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INFLUENCE OF SOME MAJOR GENES ON EARLY LAY TRAITS OF CROSSBRED LOCAL PULLETS IN A HUMID TROPICAL ENVIRONMENT

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ABSTRACT: *The study evaluated the effect of some major genes on early lay characteristics of Nigerian local pullets in randomized complete block design experiment. A total of 210 day-old crossbred local chicken were generated from a main and reciprocal crossing of local chickens possessing some major genes (naked-neck (Na), frizzle (F), and normal feathered genes (na). Results indicate that feed per hen, feed per dozen egg, and percent hen-day production did not differ significantly (P>0.05) among the genotypes. However, significant difference (P<0.05) were observed in body weight at first egg, age at first egg , age at sexual maturity, weight of first egg and egg number at 56 days with greater (P<0.05) value favoring F genotypes. Highest significant (P<0.05) values of weight at 1st egg were also noted in F/F genotypes (38.22±0.70g) and shell thickness (0.92mm±0.01), respectively. Highest significant means of yolk weight, yolk height, and yolk index and yolk width were obtained from F/F, Na/F and Na/Na genotypes. There were no significant difference (P>0.05) observed in albumen weight, albumen height and Haugh unit among genotype groups. However, HU values were very high in all the genetic groups. Highest positive significant correlation among egg weight, yolk weight, albumen weight and Hough unit were obtained in Na/Na, Na/F, and F/Na. Eggs laid by F/F, F/Na, Na/F and Na/Na were better in external egg qualities than other genetic groups. It is suggested that F and Na genes should be involved in the improvement of egg quality traits in the humid tropics.*

ORIGINAL ARTICLE

Keywords: *Major genes, early lay traits, crossbred local chicken, humid tropics*

INTRODUCTION

The major genes also called advantageous genes complexes or plumage reducing genes (Ibe and Nwohu, 1999), have been described as genes that reduce feather coverage in chicken. Yunis and Cahaner (1999), Horst (1988), describe nine of such major genes and stated that they could be used in genetic improvement programs. These genes are relevant to hot tropical regions because they enable the local chicken to adapt favorably to the tropical environment. Naked-neck (na) and frizzle (f) genes constitute the two types of the major genes found in the local fowl population. Naked-neck is caused by a single autosomal gene, Na. The gene is incompletely dominant with Na/na^+ chicken showing an isolated tuft of feathers on the neutral side of the neck above the crop, while the Na/Na chicken either lack this tuft or it is reduced to just a few pinfeathers or small feathers (Somas, 1990). On the other hands, frizzling is caused by a single incompletely dominant autosomal gene F restricted by an autosomal recessive modifier, mf. In unmodified homozygous frizzled chickens, the rachises of all feathers are extremely reserved.

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The advantages of these genes over their normal feathered counterparts in a hot humid environment are in terms of feed intake, growth rate, and weight gains which have been fully reviewed (Hanzle and Somas, 1983, Merat, 1990, Lout et al., 1992, Cahaner et al., 1993). The quality of eggs, apart from determining their food value, market desirability, or economic value (Singh and Kumar, 1994) is significant in poultry for their influence on the embryo development and successful hatching (Namshin and Ramanov, 2002). It has been reported that external and internal qualities of egg in both hens (Hurnick et al., 1978, Norstron and Ousterhout, 1982) had significant effects on the hatchability of incubated and fertile eggs, weight and development of the laying chickens. Egg quality can be external or internal. The external qualities of an egg are based on the size, shape, shell colour and texture of the eggs.

Genetic and phenotypic heterogeneity have been observed to exist in the domestic chickens. The diversity, which constitutes a valuable genetic resource, informs the reason for incorporating the local chicken into breeding programs aimed at producing an indigenous meat and egg type breed adapted to the tropical environment. Moreover, there is a major global thrust on genetic preservation and biodiversity as reflected in the efforts on development of genome and data banks. Following this strategy the local chicken especially the naked neck and frizzle which are tropically relevant should be preserved from becoming extinct. More importantly, the use of management practices to ameliorate the adverse effects of heat stress on poultry in many cases are not economical and alternative approach of breeding pullet lines with better heat tolerance has been suggested. Genetic improvement of heat tolerance may therefore provide a low-cost that is particularly attractive to developing countries with hot climates like Nigeria. The objective of this study therefore was to determine the effect of major genes on early lay traits of crossbred local chicken and to recommend the genotypes with the best performance for selection for further improvement.

