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Evaluation of Reproductive Performance, Egg Production and Egg Quality Traits in the Fulani Ecotype Chicken Raised Intensively.

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Target Audience: breeders, animal scientist, extension workers

Abstract

Five hundred and ten (510) indigenous Fulani Ecotype (FE) chicken eggs collected from three different Fulani Kraals in Kwara state were used to evaluate the reproductive performance of intensively raised FE. The results revealed that 98.0, 79.2 and 65.8% were settable, fertile and hatchable, respectively. At 18 weeks of age, seventy two (72) adult females FE were housed singly in battery cages and evaluated for egg production from sexual maturity to 52 weeks in lay. The results showed that age at sexual maturity, body weight at first egg, total egg number and egg weight were 26 weeks, 1437g 128 and 44.11g, respectively. Clutch size ranged from 3- 9, pause length ranged from 7-10days. Percentage hen housed production (HHP) was 53.10% while the percentage hen day production (HDP) was 57.6%. Age had significant (P<0.05) effect on some of the egg quality traits measured at 15, 30, 45 and 52 weeks in lay. Haugh Unit, Yolk Index, and Shell Thickness of FE eggs were above 80, 60 and 0.50, respectively. This study indicates the reproductive potentials of FE chicken that could be useful in developing an indigenous chicken with desirable egg production traits.

Key words: Indigenous Chicken, Fulani Ecotype, Intensive management, Egg characteristics.

Description of Problem

Available information on the animal protein availability and consumption in Nigeria clearly indicate protein crisis. (1) described Nigeria as a protein deficient country with daily animal protein consumption reported to be below the Food and Agriculture Organization's recommended minimum of (20g) for developing countries. This situation is awful, particularly when compared with the minimum of 35g recommended for normal growth and development (2). (3) reported that the average animal protein intake per day in Nigeria was a mere 7.6g while (4) reported that the intake was 4.82g/head/day. Given the fact that the Gross Domestic Product per capita in Nigeria has fallen over the years, the level of animal protein consumption per

head would have similarly declined. The effect of this deficit is manifested in various forms of protein per caloric

malnutrition disease (5). Meanwhile, the World Bank Assisted National Agricultural Research Strategy Plan (1996-2010) projected animal protein supply of only 5.32g/ head /day for the estimated 159 million Nigerian populace in 2010.

The significance of animal protein in sufficient and balanced nourishment cannot be over emphasized in human health with respect to physical and mental progress (6). Among the animal protein sources, poultry has a significant place. Chicken is the most available protein source either in terms of egg and meat, and is reared more widely than any other livestock. The current global economic meltdown, no doubt, would further impact negatively on the protein crisis unless the deficiency in protein intake in Nigeria can be augmented through improved indigenous production or massive importation, the latter is not advisable.

Indigenous chicken production systems are popular in most resource-poor countries and serves as means of producing supplementary food, extra income and employment for family members. They also capitalize on harvest waste and inferior grains produced on farms (7). The primary advantage of these birds is inherent high breeding potential (as measured by hatchability) which saves hatchery expenses. This is exploited by owners to maximize household stock and revenue from sale of the same.

The Fulani Ecotype (FE) chicken is one among many indigenous chicken in Nigeria that are named after the tribe of their keeper. They are typical to the Fulani tribe in Nigeria as well as parts of Niger and Chad Republic. Their origin is uncertain but some authors (8 ; 9) were of the opinion that the Fulani Ecotype chicken is a cross-product between indigenous fowls and Rhode Island Red used in previous cockerel exchange programmes in Nigeria. There is a wide variation in productive and reproductive performance of local chicken phenotypes, which might be due to factors such as management practices and the effect of crossbreeding with exotic birds. Evaluation of the reproductive performance of Fulani Ecotype chicken will reveal their potential for future breeding purposes. It will also give the breeder opportunity to determine the level of variation that exists within the Fulani Ecotype chicken population and show the extent to which selection for improved performance is possible.

