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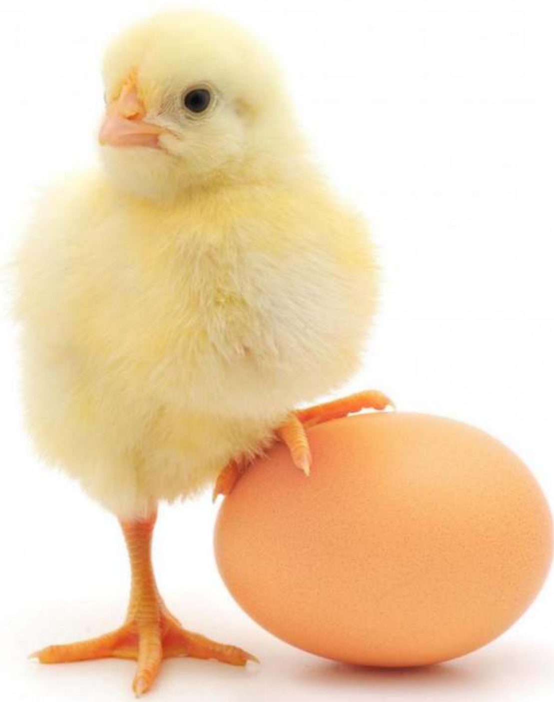

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Genotype by Diet Interaction on Body Weight of the Local Chicken and its Crosses with Barred Plymouth Rock

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Abstract: In a 2x4 factorial arrangement, the effect of genotype, diet and their interaction on body weight and weight gain of the F_1 crosses between the local chicken and Barred Plymouth Rock were investigated. Birds of each genotype were separated into two dietary groups at day old. One group was placed on layer type diets and other on broiler type diet. The body weights and weight gains of the two diet groups were monitored up to 12 weeks of age. The effect of genotype by diet interaction on body weight and weight gain was not significant ($p>0.05$) throughout the period. Birds on broiler diet regime were significantly ($p<0.01$) heavier at 8 and 12 weeks of age compared with those on layer type diets. The effect of genotype on bodyweight was significant throughout the 12 week period and significant in weight gain at the periods of 0-4 weeks and 4-8 weeks of age only. During these periods, the F_1 reciprocal crossbred groups (G_2 and G_3) compared favourably with the exotic (G_4) in weight gain indicating that the local chicken could be used in crosses with the exotic birds for the production of table birds, which are adapted to the local harsh environmental conditions and which are resistant to most of the endemic diseases.

Key words: Genotype, diet, interaction, crosses, weight gain

INTRODUCTION

The Nigerian local chicken has some useful genetic attributes such as adaptability to our local environment, resistance to some diseases, possesses good nicking ability and when subjected to multiple crossing with the exotic strains, transmits genes for early age at first egg, lower clutch number and lower pause number (Omeje 1989; Mmereole, 2004). These attributes can be harnessed in a cross breeding programme with the exotic for the development of meat and eggs type chickens (Nwosu, 1987; Nwosu *et al.*, 1987). Crossbreeding experiments involving the local and exotic chickens showed that the local chicken exhibited reasonable hybrid vigour in growth and egg production traits (Omeje and Nwosu, 1988; Nwosu, 1989; Omeje, 1989). In an effort to improve the local chicken through cross breeding and selection, it is important to subject the crossbred local chicken to different environmental treatments to determine the effect of genotype by environment interaction on production traits. According to Boettcher *et al.* (2003), one factor that could cause genotype by environment interaction in poultry is feeding and management systems. A number of works have evaluated the influence of genotype by environment interaction in poultry and farm animals. For example Smith *et al.* (1998) reported significant genotype by diet (protein level) interaction on body weight, carcass yield and feed conversion ratio. Similarly, Petek *et al.* (1999) reported a significant season by genotype interaction on heat stress in broilers, which was attributed to the presence of substantial genetic variation in the magnitude of heat tolerance. In egg production strains, a sire family by climate interaction was found for egg production (Mukherjee *et al.*, 1980; Mathur and Horst, 1994). Deeb and Cahamer (2001) investigated the level of genotype by environment interaction with broiler genotypes differing in growth rates and reported significant growth improvement in the genotype with lower growth rate. Zaky (2005) estimated the genetic differences of some productive and reproductive traits of two local breeds of chickens and confirmed the relevance of genotype x environment interaction effects in the improvement of meat and egg production in the local chickens when crossed with the exotic breeds. Esan El-Gandy (2009) crossed chickens local to warm climate with fast growing strains and observed remarkable improvement in the growth characteristics of the crossbreds. He suggested genetic selection for increased body weight in the crossbreds. Breeding for improved adaptation to particular stressful environmental conditions should be the strategy when genotype by environment interactions significantly affects economically important traits (Cahar, 1990; Hartman, 1990).

This study was undertaken to test the effect of genotype by diet interaction on body weight and weight gain of the F_1 crosses between the local chicken and Barred Plymouth Rock.

