Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2639

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (3):** 293-300 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Egg Weight on Egg Quality Traits of Laying Hens

Beena Sinha[1*], K. G. Mandal[2] and Ragini Kumari[1]

[1]Ph.D. Scholar, Animal Genetics and Breeding Division, ICAR-NDRI, Karnal - 132001, Haryana

[2]University Professor, Department of Animal Genetics and Breeding,

Bihar Veterinary College, Patna- 800014, Bihar

*Corresponding Author E-mail: bkumarvet@gmail.com

Received: 27.02.2017 | Revised: 8.03.2017 | Accepted: 10.03.2017

ABSTRACT

The present experiment aimed to analyse effect of egg weight on egg quality traits both external and internal.Experiment was carried out with total of 211 eggs, which were collected from a Vanaraja and Gramapriya birds pooled over the genetic groups . These hens were reared in a deep litter system. Collected eggs were categorized according to weight and classified in different egg groups with a difference of 5g each. The purpose of the study was to determine the effect of egg weight on egg quality traits. Egg weight pooled upto 28 weeks of age was found to have significant (P<0.05) effect on all the egg quality traits. The heavier egg weight groups had higher egg width, shape index, albumen height and yolk height. The absolute weight of albumen, yolk and egg shell were estimated to be more in heavier egg weight groups. The 51-55g egg weight group observed to have higher albumen percent, albumen index, egg length and shell thickness. Shell percent found to be higher both in small and large sized egg groups, suggesting that shell weight of small and large sized eggs had higher shell weight percent than medium size. The egg weight was found to have significant (P<0.05) effect on egg quality traits and heavier egg weight groups had higher estimates for all the egg quality traits except yolk index and yolk percentage.

Key words: *Egg Weight, External Egg Quality, Internal Egg Quality.*

INTRODUCTION

The number of eggs laid by a bird is not the only criterion to be considered in breeding for egg production. Emphasis must also be given to egg size since it adds equally well to the economics of production. The avian egg is not only a tool for reproduction but is also a valuable food source for humans[1]. The sizes and shapes of avian eggs differ among the various species of birds. The egg size and internal quality of eggs are important for both table and hatching eggs[1]. The nutrient content of eggs and the weight of day-old chicks depend on the weight of the egg. A laying hen's egg weight is affected by many factors such as heredity, breed, strain, age of hen, body size, feed and water consumption, ambient temperature and diseases[2]. Egg weight is an important trait that influences egg quality as well as grading[3].

Cite this article: Sinha, B., Mandal, K.G. and Kumari, R., Effect of Egg Weight on Egg Quality Traits of Laying Hens, *Int. J. Pure App. Biosci.* **5(3):** 293-300 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2639

It is a parameter that can be determined without breaking the egg[4]. Egg weight is a direct proportion of albumen, yolk and shell. Significant differences in egg size were reported among lines of white leghorns[5]. The proportion of yolk tends to be greater in larger eggs and the proportion of albumen was measured as smaller in light eggs. In addition, egg weight influences egg shell quality[6]. Thus owing to the above consideration and importance of egg weight, present study was taken over.

MATERIAL AND METHOD

To examine the effect of egg weight on egg quality traits, a total of 211 eggs were collected at random for the research from the Institutional Livestock Farm of Bihar veterinary college, Patna-14. All these eggs were divided into 4 different groups according to the egg weight with the difference of 5 g from each. These groups were designated as group I (40-45 g), Group II (46-50 g), Group III (51-55 g) and group IV (56 g and above), similar to the Indian egg size standards. During the entire period of experiment, the chicks were kept under uniform managmental conditions and standard poultry ration. Feed and water were provided *ad lib* throughout the experimental period.

Measurements of traits

Egg Weight: The weight of eggs were taken with the help of electronic balance to the nearest of 0.01 g accuracy at the age of sexual maturity and at different weeks of age.

Egg Length & Width: The length and width of the measured with the help of Vanier Caliper to the nearest of 0.01 cm.

Shape Index: The shape index was calculated as the ratio of egg width to the egg length as given by Olawumi and Ogunlade[7].

