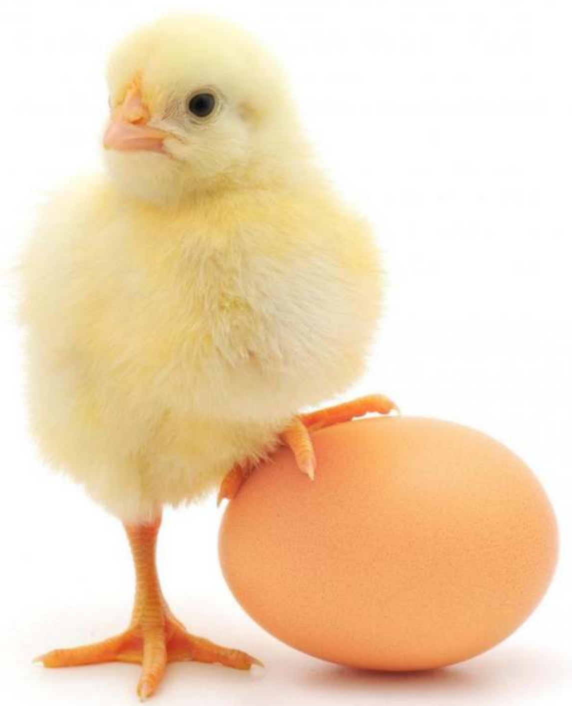
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 9 (8): 744-748, 2010
ISSN 1682-8356

Part-period Egg Production and Egg Quality Characteristics of Two Ecotypes of Nigerian Local Chickens and Their F_1 Crosses

O.M. Momoh[1], A.O. Ani[2] and L.C. Ugwuowo[2]
[1]Department of Animal Breeding and Physiology,
University of Agriculture, Makurdi, Benue State, Nigeria
[2]Department of Animal Science, University of Nigeria, Nsukka, Enugu State, Nigeria

Abstract: Adaptation of the local chickens in Nigeria to the different agro-ecological zones has produced ecotypes that can be conveniently classified on the basis of body weight and size into two viz; Heavy Ecotype (HE) and Light Ecotype (LE). These distinct types may differ in their egg production characteristics. Short-term egg production and egg quality characteristics of HE and LE and their F_1 crosses (HExLE and LExHE) were studied. The objective of the study was to evaluate the short-term egg production and quality traits of the HE, LE and their F_1 reciprocal crosses. Data on percent hen-day production, egg number per hen, egg weight and egg mass of 50 pullets each of HE, LE, HEXLE and LEXHE were collected. Also, external and internal egg quality traits were assessed on a total of 640 eggs. Data were subjected to ANOVA technique. Result showed that there was no significant ($p>0.05$) genetic group effect on short-term percent hen-day production, egg number and egg mass. However, genetic group significantly affected egg weight ($p<0.05$). Genetic group effect was significant ($p<0.01$) in all the egg quality traits studied except shell weight. The crossbred groups demonstrated heterotic effects in egg width and egg shape index but their performances in the other egg quality traits remained intermediate between the two parents. On the basis of short-term egg production the HE and LE may not be considered as distinct strains. Egg quality traits obtained are comparable with most exotic breeds thus demonstrating high egg quality traits of the local chickens of Nigeria.

Key words: Heavy ecotype, light ecotype, egg production, egg quality traits, local chicken

INTRODUCTION

Nigeria is endowed with many poultry species, which have lived, adopted and produced for several generations in the Nigerian environment. The local chickens constitute the majority of these poultry types, numbering about 103 millions (RIM, 1992). They are usually kept at subsistence level in the rural areas where they contribute substantially to annual eggs and meat production, thus elevating the socio-economic status of the rural dwellers, mostly women and children.

The adaptation of the local chickens to the different agro-ecological zones in Nigeria has produced ecotypes that can be conveniently classified on the basis of body weight and size into two viz; heavy ecotype and light ecotype (Momoh, 2005; Momoh and Nwosu, 2008). The light ecotype represents the chicken type from the Swamp, Rainforest and Derived savannah agro-ecological zones, whose mature body weight ranges from 0.68-1.5 kg and the heavy ecotype are those of the Guinea savannah, Sahel savannah and some montane regions, whose mature body weight ranges from 0.9-2.5 kg (Atteh, 1990). These local chickens have been extensively studied and evaluated for meat and egg production and found to be dual purpose (Nwosu, 1990), with the heavy ecotype tending to have potential for meat production while the light ecotype appears to have potentials for egg production (Momoh, 2005).

