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Effect of strain and associations of some fertility and hatchability traits of indigenous guinea fowls raised in the rain-forest zone of South-East Nigeria

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Abstract

A total of 204 eggs consisting of 102 eggs each from Pearl x Pearl and Black x Black matings were collected and hatched in 3 batches to evaluate strain effect and phenotypic correlations (r_p) among the following hatching traits – hatchability on eggs set (HES), hatchability on fertile eggs (HFE), fertility (FER), dead-in-germ (DG), dead-in-shell (DS), normal keets (NRK) and abnormal keets (ABK). Strain had no significant (P > 0.05) effect on the entire traits studied, except for DS. The Black strain had significantly (P < 0.05) lower DS values (8.89 ± 4.00, 21.39 ± 4.62 and 23.90 ± 3.03) compared to the Pearl (33.33 ± 16.66, 44.53 ± 13.40 and 83.33 ± 25.45) in the 3 batches, respectively. The r_p among the traits for the 2 strains ranged from low to unity. However, the association between HES and HFE of the Black strain was not significant (P > 0.05). The significant (P < 0.05; P < 0.01) correlations among DG, HES, HFE and FER ranged between -0.201 to -0.728 (Pearl) and -0.369 to -0.700 (Black). The r_p estimates among DS, HES, HFE, FER and DG ranged between -0.526 to -0.883 (Pearl) and -0.528 to -0.709 (Black). The correlation between fertility and hatchability traits were significant and positively related in both strains. The non-significant strain effect indicates that these fertility and hatchability traits are less dependent on genetic profile but are more influenced by non-genetic factors like management and environment. Estimates of r_p observed among the traits suggest that they could be improved phenotypically through selection.

Keywords: Fertility, hatchability, guinea fowl, phenotypic correlation, strain

INTRODUCTION

Fertility and hatchability traits are the most important determinants of degree of multiplication from a given number of breeding stocks within a specific period (Islam *et al*., 2002). Jull (1970) reported that fertility and hatchability performance of eggs depends on a number of factors such as genetic, physiological and environmental. In corroboration, Stromberg (1975) reported that fertility and hatchability traits are highly sensitive to environmental and genetic influences. Coony (1943) had earlier observed that fertility and hatchability are interrelated heritable traits that vary among breeds, varieties and individuals within breeds. Limited information are available on the influence of strain on

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Table 1: Mating scheme and total numbers of eggs laid by the two strains (Pearl and Black)

Mating scheme	Number of guinea hens	Number of guinea cocks	Number of eggs
Pearl x Pearl	24	8	102
Black x Black	24	8	102
Total	48	16	204

fertility and hatchability of guinea fowl eggs particularly in Nigeria.

Nwagu and Alawa (1995) indicated that poor fertility and hatchability are the major constraints in guinea fowl production in Nigeria. It has been reported that the Nigerian indigenous guinea fowl is still genetically uncharacterized and unimproved (Nwagu and Alawa, 1995). Therefore, one plausible solution to the aforementioned constraint is genetic selection. This in turn is possible through knowledge of the genetic as well as the phenotypic differences among these traits of interest. Kosum *et al*. (2004) had noted that genetic improvement of traits depends largely on the genetic and phenotypic relationships between traits of economic importance. Estimates of phenotypic and/or genetic associations among fertility and hatchability traits of guinea fowl eggs are highly scant in literature. The few documented studies are mainly on chicken eggs.

This study was therefore designed to investigate the effect of strain on the fertility and hatchability traits of indigenous guinea fowl eggs and to estimate the phenotypic associations among the traits. This effort is aimed at developing base line information leading to increased production of this poultry specie which is expected to contribute substantially to the much needed animal protein in Nigeria.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry unit of the Teaching and Research farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The area is located within the humid rain-forest zone of the country on 05° 29' N and longitude 07° 33' E on an elevation of 122 m above sea level. The zone is characterized by long rainfall duration and short dry season period with minimum and maximum temperatures of 22°C and 32°C, respectively. Relative humidity lies between 50 – 95 %.