Shape index = Egg Width / Egg length x 100

Egg Shell Thickness: The shell was separated from the vitelline membrane and thickness was measured by Screw Gauge. The shell thickness was measured at three places, first at the broaden end, second at narrow end and third at the middle part of the body of the egg shell. The mean of these three measurements was considered as shell thickness of the egg.

Shell Weight and Percent Shell: For taking shell weight the vitelline membrane was separated from the egg shell then washed and kept for a period of 24 hrs after that, weight of egg shell was taken with the help of electronic balance with accuracy of 0.01 g. The percent egg shell was calculated as the ratio of shell weight to the total egg weight and expressed as percentage.

Albumen Height: The egg was broken on a perfectly leveled glass plate. The height of thick albumen was measured by Spherometer at the highest and lowest points of the albumen. The average of two measurements was taken as mean height.

Albumen Index: Albumen index was calculated by the following formula, given by Olawumi and Ogunlade[7].

Albumen index = Height of albumen/ Width of albumen x 100

Albumen and Yolk Weight and Percentage: The egg albumen and yolk were separated with the help of spatula and poured in two clean beakers after cleaning the residual albumen from the shell and weighted by Top pan sartorius balance with accuracy of 0.01g. The percent albumen was calculated as the ratio of albumen weight to the total egg weight and percent yolk was calculated as the ratio of yolk weight to the total egg weight and expressed as percentage[7].

Yolk Height: The yolk height was measured using the Spherometer. The height was taken at the highest point of egg yolk.

Yolk Index: Yolk index was calculated as per the formula given by Olawumi and Ogunlade[7].

Yolk index = Height of the yolk/ Width of yolk x 100

Yolk width: Yolk width (diameter) of egg yolk was measured with the Vernier Calipers. The width was multiplied by 10 to convert it into millimeter and the average of three measurements was taken for each observation.

Statistical Analysis

Data were analyzed by Mixed model least-squares and maximum likelihood computer program pc-2 in the Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna-14. The least squares means and standard error were calculated through least squares models[8] and some of the minor calculations were carried out by a programmable scientific calculator $CASIO_{fx-100s}$ as per standard statistical method[9]. Significant differences between means were tested by Duncan multiple range test (DMRT) and modified by Kramer, 1957.

RESULT AND DISCUSSION

Effect of egg weight on external egg quality traits : The least squares means and SE of egg length, egg width, shape index and shell thickness have been presented in Table -1. The average egg length in different egg weight group ranged from 51.21mm to 53.705mm. The lowest egg length was estimated in 40-45 g egg weight group and the highest was in 60 and above weight group. The egg length found in present study were similar to the earlier findings[10,11,12,13]. The analysis of variance revealed significant (P<0.05) effect of egg weight on egg length [1]. The average egg width was found to be increased with the increase in egg weight in subsequent groups. The analysis of variance revealed significant (P<0.05) effect of egg weight on egg width[1]. The average egg width ranged from 39.68 to 44.30 mm. The highest egg width was seen in >56gm egg wight group where as lowest was seen in 40-45gm egg weight group[10,11]. The analysis of variance revealed significant (P<0.05) effect of egg weight on shape index. The average shape index ranged from 75.89 in 51-55gm egg weight group to 82.05 in 56g and above egg weight group indicating normal to round shape index. Padhi *et al.*[14] observed shape index value as 76.49 at 28th week and 77.45 at 72nd week which are in close agreement with the findings of the present study. Sekeroglu and Altuntas[15] stated that the egg shapes can be differentiated using shape index. The shapes most often encountered are sharp, normal and round eggs, their shape indices were reported to be <72, 72-76 and >76 respectively. Thus in present study shape index obtained were both normal and round. The effect of egg weight on egg shape index was not significant as reported by Sekeroglu and Altuntas[15] and Alkan *et al.*[1] unlike present finding . The difference among the egg shape index reported in the various studies may be due to variations in strain, stocking density, seasonal factors, feeding and watering systems, age and the breed of birds studies. The significant (P<0.05) effect of egg weight on shell thickness was observed. The shell thickness between 40-45, 46-50 and 56 and above groups did not differ significantly however shell thickness of 51-55gm egg weight group differed significantly. Alewi *et al.*[16] and Jha and Prasad[17] reported lower shell thickness than the findings of present study. The significant effect of egg weight on shell thickness and shell weight were also reported[1,15]. The higher shell thickness in the birds developed for backyard poultry keeping was a better indication for their suitability for rural backyard farming. The differences in egg shell thickness reported by different researcher may be due to the environmental condition, feed quality and strain of layers. The average shell weight observed ranged from 4.31gm to 5.62gm. There was significant effect of egg weight on shell weight[10,12,14,18]. The higher average estimate of shell weight reported by Islam and Dutta[11] as compared to the present findings may be due to different breeds taken. The analysis of variance revealed the significant (P<0.05) effect of egg weight on angles corresponding to the percentage of egg shell[1]. The present study suggested that in very small and very large sized eggs have higher percentage of egg shells as compared to the medium sized eggs. The average shell weight observed by Niranjan *et al.*[10], Sreenivas *et al.*[18] and Padhi *et al.*[14] were in close agreement with the values estimated in the present investigation.

