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Fertility, Hatchability and Eggs Quality Traits of Nigerian Locally Adapted Chickens in the Derived Savanna Environment of Nigeria

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Abstract

An experiment was carried out to compare fertility, hatchability and egg quality traits of Nigerian locally adapted chickens in derived savanna environment of Nigeria. A total number of 1928 eggs consistof309eggs of naked neck, 635 eggs of frizzle feather, 590 eggs of Fulani ecotype and 394 eggs of normal feather eggs were used to study hatchability traits of the four genotypes. The results showed that fulani ecotypes had highest eggset (100%), fertile eggs (85.59%) and lowest infertile egg (14.41%) while highest and lowest hatchability and dead in shell was obtained for normal feather eggs of 86.67% and 13.33% respectivelythan other genotypes. Most of the parameters measured for correlation coefficient were positively significant for all the genotypes. Significant ($P < 0.05$) effect was observed among the egg traits measured and the genotypes. Naked neck eggs had highest egg weight (44.86g), egg length (7.03mm), shell weight (4.29mm), yolk weight (14.57mm) and yolk height (3.29mm) than its counterpart genotype eggs while normal feather eggs recorded highest egg breadth (5.34mm), albumen weight (22.68mm) and albumen height (4.58mm) over other genotype groups eggs.The presentresults indicated that fulani ecotype eggs performed better than other genotypes group used in this study in respect to hatchability traits and naked neck and normal feather eggs were better in egg quality traits than their counterpart genotype eggs.

Keywords: Local chickens, egg quality traits, hatchability, fertility and derived savanna.

Introduction

There has been rapid increase in the number of farmers keeping chicken parent and grandparent stock leading to increase in the population of meat type chicken in Nigeria (Kathleen 2002). Unfortunately, in Nigeria, poor fertility and hatchability rates among other factors constitute the major threat to performance of the industry (Adebambo 2005).The fertility and hatchability characteristics of egg type chickens in Nigeria are two main traits of assessing the potentials of hens (Allanah et al 2014). According to Peters et al (2008), the gene make-up of an individual chicken is fixed at fertilization and hence fertility and hatchability are generally considered as traits of two parents.

Fertility is an important parameter in chicken and reflects the total actual reproductive capacity of females and males expressed by their ability when mated together to produce offspring. An egg is said to be infertile when it fails to show any evidence of developing embryo (Miazi et al 2012). Hatchability is a trait of economic importance in the chicken industry because it has a strong effect on chick output (Wolc et al 2010). It is influenced by a number of factors such as egg weight, turning of eggs, storage, humidity, shell strength, egg size and genetic factors within the chickens kept. The ability of the embryo to successfully escape from the shell is called hatchability (Tarek 1992). Good hatchability of eggs is to some extent heritable, but is determined by a complicated genetic constitution and the environment.

Egg quality is important for consumer appeal, and the economic success of a producer depends on the total number of eggs sold. Egg quality comprises several aspects (Tumova et al 2007) related to egg weight, egg length, egg breath, shell weight, shell thickness and specific gravity (external quality) and to the albumen weight, haugh unit and yolk colour (internal quality). Egg quality has a genetic basis and the parameters of egg quality vary between strains of hens (Silverside et al 2006). However, the eggshell may be affected by interactions of age and breed (Campo et al 2007).

The relationship between external traits, yolk and albumen had contributed to the egg weight increases with hen's age, reaching an apex by the end of laying cycle (Danilov 2000). Thus egg external qualities are one of the important phenotypic traits which influence egg quality and reproductive fitness of the chicken parent (Islam and Dulta 2010). It is real that beneficial egg quality traits are of immense importance to poultry breeding industries (Bain 2005). In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of hen (Onagbesan et al 2007). This study therefore, was designed to access the fertility and hatchability and egg quality characteristicsNigerian locally adapted chickens in derived savanna environment of Nigeria.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Unit of Teaching and Research Farm, LadokeAkintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated in the derived savannah zone of Nigeria on longitude 4^{o} 15$^{'}$ East and latitude 8^{o} 15$^{'}$ North east of the Greenwich meridian. The altitude is between 300 and 600m above sea level. The mean annual rainfall and temperature are 1247mm and 27^{o}C respectively (Ojedapo and Amao 2014).