Management of experimental flock

The breeding stock comprised of 64 guinea fowls (32 each of Pearl and Black strains). Each strain was grouped into 2 with 16 birds per group which were replicated 4 times. They were mated in a ratio of 3 guinea hens: 1 guinea cock. The mating procedure is as shown in Table 1 as well as the number of eggs laid by each strain. Two different feeds (15.95 % CP and 2828.23 Kcal/kgME; 18.08 % CP and 2992.50 Kcal/kgME) were compounded and fed *ad libitum* to the birds. Each strain group received each of the feeds for 10 weeks. Water was also given *ad libitum*.

Data collection and analysis

Egg collection was done on a daily basis within the above-stated period, bulked and sent to an automated hatchery in batches. The eggs were stored at a temperature of 10-16°C prior to incubation. Temperature and relative humidity were maintained at 37°C and 56 %, respectively in the incubator. Eggs were candled on the 9^{th} and 25^{th} day of incubation to identify infertile eggs and dead-in-germ (eggs with dead embryos). Such eggs were quickly removed from among the eggs set. On the 28^{th} day, the hatched keets were collected (normal, abnormal weak and dead). The unhatched eggs and pips were separated differently as dead-in-shell. Undersized, poorly feathered, lame, open naveled and blind keets were regarded as abnormal. The remaining keets were then termed normal. The following fertility and hatchability parameters – fertility, hatchability on fertile eggs, hatchability on eggs set, dead-in-germ, dead-in-shell, normal keets and abnormal keets were calculated as percentages.

Data generated from 204 eggs; 102 each from the pure matings (Pearl x Pearl and Black x Black) were subjected to analysis of variance with the use of SPSS (2004) software package. The study was a 2 x 2 factorial in RCBD with strain and feed as factors of interest and batch as the blocking variable. The analytical model is as shown below.

$$Y_{ijk} = \mu + S_i + F_j + (SF)_{ij} + e_{ijk}$$

Where,

Y_{ijk} = k^{th} observation on the i^{th} strain with the j^{th} feed

μ = overall mean

S_i = fixed effect of strain

Table 2: Means ± SE of hatching traits for the Pearl and Black strain

Batch	Strain	HES	HFE	FER	DG	DS	ABK	NRK
1	Pearl	46.67±2.11	58.89±6.42	67.22±2.74	24.21±4.77	33.33±6.66[a]	8.33±2.33	91.67±8.33
	Black	60.00±3.33	65.28±5.01	70.00±3.33	31.11±4.84	8.89±4.00[b]	0.00±0.00	100.00±0.00
2	Pearl	46.95±5.62	72.22±6.69	52.46±6.67	32.78±2.74	44.53±3.39[a]	8.35±2.55	90.76±8.23
	Black	50.5 ±3.98	76.67±7.45	68.89±4.84	31.68±4.90	21.39±4.62[b]	9.72±6.24	90.20±6.24
3	Pearl	46.11±5.05	75.00±8.33	49.17±6.01	39.17±5.54	53.33±5.45[a]	5.56±3.56	94.45±5.56
	Black	49.37±4.19	82.79±5.72	68.33±4.91	32.00±3.33	23.90±3.03[b]	6.56±3.24	93.45±5.56

a-b Means with different superscripts on the column are significantly ($P < 0.05$) different
HES = hatchability on eggs set, HFE = hatchability on fertile eggs, FER = fertility, DG = dead-in-germ, DS = dead-in-shell, ABK = abnormal keets, NRK = normal keets.

F_j = fixed effect of feed
$(SF)_{ij}$ = interaction effect
e_{ijk} = random error
The phenotypic correlation coefficients among the traits for each strain were also estimated using the Pearson's Correlation method of SPSS (2004) procedure.

