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Mode of Inheritance and Interrelationship among Age at First Egg, Body Weight at First Egg and Weight of First Egg in Local by Exotic Inbred Chicken Crosses

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Abstract: The interrelationship among Age at First Egg (AFE), Body Weight at First Egg (BWFE) and Weight of First Egg (WFE) and their inheritance were studied in the F_1 crossbred groups generated from the mating of inbredlines of two exotic and the local chickens. The birds were reared on deep litter pens from day old to 24 weeks of age when all the groups had started laying. The results indicated that the F_1 crossbred groups differed significantly ($p<0.01$) with respect to AFE, BWFE and WFE. Sire influence as well as non additive genetic effects were responsible for the inheritance of AFE of the crossbred groups while their BWFE were controlled by the dominant genes transmitted from the exotic parent. It was also observed that WFE of the crossbred groups were influenced by both additive and dominance gene actions. The results further showed that BWFE and WFE were closely related in all the F_1 crossbred groups while correlated responses were found among AFE, BWFE and WFE only in the combined F_1 crosses of the local and pure black groups. The implication of this result was that selection for any of these traits could give positive response to others.

Key words: Local, exotic chicken, crosses, age, bodyweight, egg weight, inheritance

INTRODUCTION

Lufadeju *et al.* (1995) and Lamorde (1997) estimated the Nigerian local chicken population at 150 million. These local chicken population consists of mixed varieties of unimproved, unselected and random breeding birds. They are characterized by adult body weight of 0.68-1.71 kg for the male and 0.43-1.35 kg for the females (Nwosu, 1979; Oluyemi and Ogunmodebe, 1979). Nwosu *et al.* (1985) reported that the commonest plumage colour patterns of the local chicken were black, red, brown with various laced colours and mottlings. Nwosu (1979) and Obioha *et al.* (1983) reported that the egg production for the local chicken ranged 60-80 eggs per annum under extensive system and 124-141 eggs per annum under intensive system with a mean egg weight of 32.75 g. Other authors namely, Oluyemi (1974), Akinokun and Dettmers (1977) and Adegbola *et al.* (1986) reported on the small egg number and egg size of the local chicken. Crossbreeding and selection are the two important genetic tools for the improvement of body size and egg production traits of the local chicken. In any selection programme, care should be taken to prevent the loss of already gained genetic progress because of the problem of negative genetic correlation between two or more traits considered at a time. Therefore it is imperative to understand the mode of inheritance and interrelationship among characters in the domestic chicken. This is to enable the breeder develop appropriate breeding plan for the improvement of the desired traits. A number of researches have been done earlier on the relationship between body weight, age at sexual maturity, egg weight and egg production in the domestic chickens (Omeje and Nwosu, 1984; Ayorinde *et al.*, 1988; Oni *et al.*, 1991; Adenowo *et al.*, 1995; Chineke, 2001). However, it is important to understand the relationship among these egg production characters in the local chicken and its crosses with the exotic. The objective of this study is to investigate the mode of inheritance and interrelationship of age, body weight and egg weight in the local and exotic inbred chickens and their crosses.

MATERIALS AND METHODS

The experimental birds: This comprised inbred lines generated from the within strain mating of two exotic layer strains (H and N Brown Nick and Black Olympia) and the local chicken maintained at the poultry breeding research unit of the Department of Animal Science, Enugu State University of Science and Technology, Enugu. The inbred lines were Pure White (PW) and Pure Brown (PBr) from H and N Brown nick (strain 1) and Pure Black (PBl) and barred (Brr) from Black Olympia chicken (strain 2). The inbred lines of the local chicken (strain 3) were maintained as two replicate groups (LC_1 and LC_2). They cannot be classified on the basis of plumage colour because of their multiple colour pattern.

Crossbreeding procedure: At 28 weeks of age, 4 cocks and 40 hens from each exotic line (PW, PBr, PBl and Brr) were reciprocally mated to 8 cocks and 80 hens each from the two replicate groups of the local chicken (LC_1 and LC_2) to generate eight F_1 crossbred populations with a total of 670 chicks.