Materials and Method

Source and Management of Study Animals

Five hundred and ten (510) Fulani Ecotype chicken eggs were collected from three Fulani settlements in Kwara State over a period of two weeks. The eggs were collected from Fulani Kraals at Oke-Ode, Malete and Oke Ose. These Kraals are isolated being at least 20km away from other settlement.

Eggs collected were carefully examined, cracked eggs were removed and number

expressed as a percentage of total egg collected to calculate the set ability of the eggs. Settable eggs were taken to a commercial hatchery (Nefraday Farm Lasoju, Kwara State) for incubation and hatching. On arrival, the eggs were allowed to rest, fumigated with 17g potassium permanganate and 100ml of 20% formalin before incubation. The eggs were candled for fertility on the 18th day of incubation. Three hours before transfer of eggs from Setter to Hatcher, and before candling, 1% formalin was sprayed in the hatchery room to disinfect the compartment. On the day of hatch, all chicks were given New castle vaccine (Lasota) intra ocular. Fertility was calculated by expressing total number of fertile eggs as a percentage of total number of eggs set, while hatchability was calculated by expressing total number of hatched chicks as a percentage of total number of live germ moved to the Hatcher.

The poultry house at the Animal Pavilion Unit of the Faculty of Agriculture, University of Ilorin was used for the experiment. The experimental pens and equipment were washed thoroughly with detergents and disinfectants and then sprayed with 2% formalin a day before the birds arrived. Each pen was bedded with wood shavings, and had electric bulb, lanterns and charcoal pots for brooding as source of heat. On arrival, the chicks were weighed, wing tagged and randomly distributed to the pens. They were placed on the same diets and other management conditions throughout the experimental period. The chicks were supplied with chicks ration for eight weeks, after which the diet was changed to grower mash until maturity. De-beaking was carried out at 12 weeks, and at 18 weeks of age seventy two (72) female FE were separated from the flock and housed singly in battery cage. Two weeks after onset of lay, the diet was changed to layers mash (10). All necessary routine management practices and vaccinations were carried out accordingly.

Determination of Egg Production and Egg Quality traits of Fulani Ecotype chicken

Fulani Ecotype hens were weighed singly at the sight of first egg with the aid of 10 kg measuring scale to determine the body weight at first egg (BWF) and the age was recorded as age at sexual maturity (ASM). Total number of eggs laid were recorded on a daily basis and expressed as percentage of total number of hen for that day as hen day production (HDP), while total number of eggs laid for 52 weeks were expressed as percentage of total number of hen in the house for 52 weeks as hen house production (HHP), weight of the egg was determine daily by the use of a sensitive electronic weighing balance (600g capacity). Hens were observed for broodiness, clutch size and pause length during the laying period. Egg quality traits were observed at 15, 30, 45 and 52 weeks after sexual maturity to study the effect of age on egg quality.

Thirty (30) eggs were randomly taken at 15, 30, 45 and 52 weeks of age, weighed,

broken and content poured into a Petri dish to determine the external and internal egg quality traits and to study the effect of age on egg quality traits of the FE chicken. 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 (11), 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 (12). The Haugh Unit values were obtained using the formula:

$HU = 100\log (H + 7.57, 1.7W^{0.37})$.

HU = Haugh Unit
H = Observed height of the albumen (mm)
W= weight of the eggs in grams (13).

The shells of the broken eggs were rinsed in warm water, air dried for 48 hours and weighed in replicates 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, and the average of the three measurements was taken as shell thickness in millimetres.

Statistical Analysis

Data collected on egg quality traits were subjected to one way analysis of variance. Duncan Multiple Range Test (DMRT) was used to separate the means when significant differences existed between them at 5% significance level. The analysis was done using the General Linear Models (GLM) procedure of Statistical Analysis System (14). The statistical model used was:

$Y_{ij} = \mu + g_i + e_{ij;}$

Where:

Y_{ij} = performance of the j^{th} individual.
μ = general mean of the parameter
g_i = fixed effect of age (i=1- 4)
e_{ij} = residual error.