Effect of egg weight on internal egg quality traits :The least squares means and SE of albumen height, albumen index, yolk height, yolk width and yolk indices of various egg weight groups pooled over genetic groups have been presented in Table-2. The analysis of variance revealed significant (P<0.05) effect of egg weight on albumen height. The average albumen height ranged from 5.69gm to 6.55gm[10,15]. Albumen height subsequently increased with the increase in egg weight. The value of albumen height reported by Kumar *et al*.[19] were higher. There was significant effect of egg weight on albumen height[1,15].

The analysis of variance revealed significant (P<0.05) effect of egg weight on albumen index[1]. However, the average albumen index in 40-45 and 56g and above egg weight groups did not differ significantly. The observed value of albumen index was in close agreement Sreenivas *et al* .[18] in IWH strain and Rajaravindra *et al*[13]. A similar albumen index was also reported by Jha and Prasad[17] and Debata *et al*[12].

The analysis of variance revealed significant (P<0.05) effect of egg weight on yolk height[1,15]. The values of yolk height found in present study are in close agreement to the values obtained by different researchers in different breed and age[15,16,19]. A lower value was observed by Alkan *et al*.[1] and Rajaravindra *et al*.[13] than the present findings. The analysis of variance revealed significant (P<0.05) effect of egg weight on yolk width[15]. The average yolk width ranged from 36.46mm to 40.27mm Reports on yolk width is very scanty however Rajravindra *et al*.[13] reported lower value of yolk width where as reports of Alkan *et al*.[1] is similar to the findings of present study. Significant (P<0.05) differences were observed between different egg weight groups for yolk index. The average yolk index of 40-45 and 46-50 g egg weight groups were observed to be significantly (p<0.05) higher than the 51-55 g egg weight group. However, yolk indices of the other egg weight groups among themselves did not differ significantly. The yolk indices reported by Padhi *et al*.[14] and Rajaravindra *et al*.[13] were similar to the present study.

The analysis of variance revealed significant (P<0.05) effect of egg weight on albumen weight[1]. The average albumen weight was shown to be increased gradually with the increase in egg weight in the subsequent groups. The average albumen weight differed significantly (p<0.05) among the groups. The values were in close agreement to the values reported by Padhi *et al*.[14] in Vanaraja and Gramapriya birds, Sreenivas *et al*.[18] in White Leghorn strains and Rajaravindra *et al*[13]. The egg weight groups were shown to be differed significantly (P<0.05) for yolk weight. The average yolk weight was shown to be increased gradually with the increase in egg weight in the subsequent groups. The values found in the present study are comparable to the values of Niranjan *et al*.[10] in Vanaraja and Grampriya , Padhi *et al*.[14] in Vanaraja.

The mean angles corresponding to the percentage of albumen weight were found to be differed significantly (P<0.05) among the various egg weight groups (Table-2). The 56 and above g egg weight group was also found to have significantly (P<0.05) lowest percentage of egg albumen. The angles corresponding to the percentage of yolk weight were found to be differed significantly (P<0.05) among various egg weight groups. The yolk percentage in general was shown to be varied inversely with the egg weight except 56g and above egg weight group. Significantly highest yolk percentage was estimated to be 33.850 in 56g and above egg weight group. The values found in the present study are comparable to the values of Niranjan *et al*.[10] in Vanaraja and Grampriya and Padhi *et al*[14]. Higher value was reported by Alkan *et al*.[1] than the present study.

