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Study of egg quality traits in Vanaraja male line (PD-1)

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Abstract
The experiment was carried out to evaluate different external and internal egg quality traits in Vanaraja male line (PD-1) chicken. The average egg weight (g), yolk colour, shape index, Haugh unit, yolk weight (g), albumen weight (g), shell weight (g), and shell thickness (mm) were, respectively, 56.94±0.21, 7.58±0.06, 76.61±0.22, 84.88±0.49, 17.38±0.07, 30.53±0.16, 5.07±0.11 and 0.32±0.0013. Significant differences ($p \leq 0.05$) in haugh unit, shell weight and shell thickness, high significant difference ($p \leq 0.01$) in albumen weight and very high significant difference ($p \leq 0.001$) in egg weight, yolk colour, yolk weight, at 40 weeks of age were observed among four hatches.

Keywords: Vanaraja male line (PD-1), egg quality traits, Haugh unit, shape index

Introduction
Poultry eggs and meat are cost-effective and widely accessible sources of high-quality protein for humans. Among the various economically important poultry species, chickens are particularly valuable as they provide both nutrient rich eggs and protein dense meat. In backyard poultry systems, analyzing egg quality is essential for maintaining food safety, ensuring optimal nutritional value, and promoting economic sustainability. Unlike commercial farms that operate under controlled and standardized conditions, backyard setups tend to be more variable and less regulated. As a result, regular assessment of egg quality becomes a practical and valuable tool for optimizing egg production, monitoring flock health, and enhancing overall management efficiency.

Material and Methods
Location of the study: The experiment was conducted at ICAR-Directorate of Poultry Research, Hyderabad, Telangana, India.
A total of 401 eggs were collected from the four hatches at 40 weeks of age (five consecutive days) and various external and internal egg quality traits were estimated. The external characters like egg weight, length and width were measured. Thereafter the eggs were broken and the internal traits like yolk weight, colour, height, albumin weight were recorded using standard procedure. Egg weight, haugh unit, albumin height and yolk colour were measured using egg quality tester (EMT 5200, Japan). The shells of the broken eggs were dried at room temperature to further measure the shell weight and shell thickness. The average egg weight was calculated based on freshly collected eggs from farm individually and the weight was measured to the precision of 0.5 g. Shape index was measured based on the longest length and largest width of each of the eggs was measured (mm) using digital Vernier calipers to the accuracy of 0.1 mm. Yolk colour of each egg was scored by using egg quality tester (EMT 5200, Japan). Yolk weight was recorded for each egg after separating albumen using digital balance to the accuracy of 0.5 g then computing average yolk weight. Albumen weight was recorded for each egg after separating yolk using digital balance to the accuracy of 0.5 g then computing average yolk weight. Haugh Unit score (HU) was computed by using Ames micrometer. The haugh unit score was computed as per the following formula: HU = 100 log (H + 7.57-1.7W0.37) Where H is the albumen height in millimeters and W is the weight of the egg in grams. The shell membrane was removed from the shells and the shells were dried at room temperature. Thereafter the weight was recorded individually closest to 0.1 g accuracy. The shell thickness was measured by using a shell thickness machine (mitutoyo no.7301) with precision of 0.01 mm, at three spots on the shell-one at the broader end,

second at the narrow end and third at center, and average of these was considered as the mean shell thickness.

Statistical analysis

The data were analyzed using least squares technique (Harvey, 1990) to know the effect of hatch on the traits studied. Mean and standard error of egg quality traits was estimated by using SPSS Computer software package The statistical model for least-squares analysis was

$$Yijk=\mu + hi + sj + eijk$$

Where,

Yijk=measurement of a trait on k^{th} bird belonging to i^{th} hatch and j^{th}sex μ=overall mean, hi= effect of i^{th} hatch sj= effect of j^{th} sex, eijk= random error

Results and Discussion

ANOVA for effect of hatch on egg quality traits are presented in Table 1 and 2. All egg quality traits were measured on eggs obtained from birds at 40 weeks of age. Significant difference ($p\leq0.05$) in haugh unit, shell weight and shell thickness, high significant difference ($p\leq0.01$) in albumen weight and very high significant difference ($p\leq0.001$) in egg weight, yolk colour, yolk weight, except shape index were observed among four hatches (Table 3 and 4).