Experimental Birds and Management

Total of eighteen (18) sires and fifty-two (52) dams belonging to four different strains were used for the experiment. The four strains were from four indigenous (Naked-neck (hens: 10; cocks: 5), Normal feather (hens: 15; cocks: 4), Frizzle feather (hens: 15; cocks: 5) and Fulani ecotype (hens: 12; cocks: 4) chickens. The indigenous chickens used as parents stock were purchased from some villages around the study site. All hens were purchased at age range of 16 - 18weeks, while the cocks were purchased at age range of 15 - 17weeks old. The birds were individually wing tagged for identification purpose. The sires were trained for semen collection by applying slight pressure at the back towards the tail forty times daily before sperm production. Feathers around the sire's vent were shaved at two weeks interval and semen collection started at 22 weeks of age.

Experimental Feeds and Feeding

The birds were fed were *ad-libitum* with commercial breeder mash containing 17.5% crude protein and 2700kcal metabolizable energy. Clean water was also supplied *ad- libitum*. Medications and vaccinations were done as required.

Experimental Mating

Artificial Insemination (AI) was adopted in mating the hens. The massage technique was used to collect semen from the cocks (Frizzle feather, Naked-Neck, Normal Feather, Fulani Ecotype). The semen collected was inseminated immediately into a doughnut shape in the left vent of the hens. This was done once a week in the evening. For each hen 0.1ml of undiluted semen was used for insemination each time.
The mating procedure is as follows:
Normal Feather (Male) × Normal Feather (Female): NF_mxNF_f
Frizzle Feather (Male) × Frizzle Feather (Female):FF_mxFF_f
Fulani Ecotype (Male) × Fulani Ecotype (Female):FE_mxFE_f
Naked-Neck (Male) × Naked-Neck (Female):NN_mxNN_f

Method of Egg Collection and Incubation

Eggs from artificial insemination hens were collected pedigreed along genotype lines and stored in a cool room at 18°C to 20°C for five days before the eggs were taken to the hatchery for incubation. The eggs were set in a cabinet type incubator at a commercial hatchery. The eggs were set along the genotype lines at a temperature between 27 - 39°C and a relative humidity of 55 – 56% for eighteen days, then the temperature was then increased to 29 - 40°C and a relative humidity of 70 – 75% from nineteenth day to hatching time. The eggs were also turned automatically through 90^{o}C in the incubator.

Candling Process

Candling was carried out on the 18th day of incubation for the identification of fertile eggs, and clear eggs. The process was carried out in a dark room using a Candler fixed with a neon fluorescent tube. The eggs were placed on the Candler for easy penetration of light through the eggs and the eggs were viewed against the source of light. The fertile eggs were seen to be densely clouded and opaque with network of veins indicating development of embryo within the eggs while the unfertile eggs were translucent under the light. Number of infertile and embryonic mortality was recorded. After candling, the fertile eggs were transferred into the hatching tray according to the genotypes into the hatchery unit and spent three days. After the chicks hatched, they were leaved in the hatchery until 90% were dried. On the 21st day, the numbers of hatched chicks including the normal, weak, abnormal chicks and dead chicks after hatch were recorded.

Data Collection

(a). Data were obtained on the following parameters when the birds were twelve weeks into laying: number of egg set per genotype, number and percentage of fertile eggs, number and percentage of infertile eggs, number of eggs hatched and hatchability percentage, number of dead in shell and percentageusing the formular below:

Number of fertile eggs =

% fertility = $\frac{\text{No of fertile eggs}}{\text{No of egg set}} \times \frac{100}{1}$

The eggs hatched and hatchability was calculated thus:

% hatchability = $\frac{\text{No of chicks hatched}}{\text{No of fertile eggs}} \times \frac{100}{1}$

Percentage of dead in shell was estimated.

$$\frac{\text{No of dead in shell}}{\text{No of fertile eggs}} \times \frac{100}{1}$$

(b) A total number of 480 eggs was used for the assessment of egg quality traits. 120 freshly laid eggs were randomly selected from the eggs laid by each strainwhen the hens were 20 weeks in laying. Egg quality parameters evaluated on weekly bases and this include, egg weight (g), egg length (mm), egg breath (mm), shell weight (g), albumen weight (g), albumen height (mm), yolk weight (g) and yolk height (mm) using procedures described by Ojedapo*et al*., (2008).

