

Egg Quality Traits and their Repeatability Estimates in High and Low Body Weight Lines of Crossbred Normal Feather, Naked Neck and Frizzle Chicken.

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Target audience: Poultry geneticist, Poultry farmers, Extension workers

Abstract:

Egg quality traits and their repeatability estimates were studied using a flock of 179 divergently selected crossbred normal feather (NF), naked neck (Na) and frizzle feather (FF) chickens. The high body weight line birds had heavier egg weights with the frizzle individuals (HFF) recording the highest egg weight of 54.22g at 42 weeks. The frizzle birds in the low body weight line (LFF) also had the heaviest egg weight of 50.05g while the naked necks (LNa) had the lowest egg weight of 34.64g. Shell thickness was not significantly different in both body weight lines, while yolk index (YI) was highest in the high naked neck line (HNa; YI = 0.59). Haugh unit was generally high and above 90% in both lines. Repeatability estimates for egg weight were low to moderate and ranged from 0.22 in HNF to 0.41 in HFF while estimates of repeatability for shell thickness and Haugh unit were higher in the heavy body weight lines when compared to their low weight line counterparts. The magnitude of repeatability estimates for these traits seem to indicate that improvement for them could be achieved more by enhancing their non genetic factors.

Keywords: Egg quality traits, repeatability estimates, divergent body weights, crossbred indigenous chicken.

Description of Problem

To fully characterise an avian and other animal species, reliable estimates of their genetic parameters are required. Apart from heritability and genetic correlations among traits, repeatability is another useful genetic parameter, providing a tool for quantifying the transmitting ability of a stock and its ability to maintain its performance and ranking within a test group on subsequent performance (1). This transmitting ability according to (2)

arises from inherent and other permanent influences causing observable differences among the individuals. Generally, the magnitude of a repeatability estimate gives indication of the extent to which selection practised at any stage would affect subsequent flock performance (3).

A number of egg quality traits are known to be moderately to highly heritable and repeatable (4,5) and consequently, they tend to lend themselves to improvement through selection (2). However, a number

of investigators have reported low repeatability values for egg production and egg quality traits in different strains of chicken (1, 6).

Major problem arising in the measurement of egg traits such as egg weight, egg shape, shell thickness and Haugh unit for selection purpose is the variability of repeat measurements on the same individual over a short period of time. The question which has often arisen is how many eggs per bird will be needed to reasonably characterise the inherent quality of a chicken egg. To this question, (7) suggested six to ten eggs per hen to be satisfactory, while (8) considered measurement of five to ten eggs. It therefore follows that any number of eggs between five to ten eggs would be adequate to effectively characterise egg quality traits in a chicken strain. This study therefore, aimed at evaluating the egg quality traits and their repeatability estimates in high and low body weight lines of crossbred normal feather, naked neck and frizzle chickens in a humid tropical environment.

Materials and Methods

Study location

This study was conducted at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The study site is located within the rainforest agro-ecological zone of South Eastern, Nigeria with average annual precipitation of 1950mm, temperature range of 23-28^oC and average relative humidity of 75% during

the rainy season and relative humidity of 55% during the dry season.

Management of experimental birds

The experimental birds consist of two divergently selected body weight lines made up of three high and three low body weight lines of normal feather (NF), naked neck (Na) and frizzle feather birds (FF). A total of 179 birds aged 42 weeks were utilized and they were developed by a main crossing (Exotic cocks x Local hens) and reciprocal crossing (Local cocks x Exotic hens) with the main crossbreds constituting the low body weight lines while the reciprocal crossbreds were the high weight lines. The low body weight line birds ranged from 1500-1900g while the high body weight lines were 2000-2800g. These birds were maintained at the University Poultry Farm where they were kept in conventional open-sided deep litter pens according to their genetic groups. Routine poultry husbandry practices were strictly carried out. Deworming and delousing of birds were carried out since the stock had been on deep litter pens for about ten months.

Measurement of egg quality traits

Ten eggs per genetic group were collected for egg quality traits determination. Egg weight was taken using Metler electronic scale balance of 0.01g sensitivity. Shell thickness was determined with Ames tripod meter screw gauge (Ames 75 Ms). Evaluation of yolk widths, yolk height and albumen heights was done after the eggs were neatly broken at the middle and the

contents poured into a petri dish. These parameters were measured using Ames Tripod thickness measure (Ames 5 – 6418, 0.1mm). Yolk index (YI) was calculated as ratio of yolk height to yolk width, while Haugh unit was calculated based on albumen height and egg weight using an interior quality calculation for eggs (USDA chart for scoring broken-out-egg).