Egg production in birds can be reported as whole record performance (annual production) or part-period performance (short-term production). Whole record egg production can be predicted from part-record egg production through the use of mathematical models of the egg production curve. Moreover, if significant positive genetic relationship is found to exist between part-period egg traits and full or annual egg traits, early selection can be undertaken using the part-period records.

The evaluation of external and internal quality of the egg is essential for consumers' preference. Many factors are known to influence egg quality traits. These include; breeds/strain/variety, temperature, relative humidity, rearing practices and season (Washburn, 1990). Though many reported works on egg quality traits abound, information on the Nigerian local chickens classified as heavy and light ecotypes and their F_1 crosses are limited.

The objective of this study, therefore, was to evaluate the short-term egg production and quality traits of the heavy and light ecotypes of the Nigerian local chicken and their F_1 crosses.

Corresponding Author: O.M. Momoh, Department of Animal Breeding and Physiology, University of Agriculture, Makurdi, Benue State, Nigeria

MATERIALS AND METHODS

This study was carried out at the local chicken unit of the Poultry Farm of the Department of Animal Science, University of Nigeria, Nsukka. Nsukka is located on latitude 05°22' North and longitude 07°54'East with annual rainfall ranging from 986-2098mm (Inyang, 1978). The natural day length for Nsukka is 12-13 h and average annual maximum and minimum temperatures are 29.7°C and 21.0°C, respectively. The relative humidity ranges from 34 to 78% (Monanu, 1978).

The foundation stock from which the birds used for the study were hatched consisted of the Heavy Chicken Ecotype (HE) gathered from the rural areas of Obudu, a montane region in Cross River state, south east Nigeria and the Guinea agro-ecological zone of northern Nigeria. The Light Ecotype (LE) was obtained from the Swamp, Rainforest and Derived Savannah agro-ecological zones of southern Nigeria. The HE and LE were maintained on the farm as two separate non-pedigreed, unselected and unimproved random mating populations.

The HE and LE foundation stock were involved in mating procedure that generation 214 day-old chicks (doc) of pure HE, 142 doc of pure LE, 190 doc of HEXLE and of 185 doc of LEXHE. The full details of the mating arrangement have been described by Momoh and Nwosu (2008). The management of the experimental chicks in each genetic group from hatching to 20 weeks of age has also been described by Momoh and Nwosu (2008).

At 20 weeks of age, 50 pullets each of HE, LE, HEXLE and LEXHE were randomly chosen and placed singly in two-tier battery cages and monitored for short-term (16 weeks) egg production. While in egg production, the birds were fed formulated layers' diet containing 17% crude protein and 2750 ME kcal/kg of feed. Strict sanitary standard was maintained throughout the period of study. Egg were collected twice daily at 10.00 am and 5. 00 pm and recorded on egg chart.

Traits measured: Traits evaluated at the short-term for the genetic groups include percent egg production expressed as hen-day rate of production, egg number per bird, egg weight and egg mass.

Percent egg production: This expressed as:

$$\text{Hen-day rate} = \frac{\text{No. of egg produced x 100}}{\text{Average No. of Birds x Average No. of hen-day}}$$

Egg number: This was measured as the total number of egg per bird for the short-term production.

Egg weight: All egg laid by each genetic group were weighed singly one day each week, usually on Saturday, using a 250 g capacity weighing balance. The arithmetic average of all the single weights was computed to form the average short-term egg weight.

Egg mass: This was calculated as the product of egg number and weight.

For egg quality traits evaluation, forty (40) eggs, ten (10) from each genetic group per week, making a total of 640 eggs was studied. Egg length and width were measured using veneer calipers. Shell thickness, shell weight and Haugh unit were measured using paper thickness gauge, sensitive weighing machine and an Amestripod micrometer screw gauge, respectively. The other internal quality traits were measured using standard procedures as outlined by Stadleman (1977).

Statistical analysis: The data collected on short-term egg production and quality traits were subjected to analysis of variance. Significance differences were detected using the Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Table 1 shows the means of short-term egg production characteristics of the Nigeria heavy and light chicken ecotypes and their F_1 crosses. There was no genetic group effect ($p>0.05$) on short-term (120 days) percent hen-day production, egg number and egg mass. However, the combined means of the crossbred groups for these traits were higher than the mean of the straight bred. In fact, the LExHE genetic group (reciprocal cross) appeared to have superior performance in all the three traits than the other genetic groups. Dominance/over-dominance gene action at some loci must have been responsible for the apparent hybrid vigour effect, which caused the mean crossbred performances in short-term hen-day, egg number and egg mass to be more than the means of the two parents. This could also be explained in terms of the ability of heterozygotes to be better buffered than homozygotes against environmental deviations.