MATERIALS AND METHODS

The experiment was conducted at the Poultry unit, Teaching and Research farm, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, located on latitude 05^{0} 21^{I} N and longitude 07^{0} 33^{I} E. It is approximately 122 meters above sea level with maximum and minimum daily temperature of 27-36^{o} C and 20-26^{o}C respectively. The relative humidity is 57-91% and annual rainfall of 2177mm.

Mating procedure

A base population of 180 local chickens consisting of 10 naked neck males, 50 naked - neck females, 10 frizzle males, 50 frizzle females, 10 common males and 50 common feathered females obtained from the University of Agriculture fowl were used for the study. The birds were randomly selected and moved into deep litter pens and mating was in the ratio of 1:4. The entire mating scheme resulted in 3 homozygous and 2 heterozygous main crosses, each of naked-neck and frizzle, 2 reciprocal crosses between naked-neck and frizzle and one main cross of common feathered birds as shown in Fig 1. The hens after being mated produced fertile eggs which were identified and set in a western type.

Cabinet incubator. Incubation and hatchery condition were 0-23days temperature 37.5^{0} C and relative humidity of 55-60%; 24days to hatching, the temperature was 37.C and relative humidity of 98%. A total of 400 day-old local chicks were produced.

Table 1 - Mating scheme of the base population for the production of F1 crossbred local chickens

Naked neck male (Na/Na)	**x**	**Naked neck female (Na/Na)**
(Na/Na = Homozygous naked neck cross)		
Naked neck male (Na/Na)	**x**	**Frizzle female (F/F)**
(Na/F = Naked neck reciprocal cross)		
Naked neck male (Na/Na)	**x**	**Normal female (na/na)**
(Na/na = Heterozygous naked neck main cross)		
Frizzle male (F/F)	**x**	**Frizzle female (F/F)**
(F/F = Homozygous frizzle main cross)		
Frizzle male (F/F)	**x**	**Naked neck female (Na/Na)**
(F/Na = Frizzle reciprocal cross)		
Frizzle female (FF)	**x**	**Normal male (nana)**
(F/na = Heterozygous frizzle main cross)		
Normal male (nana)	**x**	**Normal female (nana)**
(na/na Homozygous normal main cross)		

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Management of crossbreed local pullets

The chicks were brooded for the first five weeks of life under continuous illumination. There after they were raised on the deep litter under natural light until 26 weeks of age. At this age 280 pullets were sexed and separated from their male counterparts. Sexing was achieved by placing the fingers at the rear of the animal and applying a gentle upward thrust on the testicles to make it sexually excited. The resultant effect was a simultaneous jerking of the body and stretching of the two shanks if the chicken was a male. Each genetic group were randomly selected and kept in an open-sided deep litter pen with 40 birds per genotype group of which 39 birds were selected with 3 replicates of 13 birds per sub group. The pullets were fed growers mash containing 2700Kcal/kg ME and 16% CP. Thereafter, they were fed layers mash containing 2500 Kcal/kg ME and 18.5% CP at 24 weeks. The birds had access to feed and water *ad-libitum.* The experiment lasted for 42 weeks. Age at first egg was determined as the number of days from day of hatch to the day the first chicken of a given genetic group laid the first egg and its weight in grammas. Age at sexual maturity was determined as the age in days when 50% rate of lay was achieved. Feed per dozen egg measured as feed consumed divided by dozen egg laid, percent hen-day production =

Number of egg laid X 100.

Daily egg production records were kept.

The number of hen-day was obtained as the product of the number of days in lay and the number of hens alive (Singh and Kumar (1994)

Egg traits measurements were taken on all eggs lay first two days of each week throughout the laying cycle. Egg index value was derived from the ratio of egg width to mean egg length. Egg length and egg width of individual eggs were each measured thrice and their means used to compute the EI with the aid of scalpel, the egg shell was broken, the egg content were emptied into a Petridis. The albumen and yolk height were measured with the aid of a spherometer. The albumen was separated from the yolk; the yolk was placed in a weighed Petridis. Weighed again and weights of the yolk found by difference. A micrometer screw gauge was used to measure shell thickness in millimeters. The average of the 3 readings at the broad, narrow and mid sections was taken as the shell thickness for each bird in the week. Yolk index value was calculated as the ratio of yolk height (mm) to yolk diameter. Haugh unit was estimated using the equation according to Haugh (1937).