Table 1: Least square mean and SE of external egg quality traits

TRAITS	Egg weight groups(gm)			
	40-45	46-50	51-55	>56
Egg Length	$51.21^{a} \pm 0.236$	$52.24^{b} \pm 0.096$	$55.24^{c} \pm 0.183$	$53.705^{d} \pm 0.136$
Egg Width	$39.68^{a} \pm 0.295$	$40.67^{b} \pm 0.120$	$41.92^{c} \pm 0.228$	$44.305^{c} \pm 0.170$
Shape Index	$77.57^{ac} \pm 0.557$	$77.87^{a} \pm 0.226$	$75.89^{c} \pm 0.431$	$82.509^{b} \pm 0.321$
Shell Thickness	$0.377^{ac} \pm 0.003$	$0.37^{a} \pm 0.001$	$0.41^{b} \pm 0.002$	$0.39^{c} \pm 0.002$
Shell Weight	$4.435^{a} \pm 0.061$	$4.316^{a} \pm 0.025$	$5.014^{b} \pm 0.047$	$5.627^{c} \pm 0.035$
Percent Shell weight	$18.344^{a} \pm 0.133$ (25.33)	$17.47^{b} \pm 0.054$ (24.65)	$18.13^{a} \pm 0.103$ (25.10)	$18.003^{a} \pm 0.077$ (25.10)

NB- 1. Values present within the parentheses indicating actual percentage.

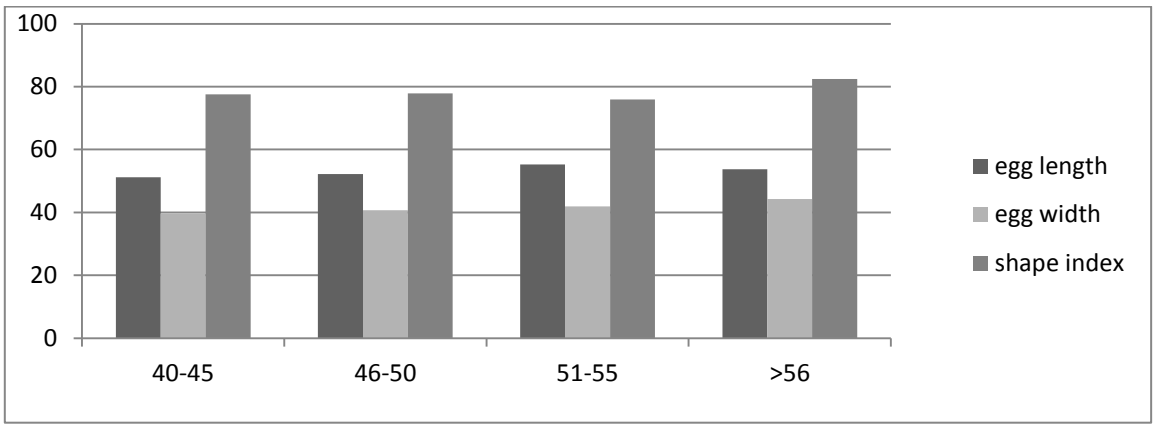
2. Means with similar superscripts (row wise-abc) did not differ significantly.