Data analysis

The analysis of variance technique was employed to estimate variance components which were utilized in the estimation of repeatability of traits’ response. The mixed model used was of the form:

$$y_{ij} = u + G_i + R_{ij} + e_{ij}$$

where y_{ij} = the j^{th} individual record in the i^{th} genotype.

u = overall mean

G_i = effect of the i^{th} genotype ($i = 1, \dots, 6$)

R_{ij} = effect of the j^{th} individual record in the i^{th} genotype ($j = 1, \dots, 60$ eggs)

e_{ij} = random error, assumed to be independently, identically and normally distributed with zero mean and constant variance ($0, \delta^2$)

The estimator of repeatability (R) was obtained as follows:

$$R = \frac{\sigma_i^2}{\sigma_i^2 + \sigma_e^2}$$

Where R = repeatability estimate in line with Henderson (9)

σ_i^2 = individual variance component

$\sigma_i^2 + \sigma_e^2$ = total phenotypic variance

The standard error of each estimate was calculated using (10) formula:

$$SE_{Error}(r) = \frac{\sqrt{2(1-r)^2[1+(k-1)r]^2}}{K(k-1)(n-1)}$$

Where r = repeatability estimate

K = number of eggs per bird

n = number of birds involved.

Results and Discussion

Egg weight of birds in the six genetic groups varied significantly ($P < 0.05$) with the eggs from the high body weight frizzle feather (HFF), normal feather (HNF) and naked neck (HNa) individuals weighing heavier (54.22, 52.05 and 50.22g), respectively than the low weight lines of the naked neck (LNa = 34.64g), normal feather (LNF = 45.36g) and frizzle feather (LFF = 50.50g). The frizzled individuals in both body weight lines showed superior egg weights than their counterparts. This finding seems to support the report of (11) that the frizzle genotypes are heavy birds and showed superior egg weight and egg quality traits over the naked neck and the normal feather individuals.

Shell thickness was not significantly different in the high and low body weight lines and values obtained in this study were similar to the value of 0.31mm reported by (6) for black Olympia layers. The values however, were lower than mean value of 0.58mm reported by (12) for Fulani-ecotype chicken. Differences in shell thickness could be due to breed of bird, calcium-phosphorus ratio in feed and the method of determination of this

parameter, which of course should be disclosed when reporting such result (13).

Yolk index – an indicator of yolk firmness was high and generally above 0.50 in all the genetic groups. However, the heavy naked neck group (HNa) had

significantly the highest yolk index of 0.59. The Haugh unit was also excellent and measured above 90% in all the genotypes which is an indication that these hybrid birds laid good quality eggs (14,15).

Table 1: Egg quality characteristics of high and low body weight lines of normal feather (NF), naked neck (Na) and frizzle (FF) hybrid chicken.

Trait	High body weight line Range (2000 – 2800g)			Low body weight line Range (1,500 – 1900g)			SEM
	HNF	HNa	HFF	LNF	LNa	LFF	
	N=93	N=11	N=21	N=21	N=19	N=14	
Egg weight (g)	52.05 ^b	50.02 ^b	54.22 ^a	45.36 ^c	34.64 ^d	50.50 ^b	0.14
Shell thick (mm)	0.31	0.34	0.31	0.31	0.30	0.33	0.02
Yolk index	0.53 ^b	0.59 ^a	0.54 ^{ab}	0.52 ^b	0.51 ^b	0.55 ^{ab}	0.03
Haugh unit (%)	93.20	96.60	96.70	95.40	91.94	95.07	0.47

^{a-c} Means in the same row with different superscripts are significantly different ($P < 0.05$).

Table 2: Repeatability (R) and standard error of estimates (±) of major egg quality traits in the high and low body weight lines of normal feather (NF), naked neck (Na) and frizzle (FF) hybrid chicken.

Trait	High body weight line Range (2000 – 2800g)			Low body weight line Range (1,500 – 1900g)		
	HNF	HNa	HFF	LNF	LNa	LFF
	42 wk egg wt	0.22±0.02	0.39±0.03	0.41±0.03	0.11±0.01	0.13±0.01
Shell thickness	0.24±0.02	0.38±0.03	0.43±0.03	0.12±0.02	0.14±0.03	0.21±0.02
Haugh unit	0.36±0.01	0.35±0.04	0.58±0.02	0.28±0.01	0.12±0.02	0.30±0.01

The repeatability estimates and their associated standard errors for egg quality traits in the genetic groups are shown in Table 2. Repeatability estimates for egg weight at 42 weeks were low to moderate and ranged from 0.22 to 0.41 being lowest in the normal feather genotypes (HNF=0.22 and LNF=0.11) and highest in

the frizzle feather individuals in both weight lines (HFF=0.41 and LFF=0.14). Estimates of repeatability for the high body weight lines in this study were comparable to values of 0.19 and 0.44 reported by (1) for two strains of 40 week old exotic layers in the same ecological zone. Bennerwitz *et al.* (16) had reported

low estimates of heritability and repeatability for fertility traits and were of the opinion that such observations were as a result of huge influence of non-genetic factors affecting the expression of these traits in laying birds.