The overall least squares mean of egg weight in the present study was 56.94±0.21 g and varying from 55.82±0.28 to 58.89±0.52 g (Table 3). Similar values were reported by Niranjan *et al.* (2008) [10], Kundu *et al.* (2015) [8] and Padhi *et al.* (2015) [12] in Vanaraja and PD1. Slightly lower values among improved varieties were reported by Haunshi *et al.* (2009) [2] and Padhi *et al.* (2015) [12] in Vanaraja and PD1 line. Higher values were reported by Kalita *et al.* (2012) [7] in PD1 x IWI x PD3 cross and Vanaraja.

The overall least squares mean of Shape index was 76.61±0.22 varying from 76.31±0.34 to 76.80±0.38 among hatches (Table 3). Similar trends were reported in literature for Gramapriya (Haunshi *et al.*, 2009) [2]; Kadaknath (Haunshi *et al.*, 2011) [3]; Gramapriya (Patel *et al.*, 2013) [13]; Ghagus and PD4 cross (Haunshi *et al.*, 2015) [4] and Vanaraja male line (Padhi *et al.*, 2015) [12]. Similarly Higher values were reported by Niranjan *et al.* (2008) [10] in C1 cross.

The yolk colour in Vanaraja male line (PD-1) population varied from 7.30±0.09 to 8.27±0.18 with an overall least squares mean of 7.58±0.06 (Table 3). The present findings were in agreement with the reports of Niranjan *et al.* (2008) [10] in (C1, C2 cross and Gramapriya). Lower values were reported by 103 Padhi *et al.* (2015) [12] in PD1. Whereas, Niranjan *et al.* (2008) [10] reported higher values than the mean values obtained in the present study.

The overall least squares mean of yolk weight and albumen weight recorded in the present study were 17.38±0.07 and 30.53±0.16 g and the corresponding ranges were 17.10±0.17 to 18.05±0.14 g and 30.00±0.21 to 32.00±0.54 g, respectively (Table 3 and 4). Similar values were reported by Malik and Singh (2010) [9] in CARI Nirbheek and Kundu *et al.* (2015) [8] in BrN x Van cross. While Chatterjee *et al.* (2007) [1] and Haunshi *et al.* (2011) [3] reported lower values, with respect to albumin, which was comparable with reports by Sreenivas *et al.* (2013) [17]. Slightly higher values among improved varieties were reported by Niranjan *et al.* (2008) [10] and lower values were reported by Chatterjee *et al.* (2007) [1], Haunshi *et al.* (2011) [3] and Kundu *et al.* (2015) [8].

The overall least squares mean of haugh unit, a measure of albumin quality was found to be 84.88±0.49 and the corresponding ranges were 82.12±1.65 to 85.51±0.67 (Table 4), which was comparable to the reports by Padhi *et al.* (2013) [11] in PD1 line and was higher than mean values reported by Haunshi *et al.* (2011) [3] in Aseel and Kadaknath, Sreenivas *et al.* (2013) [17] in strains of WLH and Jha *et al.* (2013) [5, 6]. While the present estimates were lower than the values reported by Kundu *et al.* (2015) [8] and Rath *et al.* (2015) [15] in Van x BrN and WLH, respectively.