Data Analysis

Data on egg traits were collected for weeks (age) effect and subsequently subjected to One-way analysis of variance in a Completely Randomised Design using the procedure of SAS (2003) and significant means were separate with the same procedure of SAS (2003). The below model is adopted:

$Y_{ij} = \mu + \alpha_i + e_{ij}$

Where,

Y_{ij} = individual observation

μ = overall mean

α_i = fixed effect of i^{th} genotypes (1, 2, 3, 4)

e_{ij}= experimental errors which is evenly distributed.

Correlations of egg quality parameters was also done using the formular below;

$$r = \frac{\sum XY}{(\sum X^2 \sum Y^2)^{1/2}}$$

Where r = correlation coefficient

$\sum XY$, $\sum X^2$ and $\sum Y^2$ = sum of the variables

RESULTS

Table 1 revealed the absolute values and percentage of egg set, fertility and hatchability estimated in different chicken genotypes. Frizzle feather birds had the highest percentage (99.22%) of egg set followed by those of the Fulani ecotypes. Out of the number of egg set in all the genotypes, Fulani ecotype had the highest percentage (85.59%) fertility followed by Naked-neck with 77.67%. Infertility was observed to be highest in Frizzle feather hens with 32.28% infertility while the least infertility was obtained Fulani ecotype.

Out of the fertile eggs in each genotype, highest hatchability was observed in the normal feather eggs with 86.67% hatchable eggs followed by the Frizzle feather eggs with 84.16% hatchable eggs. This shows that normal feather eggs performed better in terms of hatchability followed by the Frizzle feather eggs in all the genotypes. Dead-in-shell was highest in naked-neck eggs of (25%) while the lowest was observed in normal feather eggs (3.33%).

Table 2 revealed the correlation coefficients of egg set, fertility and hatchability of egg laid by each of the Nigerian locally adapted chickens.Generally, the correlation coefficients in each of the genotype revealed positively high significant relationship. The relationships between egg set and fertility were very high and significant ($P < 0.001$) in each of NN (0.932), FF (0.882), NF (0.924) and FE (0.993) and tend towards units. Similarly, very high significant correlations ($P < 0.001$) existed between fertility and hatchability in all the genotypes. However, positive significant correlations ($P < 0.05$) between dead in shell and fertility were found in all the genotypes except in the NF ($P > 0.05$).

Significant differences ($P < 0.05$) obtained in the egg quality traits regarding the genotypes as shown in Table 3 revealed that naked neck birds had the highest egg weight, egg length, shell weight, yolk weight and yolk height than other genotype group. The normal feather eggs were also highest in egg length, albumen weight, yolk weight, and yolk height while fulani ecotype eggs had more of albumen height. Interestingly, frizzle feather eggs had the lowest values for all parameters measured.