Results and Discussions

Fertility and Hatchability of Fulani Ecotype chicken eggs

Five hundred (500) out of five hundred and ten (510) eggs collected from three different Fulani Kraals were set (98 %), the fertility and hatchability of eggs set was 79.2 and 65.4%, respectively (Table 1). The small number of cracked eggs (10) out of 510, obtained at the point of incubation showed that the FE have ability to produce eggs with good shell quality because the total number of cracked eggs were not up to 2 % as the quality of egg shell is closely related to the number of cracked eggs (15). It is also an indication that the FE is unique as a strain that has not been scientifically

bred for better egg production. Eighty five percent of fertile eggs were live germ at 18 days of incubation, about 45.85% of live germs did not hatch of which 17.16% were lost due to poor handling of the incubated eggs, while 53.78% of fertile eggs could not hatch as a result of either early death of germ or late embryonic mortality. Fifty four percent of live germs were able to hatch at the 21st day. One hundred and eighty three (183) chicks were obtained on the 21st day of incubation out of 280 living germs that were taken to the Hatcher on the 18th day, 34.64% of the chicks died before the day of hatch, this might also be as a result of late embryonic mortality or other extraneous factors.

Table1: Fertility and Hatchability of Fulani Ecotype Chicken Eggs Obtained from the Fulani Kraals

Traits	**Eggs(no)**	**Settable eggs, Fertile, Live germ and hatched chicks (no)**	**Percent**
Set ability	510	500	98.0
Fertility	500	396	79.2
Live germ at 18th days	396	338	67.6
Hatchability	280	183	65.4

The result of this study showed that fertility of the FE chicken was about 80%, which agrees with the findings of (16) who reported high percentage fertility for FE chicken and related this to the body size of the FE that allows higher genital contact and ensured good insemination. This also corroborated the findings of (17) where 76% fertility was reported for the FE chicken. Percentage hatchability (65.8%) of fertile eggs obtained in this study agreed with the findings of (16) who reported similar high hatchability. Although the hatchability was high, it was still lower than the 100% reported for unclassified Nigerian local chicken under natural incubation by (18). This might be as a result of the different incubation methods evaluated in the current study. Above average hatchability obtained in this study contradicts the findings of (17) where hatchability of 48% was reported. They however stated that the low hatchability of the Fulani Ecotype chicken as reported might not be a true reflection of their percentage hatchability. High hatchability of Fulani Ecotype chicken eggs obtained in this study was based on the estimation of hatched chicks relative to the number of live germs that were taken to the hatchers on the 18th day of incubation.

Egg production potentials of the Fulani Ecotype chicken

Determination of body weight at first egg and age at first egg has helped in

classifying breeds of chicken as heavy or light strains. Egg records that are of interest for determining production potential include egg size, egg quality, egg score and yolk quality (18). Age at Sexual Maturity (ASM) of the FE chicken ranged from 22 weeks to 31 weeks with mean of 26.73± 4.06 weeks (Table 2) The ASM was normally distributed with most hen coming to lay at 26 weeks. The mean body weight at first egg was 1437± 35.35 g. The difference in weight between the heaviest FE and the lightest one was 300g at point of lay. Average total number of eggs laid for 52 weeks was 128±15.48. The difference between the highest number of eggs laid by the hen and the least eggs was 94 while the weight of the eggs laid ranged from 35.72 to 52.50g. These results showed wide differences in the total numbers of egg laid by the FE as well as in egg weight and this could form the basis for selection of this chicken ecotype for better egg production.

Table 2: Laying Characteristics in the Fulani Ecotype chicken

Parameters	**Mean±SEM**	**Range**
ASM (wks)	26.7±4.06	22-31
BFE(g)	1437.4±35.35	1350-1650
Avg.EN/Hen	128.0±1.18	78-174
EW(g)	44.4±4.48	35.72-52.50
CS	5.5±2.15	3-9
PL	7.0±0.33	7-10
HHP (%)	53.1	45-59
HDP(%)	57.6	30- 60

ASM = Age at Sexual Maturity, BFE = Body weight at first egg, Avg.EN/Hen = Average egg number per hen, EW = Egg weight, CS = Clutch size, PL = Pause length, HHP = Hen housed production, HDP = Hen day production.