The overall least squares mean of shell thickness was found to be 0.32±0.01 mm and varied from 0.32±0.02 to 0.33±0.03 (Table 4), which was comparable with reported values for PD1 (Padhi *et al.*, 2013 and Padhi *et al.*, 2015) [11, 12]; Gramapriya (Jha and Prasad, 2013) [5, 6]; Kadaknath (Jha *et al.*, 2013) [5, 6]; BN x Van (Kundu *et al.*, 2015) [8] and WLH (Rath *et al.*, 2015) [15]. While Rayan *et al.* (2015) [16] and Rajaravindra *et al.* (2015) reported slightly higher shell thickness values in RIR, Bahig, Matrouh and PB2 genotypes.

The overall least squares mean of shell weight recorded in the present study was 5.07±0.11 g and ranged from 4.83±0.03 to 5.73±0.59 g (Table 4), which was in close comparison with strains of IWK reported by Sreenivas *et al.* (2013) [17] but was lower than the reported values in backyard varieties, their crosses and exotic breeds (Kundu *et al.*, 2015 and Rayan *et al.*, 2015) [8, 16]. These differences are expected as shell weight depends on egg weight which in turn depends on genotype and nutritional background of their stock.

Table 1: ANOVA for effect of hatch on egg quality traits egg weight, shape index, yolk weight and yolk colour

Source of variation	d.f	Egg weight		Shape index		Yolk weight		Yolk colour	
		MS	F	MS	F	MS	F	MS	F
Between hatches	3	203.153	12.085***	0.298	15.088	17.295	7.456***	16.359	11.12***
Error	397	16.811		19.774		2.32		1.471	

***Significant ($p\leq0.001$)

Table 2: ANOVA for effect of hatch on egg quality traits albumen weight, haugh unit, shell weight and shell thickness

Source of variation	d.f	Albumen weight		Haugh unit		Shell weight		Shell thickness	
		MS	F	MS	MS	MS	F	MS	F
Between hatches	3	85.606	8.295**	2.771*	4.716*	2.771*	0.004	4.716*	5.884
Error	397	10.321		5.446	0.001	5.446		0.001	

*Significant ($p\leq0.05$) and ** Significant ($p\leq0.01$)

Table 3: Least squares means for egg quality traits egg weight, shape index, yolk weight and yolk colour

Effect	n	Egg weight	Shape index	Yolk weight	Yolk colour
Overall	401	56.94±0.21	76.61±0.22	17.38±0.07	7.58±0.06
HatchI	188	55.82±0.28^{a}	76.80±0.38	17.20±0.10^{a}	7.30±0.09^{a}
HatchII	96	56.96±0.28^{a}	76.31±0.34	17.10±0.17^{a}	7.50±0.12^{a}
HatchIII	77	58.89±0.52^{b}	76.47±0.43	18.05±0.14^{b}	8.02±0.10^{b}
HatchIV	40	58.38±0.75^{b}	76.70±0.49	17.67±0.29^{b}	8.27±0.18^{b}

Means with the different superscripts in a column differ significantly ($p \leq 0.001$)

Table 4: Least square means for egg quality traits albumen weight, haugh unit, shell weight and shell thickness

Effect	n	Albumen Weight	Haugh unit	Shell weight	Shell thickness
Overall	401	30.53±0.16	84.88±0.49	5.07±0.11	0.32±0.0013
HatchI	188	30.00±0.21^{a}	85.51±0.67^{c}	4.83±0.03^{c}	0.33±0.0021^{a}
HatchII	96	30.06±0.26^{a}	84.78±0.99^{b}	4.97±0.05^{b}	0.32±0.0028^{b}
HatchIII	77	31.65±0.48^{b}	84.89±1.22^{b}	5.73±0.59^{a}	0.32±0.0024^{b}
HatchIV	40	32.00±0.54^{b}	82.12±1.65^{a}	5.17±0.07^{b}	0.33±0.0034^{a}

Means with the different superscripts in a column differ significantly ($p \leq 0.05$) and ($p \leq 0.01$)

Conclusion

The egg quality traits observed in the Vanaraja male line at 40 weeks of age are optimal for maximizing the production of high-quality chicks per hen, thereby contributing to improved economic returns for farmers.

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