Management of the birds: Standard management procedures as described by Oluyemi and Roberts (2007) were conformed in the management of the birds. The chicks were brooded and fed *ad libitum* for 8 weeks with a chick mash diet which on analysis yielded 20% Cp and 2685 Kcal ME/kg. From 8-18 weeks they were fed *ad libitum* with growers mash containing 2642 Kcal ME/kg and 16% Cp while from 19-24 weeks, they were

provided with layers mash containing 2676 Kcal ME/kg, 17% Cp and about 3.00% calcium. *Ad libitum* water was also provided through out the period. The birds were vaccinated against new castle disease at day old, 28 days and 63 days of age and against infectious bursal disease and fowl pox disease at the age of 14 days and 56 days respectively. Occasionally, vitalyte, a vitamin supplement was administered to enhance productivity.

Data collection and analysis: Data were collected on the following traits.

Age at First Egg (AFE): Which was taken as the number of days from hatch to first egg.

Body Weight at First Egg (BWFE): This was taken at the onset of lay.

Weight of First Egg (WFE): This was taken as the average weight of first 10 eggs laid consecutively for each group.

For the inbred progeny data, a simple analysis of variance in a completely randomized design using unequal cell replicate model as given by Winer (1971) was used to test the effect of strain and lines within strain on the trait. The statistical model used was as follows:

$$Xijk = U + gi + Lij + eijk$$

Where:

Xijk = The K^{th} observation egg body weight in the j^{th} line (J = 1, 2 ….6) within the ith strain (I = 1,2,3)

U = The estimate of the overall population mean

gi = Effect of I^{th} strain on the traits (eg. egg weight)

Lij = Random variable (eg. egg weight) due to the effect of the j^{th} line within the i^{th} strain

Eijk = k^{th} error or offspring effect or individual chick differences.

For the F_1 crossbred, data were analyzed by means of one way analysis of variance in a completely randomized design (Winer, 1971) with breeding group as the main source of variation. Duncan's multiple range test was used to compare means when ANOVA showed significant effect.

RESULTS AND DISCUSSION

Table 1 presents the mean and the standard error for Age at First Egg (AFE), Body Weight at First Egg (BWFE) and Weight of First Egg (WFE) of the inbred lines of two exotic and the local chickens. As shown in the table, highly significant ($p<0.01$) lines within strain differences were observed for AFE, BWFE and WFE in strain 1 and only for BWFE and WFE in strain 2. The Pure White (PW) feathered group was superior to the Pure Brown (PBr) counterpart in strain 1 for AFE and BWFE. The PBr group was however, superior to the PW group in weight of first egg probably on account of the delayed onset of lay by this group which came to lay about 27 days later than the PW. Similarly, the PBl pullets in strain 2 produced heavier eggs at the onset of lay then the Brr type probably on account of the body weight differences at this period.

Table 2 shows the mean and the standard error for AFE, BWFE and WFE of the crosses involving the local and exotic inbred lines. It will be observed that the crossbred

Table 1: Age at First Egg (AFE), Body Weight at First Egg (BWFE) and Weight of First Eggs (WFE) of inbred lines of two exotic and local chickens

	Strains	1		2		3	
Traits	Lines	Pw	PBr	PBl	Brr	LC_1	LC_2
AFE (days)	..	166.00^{a}	192.63^{b}	185.10^{a}	182.40^{a}	155.40^{a}	155.30^{a}
		(1.03)	(2.83)	(2.57)	(2.24)	(0.69)	(0.34)
BWFE (g)		1322.50^{b}	1254.41^{a}	1408.00^{b}	1361.58^{a}	888.75^{a}	860.63^{a}
		(12.84)	(26.60)	(27.79)	(29.04)	(11.74)	(8.59)
WFE (g)		41.50^{a}	48.35^{b}	52.00^{b}	47.93^{a}	34.47^{a}	33.90^{a}
		(1.45)	(3.13)	(0.81)	(1.09)	(0.64)	(0.35)