The least number of eggs laid per clutch was three, the highest was nine, and the paused length ranged from 7 to 10 days, this could form another basis for selection of FE hen. The mean of hen housed production was 53.10%, while the average Hen Day Production was 57.6%. The egg production curve (Fig.1) showed that the FE hens were more stable at 50 % HDP between 27 to 40 weeks of age in lay, while the HDP was more than 50 % from 41 weeks to 52 weeks in lay, this showed that, the birds laid more eggs as they grow older. The egg sizes ranged from 35 to 52g, while most of the eggs clustered around 45g throughout the 52 weeks of egg production. However, FE used in this study produced eggs that weigh between 50 – 52g from 40 to 51 weeks in lay (Fig.1). There is a noticeable fluctuation in egg production pattern as measured by HDP from 1st to 52nd weeks in lay of the Fulani Ecotype hen and selection for stable production will play a major role in improvement of Fulani Ecotype chicken for better egg production.

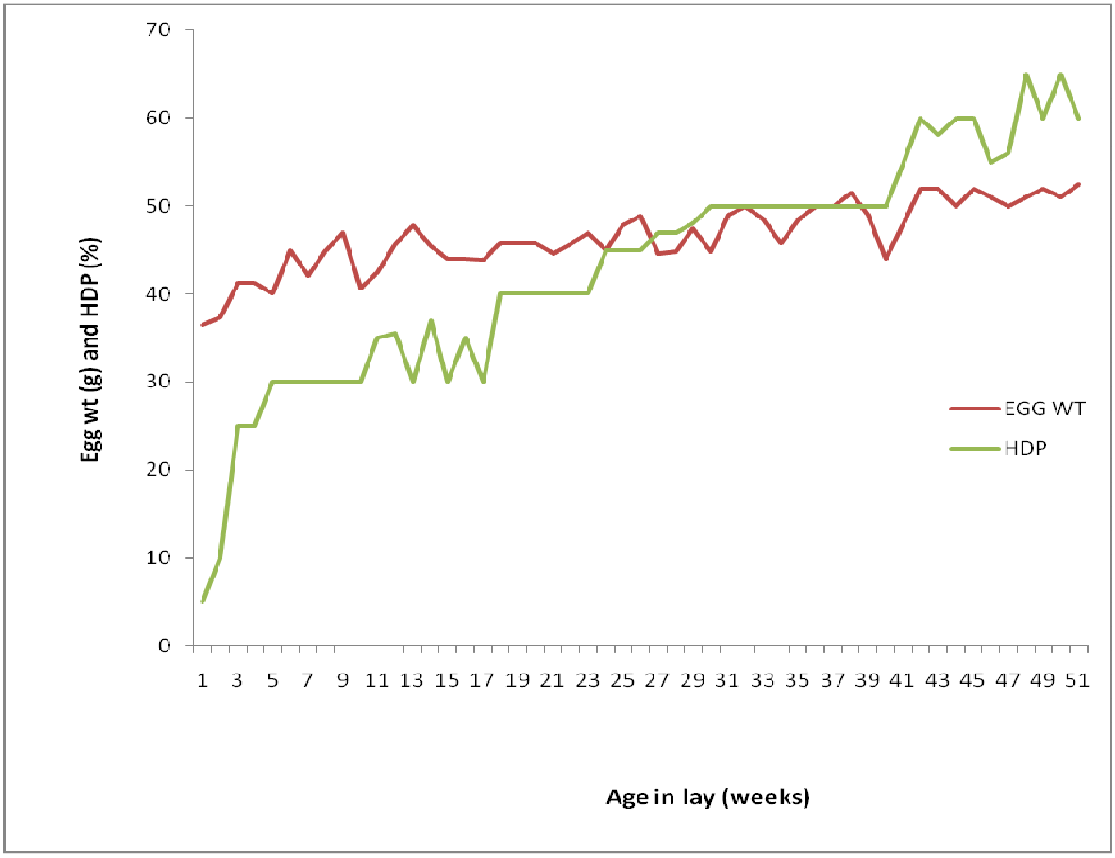

Fig. 1: Egg Production Pattern of the Fulani Ecotype chicken

Average number of eggs laid by FE in this study (128) was numerically higher than 124 reported by (19), while the age at first egg obtained for FE in this study corresponds with 21- 31 weeks reported for local chickens kept in battery cages by (20). The egg weight of FE used in this study also falls within the range of 30 – 50g reported by other workers (20; 21; 22). The average egg weight of the FE in this experiment was higher than the 34.5g reported for local chicken by (21), but corresponds with 44g reported for local chicken under different systems of management by (19). The higher egg weight obtained might be due to the fact that most of FE hen used in this study started laying with heavier body weights at older ages which corroborates the findings of (15) who stated that the older a pullet is when her first egg is laid, the larger her eggs during the laying period. The FE have lower pause lengths but higher clutch sizes compared with the report of (7) and (21) where clutch sizes of about 1-4 eggs were reported for local chicken, indicating better laying performance of the present stock under the present conditions.

Effects of age on egg quality traits of Fulani Ecotype chicken