MATERIALS AND METHODS

The experimental birds comprised the local chicken made up of 20 cocks and 82 hens and Barred Plymouth

Table 1: The experimental layout of chicks and diets

Pen	Group	No. of chicks.	Pen	Group	No. of chicks
1	G_1D_1	27	9	G_1D_1	20
2	G_1D_2	27	10	G_1D_2	20
3	G_2D_1	27	11	G_2D_1	20
4	G_2G_2	27	12	G_2G_2	20
5	G_3D_1	27	13	G_3D_1	33
6	G_3D_2	27	14	G_3D_2	33
7	G_4D_1	29	15	G_4D_1	25
8	G_4D_2	29	16	G_4D_2	25

Table 2: Nutrient composition of the commercial diets used in the study

Nutrient (%)	Broiler starter	Broiler finisher	Chick mash	Grower mash
Crude protein	24.0	19.00	20.0	14.5
Crude fat	7.20	5.00	5.00	4.80
Crude fibre	5.5	5.00	5.05	7,20
Crude ash	5.80	6.40	6.20	8.00
Calcium	1.30	1.10	1.20	0.80
Phosphorus	0.65	0.60	0.66	0.62
Lysine	1.20	0.90	1.20	0.60
Methionine	0.45	0.45	0.45	0.29
M.E (kcal/kg)	3000	2850	2685	2300

rock numbering 20 cocks and 60 hens. The birds were housed at day old and maintained at the Poultry Breeding and Research Unit of the Department of Animal Science University of Nigeria Nsukka. At 30 weeks of age, these birds were reciprocally crossed by artificial insemination and the following mating groups with their corresponding genotypes generated are shown below:

- Local chicken males x local chicken females (LC♂ x LC♀) or G_1
- Barred Plymouth Rock males x local chicken females (BR♂ x LC♀) or G_2
- Local chicken males x Barred Plymouth females (LC♂ x BR♀) or G_3
- Barred Plymouth Rocks males x Barred Plymouth rock females (BR♂ x BR♀) or G_4

From the various mating groups, eggs were collected for 14 days, incubated and hatched. The progeny of each mating group was divided into two groups at day old. One diet group was placed on the broiler diet (D_1) while, the other group was placed on layer type diet (D_2). The chicks were raised from day old to 12 weeks of age. The experiment was replicated once. The experimental layout and the number of birds are presented in Table 1. The chicks were brooded on deep litter for 6 weeks after which they were transferred to the rearing house (deep litter) according to the test groups. Those on broiler regime were fed on commercial broiler starter for 6 weeks. From 6-12 weeks, they were fed on commercial broiler finisher ration. Those on layer regime were fed on commercial chick mash for 6weeks and on commercial growers mash from 6-12 weeks. Both feeds and water were provided *ad libitum* to the experimental birds. The analyzed nutrient compositions of the diets are shown in Table 2. The birds were weighed at day old and subsequently weighed weekly and the weight gain computed. All the data generated were subjected to a 2x4 factorial analysis of variance in a completely randomized design (Steel and Torrie, 1980). Significant means were further tested using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The mean square values from the analysis of variance: for the effect of diet, genotype and genotype by diet interaction on the body weight and weight gain of the F1 crosses between the Local Chicken (LC) and the Barred Plymouth Rock (BR) are presented on Table 3 and 4, respectively. It can be observed from these tables that treatment combinations were significant ($P<0.05$, $P<0.01$) on the body weight of the experimental chickens throughout the trial tests periods and on weight gains during the periods of 4-8 weeks of age. A breakdown of the treatment combinations showed that the effect of diet was highly significant ($P<0.01$) on the body weight only at 8th and 12th weeks of age. The effects of genotype were highly significant ($P<0.01$) on body weight and weight gain of the experimental birds in most of the age periods. The effects of genotype by diet interaction on body weight and weight gain were not significant ($P>0.05$) throughout the 12 week- period. The implication of these results is that any of the diets used in this study could support the growth of the local chicken, Barred Plymouth Rock and their crosses.

Effect of diet on the body weight and weight gains of the chickens: Table 5 presents the effect of diet on body weight of the experimental birds for the period of 12 weeks. There were no significant differences ($P>0.05$) between the birds on broiler regime (D_1) and those on layer type diets (D_2) on body weight at the 1st and 4th week of age, in spite of the differences in crude protein and energy content of the two different diets (Table 2). This implies that either of the diet could be fed to the crossbred local chicken at this age period. This result is in line with the report of Parr and Summer (1991), Moren and Stillborn (1996), that reducing crude protein diet by 2% or less in the starter period could not affect the weight gain of broilers. This conclusion is however at variance with the report of Esan El-Gandy (2009) that the interaction between genotype and diet has significant effects on the growth patterns of the local x exotic chicken crossbreds. However, birds placed on broiler regime were significantly ($P<0.01$) heavier at 8 and 12 weeks of age than those placed on layer type diets within the corresponding period. A similar observation was made by Zaky (2005). This could be attributed to

Table 3: Variance analysis for body weight at different age periods in the Local chicken and its crosses with Barred Plymouth rock