For each strain result and trait, mean values with different superscript are significantly different ($p<0.01$). Note: Standard errors are in parentheses. Pw = Pure White; Pbr = Pure Brown; Pbl = Pure Black; Brr = Barred; LC_1 and LC_2 = Local Chicken

Table 2: Age at first egg, body weight at first egg and weight of first eggs of the crossbred groups

	Crossbred groups							
Traits	LC_1 x Pw	Pw x LC_1	LC_1 x PBr	PBr x LC_1	LC_2 x PBL	PBL x LC_2	LC_2 x Brr	Brr x LC_2
AFE (days)	171.70^{b}	170.10^{ab}	196.20^{d}	199.50^{d}	162.20^{a}	187.60^{a}	197.90^{d}	182.10^{c}
	(1.37)	(1.72)	(1.41)	(1.19)	(0.81)	(1.41)	(4.05)	(2.43)
BWFE (g)	1306.25^{cd}	1225.55^{b}	1312.50^{d}	1110.91^{a}	1326.14^{d}	1220.50^{b}	1350.00^{d}	1233.20^{bc}
	(17.94)	(7.24)	(10.45)	(10.55)	(13.81)	(9.45)	(17.01)	(14.24)
WFE (g)	37.76^{b}	39.32^{b}	42.02^{c}	41.79^{c}	3546.00^{a}	42.98^{cd}	43.33^{cd}	44.34^{d}
	(0.51)	(0.52)	(1.08)	(0.51)	(0.57)	(0.96)	(0.57)	(0.61)

For each trait, mean values with different super script letters are significantly different ($p<0.01$). Note: Standard errors are in parentheses. Pw = Pure White; PBr = Pure Brown; PBl = Pure Black; Brr = Barred; LC_1 and LC_2 = Local Chicken

groups differed significantly ($p<0.01$) in the three traits. The LC_2 x PBL was the first group to lay about 163.20 days, followed by the PW x LC_1 (170.00 days). The PBr x LC_1 (199.50 days) was the last group to lay. A gap of 36 days existed in the AFE between the first and the last to lay among the crossbred groups.

On BWFE, the reciprocal crossbred groups (LC_1 X PW, LC_1 x PBr, LC_2 x PBL and LC_2 x Brr) were significantly ($p<0.01$) superior to the main crossbred groups (PW x LC_1, PBr x LC_1, PBL x LC_2 and Brr x LC_2) in this trait. It appears that the body weight of the reciprocal crossbred groups were influenced by the dominant genes transmitted from the exotic dams. The Brr x LC_2 was the most superior in WFE. This was closely followed by the LC_2 x Brr. Figures 1a and 1b presents the relationship between AFE, BWFE and WFE while Fig. 2a and 2b shows the mode of inheritance of these traits among the F_1 crossbred groups. It will be observed from Fig. 1a and 1b that while sire influenced the AFE of PBL x LC_2 and Brr x LC_2 main crossbred groups, non additive genetic effects were responsible for the inheritance of this trait in the other crossbred groups (LC_1 x PW, PW x LC_1, LC_1 x PBr, PBr x LC_1, LC_2 x PBL and LC_2 x Brr). This mean that some of the exotic inbred lines had dominant alleles governing this trait which were transmitted to the crossbred groups. Omeje (1983) and Adenowo *et al.* (1995) had reported earlier that sire influence as well as additive gene effects were important in the inheritance of AFE in crossbred chickens. Similarly, BWFE seemed to be controlled by dominant genes from the exotic parent as most of the crossbred values for this trait lie close to the exotic parents (Fig. 1a and 1b). This is also in line with the observations of Omeje (1983) and Adenowo *et al.* (1995). With regard to WFE, both additive and non additive gene actions were important in the inheritance of this trait. A closer observation of Fig. 2a and 2b, will show that BWFE and WFE were closely related. This means that the heavier the body size of birds at onset of lay, the bigger the weight of first eggs produced. Omeje (1983), Oni *et al.* (1991) and Adenowo *et al.* (1995) obtained positive correlation between BWFE and WFE. Correlated responses were found between AFE, BWFE and WFE only in the combined F_1 crosses of the local and pure black groups (Fig. 2b). It was shown in this group that the lower the body size at onset of lay and earlier the age at first egg, the more retarding effect on weight of first eggs. The relationship between the three traits appeared not to exist in the other F_1 combined crosses. The correlated responses among the three traits agreed with results reported in literature by other

