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Comparison of Egg Production Performance and Egg Quality Traits of Pearl and Black Strains of Guinea Fowl in a Humid Rain-Forest Zone of Nigeria

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Abstract: Data on 272 eggs collected from Pearl (175 eggs) and Black (97 eggs) adult guinea fowl strains were analyzed to determine the egg production performance and egg quality characteristics of the birds. Data generated were analyzed using Student's t-test. The external egg quality traits measured were egg weight, egg length, egg width, shell weight, shell thickness and egg shape index. Internal egg quality traits studied include egg mass, yolk weight, yolk height, yolk diameter, yolk index, albumen weight, albumen height and albumen diameter and albumen index. The production performance traits measured were egg number and Hen-Day Production (HDP). In addition, weekly body weight of the hens was also recorded. Egg number was significantly ($p<0.05$) different between the two strains. The mean values were 22.71±0.30 and 12.84±0.29, respectively for Pearl and Black. Although there was no significant difference ($p>0.05$) between HDP of the two strains, the Black strain had higher HDP in all the weeks except in weeks 1, 5 and 6. Among the internal traits, albumen diameter differed significantly ($p<0.05$) between Pearl and Black with mean values of 61.27±2.02 mm and 66.97±1.20 mm, respectively. Effect of strain was not observed for all the other egg traits measured. However, the significant difference ($p<0.05$) observed for egg number and albumen diameter between the strains suggests at least some degree of genetic dissimilarity, which implies that the strains could be used to improve egg production and egg quality characteristics of guinea fowl in the study region.

Key words: Guinea fowl, egg quality traits, egg number, albumen diameter, strain

INTRODUCTION

Animal protein deficiency, particularly among the rural populace, has remained an issue of concern in developing countries. The need, therefore, to evaluate the production potentials of any promising animal species for increased supply of animal protein in these regions is pertinent. Guinea fowl, which is indigenous to Africa where the shortage of animal protein is most acute (Ocheja *et al*., 2010), is one of such promising specie. This indigenous specie makes significant contributions to animal protein availability in Nigeria through cheap meat and eggs which serve as buffer to shortages of poultry products. This, in turn, provides sustenance to the rural populace which is mostly dominated by poor and low-income earners.

In corroboration, Ayorinde (2004) stated that guinea fowl is second to the domestic fowl in terms of number and supply of poultry protein in Nigeria. However, as with other indigenous species little or no attention has been paid to their conservation and improvement which according to Drucker *et al*. (2001) leads to gradual loss of indigenous animal genetic resources. Being native to Africa, guinea fowl possess valuable adaptive genetic potentials and yield valuable products under low input agriculture typical of rural Nigeria. With regard to number, a larger population of guinea fowl is found mostly in the northern region of Nigeria. This calls for systematic effort to conserve, sustainably manage and improve these birds in other regions, like the rain-forest zone owing to their economic importance. Such effort would be assumed timely since there seems to be an upsurge of interest in the production of guinea fowl in the zone. In this regard, evaluation of the egg production performance, external and internal egg qualities of the guinea fowl will not only be useful as a selection criterion but will also enhance economic decisions for intending backyard and/or commercial guinea fowl producers in this region.

In poultry, efficiency of production and profitability depends largely on characters like fertility, egg number, hatchability and egg quality traits among others (Balvir *et al*., 2000; Yahaya *et al*., 2009). Wolc and Olori (2009) reported that the dam was the main source of genetic variation in hatchability of fertile eggs, suggesting a huge impact of egg quality traits. These corroborated the report that many characteristics of egg quality have a genetic basis (Stadelman, 1977). This implies that egg quality traits can be improved genetically through knowledge of their genetic variability. Egg quality reflects those egg characteristics that determines it acceptability

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to consumers (Song *et al*., 2000; Stadelman, 1977). The eggs of chicken have been widely studied for its external and internal traits whereas such information are not well documented for other poultry species including guinea fowl, particularly in their native countries like Nigeria.

It is to this effect that this study was undertaken to compare the egg production performance and egg quality traits of two strains of guinea fowl in a humid rain-forest zone of Nigeria.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of the Teaching and Research farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike lies on latitude 05° 29´N and longitude 07° 33´E. It is on an elevation of 122 m above sea level and is located in the tropical rain-forest zone of Nigeria. This zone is characterized by annual rainfall of about 2177 mm, monthly ambient temperature range of 22-32°C and relative humidity of 50-95% depending on the season.