DISCUSSION

The data obtained on eggset, fertility and hatchability of egg laid by differentgenotypes in the present study in favour of fulani ecotypesis in accordancewith the documentation of Peter et al (2007) and Fayeye et al (2005) who reported similar findings in favour of fulani ecotype over other strains of local birds considered in their studies. The present results on hatchability parameters are similar to the findings of Miazi et al (2012) in Bangladesh for Fayoumi and Sonali chickens. The current results are alsoin agreement with Bobbo et al (2013) in Nigeria. The authors reported variability in hatchability parameters in their studies.However, a previous study by Yakubu et al (2008) in Nigeria reported that hatchability of naked neck and normal feathered chickens did not differ. Similar observations were made by Ahmed et al (2012) in Bangladesh where no significant differences were noted among the genotypes considered. Heier and Jerp (2001) stated that hatchability is influenced significantly by genetic factors acting directly or indirectly through the egg. In the present study, hatchability values for naked neck and normal feathered chickens were lower compared to the values reported by Ahmed et al (2012). The authors reported hatchability values for naked neck chickens to be 87.40% compared to 75% forthe same strain in this study. The differences in the results of the present study and that of Ahmed et al (2012) could be ascribed to the differences in rearing conditions/systems. Birds in the study by Ahmed et al (2012) were reared under extensive/scavenging system which is contrary to the management adopted in the present study.

Significant positive correlations as witnessed amongst eggset, fertility, infertility, hatchability and dead in shell compares favourably with Islam et al (2002), except fertility and dead in shell and dead in shell and normal chicks which contradicts (Islam et al 2002). The non- significant correlation found between some of the variables and the hatchability parameters in all the four genotypes studied were in contrast with the previous findings of Islam et al (2002). The authors reported significant positive correlation between some hatchability parameters on Bangladesh chickens. Naked neck had the highest correlation coefficients than others for fertility and hatchability on eggset, fertility and hatchability on fertile eggs and fertility was in line with earlier documentation of Islam et al (2002). The researchers reported a similar relationship for white leghorn and Rhode Island Red. On the contrast significant positive correlations obtained in the present study between fertility and dead embryo by frizzle feathered chickens compared favourably with Islam et al (2002) on white Leghorn hens. The variation documented in respect to correlation coefficient of individual genotype in the present study was conformed to the findings of Bobbo et al (2013). The authors reported similar findingsin Nigerian for frizzle, smooth and naked neck chickens.

Egg quality traits results noted on this present study was similar to the observation of Monira et al (2003) who reported significant variation among breeds of poultry for egg quality traits. The significant difference between the groups for egg traits is in agreement with the earlier reports by Peters et al (2007). However, the ranges of egg weights in the present study were higher than Sudanese indigenous chicken types documented by Mohammed et al (2005).The highest weights of eggs of naked neck hen might be as result of the greater adaptation of naked neck hen to the hot humid environment especially in terms of body temperature regulation. This followed the trend earlier reported by Peters et al (2007). The authors reported the measured variable as in egg weight favoured naked neck hen over other Nigerian local chicken. These results on heaviereggs of naked neck hen were similar to the results obtained by Peters et al (2002). They reportedthat naked neck hen laid heavier eggs compared to their normal feathered counterpart. The highest shell weight from eggs of naked neck over those from their counterpart might due to the genotype influences on the amount of egg shell being deposited during the egg formation. Thus, this supported the noticed of Peters et al (2004). These researchers reported similar findings that favoured the naked neck hen in their study. Meanwhile, the values observed that favoured naked neck for shell weight is inconsistent with the findings of El-Safty et al (2006). The mean albumen weight and albumen height of naked necks are in agreement with those reported by Fayeye et al (2005) for Fulani ecotype chicken. The higher yolk weight and yolk height for naked neck hen have been reported by Yakubu et al (2008) as the best indicators of internal egg quality with suggestion that egg from naked neck genotype are of good quality.

CONCLUSION

This study has indicated that Fulani ecotype eggs were superior to their other indigenous counterpart in eggset, fertile eggs and the least infertility while normal feather eggs told the lead for hatchable eggs. Meanwhile, the egg quality traits were in better for naked neck eggs than its counterparts. It is therefore, concluded that Fulani ecotype should be used for their better egg production and naked neck hens for their better potential displayed of egg traits in the derived savanna environment of Nigeria.