The short-term egg number of 48.6±2.13 and 51.92±1.97 obtained in this study for the heavy and light ecotypes, respectively, are slightly higher than the value of 48.5±4.1 reported by Omeje (1983) for the Nigerian local chicken, which is described as the light ecotype in the present study. This slight difference between the present result and Omeje (1983) previous result may be due to differences in experimental conditions as well as size of population studied.

The non significant difference between genetic groups in percent hen-day production, egg number and egg mass in the short-term may lead to the conclusion that the heavy ecotype may not be a distinct genetic group (strain) from the light ecotype. This may be a confirmation of an earlier conclusion reached by Adedokun and Sonaiya (2001) that Nigerian local chickens (drawn from three agro-ecological zones) did not differ significantly in egg production.

Table 1: Means of short-term egg production characteristics of the Nigerian heavy and light chicken ecotypes and their F_1 crossbred progeny

	Ecotype/genetic group*				
Parameter	HE	LE	HEXLE	LExHE	SEM
Hen-day (%)	39.62	42.24	41.97	43.50	2.35
Egg number	48.60	51.92	52.06	52.94	2.19
Egg weight (g)	38.98^a	34.25^c	37.14^b	37.43^b	0.19
Egg mass (g)	1925.29	1776.22	1923.70	1993.24	77.11

*HE = Heavy Ecotype, LE = Light Ecotype, HExLE = Main crossbred, LExHE = Reciprocal Crossbred.
abc = Means within the same row with different superscripts are significantly different (p<0.05)

Table 2: Egg quality traits n the Nigerian heavy and light chicken ecotypes and their F_1 crosses at the short-term egg production

	Genetic group*				
Traits	HE	LE	HExLE	LExHE	SEM
Egg length (mm)	53.6^b	52.9^b	53.8^a	53.4^a	0.063
Egg width (mm)	40.9^a	40.6^b	41.4^a	41.2^a	0.042
Shape index	0.76^c	0.77^b	0.77^b	0.78^a	0.087
Shell weight (mm)	5.06	4.91	4.81	5.05	0.012
Shell thickness (mm)	0.45^a	0.42^b	0.40^c	0.41^{bc}	0.(2)
Hangh unit	79.1^a	78.3^b	78.7^b	77.9^c	0.164
Yolk weight (g)	18.3^a	17.9^b	18.1^b	18.0^b	0.072
Yolk height (mm)	15.9^a	15.2^b	15.6^b	15.5^b	0.055
yolk width (mm)	38.5^a	37.4^b	32.4^c	35.0^d	0.41
Yolk index	0.46^a	0.44^b	0.45^b	0.44^c	0.003
Albumin weight (g)	31.1^a	30.2^b	28.5^c	30.1^b	0.001
Albumin height (mm)	5.82^a	5.41^b	5.88^a	5.50^b	0.003

*HE = Heavy Ecotype, LE = Light Ecotype, HExLE = Main crossbred, LExHE = Reciprocal Crossbred.
abc = Means within the same row with different superscripts are significantly different (p<0.01)

The short-term egg weight ranged from 24.25 g in the light ecotype to 38.98 g in the heavy ecotype, with the heavy ecotype laying significantly heavier (p<0.05) eggs than the light ecotype and the crossbred groups. The performance in egg weight of the two crossbred were in-between the performances of the two parents. Arad and Marder (1982) reported such an intermediate position of crossbreds of a crossing between Sinai Bedouin fowl and leghorn breed in egg weight. Omeje (1983) also reported the mean performance of the crossbred between Nigerian local chicken and exotic Gold-link parent stock as being intermediate between the two parents. This shows that the inheritance of egg weight in the F_1 crosses from the local ecotypes (heavy and light) revealed an additive gene action. Additive differences in parental genes are beneficial and easily inherited by crossbred progeny if heritability of the traits is high. However, the low heritability estimate for egg weight reported for both the heavy and light ecotypes used in this study (Momoh, 2005) may suggest lack of high additive difference in the parental (heavy and light ecotypes) genes.

