Heterosis for egg production in native by exotic inbred chicken crosses

I. Udeh and S. I. Omeje

Department of Animal Science, Enugu State University of Science and Technology, Enugu, Nigeria.

Abstract

Inbred lines generated from the native and exotic chickens were compared with their F_1 and backcross populations for a range of short term egg production traits. The experimental birds were brooded for 8 weeks and raised on deep litter pens from 8 to 40 weeks of age. Age at first eggs were longer in the crossbred groups and the delay was mostly caused by the dominant genes from the exotic parents. Highly significant ($P < 0.01$) heterosis were obtained by the crossbred groups in hen day rate and total egg mass respectively. The heterosis observed in the crossbred groups for egg weight was low and mostly non significant. The backcross groups recorded residual heterosis in egg production traits (hen day rate, total egg mass and egg weight) and the magnitude was higher in the exotic than the native backcrosses. The results further indicate that the egg production performance of the crossbred groups were mostly influenced by maternal, sex linked, dominance and epistatic gene effects. It was suggested that the egg production potential of the native chicken could be improved further by cross mating-selected native and exotic backcross groups. This should be followed by crisscrossing.

Key Words: Inbred lines, crosses, egg production, heterosis, genetic basis

Introduction

For a long time now Nigeria has depended much on importation of poultry inputs such as day old chicks, parent stocks, feed concentrates, drugs and vaccines for the sustenance of her poultry industry. This importation stagnated her ability of sourcing for poultry inputs inwardly. Nwosu (1987) strongly stressed that in order to obtain a solid foundation and a less hazardous poultry farming in Nigeria, it is necessary to use the native chicken as part of the seed stock development. Previous research efforts have

shown that although the native chicken perform very poorly in meat and egg production, it possesses useful genetic attributes that can be harnessed in a crossbreeding programme for the development of egg and meat type chickens (Nwosu, 1987, and Nwosu *et al.*, 1987). Some of the genetic attributes of the native chicken are: disease tolerant, adaptability to our environment, compares favourably in growth characteristic with the exotic strains, possesses good nicking ability when subjected to multiple crossing with the exotic strains, transmit genes for early age at

first egg, lower clutch number and lower pause number (Omeje, 1989).

Crossbreeding experiments involving the native and exotic chicken showed that the native chicken exhibited reasonable hybrid vigour in growth and egg production traits (Omeje and Nwosu, 1988, Nwosu, 1989 and Omeje, 1989). It is true that the National Animal Production Research Institute (NAPRI) had initiated some on going poultry breeding project, the stock has been tested at the various ecological zones of the country and registered as Shika brown. Reports on the activities of this project as published by Oni *et al* (1998) and Ayorinde *et al* (1999) indicate no incorporation of the native genes in the foundation lines. In this new millenium, there is the need to commission other breeding projects that will incorporate the native chicken as a breeding parent. This incorporation will produce strains of chicken that are adaptable to our local environment and as well achieve the much desired objectives of making Nigeria attain self sufficiency in the sourcing of poultry breeding stocks and boosting of her poultry industry.

This study evaluates the heterosis for egg production traits in the F_1 and the residual heterosis in the backcrosses of the native and exotic inbred lines of chicken using a crossbreeding procedure known as back and crisscross heterosis evaluation technique (BACCET) by Omeje (1989).

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 native 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 I) and pure black (PBL) and barred (Brr) from Black Olympia chicken (strain II). The inbred lines of the native chicken (strain III) were maintained as two replicate groups (LC₁ and LC₂). 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 native chicken (LC₁ and LC₂) to generate eight F_1 crossbred populations with a total of 670 chicks. The mating arrangement which is part of the BAC-CET breeding design (Omeje, 1989) is shown in Figure 1. Similarly, at 28 weeks, 30 hens from each crossbred group were backcrossed to their male parents to obtain eight backcross progeny groups as illustrated in Figure 1. Mating was at random on floor pens with a mating ratio of 1 cock to 10 hens. A total of 700 backcross chicks were produced.

Management of the stocks: Standard management procedures as described by Oluyemi and Roberts (1979) 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 weeks to the end of the test (40 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 throughout 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 which was taken as the number of days from hatch to first egg.

Hen day rate of lay: taken as the number of eggs laid by each group at a given day divided by the number of birds alive expressed in percentage.

Egg weight: the average weight of eggs (g) laid throughout the period.

Total egg mass: obtained from the direct product of egg number and egg weight. For the inbred progeny data, a simple analysis of variance in a completely randomized design using unequal cell

Figure 1: The crossbreeding procedure involving the native and exotic chicken.1

1: The crossbreeding procedure is a part of the BAC-CET strategy by Omeje (1989).

Key:

PO: Base population

PW: Pure white

PBr: Pure brown

PBL: Pure black

Br: Barred

LC₁: Native chicken replicate I

LC₂: Native chicken replicate II

replicate model as given by Winer (1971) was used to test the effect of strain, and line within strain on the trait. The statistical model used was as follows: $X_{ijk} = U + g_i + L_{ij} + e_{ijk}$ where

X_{ijk} = the k th observation egg weight in the j th line ($j = 1, 2, \dots, 6$) within the i th strain ($i = 1, 2, 3$)

U = the estimate of the overall population mean.

g_i = effect of i th strain on the traits (eg, egg weight).