Table 2: Effect of egg weight on internal egg quality traits

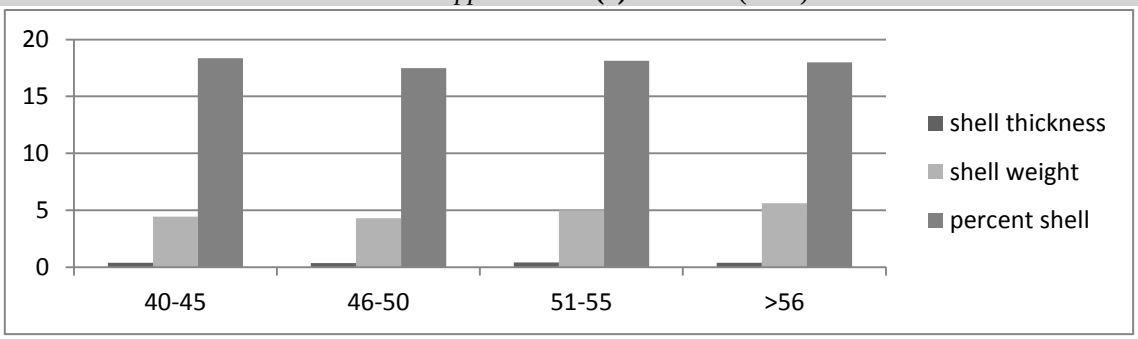
TRAITS	Egg weight groups(gm)			
	40-45	46-50	51-55	>56
Albumen height	$5.708^{b} \pm 0.062$	$5.922^{c} \pm 0.025$	$6.689^{a} \pm 0.028$	$6.757^{a} \pm 0.036$
Albumen index	$7.350^{a} \pm 0.116$	$7.772^{b} \pm 0.047$	$9.000^{c} \pm 0.090$	$7.55^{a} \pm 0.067$
Yolk height	$16.438^{ac} \pm 0.278$	$15.74^{a} \pm 0.113$	$16.69^{bc} \pm 0.215$	$17.350^{b} \pm 0.160$
Yolk width	$36.466^{a} \pm 0.379$	$36.48^{a} \pm 0.154$	$40.27^{b} \pm 0.294$	$40.22^{b} \pm 0.219$
Yolk index	$45.061^{a} \pm 0.732$	$43.172^{a} \pm 0.297$	$41.466^{b} \pm 0.567$	$43.201^{a} \pm 0.098$
Albumen weight	$27.361^{a} \pm 0.271$	$29.954^{b} \pm 0.11$	$33.126^{c} \pm 0.21$	$34.833^{d} \pm 0.156$
Yolk weight	$12.761^{a} \pm 0.175$	$13.14^{b} \pm 0.071$	$13.656^{c} \pm 0.135$	$18.28^{d} \pm 0.101$
Percent Albumen weight	$51.577^{a} \pm 0.191$ (45.86)	$52.592^{b} \pm 0.077$ (46.43)	$53.083^{c} \pm 0.148$ (47.18)	$50.346^{d} \pm 0.110$ (45.17)
Percent yolk weight	$32.322^{a} \pm 0.189$ (34.63)	$31.733^{b} \pm 0.077$ (34.27)	$30.850^{c} \pm 0.147$ (33.71)	$33.850^{d} \pm 0.109$ (35.55)

NB- 1. Values present within the parentheses indicating actual percentage.

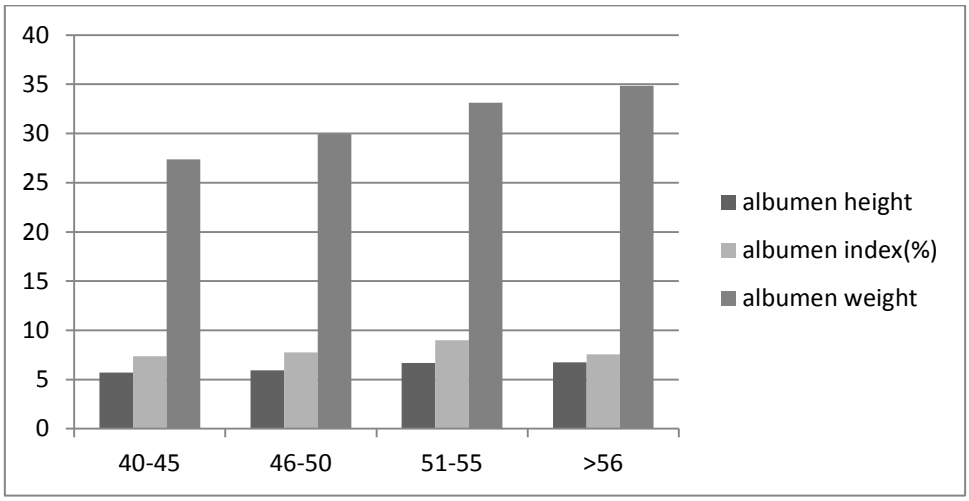
2. Means with similar superscripts (row wise-abc) did not differ significantly.