Table 2 presents the results of both external and internal egg quality traits. Genetic group effect was significant (p<0.01) in all the egg quality traits studied except shell weight. Also in all the egg quality traits except shape index, the heavy ecotype had higher performances when compared to the light ecotype. The mean performance of their F_1 crosses were in-between the two parental performances for egg length, shell weight, shell thickness Haugh unit, yolk weight, yolk width, yolk height, yolk index, albumin height and albumin weight, but showed heterotic effects in egg width and egg shape index.

Shape index which is the ratio of width to length of egg ranged from 0.78 in the LExHE cross to 0.76 in the heavy ecotype. The shape indices obtained in the present study for all the genetic groups are lower than 0.83±0.04 reported by Ikeobi *et al.* (1999) for Nigeria local chickens, but are closely similar with the values of 0.76, 0.763 and 0.79 reported by Olurede and Longe (2002), Chineke (2001) and Ukachukwu and Akpan (2007), respectively, for some exotic chickens in Nigeria. Shell thickness did not show significant difference (p>0.01 among the crossbred groups. However, the egg of the heavy ecotype had thicker shell than the light ecotype. Eggs with thick shell are desirable to withstand externally applied force, thus preventing breakage of eggs. This would improve the marketing quality of the eggs. However, excessive shell thickness decreases hatchability. Mean shell thickness of 0.39 had been reported for two backyard poultry varieties in Indian by Niranjan *et al.* (2008). This is less than the values reported here for two ecotypes of Nigeria local chicken and their F_1 reciprocal crosses.

The haugh units reported for the various genetic groups in this study are within the range of 62.58 to 90.00 reported by Parmar *et al.* (2006) for Kadaknath birds under field conditions in Indian. Niranjan *et al.* (2008) also reported ranges of 74.60 to 79.42 for some indigenous backyard poultry and their crosses in Indian. Ikeobi *et al.* (1999) reported a lower value of 61.85 for some indigenous bird of Nigeria. Chatterjee *et al.* (2006) also reported lower Haugh unit values; 59.62 to 71.62 for the White Leghorn strains. Since Haugh unit is the measure of albumin quality which determines the quality of the egg, the higher Haugh unit values obtained in this study indicates the superior quality of the albumin in the genetic groups studied.

The yolk indices reported for the heavy and light ecotype and their F_1 reciprocal crosses are similar to the yolk indices of 0.41±0.01 to 0.45±0.01 reported by Padhi *et al.* (1998) for Nicobari varieties of Andaman. Chatterjee *et al.* (2007) on the other hand reported lower yolk indices among six breeds of indigenous chickens of Andamans when compared with the present result.

Other internal quality traits such as yolk weight, yolk height, yolk width, albumin weigh and height as reported in the present study are comparable with values reported by other workers (Niranjan *et al.*, 2008; Chatterjee *et al.*, 2007) for rural birds of Indian.

Conclusion: On the basis of short-term egg production, the heavy and light chicken ecotypes of Nigeria and their F_1 crosses did not differ significantly in terms of percent hen-day production, egg number and egg mass. This may lead to the conclusion that the heavy ecotype is not a distinct strain from the light ecotype. However, the heavy ecotype lay significantly ($p<0.05$) heavier eggs than the light ecotype. The inheritance of egg weight in the reciprocal crosses between the two ecotypes showed additivity of gene actions.

In egg quality traits, the genetic groups showed significant differences in most of the traits studied, with the crossbreds demonstrating heterotic effects in egg width and shape index. This indicates that improvement in these egg quality traits can easily be achieved through crossbreeding. More-over, the egg quality traits obtained in this present study are comparable with those of exotic layers and even higher (Haugh unit) than in some exotic breeds. High egg quality characteristics are desirable in local chickens and their crosses in order to withstand the handling pressures under free range system where the chickens are raised.

ACKNOWLEDGEMENT

The authors are grateful to the Department of Animal Science, University of Nigeria, Nsukka for the kind permission to use the facilities at the department for this study.

REFERENCES

Adedokun, S.A. and E.B. Sonaiya, 2001. Comparison of the performance of Nigerian indigenous chickens from three agro-ecological zones. Livestock Res. Rural Dev., Vol. 3.

Arad, Z. and J. Marder, 1982. Comparison of the productive performance of the Sanai Bedouin fowl, the White Leghorn and their crossbreds. Study under laboratory conditions. Br. Poult. Sci., 23: 329-332.