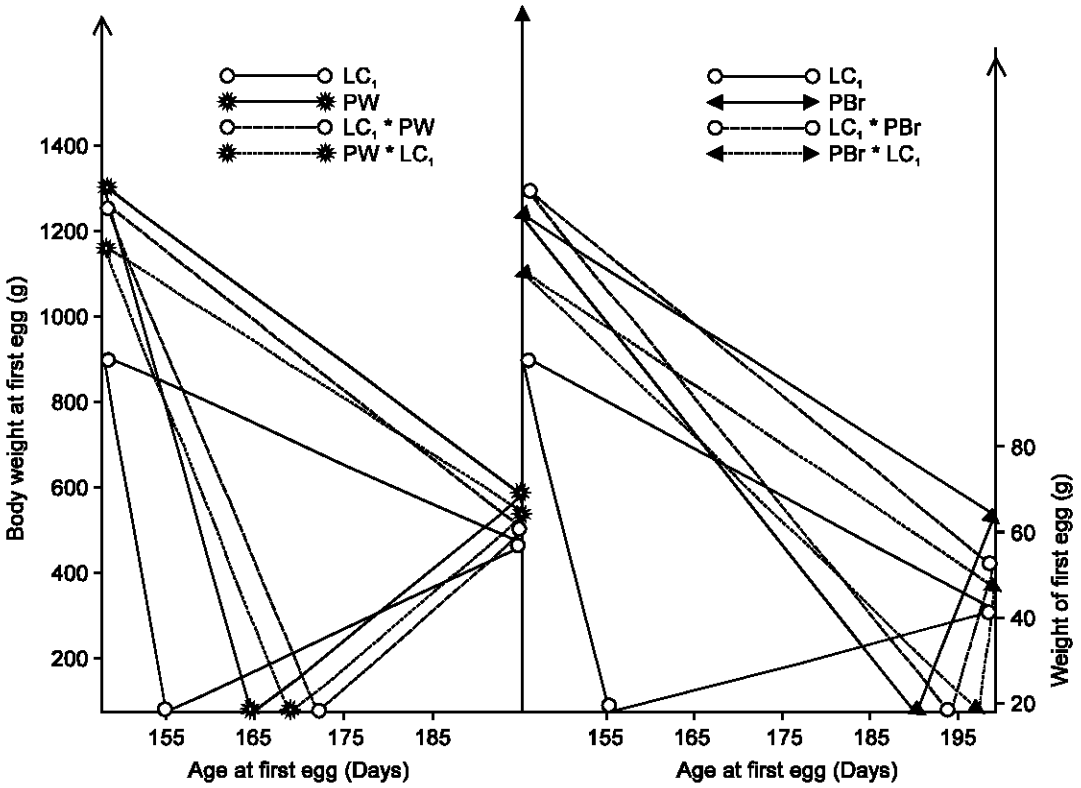

Fig. 1a: Relationship between AFE, BFE and WFE in local by pure white and local by pure brown reciprocal crosses

