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EGG PRODUCTION AND EGG QUALITY TRAITS AND THEIR ASSOCIATION WITH HEN BODYWEIGHT IN NIGERIAN LOCAL, NICHOLAS WHITE AND CROSSBRED TURKEYS

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The records of 142, twenty-week old turkey hens were used to assess egg production, egg quality traits and their correlations with body weight in Nigeria Local, Nicholas White and their reciprocal crossbred hens. The birds were raised over a period of 52 weeks laying period to assess Age at first egg laid (AFE), Hen Body Weights at first egg (HBW), Egg Number (EN), Egg Weight (EW), Egg mass (EM), Hen Day Production (HDP),Feed Intake (FI), Feed per Egg (F/E) and Feed per Gramme Egg (FGE). Ten eggs were selected weekly to assess the following egg quality traits: Egg Length (EL), Egg Breadth (EB), Egg Index (EI), Egg Shell Thickness (SHT) and Shell Weight (SHW). The results showed that significant differences ($p<0.05$) among genotypes in age at first egg, hen body weight at first egg, Egg number, Egg mass and Hen day production. The Lowest age at first egg, hen body weight at first egg, Feed intake, Feed per egg and Feed per gram egg occurred in purebred Nigerian local (272.23± 4.41days, 2905.47 ± 11.20 g, 46903.92±236.81, 829.71±420.35and 12.64± 6.40, respectively) while the highest values for these traits (except for Feed per egg and Feed per gramme egg) were occurred in purebred Nicholas White. The Nigerian local hen was significantly higher ($p<0.05$) in egg number, egg mass and hen day production than Nicholas White and crossbred hens. However, the eggs laid by Nicholas White and crossbred hens were significantly heavier ($p<0.05$)in weight. Generally, crossbred hens were intermediate between the two purebred genotypes in egg production indices. The eggs from crossbred NWxNL hens were slightly lower in weight compared with eggs obtained from its reciprocal (69.99 ± 1.07g vs 71.24± 1.17g). The higher number of eggs produced by crossbred NWxNL than its reciprocal may be due to maternal effect of Nigeria local hens. Significant positive correlations ($p<0.05$) were obtained between hen's body weight and EL, SHT and SHW in all the four genotypes. Significant positive correlation ($p<0.05$) occurred among the measurements of EW, EL, SHT and SHW in Nicholas White and crossbred hens. The study therefore recommended the crossing of Nicholas males with Nigerian local hens to improve the overall productivity of turkey hens in Nigeria.

Keywords: Crossbred, Hen Body weight, Hen Day production, Nicholas White, Nigerian local

Poultry egg has shown to be a cheap source of animal protein and a means of continuity of the flock. Isidahomen *et al.,* (2011) stated that, the productivity and quality of the breeding hen has an overall effect for poultry flock and for economic breeding.

Genetic variation in egg production between breeds, strains and lines has been reported (Suk and Park, 2001; Hocking et al., 2003). This (in part), is due to selective breeding and crossbreeding which have been employed to enhance the productivity of exotic strains of poultry birds, thereby giving them advantage over the native strains under intensive management system (Ershad, 2005). However, the superiority of exotic strain is not sacrosanct, due to variation in their productive adaptability. According to Ilori *et al.,* (2009), the exotic strains of turkey have better performance in body weight, but are faced with the problem of adaptation to Nigerian local environment. This calls for evaluation of exotic strains in

different production environments with a view to ascertain the productive adaptability of each of them for meat and or egg production. Another general problem with the production of exotic birds is the fixation which arises during selection of genes favouring such traits as larger body weight. This often results in the domination of segregating genetic variation by pleiotropic loci with antagonistic effects on other traits like egg production (Kranis *et al.*, 2006).The use of crossbreeding has been one of the tools for exploitation of genetic variation by combination of different important characteristics of each breed (Hanafi and Iraqi, 2001).

Among the most important productive traits in poultry are body weight and egg weight (Di Masso *et al*., 2008). The study of correlations between productive traits is of great importance in the development of poultry breeding programs (Silva *et al*., 2013). Information derive from correlation study may help in the careful selection of traits in breeding programme with a view to avert undesirable responses in traits that are antagonistic. Earlier, Amao *et al*. (2014)reported a high correlation Among carcass measurements in Nigeria Local, Nicolas White and their reciprocal crossbred turkey hens. A similar result was obtained in chicken by Isidahomen *et al.*(2012).

This study was undertaken to assess egg production and egg quality traits as well as the correlations among body weight, egg production and egg quality traits in Nigeria Local, Nicholas White and their reciprocal crossbred turkey hens.

