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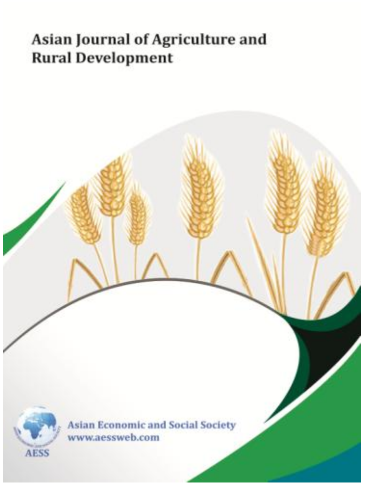

Comparative Studies of Two Nigerian Ecotypes Chicken Kept in Battery Cages for Laying Performance and Egg Quality Traits

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Abstract

This study was conducted to evaluate and determine the effects of ecotype on laying performance and some egg quality traits of two indigenous chickens ecotype in Kwara state Nigeria {Fulani Ecotype chicken (FE) and Yoruba Ecotype chicken (YE)} kept in battery cage for a period of fifty two (52) weeks. It was observed that the YE matured earlier than FE with Age at First Egg (AFE) of 20.56 (20 – 23weeks) compared to 26.73weeks (22-31wks) obtained for FE. Significant difference ($p<0.05$) existed between their body weight at first egg, (BFE) with FE significantly bigger 1437.5g than the YE 1314.60g. The mean Egg weight (EW), Total Egg Number (TEN), Hen House Production (HHP) in FE were 44.11g, 128 and 53.16%, and significantly ($p<0.05$) higher than 42.44g, 98, 45.50% obtained for YE, the differences between these parameters were significant ($p<0.05$). YE had a lower clutch size (CS) of 2- 6 eggs per clutch and a longer pause length (PL) of 1- 6 days while the FE had a larger Clutch size of 3-9 eggs per clutch and a shorter pause length of 1-3 days. External and internal quality traits of eggs from both ecotypes were similar except shell thickness that was significantly ($p<0.05$) better in the YE and yolk height that was significantly ($p<0.05$) higher in FE. The results of this finding indicated a marked difference in laying performances of the two indigenous chickens, yolk height and shell thickness and no significant ($p>0.05$) differences in other egg quality traits measured.

Keywords: Chicken, Ecotypes, Hen, Egg production, Egg quality traits

Introduction

Indigenous stocks, the world over, contribute significantly to animal protein intake, especially in developing countries. These countries are characterized by undeveloped poultry stocks named according to the tribe keeping them or geographical location where they are found (Oluyemi, 1979). Indigenous chicken with diverse uses and benefits are many and the origin of each strain or ecotype is the product of mutation, genetic drift, adaptation and evolution with differing selection pressures imposed by climate, endemic parasites and diseases, available nutrition and selection criteria imposed by man (Barker, 1994). In Nigeria, village poultry production is mostly based on scavenging indigenous fowl which are pools of heterogenous individuals that differs in adult body size, weight and plumage. Peters *et al*. (1998) regarded local chicken populations as a pool of heterogeneous individuals which can be separated by geographical location and are referred to as ecotypes.

Indigenous chickens are variable in colour, none of which appears more prevalent than the others. Mature indigenous chickens are smaller than the exotic breeds, yet they are among the local assets of poor people living in rural areas of Sub – Saharan Africa. Over 90% of rural households keep and rear chicken in small flocks of about 20 birds. Every family in rural areas of Nigeria keeps some local chickens as source of family egg and occasional meat (Ayorinde, 1986, 1990). These indigenous chickens are one of the major sources of protein in forms of eggs and meat for the rural populace but are poor in productivity, slow growing and low in egg production. The low productivity is also probably as a result of the birds' exposure to extreme weather conditions, low standards of nutrition and dependence on scavenging feed resources, which partly account for their annual heavy mortality and lower production, seasonality in laying and broodiness. Ndegwa et al. (1998) and Musharaf et al. (1990) stated that several factors which contribute to low productivity of the indigenous chicken are manifested in terms of very high mortality, low growth rate, small mature weights and low egg production. Gueye (2000) however opined that despite the low productivity of indigenous chickens, the birds play a significant role in poverty alleviation.