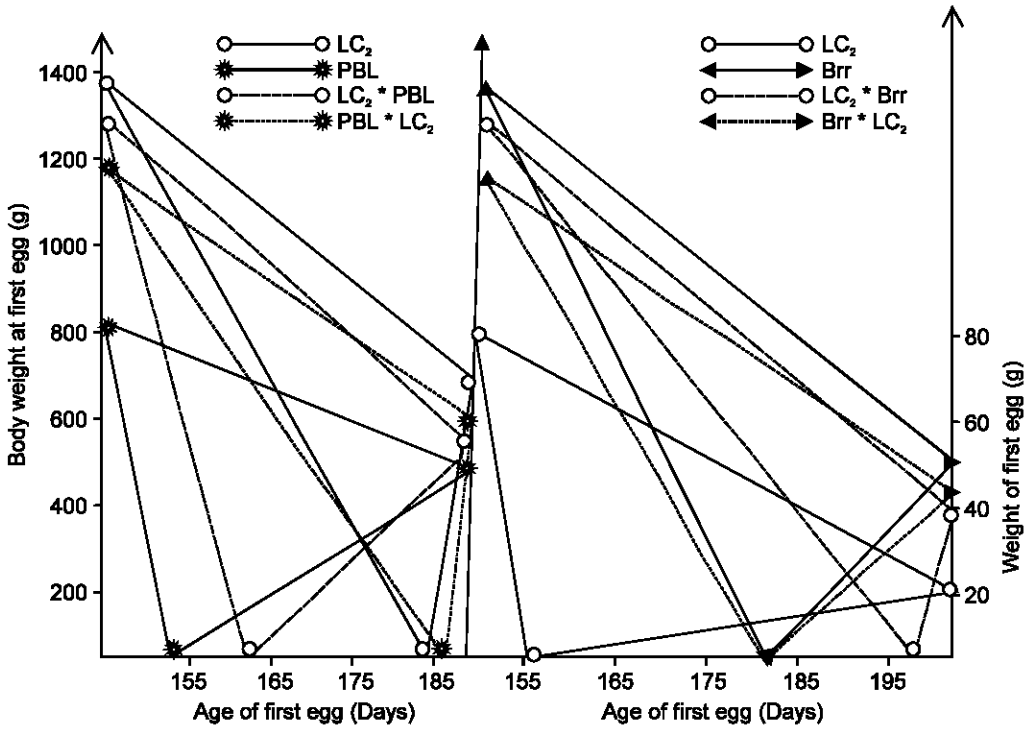

Fig. 1b: Relationship between AFE, BFE and WFE in local by pure black and local by Barred reciprocal crosses