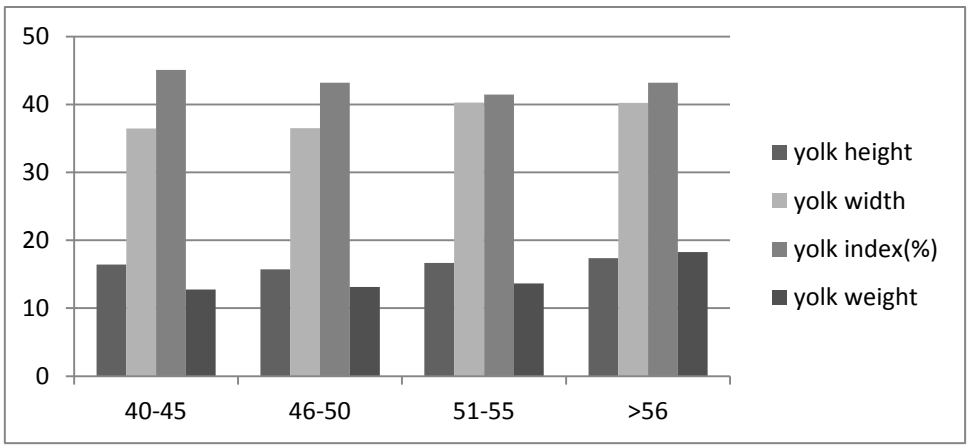
Graph 1: This graph shows egg length, egg width and shape index in different egg weight groups



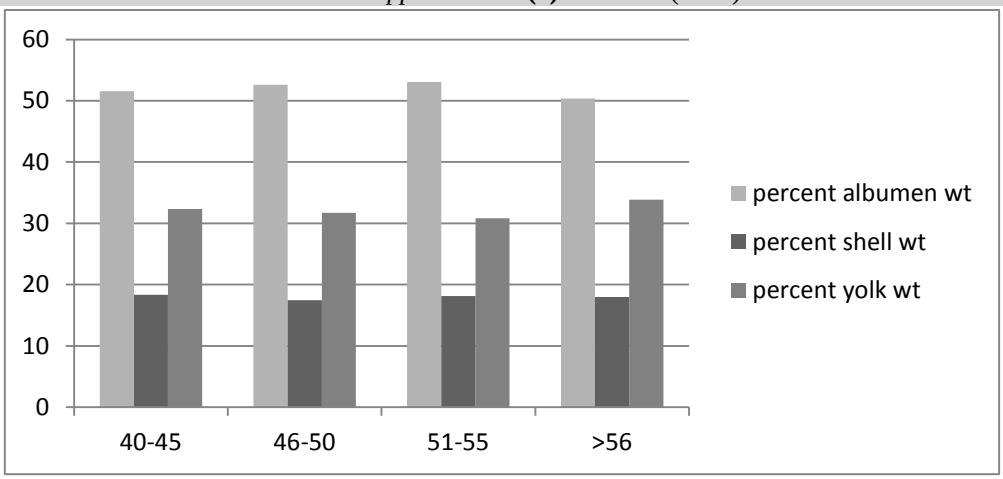
Graph 2: This graph shows shell thickness, shell weight and percent shell in different egg weight group



Graph 3: This graph shows albumen height, albumen index and albumen weight in different egg weight group



Graph 4: This graph shows yolk height, yolk width, yolk index and yolk weight in different egg weight group



Graph 5: This graph shows percent albumen weight, percent shell weight and percent yolk weight

CONCLUSION

Based on present study it was concluded that the heaviest egg weight group reported to have significantly (P<0.05) highest egg width, yolk weight, albumen weight, shell weight, yolk height, albumen height, shape index and yolk percentage as compared to the lower egg weight groups except for egg length, shell thickness, albumen index. The average estimates of shell percentage was found to be more both in large and small sized eggs as compared to the medium sized eggs.