Atteh, J.O., 1990. Rural poultry producion in western middle-belt region of Nigeria. In: Rural Poultry Production in Africa. Ed Sonaiya E.B. Proceeding of an international workshop on rural poultry production in Africa. Ile-Ife, Nigeria, 13-16 Nov. 1989. 211-217.

Chatterjee, R.N., R.P. Sharma, M. Niranjan, B.L.N. Reddy and A. Mishra, 2006. Genetic studies on egg quality traits in different White Leghorn populations. In. J. Anim. Genet. Breeding, 27: 51-54.

Chatterjee, R.N., R.B. Rai, A. Kundu, S. Senani and J. Sundar, 2007. Egg quality traits in indigenous breeds of chicken of Andaman. In. Vet. J., 84: 206-208.

Chineke, C.A., 2001. Interaction existing between body weight and egg production traits in Olympia Black Layers. Nig. J. Anim. Prod., 28: 1-8.

Duncan, D.B., 1955. Multiple range test and multiple F-tests. Biometrics, 11: 1-42.

Ikeobi, C.O.N., C.M. Hyginus, J.A. Adenowo and O.A. Adedambo, 1999. Egg quality characteristics of four local poultry species in Nigeria. Trop. J. Anim. Sci., 1: 37-42.

Inyang, P.E.B., 1978. The Climate of Nsukka Environs. In: The Nsukka climate. Ed. Ofomata, C.EK. Enugu. Fourth Dimension publishers, pp: 152.

Momoh, O.M., 2005. Genetic and phenotypic evaluation of the Nigeria heavy chicken ecotype and its crossbreds with the light ecotype. Ph.D. thesis. Department of Animal Breeding and Physiology. University of Agriculture Makurdi Nigeria, pp: 164.

Momoh, O.M. and C.C. Nwosu, 2008. Genetic evaluation of growth traits in crosses between two ecotypes of Nigerian local chicken. Livestock Research for Rural Development 20(10). http//www.cipav.org.co/lrrd20/10/momo20158.htm.

Monanu, P.C., 1978. Temperature and Sunrise. In: Nigera in Maps: Eastern States. Editor: Ofomata C.E.K. Benin City. Ethiope Publishing House, pp: 132.

Niranjan, M., R.P. Sharma, U. Rajkumar, R.N. Chatterjee, B.L.N. Reddy and T.K. Battacharya, 2008. Egg quality traits in chicken varieties developed for backyard poultry farming in Indian. Livestock Res. Rural Dev., Vol., 20.

Nwosu, C.C., 1990. Review of indigenous poultry research in South-Eastern Nigeria. In: Rural Poultry production in Africa. Ed. Sonaiya, E.B. Proceeding of an International workshop on rural poultry production in Africa. Ile-Ife, Nigeria 13-16 Nov., pp: 62-77.

Olurede, R.R. and O.G. Longe, 2002. Effect of replacing palm kernel cake on egg quality characteristics, haematology and serum chemistry of laying hens. Nig. J. Anim Prod., 27: 19-23.

Omeje, S.S.I., 1983. Heterosis of body weight and short-term egg production in crosses between paraent stock of Gold-link and local chicken of Nigeria. M.Sc. thesis. Department of Animal Science, University of Nigeria, Nsukka, Nigeria, pp: 208.

Padhi, M.K., R.B. Rai, S. Senani and S.K. Saha, 1998. Assesment of egg quality characteristics in white Leghorn layers. Int. J. Poult. Sci., 33: 113-115.

Parmar, S.N.S., M.S. Thakur, S.S. Tumar and P.V.A. Pillai, 2006. Evaluation of egg quality traits in indigenous Kadaknath breed of poultry. Livestock Res. Rural Dev., Vol. 18. http://www.cipav.org.co-----18/9/parm18132.htm.

R.I.M., 1992. Nigerian Livestock Resources. Volume II. National synthesis. Annex publication. Resources Inventory Management Ltd.

Stadleman, W.J., 1977. Quality identification of shell eggs: In: Egg Science and Technology, 2nd Edn., Avi publishing company Inc. Westport, Connecticut.

Ukachukwu, S.N. and V.O. Akpan, 2007. Influence of level and duration of quantitative feed restriction on post-restriction egg-laying characteristics and egg quality of pullets. Int. J. Poult. Sci., 6: 567-572.

Washburn, K.W., 1990. Genetic variation in egg composition. In: Crawford R.D (Ed.) Poultry Breeding and Genetics. Elsevier Science Publishers, B V, Amsterdam, The Netherlands, pp: 781-804.