RESULTS AND DISCUSSION

Effect of strain on fertility and hatchability traits

The result of the strain effect is shown in Table 2. There was no significant ($P > 0.05$) strain effect on the traits in all the batches except for dead-in-shell (DS). In the three batches, the Black strain had significantly ($P < 0.05$) lower DS compared to the Pearl strain, indicating that the Black hatched more keets than the Pearl. The values were 33.33 ± 6.66, 44.53 ± 13.39, 53.33 ± 5.45 (Pearl) and 8.89 ± 4.00, 21.39 ± 4.62, 23.90 ± 3.03 (Black) in batches 1, 2 and 3, respectively. In contrast, Islam *et al*. (2002) found no significant difference in DS attributable to four chicken genotypes (Rhode Island Red, Barred Plymouth Rock, White Leghorn and White Rock), respectively. However, the non-significant ($P > 0.05$) strain effect observed for all the other traits is in agreement with findings of other researchers. Islam *et al*. (2002) reported that breed had little effect on the hatchability of chicken eggs. Sapp *et al*. (2004) gave a range of 0.06-0.13 as heritability estimates for fertility and hatchability in chicken. This supports minute influence of genetic factors on the traits. Ali *et al*. (1993) also reported non-significant breed effect on fertility and hatchability of Rhode Island Red (RIR), Fayoumi and RIR x Fayoumi eggs.

The low DS and dead-in-germ (DG) recorded for the Black strain seemed to be responsible for higher hatchability and fertility observed with the strain compared to its counterpart. The fertility values ranged between 49-67 % and 68-70 % while hatchability on fertile eggs (HFE) ranged between 65-82 % for Pearl and Black, respectively. The hatchability values of ≥ 70 % obtained for both strains were comparable to values reported for different guinea fowl strains which ranged between 73-90 % (naturally mated) and 70-80 % (artificially inseminated) eggs (Fisinin and Zlochevskaya, 2004). The authors noted a fertility range of 75-76 % and 72-90 % for both strains, respectively. These values were higher than the percentage values recorded in this study. This may be due to differences in environmental conditions. Generally, the Black strain had higher numerical values for fertility than the Pearl. With *deshi* chicken (broiler breeders), Salahuddin *et al*. (1990) observed higher values of 80.79 % egg fertility and 71.73 % hatchability of fertile eggs. In another investigation with the Nigerian Fulani-ecotype chicken, Fayeye *et al*. (2005) obtained 76 % and 48 % as respective values for fertility and hatchability of eggs. From our result, the strains recorded lowest fertility and hatchability of eggs in batch 1 with regard to batches 2 and 3, respectively. This agrees with earlier report that fertility and hatchability of guinea fowl were low at the beginning of the breeding season (Ayorinde, 2004).

Some authors have noted the causes and problems associated with poor hatchability as early embryonic

Table 3: Phenotypic correlation coefficients of egg hatching traits for the Pearl strain

	HES	HFE	FER	DG	DS	ABK	NRK
HES	1						
HFE	0.652**	1					
FER	0.456*	0.368*	1				
DG	-0.201*	-0.728**	-0.396*	1			
DS	-0.697**	-0.883**	-0.526*	-0.783**	1		
ABK	0.062	-0.220	-0.205	-0.107	-0.167	1	
NRK	0.260	0.220	0.251	-0.273	- 0.256	-1.00**	1

**P < 0.01, *P < 0.05, HES = hatchability on eggs set, HFE = hatchability on fertile eggs, FER = fertility, DG = dead-in-germ, DS = dead-in-shell, ABK = abnormal keets, NRK = normal keets.

