	75.31±0.501	74.48±0.538	74.72±0.267
Albumin index	0.33±0.048^a	0.12±0.054^b	0.13±0.048^b	0.14±0.051^b	0.18±0.025
Yolk index	0.41±0.0033^b	0.41±0.0037^b	0.42±0.0033^b	0.43±0.0035^a	0.42±0.0017

a-c; values bearing same superscript in a row did not differ significantly.

4. Conclusion
External and internal egg quality as well as egg derived traits were significantly influenced by genetic groups. In general, egg quality traits of DR were significantly superior then other three genetic groups. The second superior genotype for egg equality traits was RC. Hence, it was concluded that the two-purebred strain (DR and RC) were superior than two synthetic strain (VR and GP) with respect to egg quality traits of chicken.

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