Repeatability estimates for shell thickness were uniformly low in all the genetic groups except for HFF individuals which had $R = 0.43$. This group had the highest values for egg weight and Haugh unit. This observation corroborates the reports of (17) that the frizzle birds are heavy birds and that of (18) that bigger birds manifest better egg quality traits than light bodied ones. Repeatability estimates for Haugh unit were generally higher in the heavy bodied lines with the heavy frizzle birds (HFF) having the highest R value of 0.58. It is evident that these high body weight line birds are standard birds and were able to repeat their performance steadily. The frizzle genotypes in both weight lines showed promising egg quality potentials and could be further screened for improvement in both egg production and egg quality traits in the humid tropical environment

Conclusion and Application

This study showed that:

1. The frizzle birds had heavier egg weight and higher estimates of repeatability for the egg traits than their normal feather and naked neck counterparts.
2. The high Haugh unit values recorded for the eggs laid by these hybrid birds reveal that their eggs are of good quality.

3. The low estimates of repeatability for egg quality traits in the normal feather and naked neck individuals indicate that improvement for these traits in these genotypes could be achieved through efficient rearing management and improvement of most of their non genetic factors.

References

1. Udeh , I. (2010). Repeatability of egg number and egg weight in two strains of layer type chicken. *Int. J. Poult. Sci.* 9(7): 675 – 677.
2. Ibe, S.N. (1984). Repeatability of egg quality traits in white Leghorn chicken. *Nig. J. Genet.* 5: 44 – 49.
3. Buss, E.G. (1982). Genetic differences in avian egg shell formation. *Poult. Sci.* 61:2048 – 2055.
4. Kotaiah, T., Mohapatra, S.C, Aijanegulu, P.S. and Ayjagi, R.B.(1976). Heritability and repeatability estimates of some egg quality traits in chickens. *Indian Poult. Gazette* 60(3): 65 – 71.
5. Lazmi jaya, P., Prasad, V.L.K, SreeRama Murthy, A. and Eswara, C.R.C. (2002). Correlations among various egg quality traits in White Leghorn. *Indian J. Anim. Sci.* 79: 810 – 813.
6. Chineke, C.A. (2001). Interrelationships existing between body weight and egg

- production traits in Olympia black layers. *Nig. J. Anim. Prod.* 28(1): 1-8.
7. Scheinberg, S., Ward, R. and Wordskog, A. W. (1953). Breeding for egg quality, heritability and repeatability of egg weight and its components. *Poult. Sci.* 32:504-510.
 8. Farnsworth, G.M. Jr and Nordskog, A.N. (1955). Breeding for egg quality. Genetic differences in shell characteristics and other egg quality factors. *Poult. Sci.* 34: 16 – 26.
 9. Henderson, C.R. (1953). Estimation of variance and covariance components. *Biometrics* 9: 226 – 252.
 10. Becker, W.A. (1984). *Manual of Quantitative Genetics*. 4th Ed. Acad. Enterprises, Washington, USA.
 11. Nwachukwu, E.N., Ibe, S.N. and Ejekwu, K (2006). Short term egg production and egg quality characteristics of main and reciprocal crossbred normal local, naked neck and frizzle chicken x exotic broiler breeder stock in a humid tropical environment. *J. Anim. and Vet. Adv.* 5 (7): 547 – 551.
 12. Fayeye, T.R., Adeshiyan, A.B., and Olugbami, A.A. (2005). Egg traits, hatchability and early growth performance of the Fulani-ecotype chicken. *Livest. Res. Rural Dev.* 17(8) LRRD News.
 13. Oguike, M.A. and Onyekweodiri, E.O. (1998). Evaluation of egg quality of three strains of commercial layer under tropical conditions In: *NSAP Proceedings 24th Ann. Conf.* P. 410.
 14. Ayorinde, K.L. (1987). Physical and chemical characteristics of the egg of four indigenous guinea fowls in Nigeria. *Nig. J. Anim. Prod.* 14:125 – 128.
 15. Isikwenu, J.O., Okaplefe, C.S. and Nmereole, F.U.C.(1999).sStorability performance of chicken eggs under different conditions. Proc. 26th NSAP Ann. Conf. 293 – 296.
 16. Bennerwitz, J.O., Morgades, Presinger, R., Thaler, G. and E. Kalm, E. (2007). Variance components and breeding value estimation for reproductive traits in laying hens using a Bayesian threshold model. *Poult. Sci.* 86:823-828.
 17. Omlet. (2006). Omlet United States of America breed information chickens, frizzle <http://www.omletus/breeds/breed>.
 18. Okonkwo, J.C. and Ibe, S.N. (1994). Repeatbility of egg number and egg quality traits in commercial pullets. *Nig. J. Anim. Prod.*21:1-30.