MATERIALS AND METHODS

Location of the study

The study was carried out in a commercial farm located in Ilorin. Ilorin is located between the rainforest of the Southwest and Savannah grassland of Northern Nigeria. It bears the co-ordinates of 8° 30' 0" North, 4° 33' 0" East and lies on an altitude of 305m, 1001' above sea level. The annual rainfall, relative humidity and day temperature of the study location are 600-1200 mm, 65-80% and 33-37^{0} C, respectively (Fayeye *et al*, 2014)

Experimental animals

A total of 142, twenty-weeks old turkey hens were randomly selected from a previous breeding experiment. The selected birds consist of 52 purebred Nigeria Local (NLxNL), 20 purebred Nicholas White (NWxNW), 25 Nigeria Local x Nicholas White (NLxNW) and 45 Nicholas White x Nigeria Local (NWxNL). The selected hens were raised in deep litter pens and were fed grower mash from 20th to 28th week of age

Table 1:Feed composition of diets fed to turkey at the grower and laying phase

Grower (20 – 28weeks)		Layer (28 – 52wk)
Ingredient	%in diet	% in diet
Maize	66.00	64.00
Wheat bran	17.00	10.00
Groundnut cake	2.00	4.00
Soya bean meal	2.00	4.00
Fish meal	1.00	3.00
Palm kernel cake	14.00	10.00
Oyster shell	3.00	3.00
Bone meal	1.30	1.30
Salt	0.30	0.30
Premix	0.25	0.25
Lysine	0.10	0.10
Methionine	0.05	0.05
Calculated:	12%Cp 2900kcalME/kg	14 %Cp 2900kcalME/kg

and with layers mash to 80 weeks of age (Table 1). Feed and water were given to birds *ad libitum*.

Data collection

Data collected include Age at First Egg (AFE), Hen Body Weight at first egg (HBW), Egg Number (EN), Egg Weight (EW), Egg Mass (EM), Hen Day Production (HDP),Feed Intake (FI), Feed per Egg (F/E) and Feed per Gramme Egg (FGE). Ten eggs were selected weekly per genetic group to estimate egg quality characteristics. The quality egg characteristics that were considered in the study include Egg Length (EL), Egg Breadth (EB), Egg Index (EI), Egg Shell Thickness (SHT) and Shell Weight (SHW). AFE for each genotype was taken as the mean number of days between date of hatching and date when the hens laid their first egg, HBW was taken with a top loading measuring scale (20kg, Avery Tronix), EN was by direct count, EW was measured on a triple beam balance (OHAUS, 2600g) and EM was calculated as the product of egg number and egg weight. The HDP (%) for each genetic group was calculated as the total number of eggs laid each day / number of birds alive multiply by 100 (Fairful and Gowe, 1990). FI was measured as the difference between feed offered and feed left over per week. EL and EB were measured using a pair of vernier calliper (calibrated in mm), EI was taken as the ratio of egg length to egg width while SHT was determined as the average of measurements taken at the broad end, middle portion and narrow end of the shell using a micrometer screw gauge (calibrated in mm) after removing the egg membrane. SHW was measured as the weight of the shell using digital scale.

Statistical Analysis

The data obtained on egg production and egg quality characteristics of birds were subjected to Analysis of Variance using the General Linear Model of SPSS 20.0 in a one way ANOVA design. Means that were Significantlydifferent ($P<0.05$) were further separated using Duncan's New Multiple Range Test of SPSS version 20.0 at probability level of 5%.

The mathematical model used to fix the effect of genotype on egg production and egg quality characteristics is as follows:

$Y_{ij} = \mu + G_i + E_{ij}$.

Where Y_{ij} is observation made on animal *i*th that belongs to genotype *j*th,

μ is the overall mean for each of the egg production and egg quality characteristics,

G_i is the effect of the i^{th} genotype (i = 1, 2, 3, 4), and

E_{ij} is the random error associated with each record (normally, independently and identically distributed, with zero mean and variance).

Multiple correlations between hen body weight and measurements of egg traits(Age

Table 2: Egg production traits in Nigeria Local, Nicholas White and their reciprocal crossbred hens