Egg quality traits are classified either as external or internal qualities depending on whether or not the eggs were broken before the parameters were measured. (13) reported that egg external qualities include size, shell, colour, shell thickness, shell porousity while the internal qualities include yolk and albumen. The internal and external egg traits as affected by age in the FE chicken were as shown in Table 3. Yolk weight, yolk ratio, albumen height and ratio and Haugh unit values were high at 15 weeks of age in lay than at other ages in lay. Yolk weight, yolk ratio and albumen height values were low at 52 weeks of age in lay. There were increments in values obtained for yolk width, yolk index and albumen weight from 15 to 30 weeks. These values decreased again at 45 and 52 weeks. Yolk height and blood spot values increased progressively from 15 to 45 weeks of lay, blood spot value at 45 weeks of age in lay did not differ significantly ($p>0.05$) from that of 52 weeks of age in lay. The meat spot value was lowest at 30 weeks of age in lay. This result showed that as FE hens advance in age, they lay more eggs with blood and meat spots. When incidences of blood and meat spots are above 20 % it becomes abnormal (15), in the case of FE chicken eggs observed in this study their occurrences were normal as they were below 20% of the total egg examined.

Eggs laid at 15 weeks of lay were about 5g smaller in weight than subsequent eggs laid at older ages by the FE hen and this was significant ($p<0.05$). The egg length was also shorter at 15 weeks in lay than egg length obtained at older ages. Eggs laid were smaller in width at 45 weeks in lay than other ages. Egg shell weight was highest at 52 weeks while egg shell thickness value was lowest. The highest egg shell ratio and egg shell thickness were obtained at 15 weeks of age. Although, FE hen were fed the same diet throughout the experimental period, it was observed that significant and non-significant differences existed in external and internal egg quality traits of the FE at 15, 30, 45 and 52 weeks of egg production; Thus reflecting the effect of age and varying environmental conditions which the birds were subjected to.

Table 3: Internal Egg quality Traits of the Fulani Ecotype Chicken

Traits	Age in lay (weeks)			
	15	30	45	52
YW(g)	16.80^{b}±0.45	15.99^{c}±0.85	17.27^{a}±0.62	16.43^{b}±07
YWD(cm)	2.15^{c}±0.01	2.32^{b}±0.02	2.30^{b}±0.01	2.78^{a}±0.01
YH(cm)	1.05^{d} ±0.03	1.58^{c}±0.03	1.65^{b}±0.03	1.78^{a}±0.02
YR (%)	39.81^{a}±0.24	33.59^{d}±0.25	36.25^{b}±0.24	34.74^{c}±0.25
YI	64.95^{c}±0.89	65.50^{b}±0.45	65.49^{b}±0.70	66.03^{a}±0.17
AH(cm)	0.68^{c}±0.01	0.66^{d}±0.01	0.64^{a}±0.07	0.62^{b}±0.45
AW(g)	26.40^{c}±2.35	26.58^{b}±0.98	26.03^{d}±0.98	27.04^{a}±1.11
AR (%)	62.55^{a}±0.94	55.84^{c}±0.03	54.63^{d}±0.95	57.16^{b}±0.07
HU (%)	90.74^{a}±0.01	89.05^{b}±1.55	90.48^{a}±0.48	90.55^{a}±1.02
BS (%)	10^{c}	12^{b}	15^{a}	15^{a}
MS (%)	2^{c}	1^{d}	5^{b}	8^{a}