A base population of 45 adult guinea fowls comprising of 30 Pearl and 15 Black strains were used to generate the eggs. The parent stocks were obtained from Zaria in Kaduna State of Nigeria which is located in the northern region. The birds were kept for an adaption period of 3 weeks, during which they were given multivitamins, antibiotics and piperazine prophylactic doses. The Pearl strain was replicated 6 times while the Black strain had 3 replicates, all with a ratio of 1 guinea cock: 4 guinea hens. The mating system involved pure breeding using natural method. Table 1 indicates the mating scheme and total numbers of eggs laid by each strain. The birds were reared on deep litter pens and fed compounded layers mash containing 18% CP and 10.36 ME Mj/kg (Table 2). Water and feed were given *ad libitum* throughout the period of study.

Eggs were collected daily for 8 weeks. However, external egg quality traits of the two strains were measured on a weekly basis. The external traits measured include, individual Egg Weight (EWT), Egg Length (ELT), Egg Width (EW), Shell Weight (SWT), Shell Thickness (STK) and Egg Shape Index (ESI). For the internal egg quality traits, a total of 48 and 32 eggs from Pearl and Black, respectively were randomly sampled and used to estimate the traits between the strains. The internal traits were measured daily as the eggs were picked. To measure the internal traits, each sampled egg was first broken out gently in a petri dish and readings taken with an appropriate apparatus. The internal egg quality traits measured were Egg Mass (EM), Yolk Weight (YWT), Yolk Height (YHT), Yolk Diameter (YD), Yolk Index (YI), Albumen Weight (AWT), Albumen Height (AHT), Albumen Diameter (AD) and Albumen Index (AI). Egg weight, shell weight, yolk weight and albumen weight were measured to the nearest 0.01 g with an electronic balance. Egg shape index and albumen index were computed using the method of Heiman and Carver (1936) while yolk index was estimated by the method of Funk (1948). All the other traits were measured with the aid of a venier caliper. The egg shell thickness was measured at the middle and at each end of the egg and the mean of the three sides estimated.

Table 1: Mating scheme and total numbers of eggs laid by Pearl and Black strain

Mating type	No. of hens	No. of cocks	No. of eggs laid
Pearl x Pearl	24	6	175
Black x Black	12	3	97
Total	36	9	272

Table 2: Composition of feed for the experimental birds

Feed ingredients	Percentage inclusion (%)
Maize	20.76
Maize offal	20.77
Wheat offal	13.85
Palm Kernel Cake (PKC)	13.85
Groundnut Cake (GNC)	21.57
Bone meal	2.50
Limestone	6.00
Salt	0.25
Vitamin premix	0.25
Lysine	0.10
Methionine	0.10
Total	100.00

CP (%) = 18, Energy (ME Mj/kg) = 10.36

The number of eggs collected per week was also recorded as well as the weekly body weight of the hens. Percent Hen-day Production (HDP) was also calculated as the number of eggs produced per week divided by the number of birds alive in each week. i.e.

$$HDP\ (\%) = \frac{\text{Number of eggs laid per week}}{\text{Number of hens alive x Number of days}} \times 100$$

Data generated were analyzed using SAS (2001) software package. The significance of differences between guinea fowl strains regarding egg quality traits were determined using Student's t-test and statistical differences were established at the level of $p \leq 0.05$. The coefficients of variation of the traits between the two strains were also calculated.

RESULTS

The means, standard deviation and coefficient of variation of individual live weight of the hens and the number of eggs produced are presented in Table 3. From the result, only Egg Number (EN) was statistically significant ($p<0.05$) between the two guinea fowl strains. The Pearl laid higher number of eggs compared to the Black. The result is in line with the numerical values obtained from Pearl and Black (175 vs 97) (Table 1), respectively.

The hen-day production (HDP) (%) of the two strains of guinea fowl is shown in Fig. 1. There was no significant

Table 3: Means ± SE, standard deviation and Coefficient of Variation (CV) for hens' live bodyweight (kg) and egg number

Strain	Trait	Means±SE	SD	CV (%)
Pearl	Body weight	1.29±0.01	0.12	9.31
	Egg number	22.71±0.30[a]	3.93	17.30
Black	Body weight	1.29±0.02	0.13	9.77
	Egg number	12.84±0.29[b]	2.86	22.28

Table 4: Means±SE of external egg quality traits of Pearl and Black strains of guinea fowl

Strain	Traits	Means±SE	SD	CV (%)
Pearl	EWT(g)	37.67±0.27	3.53	9.38
	ELT (mm)	46.84±0.21	2.72	5.80
	EW (mm)	36.60±0.10	1.27	3.48
	SWT (g)	7.27±0.30	1.68	23.11
	STK (mm)	0.43±0.04	0.24	55.81
	ESI (%)	78.46±0.54	7.11	9.06
Black	EWT (g)	37.91±0.39	3.81	10.06
	ELT (mm)	47.40±0.27	2.62	5.53
	EW (mm)	36.83±0.15	1.46	5.53
	SWT (g)	7.12±0.32	1.81	25.42
	STK (mm)	0.41±0.21	0.21	51.21
	ESI (%)	78.14±0.52	5.08	6.50