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

H = observed albumen height (mm), W = observed weight of egg (g)

Data collected from the study were subjected to analysis of variance (ANOVA) in a randomized complete block design. SPSS (2004) and Genstat (2007) computer application programmers' were used for the analysis. The model is shown below.

$$Y_{ijk} = \mu + B_i + G_j + E_{ijk}$$

Y_{ikj} = k^{th} observation of the j^{th} genetic group in the i^{th} hatch

μ = population mean

B_i = Effect of the i^{th} hatch, I = 1— 5

Gj = Effect of the j^{th} genetic group , j =1 — 7

E_{ijk} = Random error, assumed to be independently, identically, normally distributed with zero mean and homogenous variance (iind $(0, \sigma^2)$)

Means with significant difference were separated using least significant difference at 0.05 level of probability. Pearson correlation analysis (Snedecor and Cochran, 1989) was carried out to determine the relationships among the various egg quality parameters.

RESULTS AND DISCUSSION

The physical composition of the egg of crossbred local chickens is shown in Table 2. Mean body weight at first egg of these chickens showed a significant difference (P<0.05) among genetic groups, ranging from 975±15.00g to 1299.00±1.06g for the genotypes respectively. This observation indicates that these birds are light bodied chickens. The importance of body weight in egg production is fully recognized (Yeasmin et al., 2003). Ibe and Nwohu (1999), reported that both F and Na genes which did not improve growth of pullets as in cockerels are needed in selection for egg production in layers since fast growth is usually discouraged in the management of pullets to avoid precocious maturity during laying phase.

The results indicate significant difference (P<0.05) in age at first egg among the genetic groups. The homozygous frizzle gene which had the highest body weight at first egg was mostly delayed to attain age at first egg and age at sexual maturity. This is in agreement with the observation of Nwachuckwu et al. (2006) and Ricklefs (1993), that within the same level of management, genetically heavier birds attain sexual maturity later than light bodied birds. However, the values obtained did not agree with the result of Adedukun and Sonaiya (2001), who reported lower ages at first eggs. The

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naked-neck lines which had earliest age at first egg (177.600±6.60) also attained age at sexual maturity earlier than the frizzle crosses. This result supports the finding of Zeman et al. (2003), who utilized naked-neck males in crossbred and reported that age at sexual maturity was significantly better for the naked neck carrying genotypes.

Table 2 – Influence of major genes on physical composition of the crossbred local chickens at age 26-52 weeks

	Means of genetic group						
Parameter	Na/Na	Na/F	Na/na	F/F	F/Na	F/na	na/na
WAF	1176.[b]	209.[b]	975.[a]	1299.[a]	1209.[b]	1024.c[d]	1082.[c]
	34.7	51.4	15.0	5.0	9.00	10.6	32.5
AFE	177.[a]	196.[b]	184.[ab]	211.[c]	191.[ab]	199.[b]	195.[b]
	6.60	1.36	3.93	5.37	6.12	7.00	7.35
ASM	191.00[a]	196.[b]	192.[a]	212.[b]	206.[b]	210.[b]	194.[a]
	0.00	0.00	0.00	3.60	0.00	0.00	0.00
WFE (g)	36.8[ab]	35.7[b]	29.8[c]	38.2[a]	36.3[ab]	32.0[c]	34.9[b]
	0.90	1.22	0.24	0.70	0.68	0.56	1.04
FPH (g/hen/day)	61.8	63.2	75.6	65.4	66.2	62.8	55.5
	1.66	2.40	12.24	1.51	1.43	1.47	2.46
FPDE	1.56	2.27	2.27	2.72	2.06	3.13	3.74
	0.25	0.07	3.89	0.00	0.02	0.00	0.00
EN	38.0[a]	12.5[c]	32.0[ab]	12.6[c]	20.6[bc]	21.4[bc]	12.9[c]
	7.88	7.96	5.27	6.34	7.85	4.60	5.33
HDP (%)_	68.8	65.3	66.0	49.6	52.9	56.5	49.08
	11.11	6.90	9.00	6.74	4.91	9.97	12.65
Laying mortality	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a-c]Means in the same row with different superscripts are significantly different (P<0.05); Standard errors are below the values; WAF = weight of bird at first egg (g); ASM = Age at sexual maturity; FPH = Feed per hen (g/hen/day); EN = egg per hen; ASM = Age at sexual maturity (days); WFE = Weight at first egg (g); FPDE = Feed per dozen egg; HDP = Percentage hen-day production (%).