Traits	NLxNL	NWxNL	NLxNW	NWxNW
Age at first egg (days)	272.23± 4.41$^{c\,d}$	286.27± 4.66^{c}	301.08± 6.72$^{b\,c}$	322.00± 6.25^{a}
Hen body weight (g)	2905.47± 11.20^{d}	5193.29± 17.11^{c}	6325.04± 58.80^{b}	10152 .68±
Feed intake g/hen	469.04±2.37^{d}	497.45±2.83^{c}	545.60±3.20^{b}	981.48±5.35^{a}
Egg number	87.58± 1.04^{a}	72.47± 0.81^{b}	64.52± 1.14^{c}	60.95± 0.62^{d}
%Hen day Production	24.32± 2.44^{a}	20.17± 2.07^{b}	17.81± 17.06^{c}	16.12± 1.75$^{c\,d}$
Egg weight (g)	65.66 ± 1.20^{d}	69.99 ± 1.07^{c}	71.24± 1.17^{b}	83.38± 2.50^{a}
Egg mass (g)	5750.30± 68.53^{a}	5071.22± 56.47^{b}	4596.82± 81.25^{d}	5081.40± 51.85$^{b\,c}$
Feed (g)/egg	829.71±420.35	1201.62± 454.14	1433.60±550.44	1134.91± 200.49
Feed (g)/g of egg	12.64± 6.40	17.17± 6.49	20.12± 7.86	13.61± 2.50

Mean ± SEM, NW Nicholas White, NL Nigeria Local

^{a,b,c,d} means in the same row with different superscripts are statistically different ($P<0.05$)

at first egg, Egg number, Egg mass, Egg weight, Egg length, Egg breadth, Egg index, Shell thickness and Shell weight) were assessed in the four turkey genotypes using SPSS (2011).

RESULTS AND DISCUSSION

he results of egg production in Nicholas White, Nigeria Local and their crossbreds are presented in Table 2. There was a significant difference ($p<0.05$) among genotypes in age at first egg, hen body weight at first egg, Egg number, Egg mass and Hen day production. The Lowest age at first egg, hen body weight at first egg and Feed intake were observed in purebred local (272.23± 4.41days, 2905.47 ± 11.20 g, and 469.04±2.37, respectively) while the highest values for these traits were observed in purebred Nicholas White (322.00 ± 6.25days, 10152 .68± 124.10g, and 981.48±5.35, respectively). The purebred Nigerian local hen was significantly higher ($p<0.05$) in egg number, egg mass and hen day production than Nicholas White and crossbred hens. The feed per egg and feed per gram egg were lower ($p<0.05$)in Nigerian local and crossbred hens than in Nicholas White turkey. However, the eggs laid by Nicholas White and crossbred hens were significantly heavier ($p<0.05$)in weight compared with eggs obtained from purebred Nigerian local hens. Crossbred hens were intermediate between the two purebred genotypes in egg production indices.

Crossbred NWxNL consumed less feed and was significantly higher ($p<0.05$) in egg number, egg mass and hen day production than their reciprocal (Table 2). However, the eggs laid by Crossbred NWxNL hens were slightly lower in weight compared with eggs obtained from its reciprocal (69.99 ± 1.07g vs 71.24± 1.17g).

Results of egg number in the four genotypes over a period of 52 weeks are presented in Figure 1. The NLxNL had the highest monthly egg production from January to May and from July to September. The purebred Nicholas White had the lowest egg production for most part of the year. It also had the shortest peak of lay and the lowest number of months in lay compared with purebred local and crossbred hens.

The results of egg quality traits in Nicholas White, Nigeria Local and their crossbreds are presented in Table 3. There were significant differences ($p<0.05$) among genotypes in Egg weight, Egg length, Egg breadth, Egg index, Shell thickness and Shell weight. The purebred local were significantly lower ($p<0.05$) in all the egg quality indices than Nicholas White. Crossbred hens produced eggs that were intermediate between the purebreds in egg quality indices (Table 3). Crossbred NLxNW hens produced eggs that were significantly higher ($p<0.05$) than their reciprocal in egg weight, egg length, egg breadth and shell weight.

The correlations among hen body weight,

Table 3: Egg quality traits in Nigeria Local, Nicholas White and their reciprocal crossbred hens

Traits	NLxNL	NWxNL	NLxNW	NWxNW
Egg weight (g)	65.66±1.20^{d}	69.99±1.07^{c}	71.24±1.17^{b}	83.38±2.50^{a}
Egg length (mm)	5.82±0.02^{d}	6.18±0.01^{c}	6.44±0.01^{b}	6.82±0.01^{a}
Egg Breadth (mm)	4.04±0.01^{d}	4.10±0.00^{c}	4.26±0.00^{b}	4.69±0.01^{a}
Egg index	1.44±0.00^{d}	1.51±0.00^{ab}	1.51±0.00^{a}	1.46±0.00^{c}
Shell thickness(mm)	0.33±0.00^{b}	0.36±0.00^{a}	0.36±0.00^{a}	0.36±0.00^{a}
Shell weight (g)	6.19±0.00^{d}	6.53±0.01^{c}	6.58±0.00^{b}	7.53±0.01^{a}