[ab]Means with different superscripts along the same column are significantly different ($p<0.05$). EN = Egg Number, EWT = Egg Weight, ELT = Egg Length, EW = Egg Width, SWT = Shell Weight, STK = Shell Thickness, ESI = Egg Shell Index

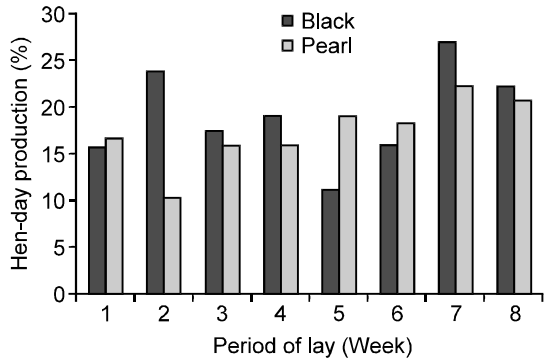

Fig. 1: Hen-day production performance of Pearl and Black strain of guinea fowl for 8 week laying period

($p<0.05$) difference between the two strains in terms of their HDP. HDP ranged from 11.11-26.98% for Black and 10.32-22.22% for Pearl. However, the Black strain had higher HDP than the Pearl in all the weeks studied except in weeks 1, 5 and 6.

The means±SE, standard deviation and coefficient of variation (%) of the external egg quality traits of the Pearl and Black strains are given in Table 4. The two strains compared favourably ($p>0.05$) in their external characteristics. This is also evident from the coefficient of variation (%) which showed no wide variation between the egg traits of the two strains. The mean egg weights (g) were 37.91±0.39 and 37.67±0.27, respectively for

Table 5: Means±SE of internal egg quality traits of Pearl and Black strains of guinea fowl

Strain	Trait	Mean±SE	SD	CV(%)
Pearl	EM	29.01±1.05	5.94	20.48
	YWT (g)	12.42±0.28	1.61	12.96
	YHT (mm)	13.09±0.39	2.23	17.04
	YD (mm)	37.29±0.58	3.29	8.82
	YI (%)	38.90±1.03	6.32	16.25
	AWT (g)	17.38±0.20	2.23	12.83
	AHT (mm)	7.30±0.21	1.20	16.44
	AD (mm)	61.27±2.02[b]	11.43	18.66
	AI (%)	11.68±0.45	2.52	21.56
Black	EM	30.00±3.45	2.52	8.39
	YWT (g)	12.17±0.21	1.16	9.53
	YHT (mm)	13.70±0.31	1.75	12.77
	YD (mm)	35.71±0.48	2.71	7.59
	YI (%)	38.65±1.13	6.39	16.53
	AWT (g)	17.48±0.30	2.58	12.47
	AHT (mm)	7.40±0.28	1.56	21.08
	AD (mm)	66.97±1.20[a]	6.80	10.15
	AI (%)	11.25±0.54	3.05	27.11

[ab]Means with different superscripts along the same column are significantly different ($p<0.05$). EM = Egg Mass, YWT = Yolk Weight, YHT = Yolk Height, YD = Yolk Diameter, YI = Yolk Index, AWT = Albumen Weight, AHT = Albumen Height, AD = Albumen Diameter, AI = Albumen Index

Black and Pearl strains. The values of the egg shape index (%) recorded were 78.46±0.54 for Pearl and 78.14±0.52 for Black. The respective values for ELT (mm) and EW (mm) were 46.84±0.21 and 36.60±0.10 for Pearl and 47. 40±0.27 and 36.83±0.15 for Black. The Pearl strain had 7.27±0.30 g for shell weight and 0.43±0.04 mm for shell thickness while Black had 7.12±0.32 g and 0.41±0.21 mm for shell weight and shell thickness, respectively.

The means plus standard error, standard deviation and coefficient of variation (%) of the internal egg quality parameters for the two strains are shown in Table 5. Albumen diameter was the only internal trait that was significantly different ($p<0.05$) between Pearl and Black strain. All the other traits studied did not differ significantly ($p>0.05$) between the strains.

DISCUSSION

The result obtained in terms of egg number suggests that the Pearl is a strain of choice in terms of egg production in this region. However, the above indication may be biased taking cognizance of the unequal number of layers used in the study. The range of values for HDP is higher when compared to 9.51-13.44% reported by Odukwe (2010) for Pearl strain in an experiment involving different levels of dietary energy and protein. In contrast, Nahashon *et al*. (2006) recorded HDP of 20-30% and 30-40% for Pearl hens aged between 32-72 weeks reared in different cage densities of 465 cm^2/hen and 697 cm^2/hen, respectively in the USA. Since egg production is best measured in terms of hen-day and house-house egg production (Akanni *et al*., 2010), then

the Black strain could also be a strain of choice with regard to egg production in the study region. Unfortunately, the number of Black hens used was lower than Pearl hens and this may have inflated HDP values of Black strain.