Nigeria indigenous chicken are lacking in uniformity, they possess a measure of within group uniformity that are peculiar. The variation in the phenotype of these birds according to Oluyemi and Roberts (2000), demonstrate the effect of natural selection and indicate the potential for improvements through genetic selection and /or cross breeding. The variations ranged from plumage, body size and this suggest that they have not been artificially selected and grouped. They differs from one localities to others, and in order to improve performance of chickens in Nigeria a supply of the level of genetic diversity in different population should be the first step. In fact, FAO (1992) initiated a program to conserve and develop the livestock and poultry resources of developing countries while Cunningham (1992) stated that such understanding can lead to discovery of chicken ecotype with best productive performance that can be use in the breeding and genetic improvement of indigenous chickens for more egg or meat production in developing countries.

There are two indigenous chicken ecotypes that are commonly found in Kwara state Nigeria, namely; the Fulani Ecotype (FE) and the Yoruba Ecotype (YE). The Fulani Ecotype are found to be native to the Kraals where the Fulani tribes are found, while the Yoruba Ecotype are found at the backyards of poultry keepers in villages, towns and cities. Study on the performance of these chicken ecotypes under an intensive system of management will shed more light on the assumed genetic diversity and provide more information on their production capacity.

Materials and Method

Sources of Experimental Animal

One hundred and eighty three (183) FE, and one hundred and two (102) YE chicks obtained through incubation and hatching of FE and YE chickens egg collected from three different Fulani Kraals located in Ilorin South Local government of Kwara state and backyard poultry keepers in the city of Ilorin Kwara state, respectively, were wing banded, weighed and randomly distributed to brooding pen according to the ecotype. They were fed standard diet recommended for chicken at different stages of development according to NRC (1994) throughout the experimental period, and raised under the same management conditions.

At eight weeks, hens were separated from cocks using body development and features like appearances of comb, at eighteen weeks, seventy two (72) FE hen and fifty two (52) YE hen were transferred to individual battery cage, each unit in the cage was labeled according to the wing banded number assigned to the hen for proper identification. Production and egg quality traits of the hen measured were recorded for a period of 52 weeks.

Data Collection

Laying Performance

The age at which each hen started laying was recorded as Age at first egg (AFE), and each hen was weighed using a 10kg Camry measuring scale to record their body weight at first egg (BFE). Egg laid by each hen was labeled, recorded and weighed on daily basis using a Scout II electronic weighing balance (600g) capacity to obtain the weight of the egg (EW). Addition of all eggs laid by each hen per ecotype over a period of 52 weeks was taken to be their total egg number (TEN). The number of eggs laid by each hen before resting was recorded as the clutch size (CS), while the total number of days spent by each hen between clutches was recorded as the Pause Length (PL). Hen–housed egg production for 52 weeks period was calculated from the formula:

$$\text{HHP (\%)} \ \frac{\text{Average daily number of eggs produced}}{\text{Number of hen housed}} \times \frac{100}{1}$$

Internal and External Egg Quality Traits

A well labeled freshly laid egg was taken on weekly basis from each genotype, weighed, broken and content poured into a Petri dish to determine the external and internal egg quality traits. The presence of blood and meat spot was noted and recorded for each of the broken eggs. Albumen and yolk were carefully separated with the aid of a spatula and each weighed. Yolk height and albumen height was measured using spherometer while yolk width, egg length and egg width were measured with the aid of vernier callipers. Egg shape index (ESI) was determined according to Reddy *et al.* (1979) yolk index (YI) was taken as the ratio of yolk height (YH) to yolk width (YWD), while albumen ratio (AR), yolk ratio (YR) and egg shell ratio (ESR) were determined using the method described by (Olawumi and Ogunlade, 2009). The Haugh Unit values were obtained using the formula: HU= 100log (H+ 7 .57, 1.7W $^{0.37}$).