Means on the same row followed by different superscripts differ (a-d) significantly ($p<0.05$) YW =Yolk Weight, YWD = Yolk Width, YH = Yolk Height, YR = Yolk Ratio, YI = Yolk Index, AH = Albumen Height, AW = Albumen Weight, AR = Albumen Ratio, HU = Haugh Unit, BS = Blood spot, MS = Meat spot.

The reduction in shell thickness and increment in egg weight as the age of the hen in lay increased conformed with the report by (23) who observed that smaller eggs have stronger shells than larger ones and that older birds tend to lay bigger eggs which impact more on the shell strength since hens deposit less calcium per unit area of shell the older they get. The reduced value in the albumen height and Haugh unit corresponds with the findings of (24), (25) and (26) that albumen qualities and the Haugh unit decreased with increasing bird age. (15) stated that albumen quality with Haugh unit above 80 are within grade AA of the USDA egg grade units; therefore, FE hen used in this study produced eggs with good albumen quality, since the Haugh unit was higher than 80 % from 1st to 52 weeks in lay.

Table 4: External Egg quality Traits of the Fulani Ecotype chicken

Traits	Age in lay (weeks)			
	15	**30**	**45**	**52**
EW(g)	42.20^{c}±3.20	47.60^{b}±4.88	47.64^{b}±2.94	47.80^{a}±3.28
EL (cm)	2.25^{d}±0.01	2.30^{c}±0.02	2.78^{b}±0.01	3.20^{a}±0.01
EWD (cm)	2.20^{b}±0.05	2.23^{b}±0.08	2.00^{c}±0.02	2.40^{a}±0.01
ESW (g)	5.29^{c}±0.01	4.28^{d}±0.08	6.12^{b}±0.01	6.25^{a}±0.24
EST(mm)	0.59±0.01	0.58±0.01	0.56±0.01	0.51±0.02
ESQ	0.24^{c}±0.01	0.22^{d}±0.01	0.28^{a}±0.07	0.26^{b}±0.45
ESR	9.50^{a}±0.05	8.96^{d}±0.20	8.99^{c}±0.07	8.20^{b}±0.89
ESI (%)	97.77^{a}±0.01	96.95^{a}±0.01	91.94^{c}±0.95	95.09^{b}±0.01

Means on the same row followed by different superscripts differ (a-d) significantly ($p<0.05$). EW = Egg Weight, EL = Egg Length, EWD = Egg Width, ESW = Egg Shell Weight, EST = Egg Shell Thickness, ESQ = Egg Shell Quality, ESR = Egg Shell Ratio, ESI = Egg Shape Index

Conclusions and application

1. TFulani Ecotype hens exhibit wide variation in body weight at first egg, age at sexual maturity, egg production, egg sizes, pause length, clutch size, and egg quality.

2. The Fulani Ecotype hens produce eggs with good albumen quality, yolk quality and shell thickness that are highly settable, fertile and hatchable.

3. The primary merit of the FE birds for poultry production in the Nigerian locale remains its adaptation to the environment (physical conditions, climate, and infectious pathogens), which is superior to that of exotic highly productive egg layers.

4. The result presented here can serve as a useful benchmark for application of scientific methods to Fulani Ecotype conservation which is increasingly urgent, for preservation of valuable Fulani Ecotype germplasm, as is the case for many local breeds worldwide.

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