Table 3 - Influence of major genes on egg quality of the crossbred local chickens at age 26-32 weeks

	Means of genetic group						
Parameter	Na/Na	Na/F	Na/na	F/F	F/Na	F/na	na/na
EWT (g)	39.8[a]	38.7[a]	34.0	40.0[a]	36.7[b]	36.6[b]	35.3[bc]
	0.42	0.69	0.45	0.45	0.50	0.40	0.38
EL	48.2[b]	48.3[b]	46.8[c]	50.3[a]	47.6[bc]	46.6[c]	47.2[bc]
	6.19	0.57	0.32	0.33	0.53	0.31	0.84
EW (mm)	41.2[a]	35.8[b]	33.8[c]	36.3[b]	33.2[c]	35.4[b]	34.5[b]
	0.19	0.27	0.27	0.20	1.18	0.24	0.26
EI	0.73[bc]	0.72[bc]	0.72[bc]	0.72[bc]	0.84[a]	0.76[b]	0.73[bc]
	0.01	0.00	0.00	0.01	0.05	0.00	0.16
ST	0.86	0.88[b]	0.84[c]	0.92[a]	0.87[b]	0.88[b]	0.81[c]
	0.03	0.01	0.01	0.01	0.02	0.01	0.04
YWT (g)	12.7[a]	12.9[a]	11.2	13.1[a]	12.6[a]	11.6[c]	12.3[b]
	0.24	0.24	0.24	0.26	0.31	0.20	0.26
YH (mm)	13.2[a]	12.5[b]	12.9[b]	13.0a[b]	13.2[a]	12.2[b]	12.8[b]
	0.23	0.23	0.23	0.25	0.30	0.19	0.25
YW (mm)	36.5[bc]	37.4[a]	35.7[c]	38.0[a]	37.3[ab]	36.1[bc]	37.4[ab]
	0.43	0.43	0.44	0.47	0.56	0.36	0.47
YI	0.37a	0.34[b]	0.34[ab]	0.34[b]	0.39[a]	0.35[ab]	0.35[ab]
	0.01	0.00	0.00	0.01	0.01	0.01	0.01
AWT (g)	21.0	23.5	19.0	21.7	21.6	20.1	19.7
	2.23	2.25	2.28	2.47	2.95	1.89	2.46
AH (mm)	6.25	6.46	5.94	6.42	6.37	6.13	6.42
	0.14	0.14	0.15	0.16	0.19	0.12	0.16
HU	83.7	89.0	84.6	86.6	84.4	83.7	87.4
	1.32	1.33	1.35	1.46	1.74	1.12	1.45

[a-c]Means in the same row with different superscripts are significantly different (P<0.05); Standard errors are below the values; EWT = Egg weight (g); ST = Shell thickness (mm); YW = Yolk width (mm); AH = Albumen height (mm); EL = Egg length (mm); YWT + Yolk weight (g); YI = Yolk index. HU = Haugh unit. EW = Egg width (mm); YH = Yolk height (mm); AWT = Albumen weight; (mm). EI = Egg index.

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There was a significant difference (P<0.05) in weight of the first egg among the genetic groups. These weights 29.30±0.24 - 38.22±0.07 fall within the range of values previously reported.

Studies by Nwosu and Omeje (1985), Akinokun (1990), Adedokun and Sonaya (2001). It was observed that the homozygous naked-neck genetic groups which had heavier weights at first egg also laid heaviest eggs. This result support the work of Ayorinde and Oke (1995) that bigger birds normally laid larger eggs than those with smaller body weights.