Table 4: Phenotypic correlation coefficients of egg hatching traits for the Black strain

	HES	HFE	FER	DG	DS	ABK	NRK
HES	1						
HFE	0.213	1					
FER	0.535*	0.369*	1				
DG	-0.535*	-0.700**	-0.469*	1			
DS	-0.534*	-0.709**	-0.598*	-0.698	1		
ABK	0.125	-0.218	-0.265	-0.265	0.280	1	
NRK	0.253	0.318	0.255	-0.245	-0.275	-1.00	1

**P < 0.01, *P < 0.05, HES = hatchability on eggs set, HFE = hatchability on fertile eggs, FER = fertility, DG = dead-in-germ, DS = dead-in-shell, ABK = abnormal keets, NRK = normal keets.

death and dead-in-shell chicks amongst others (Ipek and Hassan, 2004; Malecki *et al*., 2005).

Correlation of fertility and hatchability traits

Correlation coefficients among fertility and hatchability traits of the two strains (Pearl and Black) are shown in Tables 3 and 4, respectively. For the Pearl strain, correlations ranged from low to unity for these traits. A high significant (P < 0.01) positive association ($r_p = 0.652$) was observed between hatchability on eggs set and hatchability on fertile eggs, indicating that more eggs tend to hatch as more numbers of eggs are set. Fertility also had significant (P < 0.05) positive but moderate correlations with HES ($r_p = 0.456$) and HFE ($r_p = 0.368$) which implies that fertile eggs have higher hatchability. Some significant (P < 0.01; P < 0.05) negative correlations were noted among DG and HES ($r_p = -0.201$), DG and HFE ($r_p = -0.728$), DG and FER ($r_p = -0.396$), DS and HES ($r_p = -0.697$), DS and HFE (rp = -0.883), DS and FER ($r_p = -0.526$) and DS and DG ($r_p = -0.783$). This result is an indication that lower number of DG and DS in any set of eggs will lead to increase in both fertility and hatchability of the eggs and vice versa. The negative relationship between DS and DG also impresses that lower DG is associated with decreased DS and vice versa.

Normal keets (NRK) had a significant (P < 0.01) negative perfect association with abnormal keets (ABK), suggesting that hatching of NRK greatly reduces the incidence of ABK and vice versa. Thus, the total number of NRK determines the success of hatchability.

The phenotypic association among fertility and hatchability traits of eggs of the Black strain followed a similar trend to those of the Pearl strain. However, the relationship between HES and HFE was not significant ($P > 0.05$). Significant ($P < 0.05$) positive association was found between FER and HES ($r_p = 0.535$) and FER and HFE ($r_p = 0.369$). Also significant ($P < 0.01$; $P < 0.05$) negative relationships were recorded among DG and HES ($r_p = -0.535$), DG and HFE ($r_p = -0.700$), DG and FER ($r_p = -0.369$), DS and HES ($r_p = -0.534$), DS and HFE ($r_p = -0.709$), DS and FER ($r_p = -0.598$), DS and DG ($r_p = -0.698$) as well as between NRK and ABK ($r_p = -1.00$). The results of this correlation study is comparable to the report of Islam *et al*. (2002), who noted positive correlations among FER, HES and HFE as well as negative relationships among DG, HES, HFE, FER and DS and also between ABK and NRK with Barred Plymouth Rock, White Leghorn, RIR and White Rock breeds of chicken. Similar information on guinea fowl strains is highly scant in literature to compare with the results of these findings.

CONCLUSION

The result of this investigation indicated that the eggs of the two strains compared favorably in their hatching traits, except for DS. The Black strain had eggs with lower DS compared to the Pearl. The non-significant deviation of strain on majority of the traits gives an indication that the traits are influenced more by management and environment rather than genetic profile. Based on the phenotypic correlations among the traits, it could be concluded that selecting for lower DG and /or DS would improve fertility and hatchability of guinea fowl eggs and vice versa, assuming the negative correlations will translate into negative genetic correlations. Otherwise, they can equally be improved phenotypically through selection. Again, fertility and hatchability of the eggs showed interdependence such that phenotypic improvement of either of the traits will improve the other. High number of normal keets minimized the incidence of abnormal keets.

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