REFRENCES

1. Alkan, S., Galic, A., Karsli, T., and Karabag, K. Effects of egg weight on egg quality traits in partridge (Alectoris Chukar). Journal of Applied Animal Research, **43(4):** 450-456 (2015).
2. Fowler, C.T.S.,(1972). How management can affect egg size. *Poult Sci* **59:** 2038–2046
3. Farooq, M., Mian, M.A., Ali, M., Durrani, F.R., Asquar, A. and Muqarrab, A.K. Egg traits of Fayomi bird under subtropical conditions. *Sarad J Agric* **17:**141–145 (2001).
4. Farooq KAM, Durrani FR, Sarbiland K and Chaud N, Predicting egg weight, shell weight, shell thickness and hatching chick weight of Japanese quails using various egg traits as regressors. *Int J Poult Sci* **2:** 164–167 (2003).
5. Marion WW, Nordskog AW, Tolman HS and Forsythe RH, Egg composition as influenced by breeding, egg size, age and season. *Poult Sci* **43:** 255–264 (1964).
6. Kaminska, B. and ZandSkraba, B. Analysis of hen types considering albumen: yolk ratio and its changes during the laying cycle, in *Proceedings of the 4th European Symposium on the Quality of Poultry Products. II. Eggs and Egg Products*, Doorwerth, Netherlands, pp. 43–49 (1991).
7. Olawumi, S.O. and Ogunlade, J.T. Phenotypic Correlations Between Some External and Internal Egg Quality Traits in the Exotic Isa Brown Layer Breeders. *Asian J. Poult. Sci.,* **2(1):** 30-35 (2008).
8. Harvey, W.R. Users guide for LSMLMW, mixed model least squares and maximum likelihood computer programme. PC-2 version. Mimeograph, Ohio State University, OH, US. (1990).
9. Snedecor, G.W. and Cochran, W.G. *Statistical methods*. 8th edn. Oxford and IBH Publication, New References Delhi. (1994).
10. Niranjan, M., Sharma, R., Rajkumar, U., Chatterjee, R., Reddy, B., Battacharya, T. Egg quality traits in chicken varieties developed for backyard poultry farming in India. *Livest. Res. Rural. Dev*., **20:** 12-20 (2008).
11. Islam, M. and Dutta, R. Egg quality traits of indigenous, exotic and crossbred chickens (Gallus dometicus L.) in rajshahi, Bangladesh. *J. Life. Earth. Sci.*, **5:** 63-67 (2010).

12. Debata. D, Panigrahi ,B., Panda. N., Pradhan, C.R., Kanungo, S. and Panda, P.K. Egg production potential and egg quality traits of black rock, red cornish and vanaraja chicken reared in coastal climatic condition of odisha, india. *Indian J. Anim. Res.*, **48 (1):** 91-93 (2014).
13. Rajaravindra, K.S., Rajkumar, U., Rekha, K., Niranjan, M., Reddy, B.L.N. and Chatterjee, R.N., Evaluation of egg quality traits in a synthetic coloured broiler female line. *Journal of Applied Animal Research*, **43(1):** 10-14 (2014).
14. Padhi, M.K., Chatterjee, R.N., Haunshi, S. and Rajkumar, U. Effect of age on egg quality in chicken. *Indian J. poultry Sci*., **48(1):** 122-125(2013).
15. Sekeroglu, A. and Altuntas, E. Effects of egg weight on egg quality characteristics. *J Sci Food Agric*, **89:** 379–383 (2009).
16. Alewi, M., Melesse, A. and Teklegiorgis, Y. Crossbreeding Effect on Egg Quality Traits of Local Chickens and Their F1 Crosses With Rhode Island Red and Fayoumi Chicken Breeds Under Farmers' Management Conditions. *J Anim Sci Adv.*, **2(8):** 697-705 (2012).
17. Jha, D.K. and Prasad, S. Production performance of improved varieties and indigenous breed of chicken in Jharkhand. *Indian J. poultry Sci*., **48(1):** 109-112 (2013).
18. Sreenivas, D., Manthani, G.P., Mahender, M. and Chatterjee, R.N. Genetic analysis of egg quality traits in White Leghorn chicken. *Vet world*., **6(5)**: 263-266 (2013).
19. Kumar, N., Belay, Z.N., Asfaw, Y.T. and Kebede, E. Evaluation of egg quality traits of Rhode Island Red and Bovans White under intensive management in Mekelle, Ethopia. *J. Agri. Vet. Sci*., **7(2):** 71-75 (2014).