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Table 1: Absolute values and percentage of egg set, fertility and hatchability estimated in different chicken genotypes

		Genotype			
Parameters	**Observations**	**NN**	**FF**	**FE**	**NF**
Egg set	1928	309.00 (98.10%)	635.00 (99.22%)	590.00 (100%)	394.00 (99.75%)
Fertile eggs	1475	240.00 (77.67%)	430.00 (67.72%)	505.00 (85.59%)	300.00 (76.14%)
Infertile eggs	453	69.00 (22.33%)	205.00 (32.28%)	85.00 (14.41%)	94.00 (23.86%)
Hatchable eggs	1215	180.00 (75%)	350.00 (81.40%)	425.00 (84.16%)	260.00 (86.67%)
Dead in shell	260	60.00 (25%)	80.00 (18.60%)	80.00 (15.84%)	40.0 13.33%)

NN = Naked Neck , FF = Frizzle feather,FE = Fulani Ecotype, NF = Normal Feather

Table 2: Correlation Coefficients of egg set, fertility and hatchability of egg laid by Nigerian locally adapted chickens

Genotype		**Egg set**	**Fertility**	**Infertility**	**Hatchability**	**Dead in shell**
	Egg set					
	Fertility	0.932***				
NN	Infertility	0.707*	0.402^{ns}			
	Hatchability	0.912**	0.930***	0.489^{ns}		
	Dead in shell	0.637*	0.768**	0.110^{ns}	0.479^{ns}	
	Egg set					
	Fertility	0.882**				
FF	Infertility	0.675*	0.249^{ns}			
	Hatchability	0.735*	0.945***	0.035^{ns}		
	Dead in shell	0.712*	0.679*	0.390^{ns}	0.423^{ns}	
	Egg set					
	Fertility	0.924**				
NF	Infertility	0.721*	0.405^{ns}			
	Hatchability	0.819*	0.958***	0.222^{ns}		
	Dead in shell	0.601*	0.431^{ns}	0.635	0.284^{ns}	
	Egg set					
	Fertility	0.993***				
FE	Infertility	0.157^{ns}	0.091^{ns}			
	Hatchability	0.958***	0.971***	0.019^{ns}		
	Dead in shell	0.822*	0.813*	0.239^{ns}	0.649*	

***P < 0.001, **P < 0.01, *P < 0.05, ns = not significant
NN = Naked neck, FF = Frizzled Feather, NF = Normal Feather, FE = Fulani Ecotype

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Table 3: Egg quality traits of Nigerian locally adapted chickens.

PARAMETER	OBS	OVERALL MEAN	FF	NF	NN	FE
EW	480	43.01±0.59	38.48±0.85^{c}	44.44±0.57^{ab}	44.86±1.62^{a}	41.90±2.01^{b}
EL	480	6.85±0.04	6.57±0.01^{c}	6.96±0.04^{ab}	7.03±0.05^{a}	6.94±0.09^{ab}
EB	480	5.27±0.02	5.15±0.04^{b}	5.34±0.09^{a}	5.26±0.09^{ab}	5.15±0.09^{b}
SW	480	3.75±0.08	3.39±0.14^{c}	3.64±0.10^{b}	4.29±0.36^{a}	4.00±0.21^{ab}
ALW	480	4.89±0.34	19.96±0.47^{c}	22.68±0.36^{a}	21.71±1.11^{b}	22.40±1.86^{ab}
ALH	480	4.35±0.10	3.87±0.15^{b}	4.58±0.16^{a}	4.50±0.37^{ab}	4.59±0.34^{a}
YLW	480	14.13±0.20	12.48±0.28^{c}	14.40±0.23^{a}	14.57±0.69^{a}	13.30±0.54^{b}
YLH	480	3.26±0.02	3.11±0.02^{b}	3.30±0.02^{a}	3.29±0.06^{a}	3.12±0.03^{b}

^{a,b,c} Means occupying each row in each parameter having different superscripts are significant different (P <0.05).

Note: EW = egg weight (g), EL = egg length (mm), EB = egg breath (mm), SW = shell weight (g), ALW = albumen weight (g), ALH = albumen height (mm), YLW = yolk weight (g) and YLH = yolk height (mm), Obs = Number of observation,NN = Naked neck, FF = Frizzled Feather, NF = Normal Feather, FE = Fulani Ecotype

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