Mean ± SEM, NW Nicholas White, NL Nigeria Local

^{a,b,c,d} means in the same row with different superscripts are statistically different ($P<0.05$)

egg production and egg quality traits of purebred (NL x NL, NWxNW) turkeys are presented in Table 4.Significant positive correlation ($p<0.05$) was obtained between hen's body weight and EL, SHT and SHW in the two purebred genotypes. However, the correlation between hen's body weight and EI and EN were negative ($p<0.05$). Significant positive correlation ($p<0.05$) occurred among the measurements of EW, EL and EB in both NL x NL and NWxNW. The correlation between measurements of SHT, EW, EL, EB and SHW were significantly positive ($p<0.05$) in purebred NWxNW but low correlations were obtained among these traits in purebred NLxNL (Table 4).

The correlations among hen body weight, egg production and egg quality traits of crossbred hens (NW x NL, NLxNW) are presented in Table 5. Significant positive correlation (0.54 to 0.94, $p<0.05$) was obtained between hen's body weight and EW, EL, EB, EI, SHT and SHW in the Two crossbred genotypes. However, the correlation between hen's body weight and EN and EM were negative (-0.57 to - 0.74, $p<0.05$). Significant positive correlation ($p<0.05$) was occurred among the measurements of EW, EL, EB,SHT and SHW in crossbred genotypes. The correlation between EN and measurements of SHT, EW, EL, EI and SHW were significantly negative ($p<0.05$) in crossbred hens (Table 5).

The higher body weight at first egg obtained in exotic NWxNW hens may be due to the fact that previous selection for body weight gain had occurred in the production of commercial Nicholas White (Sharma *et al.,* 2006). The heavier body weight of crossbred hens suggests the prospects of crossbreeding in producing dual purpose adapted hens for commercial turkey farmers in Nigeria. The number of eggs laid per hen per year by Nigerian local turkey was close to 90.4 eggs reported for Egyptian Black Baladi by Amin (2014a). The results of the present work agree with the report of Amin (2014a)in his work on local Black Baladi, commercial

Table 4: Correlation between Hen-body weight and egg traits-in purebred (NL x NL, NWxNW) turkeys

	EW	EL	EB	EI	SHT	SHW	AFE	HBW	EN	EM
EW	1	0.72*	0.87*	-0.26	0.17	-0.23	-0.12	-0.96*	0.24	0.24
EL	0.94*	1	0.67*	0.26	0.10	0.03	0.15	0.80*	0.22	0.22
EB	0.93*	0.95*	1	-0.42*	0.10	-0.26	-0.01	-0.96*	0.25	0.25
EI	-0.38*	-0.27	-0.53*	1	-0.02	0.35*	- 0.18	-0.89*	-0.19	-0.19
SHT	0.44*	0.58*	0.42*	0.24	1	-0.02	-0.18	0.60*	-0.10	-0.10
SHW	0.92*	0.96*	0.98*	-0.43*	0.52*	1	-0.21	0.70*	-0.14	-0.14
AFE	0.03	0.22	0.23	-0.20	0.25	0.27	1	0.63*	0.24	0.24
HBW	0.91*	0.92*	0.97*	-0.36*	0.56*	0.97*	0.26	1	-0.50*	-0.50*
EN	-0.68*	0.81*	-0.69*	-0.09	-0.72*	-0.74*	-0.37*	-0.79*	1	0.92
EM	-0.76*	-0.30	-0.12	-0.50*	-0.55*	-0.17	-0.04	-0.25	0.78*	1

Estimates in the upper diagonal for purebred local (NLxNL) and lower diagonal values for purebred exotic (NWxNW). HBW (Hen Body Weight), EL (Egg Length), EB (Egg Breadth), EI (Egg Index), SHT (Shell Thickness), SHW (Shell Weight), AFE (Age at First Egg), EN (Egg Number), EM (Egg Mass). * Correlation value significant at$P<0.05$

Table 5: Correlation between hen body weight and egg traits in crossbred (NWxNL, NLxNW) turkeys