HU = Haugh Unit
H = Observed height of the albumen (mm)
W= weight of the eggs in grams (Neishem et al., 1979).

The shells of the broken eggs were rinsed in warm water, air dried for 48 hours, weighed and recorded according to ecotypes to determine the shell weight. Micrometer screw gauge was used to determine the shell thickness from the broad end, narrow end and the middle of the shell, the average of the three measurements was taken as shell thickness in millimetres. Egg shape index was determined as width of the egg / length of egg x 100, and egg colour were observed and recorded as brown, tinted or white.

Statistical Analysis

Mean of the data obtained were evaluated to represent the average performance of the population for a period of 52 weeks. Least squares means and standard error values for each ecotype were determined by use of Microsoft Excel, and all data were further subjected to Analysis of Variance and significantly different means (p<0.05) were separated by use of the Duncan's multiple Range procedure option in SAS (2003). The model used was of the form:
The following model was used:

$$Y_{ij} = \mu_i + a_i + e_{ij}.$$

Where Y_{ij} = Measurements of parameters.
μ= overall mean
a_i = effect of ith ecotype
e_{ij}= random residual error.

Results and Discussion

The mean Age at first egg (AFE) for the FE was 26.73 weeks, while the mean body weight at first egg (BFE) was 1437g. Average total egg number (TEN) for 52 weeks was 128 while the mean Egg weight (EW) was 44.11g. The clutch size (CS) was 3-9 eggs per clutch while the pause length (PL) ranged from 1-3 days. The hen house production (HHP) for FE was 53.10% (Table 1). Values obtained for YE was 20.56 weeks for average the AFE, 1314g for BFE. An average of 98 eggs per annum was laid by the YE, and their average EW was 42.41. The CS ranged from 2-6 per clutch while the PL ranged from 1-6 days, HHP for the YE was 45.50%. From Table 2, it was discovered that both FE and YE showed no significant differences in all internal egg quality traits except yolk height that was 9.81% significantly (p<0.05) higher in FE compared to YE. Thirty eight percent (38%) of the total egg observed for FE had blood spot, while 18% of YE egg had blood spot. External egg quality traits observed also indicated the same trend as the internal egg quality traits with shell thickness only been significantly (p<0.05) different and 22% thicker in YE eggs than FE eggs as shown in Table 3. Occurrence of brown, tinted and white shell colour in FE was 20, 70 and 10%, respectively, YE laid no egg with brown shell colour, had 5% egg shell with tinted colour and 95% of their egg had white shell colour (Table 3).

The results of this study showed that the YE matured earlier, have smaller body weight at first egg, laid smaller and fewer eggs per clutch with longer pause length and 98% of their eggs had white egg shell colour, though no significant (p > 0.05) differences was observed in most of their internal and external egg quality traits except yolk height that was significantly (p < 0.05) smaller in YE and egg shell that was significantly (p < 0.05) thicker in YE, thickness of YE egg shell could be as a results of their egg size which is smaller, since chicken deposited the same amount of shell over an egg the smaller the egg the thicker the shell, because egg size is negatively correlated with egg shell thickness (North, 1984). The results of this findings also showed that FE matured late, have bigger body weight at first egg, laid medium sized egg, more eggs per clutch, with shorter pause length than the YE chicken. FE had majority of their egg tinted (70%), it can also be said that FE requires heavier weight to induce egg laying and this was similar to observation made by Rendel and Mapple (1986) for the white leghorn chicken and that led to the conclusion that an egg type chicken must reach a minimum age and body weight before they commence laying of egg. The total egg number obtained per annum differed significantly ($p<0.05$), irrespective of age at sexual maturity.