In the temperature region, Nowaczewski *et al*. (2008) recorded egg weight of 55.3 g for French and 40.7 g for domestic Polish guinea fowls. The values also differed from the reports of Bernacki and Heller (2003) and Dudusola (2010). However, the values reported in this study were similar to 39.5 g stated by Nahashon *et al*. (2006) in the USA. The differences recorded in these studies compared to our study may be as a result of differences in environmental factors in these regions. The non-significant difference ($p>0.05$) obtained in this study for egg weight can be attributed to the similar body weight of the hens of the two strains. Oke *et al*. (2004) demonstrated a highly significant and positive correlation ($r_p = 0.85$) between body weight of guinea fowl hens and the weight of their eggs. The values of the egg shape index reported in our work are in agreement with the range of 0.75-0.78 reported for laying hens (Akanni *et al*., 2010). Dudusola (2010) reported a value of 79.57 for guinea fowl in Nigeria while Nowaczewski *et al*. (2008) gave 73.7 and 74.7 for French and Polish domestic strains of guinea fowl which did not differ statistically. The values of egg shape index observed in Black (78.14%) and Pearl (78.46%) suggests that eggs of these strains are less prone to breakage and can make for good hatchability. Although the egg shape index values from our study not significantly different between the two strains, they reflect high genetic values for shell strength which can make them resistance to environmental stress. This corroborates the report that the shape of eggs in chickens is characterized by high heritability coefficient reaching about 50% (Bednarczyk, 1991). The other external egg quality traits did not differ significantly ($p>0.05$) between Pearl and Black. However, they are in conformity with earlier reports (Fayeye *et al*., 2005; Nowaczewski *et al*., 2008; Dudusola, 2010; Odukwe, 2010). Carew *et al*. (1983) reported that shell thickness of 0.62±0.13 mm for guinea fowl. In another investigation, shell weight for guinea fowl was given as 6.68±1.24 g (Ayeni *et al*., 1983).

The mean values of yolk index (YI, %) recorded in this study for Pearl (38.90±1.03) and Black (38.65±1.13) are in close range with the 39.15±0.27 and 40.1±0.27 reported by Nwagu *et al*. (2010) for Anak and Hubbard breeds of chicken, respectively. The yolk index values obtained are also within the accepted range of 33.0-50.0 mm for fresh eggs (Ihekoronye and Ngoddy, 1985). Yolk index determines the freshness of an egg and large index makes for good hatchability as the eggs tend to store longer without spoilage (Odukwe, 2010). The values obtained in our study for yolk weight (g) were also similar to the findings of Dudusola (2010) and Nowaczewski *et al*. (2008). The eggs of the Pearl showed greater proportion of egg mass (20.48%) than the eggs of the Black strain (8.39%).

In the chicken, Suto *et al*. (1997) working with Brown and White Leghorn type layer chicken reported significant effect of genotype of layer on egg quality traits, indicating that egg quality is a breed characteristic. The non-genotypic (strain) difference observed between the two strains in almost all the traits measured could be due to environmental effect as well as similar body weight recorded for the hens. Alex (2001) reported that lowly heritable traits including egg production traits are greatly affected by environmental and non-additive gene action.

Bednarczyk (1991) noted that a number of environmental factors can exert a significant effect on the traits of hen eggs. This was corroborated by the reports of Tarasewicz *et al*. (2004) with regard to eggs of Japanese quail. In Nigeria, guinea fowl is more peculiar to the northern region than the rain-forest zone. It is also possible that the birds may have been inter-breeding since in the wild since they still remain to be fully domesticated. As a result, the strains could possess similar genetic make-up such that little or no difference would be observed in their economic traits. However, that the two strains are at least different in egg number and albumen diameter suggests some amount of genetic variability which indicates that these traits can possibly be improved using the strains.

Conclusion: The effect of strain was not observed for all the traits measured except for egg number and albumen diameter. The significant difference observed for these two traits between Pearl and Black suggests at least some degree of genetic variability. Owing to the fact that the Pearl had a better performance in terms of egg number, it could be a strain of choice for egg production in this region. However, considering other egg quality characteristics studied, both Pearl and Black strain could be used to improve egg quality parameters in the rain-forest region of Nigeria. This study may be re-investigated with larger population size. It is possible that with larger population size, more significance could be found indicating more genetic variation. Again, other guinea fowl strains existent in Nigeria like the Lavender and the White should also be investigated for these traits in order to make the best choices of strains suited for improvement in the study zone.

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