Age (weeks)	Treatment combinations	Treatment combinations: Diet	Genotype	Genotype x diet	Error
df	(7)	(1)	(3)	(3)	(8)
1	34.03**	5.15NS	76.61**	1.07^{NS}	1.47
4	527.39**	35.38NS	1191.04**	2775^{NS}	24.94
8	7558.93**	15595.64**	12411.13**	27.84^{NS}	21.90
12	12577.94*	36875.52**	16010.62*	1046.06^{NS}	2944.87

*P<0.05, **P<0.01, NS not significant, df. (Degree of freedom) for sources of variance are written in parentheses

Table 4 : Variance analysis weight gain at different age periods in the local and its crosses with the barred plymouth rock

Age (weeks)	Treatment combinations (7)	Diet (1)	Genotype (3)	Genotype x diet (3)	Error (8)
0-4	362.29	94.69	716.69*	97.10NS	169.74
4-8	3219.78**	1626.51NS	6595.58**	375.08NS	486.51
8-12	465.52NS	320.77NS	720.91NS	258.37NS	1070.80

*P<0.05, **P<0.01, NS not significant, df (degree of freedom) for sources of variation are written in parenthesis

Table 5: Effect of diet on the body weight of the experimental chickens

Age (weeks)	Diet groups: D 1	D2
1	30.96±1.42	32.09±1.53
4	152.26 ±5.14	149.29±6.50
8	344.31±4.10^{b}	281.88±1.75^{a}
12	708.82±2.53^{b}	612.93±6.28^{a}

a, b means are significantly different (P<0.01)

Table 6: Effect of genotype on the body weight of the experimental chickens (g)

Age (weeks)	G1	±SEM	Genotype (G2)	±SEM	(G3)	±SEM	G4	±SEM	Level of significance
1	27.67^{a}	0.63	27.94^{a}	0.56	34.26^{b}	0.97	36.24^{b}	0.16	P<0.01
4	128.25^{a}	4.73	146.27^{b}	1.12	164.13^{c}	1.19	164.45^{c}	1.22	P<0.01
8	229.95^{a}	1.60	334.93^{b}	2.31	348.10^{c}	2.36	339.41^{bc}	2.74	P<0.01
12	556.38^{a}	3.45	692.16^{b}	4.76	700.06^{b}	2.08	684.64^{b}	3.74	P<0.05

Mean values across row with different superscript letters are significantly different (P<0.05, P<0.01)

Table 7: Effect of genotype on weight gain of the crossbred between the local chicken and barred plymouth rock (g) genotypes

Age (weeks)	G1	±SEM	Genotype G2	±SEM	G3	±SEM	G4	±SEM	Level of significance
0-4	100.58^{a}	4.71	118.33^{b}	4.46	129.56^{b}	8.31	128.29^{b}	5.87	P<0.05
4-8	101.75^{a}	0.48	188.67^{b}	2.16	183.97^{b}	20.83	173.10^{b}	10.71	P<0.01
8-12	326.85	4.19	357.67	7.72	352.27	15.20	345.57	22.30	P>0.05

Mean values across row with different superscript letters are significantly different (P<0.05, P<0.01)

the differences in the nutrient composition of the two diets. Broiler finisher was richer than grower mash in terms of the crude protein, lysine, methionine and the energy content of the diet and this accounted for the differences in body weight between the two dietary groups. This underscores the importance of feeding local x exotic crossbred chicken with broiler type diet during the finishing period (8-12 weeks) especially when, the birds are reared as table birds. A similar observation was reported by El-Gawal *et al.* (2004) that feeding broiler birds with diets containing 20% CP at the finishing period resulted to significantly higher body weight and weight gain than birds fed on diets containing low level of crude protein (16.5% cp).

Effect of genotype on the body weight and weight gains of the experimental chickens: Table 6 and 7 present the effect of genotype on the body weight and weight gain of the experimental birds. It would be observed from Table 6 that the local chicken by Barred Plymouth rock (G3) and the Barred Plymouth rock (G4) groups were significantly (P<0.01) heavier than the local chicken (G1) and the Barred Plymouth rock by local chicken (G2) groups at the 1st, 4th and 8th weeks of age, respectively. However, the body weight of the F1 crossbred groups (G2 and G3) and the barred Plymouth rock (G4) were not significantly different (P>0.05) at 12 weeks of age. From Table 7, it will be observed that the weight gain of the F1 reciprocal crossbred groups (G2 and G3) compared favourably with the exotic (G4) during the periods of 0-4 and 4-8 weeks of age. However, they gained significantly ($P<0.05$, $P<0.01$) more weight than the local chicken (G1) during the same periods. These results together with the body weight of the crossbred groups suggests that the local chicken can be used in crosses with the exotic (meat type) chickens for the production of table birds in the Tropics. A similar observation was reported by Omeje and Nwosu (1984).

Conclusion: Since, the results have indicated that the F1 reciprocal crossbred groups (G2 and G3) compared favourably well with the exotic F1 (G4) and superior to the local F1 (G1) in terms of body weight and weight gains, it can be concluded that the local chicken should be used in crosses with the exotic (meat-type) chicken for the production of table birds in the tropics where they are indigenous to the locality. Such locally adapted meat birds will be easier and cheaper to rear since they will be resistant to the harsh environmental conditions as well as to most of the endemic diseases.

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