The average number of eggs (128) laid by FE in this study corresponds with the findings of Nwosu (1979) which reported an average of 124 eggs per annum for local chicken kept in battery cages, and 128 eggs for those kept in deep liter. Total egg production observed here (98 - 128) were more than 45 to 100 eggs per annum reported for extensively raised Nigerian local chicken by Sonaiya and Olori (1990), Nwosu (1979), Omeje and Nwosu (1983), Adedokun and Sonaiya (1999) for local chicken hens from three agro-ecological zones in Nigeria, but more than 50 - 55eggs/ annum reported by Yoshimura et al. (1997) for indigenous Bangladesh chicken raised under improved condition. High variation observed in clutch sizes FE vs. YE (3 to 9 vs. 2 to 6) and pause length between the two ecotype chicken studied here corresponds with reports of Mwalusanya et al. (2002) for Tanzania local chicken and those of Tadelle et al. (2003) and Abdelqader et al. (2008) in Ethiopian chicken. However the clutch size and egg number obtained for the two ecotypes chickens in this study were more than clutches sizes (2-3) and egg number (78) eggs reported for Morroccan chicken by Benabdeeljelil and Arfaoui (2001). Akinnokun (1975) reported that the indigenous chicken egg production increases substantially by caging, while Gueye (1998) stated that their sexual maturity can be earlier through improvement in feeding and husbandry, improvement observed in this study is highly comparable to past work on Nigerian local chicken especially with the system of management employed and closely related with the report of Sall (1990) where 90 -100 eggs were reported for Senagalese local chicken raised under improved feeding and husbandry services. Body weight at first egg (BFE) of FE (1437.45g) is closely comparable to BFE for indigenous naked neck chicken as reported by Huque et al. (2001), while BFE obtained for the YE corresponds with the findings of Ibe and Nwohu (1999) where the Nigerian local chicken were categorized as light breed of chicken. Age at sexual maturity obtained for the FE in this study corresponds with 25- 32 weeks reported by Dessie and Ogle (2001), Sall (1990), Katule (1992), Oluyemi (1979), Nwosu and Asuquo (1984), Sonaiya (1998) for age at sexual maturity for local chicken in Senegal, Tanzania and Nigeria.

The results obtained showed that the two chicken ecotype have a smaller egg weight (42.44-44.11g) compared to their exotic counterpart with egg weight range of 55 - 60g as reported by Olawumi and Ogunlade (2009). The results obtained indicated that the value for the egg weight in the two indigenous chicken ecotypes studied here is also comparable to that of other breeds such as White Leghorn (45.50g), Fayoumi (42.2g) and Rhode Island Red (43.4g) as reported by Mekky et al. (2008).The egg weight for both indigenous chicken observed here fell within the range of 33.50-48.70g reported by Fayeye et al. (2005) for Fulani Ecotype chicken, Peters et al. (2007) for the normal feather Nigeria local chicken, better than 30g obtained by Oluyemi and Oyenuga (1974) for indigenous fowl in Nigeria, and lower than 49.72g reported for normal feathered chicken in Kaduna state, Nigeria.

Average albumen weight 21.34-22.42g observed showed the proportion of albumen that is contributed to the egg weight and correspond with 20.33g reported by Zhang et al. (2005) for brown dwarf layer, but higher than 19.86g reported by Adeolu and Oleforuh–Okoteh (2011) for South Eastern Nigeria local chicken , while the albumen height obtained for the two chicken ecotypes (6.10-6.45mm) here double 3.06mm reported by Zhang et al. (2005) for brown dwarf layers but lower than 7.56mm reported for the south Eastern chicken by Adeolu and Oleforuh-Okoteh (2011), however the yolk height for these chicken ecotypes (15.17 to 16.62) was highly comparable with the range (16.80mm) reported by the authors. The findings also showed that, these indigenous chicken had better albumen and yolk quality with Haugh Unit above 50% and yolk index above 60% (North, 1984). Similarities on egg quality traits observed in this study corresponds with the findings of Orunmuyi et al. (2010) where no significant differences were reported for egg quality traits among Nigerian local Chickens in Kaduna State Nigeria Predominant white and tinted egg shell colour observed among the YE and FE studied agreed with the findings of Chaubal et al. (1994) where it was reported that the local egg shell pigmentation is predominantly white and tinted.