	EW	EL	EB	EI	SHT	SHW	AFE	HBW	EN	EM
EW	1	0.79*	0.73*	0.41*	0.67*	0.65*	-0.18	0.78*	-0.55*	-0.43*
EL	0.90*	1	0.63*	0.71*	0.85*	0.89*	-0.01	0.93*	-0.67*	0.56*
EB	0.82*	0.86*	1	0.60*	0.60*	0.49*	-0.26	0.59*	0.43*	0.35
EI	0.33	0.45*	-0.61*	1	0.58*	0.66*	0.60*	0.66*	-0.63*	0.55*
SHT	0.73*	0.70*	0.43*	0.56*	1	0.89*	0.05	0.91*	-0.66*	-0.52*
SHW	0.78*	0.80*	0.52*	0.58*	0.90*	1	0.08	0.94*	-0.69*	-0.54*
AFE	0.08	0.19	0.07	0.28	0.21	0.15	1	0.03	0.04	0.05
HBW	0.87*	0.94*	0.74*	0.54*	0.82*	0.88*	0.24	1	-0.72*	-0.57*
EN	-0.69*	-0.78*	0.63*	-0.52*	-0.67*	-0.75*	-0.09	-0.74*	1	0.98*
EM	-0.59*	0.70*	0.58*	-0.45*	-0.56*	-0.64*	-0.05	-0.64*	0.99*	1

Estimates in the upper diagonal for crossbred NWxNL and lower diagonal values for crossbred NLxNW. HBW (Hen Body Weight), EL (Egg Length), EB (Egg Breadth), EI (Egg Index), SHT (Shell Thickness), SHW (Shell Weight), AFE (Age at First Egg), EN (Egg Number), EM (Egg Mass). * Correlation value significant at P<0.05

White Nicholas and their reciprocal crossbred turkey hens. His results showed a highly significant differencebetween different genotypeswith the local Black Baladi showing superiority over commercial White Nicholas inage at sexual maturity, egg number, rate of laying, feed intake (g /egg) and feed conversation (Kg feed /Kg egg) over three generations. A similar result was obtained by Amin (2014c) in a crossbreeding work involving local

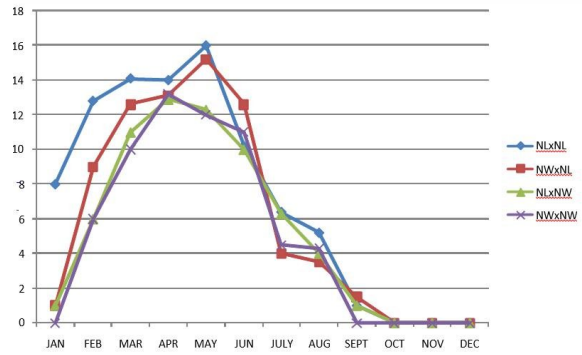

Fig.1: Mean Monthly egg production in four turkey genotypes

Mandarah and two exotic parental commercial meat type chickens (Saso and Italian).

The result of the study showed asignificant difference among different genotypes for body weight and age at 50 % egg production and egg number per hen-housed at the first 90 days. Results of other studies showed significant differences between strains, lines and crossbreds in feed intake and feed conversion (Mostafa and Younis 2001, Amin, 2008), egg number (Amin (1999), egg weight (Chatterjee *et al.,* 2007 and Isidahomen *et al.,* 2014) and egg mass (Harvenstein *et al.,* (2007).One of the ways in which genotype influences the laying performance of hens is through differential body weights. Generally light strains of poultry perform better than heavy strains in laying indices such as feed per dozen egg and feed/egg (Sterling *et al*., 2003). Apart from genotype, the environmental stressor may contribute to low egg laying performance of exotic birds (Ali *et al*., 2000; Yakubu *et al*., 2007, Islam and Nishibori,

2009, Amin, 2014b). The higher number of eggs produced by crossbred NWxNL than its reciprocal may be due to maternal effect of Nigeria local hens. The superiority of NWxNL suggest that the use of Nicholas White as a terminal sire strain in crossbreeding programs with Nigerian local hens would be beneficial for improving egg number.

Previous study in guinea fowl (Oke *et al.*, 2004)has confirmed the relationship between hen weight and egg weight. The results of the correlations between body weight and egg production traits and between body weight and egg quality parameters confirm the partial pleiotropic basis for the body weight-egg production traits and body weight-egg quality traits correlations obtained in this study. This evinces the feasibility of reducing the number of traits for inclusion in the index for selection purposes, as other traits not included would be cater for through indirect selection.

CONCLUSION

The study showed that genotype of bird significantly ($p<0.05$) affect age at first egg, egg production and egg quality traits. Nigerian Local hen was superior to exotic and crossbred hens in egg laying performance traits. Purebred Nicholas White was better than other genotypes in egg quality indices. The higher number of eggs produced by crossbred NWxNL than its reciprocal may be due to maternal effect of Nigeria local hens. Significant positive correlations ($p<0.05$) were obtained among hen's body weight, EL, SHT and SHW in both purebred and crossbred hens. It is therefore recommended that crossing of Nicholas male with Nigerian local hens should be used to improve the overall productivity of turkey hens in Nigeria.

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