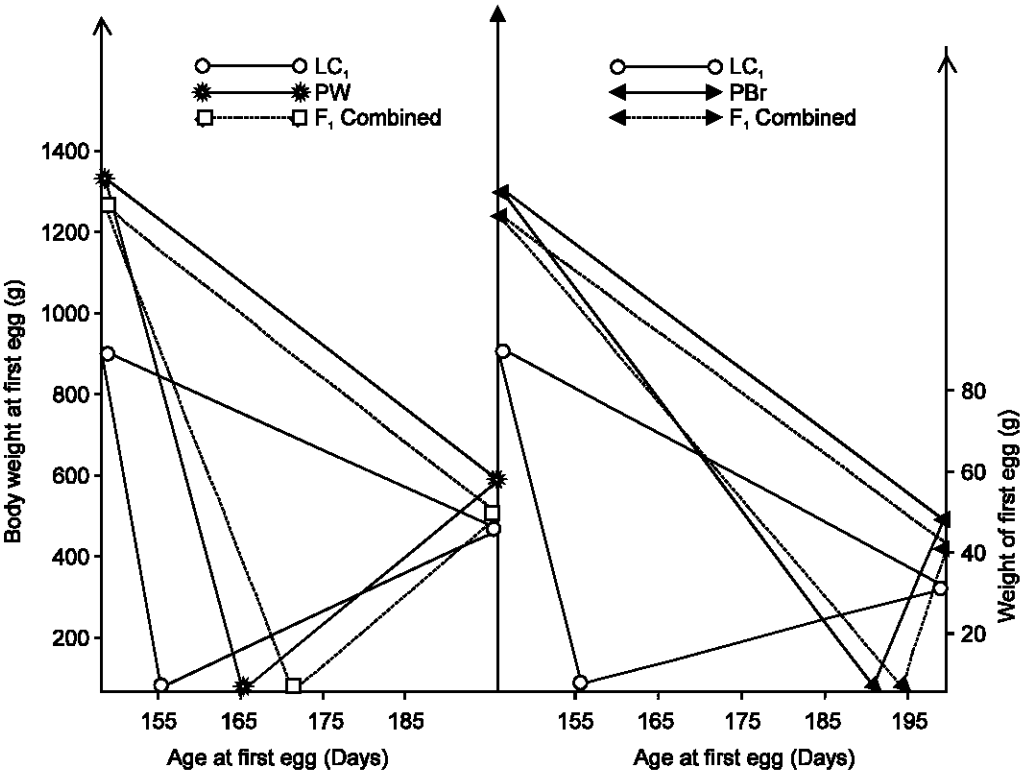

Fig. 2a: Mode of inheritance of AFE, BFE and WFE in the F_1 combined crosses

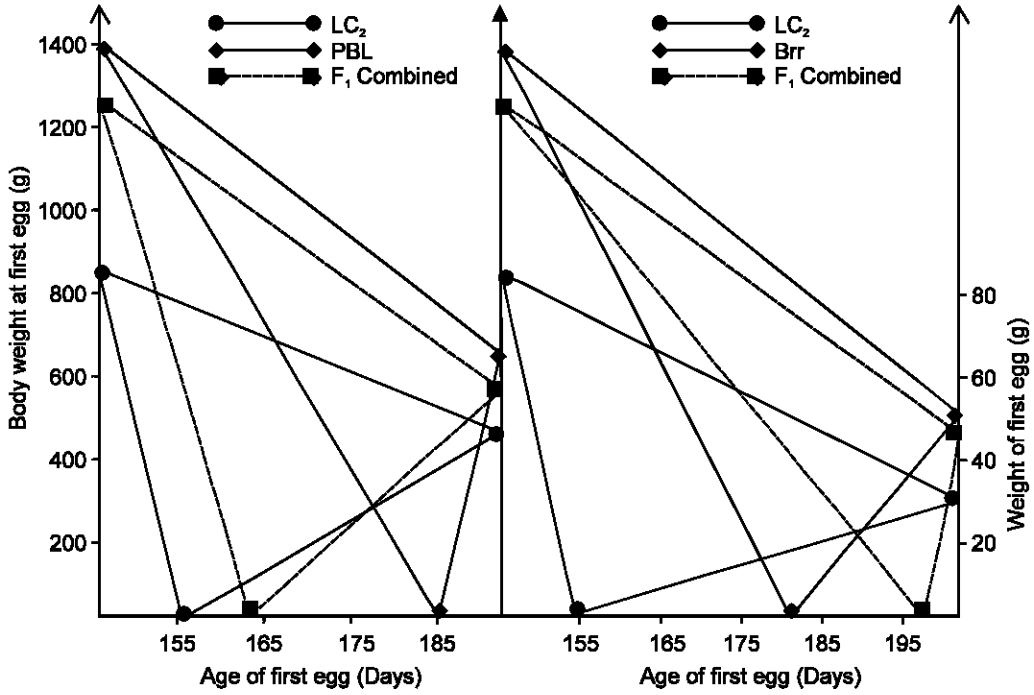

Fig. 2b: Mode of inheritance in the F_1 of AFE as compared to BFE and WFE

researchers (Akinokun and Dettmers, 1977; EL-Hossari, 1978; Oluyemi, 1978; Omeje and Nwosu, 1984; Oni *et al*., 1991; Adenowo *et al*., 1995). The implication is that selection for one of these traits could give positive response to others.

Conclusion: It was concluded that both additive and non additive gene actions played important role in the inheritance of AFE, BWFE and WFE in the crossbred local chickens and that the three traits were interrelated in the F_1 combined crosses. Therefore selection for one trait will give positive response to others.

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