Conclusively, these groups of indigenous chicken are better adapted and are resistant to some prevailing environmental condition, thus there is need to utilize these indigenous chicken ecotype in development of egg line chicken for better production in the harsh tropical environment. Efforts should be made through selection and cross breeding of the two indigenous local chickens with exotic breeds for better egg production. The highest value recorded for egg weight in FE was 52.50g, and that of YE was 50.61g, this is an indication that some of these chickens have potential to lay bigger eggs when kept under optimum management condition. High diversity in the phenotypes and egg traits obtained here compare with other past literature is a major evidence of high genetic variability on indigenous chicken in Nigeria. Further studies should focus on the genetic characterization based on molecular assessment within and between the local chicken types.

Table 1: Egg Production Traits of Two Nigerian Indigenous Chicken Ecotypes

PARAMETERS	FE	Range	YE	Range
AFE (wks)	$26.73^{a}\pm4.06$	22-31	$20.56^{b}\pm3.10$	20-23
BFE (g)	$1437.45\pm^{a}35.35$	1350-1650	$1314.60^{b}\pm 28.34$	1300-1440
TEN	$128^{a}\pm1.18$	78-174	$98^{b}\pm 1.37$	58-128
EW (g)	$44.11^{a}\pm4.48$	35.72-52.50	$42.44^{b}\pm2.71$	35.36-50.61
CS	$5.50^{a}\pm2.15$	3-9	$4.50^{b}\pm4.25$	2-6
PL (days)	$2.03^{a}\pm0.33$	1-3	$3.50^{b}\pm0.58$	1-6
HHP (%)	53.10^{NST}		45.50^{NST}	

Means on the same row followed by different superscripts (a-b) differs significantly ($p<0.05$).
^{NST}= Not Statistically Tested.

Table 2: Effects of Ecotype on Internal Egg Quality Traits of two Nigerian Indigenous Chickens

PARAMETERS	FE	YE
Yolk height (mm)	16.82 ± 1.13^{a}	15.17 ± 0.93^{b}
Albumen height (mm)	6.45 ± 1.10^{a}	6.10 ± 0.41^{a}
Yolk Width (mm)	3.81 ± 0.68^{a}	3.78 ± 0.21^{a}
Albumen Width (mm)	5.54 ± 0.68^{a}	5.27 ± 0.79^{a}
Albumen weight (g)	22.42 ± 1.91^{a}	21.34 ± 2.71^{a}
Yolk Weight (g)	20.12 ± 1.56^{a}	19.10 ± 1.44^{a}
Haugh Unit (%)	83.00 ± 2.10^{a}	84.40 ± 1.70^{a}
Yolk Index (%)	67.10 ± 1.41^{a}	66.09 ± 1.35^{a}
Blood spot (%)	38.00^{NST}	18.00^{NST}

Means on the same row followed by different superscripts are significantly different ($p<0.05$)
^{NST}= Not Statistically Tested.

Table 3: Effects of Ecotypes on External egg quality traits of two Nigerian Indigenous Chickens

PARAMETERS	FE	YE
Egg Length (cm)	2.84 ± 0.18^{a}	2.78 ± 0.15^{a}
Egg Width (cm)	2.18 ± 0.12^{a}	2.08 ± 0.08^{a}
Shell Weight (g)	4.89 ± 0.08^{a}	5.12 ± 0.06^{a}
Shell Thickness(mm)	0.53 ± 0.01^{a}	0.68 ± 0.14^{b}
Egg Shape Index (%)	76.16 ± 0.02^{a}	74.82 ± 0.02^{a}
Egg Shape Ratio	3.58 ± 0.13^{b}	4.14 ± 0.15^{a}
Egg shell colour (%) ^{NST}		
Brown	20	0
Tinted	70	5

White	10	95

Means on the same row followed by different superscripts different significantly (P<0.05)
^{NST}= Not Statistically Tested.

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