There were no significant differences (P>0.05) in feed per hen, feed per dozen egg, and hen day production. The laying mortality which was zero indicates that these hens were capable of withstanding laying stress and as such given good management can be selected for hardiness in a stressed environment. The result of egg number from 26-52 week of age shows a significant difference (P<0.05) in favour of the naked neck. This observation is in line with previous findings of Merat (1990) that naked neck genes causes increase in egg number. From the foregoing, it can be said that weight at first egg is an important trait in selection process and the value obtained for body weight at first egg, weight of first egg, age at sexual maturity and egg number tend to present the naked neck lines as potential egg laying chickens, while frizzle lines as potential meat-type birds.

The means of the egg quality parameters of the crossbred local chickens are shown in Table 3 significant differences (P<0/05) were observed in egg weight, egg length, yolk weight, yolk width, yolk index, shell thickness and yolk height but no significant difference (P>0.05) in albumen weight, albumen height and haugh unit in all the genetic groups respectively.

Table 4 - Correlation among egg quality parameters of crossbred local chickens at week 32

Genetic Group	Parameter	EWT	YWT	AWT	AH	HU
Na/Na	EWT					
	YWT	0.31				
	AWT	0.16	-0.86**			
	AH	0.18	-0.55	0.74**		
	HU	0.08	-0.56*	0.70**	0.99**	
Na/F	EWT					
	YWT	0.92**				
	AWT	0.84	0.85**			
	AH	0.29	0.23	0.49		
	HU	-0.43	-0.44	-0.14	0.74**	
Na/na	EWT					
	YWT	0.77				
	AWT	0.78	0.40			
	AH	0.92	0.46	0.89		
	HU	0.89	0.39	0.88	0.99**	
F/F	EWT					
	YWT	-0.28				
	AWT	0.74*	-0.44			
	AH	-0.08	0.11	0.15		
	HU	-0.22	0.07	0.02	0.97**	
F/Na	EWT					
	YWT	0.44				
	AWT	0.05	0.16			
	AH	0.07	0.61	0.09		
	HU	-0.22	0.60	0.9	0.99**	
F/na	EWT					
	YWT	0.76**				
	AWT	0.75**	0.39			
	AH	0.73**	0.56*	0.71**		
	HU	0.004	-0.16	-0.06	-0.003	
na/na	EWT					
	YWT	0.45				
	AWT	0.26	0.14			
	AH	-0.33	-0.80*	-0.08		
	HU	0.40	-0.82*	0.04	0.99**	

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed); EWT = Egg weight; YWT + Yolk weight (g); AWT = Albumen weight (mm); AH = Albumen height (mm); HU = Haugh unit

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Except for egg index, the values obtained in this study were lower than what Peters et al. (2007) reported for exotic pullets but fall within the range reported by Adedokun and Sonaiya (2001). This indicated that these progeny were indigenous chicken origin. Egg weight, egg index determine egg resistance to cracking and are considered very important traits when eggs are packed in container (Peters et al., 2007, Kul and Seker, 2004). The acceptable value for egg index and haugh unit are reported to be 0.75 (Smith, 1990) and at least 40% (Ayorinde et al., 1999). These results showed that the eggs of the local chickens were good quality in terms of resistance to cracking, market desirability and the quality of chicks to be produced from them.

The result of correlation among some of the egg quality traits of the crossbred local chicken is shown in Table 4. In Na/Na genetic group, correlation among egg weight, yolk weight (r = 0.31), Albumen weight (r = 0.16), albumen height (r = 0.18), haugh unit (0.08) were all positive and non-significant (P>0.05). In Na/f, F/F, F/Na, genetic groups, egg weight and haugh unit were all negatively correlated (P>0.05). However, haugh unit and albumen height in these groups were highest and positively significantly (P<0.05) correlated among groups. The positive correlation observed among egg weight, yolk weight, albumen weight, and haugh unit in these genetic groups are in agreement with earlier report of Jaya Laxim et al. (2002). This implies that improvement in egg weight could lead to corresponding improvement in other egg quality traits.

CONCLUSSION

Egg lay by F/F, F/Na, Na/F and Na/Na were better in egg quality traits than other groups. These genetic groups also gave highest positive correlations of egg quality traits. The values of HU of the eggs of the crossbred local chicken were very high above 40% baseline below which the quality of an egg should be ranked poor. It is suggested that F and Na genes should be involved in the improvement of egg quality traits. For rapid improvement in the egg production characteristics of the indigenous chickens, selection within the existing population of the local chicken and crossbreeding with exotic breeds should be considered promising.

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