L_{ij} = random variable (eg, egg weight) due to the effect of the j th line within the i th strain.

e_{ijk} = K th error or offspring effect or individual chick differences.

For the F_1 crossbred and the backcross, data were analysed 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.

Estimation of heterosis: Heterosis among the F_1 chicks were estimated as the mean crossbred deviation expressed in percentage of midparent performance.

Backcross heterosis was computed from the average additive merit $E(B \times)$ expected of each backcross as outlined by Omeje and Nwosu 1988 and stated below

$E(BX_1) = P + \frac{1}{2} [P_1 - P]$ for a backcross to P_1 parent.

$E(BX_2) = P + \frac{1}{2} [P_2 - P]$ for a backcross to P_2 parent.

Heterosis = $BX_1 - E(BX_1)$ = heterosis by the BX_1 backcross.

Or = $BX_2 - E(BX_2)$ = heterosis by the BX_2 backcross.

A simple t test was used to compare the crossbred data with their midparent for significance of heterotic performance using the procedure outlined by Yule and Kendall (1968).

Genetic analysis of heterosis: The heterosis obtained from the backcross groups were respectively compared with the F_1 heterosis by expressing the mean heterosis of the backcross group as a percentage of the F_1 . The results of the backcross heterosis relative to F_1 were fitted against the complete dominance and parental epistasis model postulated by Sheridan (1981). In this model (Table 1) the F_1 heterosis relative to itself is 100% whether it is complete dominance or epistatic gene action that is operating. The relative performance of the backcross group was compared with the figure expected of the family or mating type under any of the gene actions. If a particular result was of the same or nearly the same magnitude with the corresponding predicted value in this model, then it will be taken that the experimental data fitted well into the particular model of gene action responsible for heterosis.

Results

Table 2 shows the egg production characteristics of inbred lines of the native and exotic chicken used for the crossbreeding. Significant differences ($P < 0.01$) were observed among the inbred lines of strain I in all the traits and only in heday rate and total egg mass for those in strain II. The pure white (PW) and pure black (PBL) pullet groups were superior to their counterparts in strains I and II for most of the traits. The two replicate groups of the native chicken did not differ ($P > 0.05$) in these traits. The short term

Table 1: Comparison of percentage heterosis expected under various mating schemes for the dominance and parental epistasis models with complementary loci (Sheridan, 1981)*

Mating Schemes	Dominance hypothesis,	Parental epistasis	
		2 loci	3 loci
Purebred	0.00	0.00	0.00
F ₁	100.00	100.00	100.00
F ₂ (or two breed synthetic)	50.00	12.50	- 15.60
Backcross	50.00	25.00	12.50
Three way cross	100.00	50.00	25.00
Four way cross	100.00	0.00	- 50.00
Rotational cross (2 breeds)	66.70	44.40	29.60
Rotational Cross (3 breeds)	85.70	40.80	21.00

* The percentage values are relative to F₁

Table 2: Mean $\pm$ s.e for egg production traits of the Inbred lines belonging to the native and two exotic chicken strains

Strains	I		II		III	
	PW	PBr	PBL	Brr	LC ₁	LC ₂
Age at first egg (days)	166.00 ^a ± 1.03	192.63 ^b ± 2.83	185.10 ^a ± 2.57	182.40 ^a ± 2.24	155.40 ^a ± 0.69	155.30 ^a ± 0.54
Hen day rate (%)	34.00 ^b ± 2.97	26.61 ^a ± 3.83	38.24 ^b ± 4.46	27.08 ^a ± 2.92	29.99 ^a ± 2.16	26.34 ^a ± 1.84
Mean egg weight (g)	49.84 ^a ± 2.05	53.22 ^b ± 2.99	52.74 ^a ± 0.46	52.30 ^a ± 2.19	38.34 ^a ± 1.99	38.53 ^a ± 0.54
Total egg mass, weekly (kg)	0.12 ^b ± 0.01	0.10 ^a ± 0.02	0.14 ^b ± 0.02	0.10 ^a ± 0.01	0.08 ^a ± 0.01	0.07 ^a ± 0.01
No of hens providing data sets	46	48	40	44	82	84

For each trait and within each strain, means superscripted with different letters are significantly different ($P < 0.01$)

Note PW: Pure White
 PBr: Pure brown
 PBL: Pure black
 Brr: Barred
 LC₁ and LC₂: Native chicken

egg production performance of the F_1 crossbred and the backcross groups are presented in Table 3 and 4 respectively. Age at first egg were longer in the crossbred groups when compared with their parental averages (Table 3). The only exception being the $LC_2 \times PBL$ whose age at first egg (163.20 days) was closer to the native (155.30 days) than the pure black (185.10 days). The age at first egg of the backcrosses were similar to the F_1 mean values in most of the groups (Table 4). For mean egg weight, the $LC_2 \times Brr$ (with average of 48.73g) was the most superior, followed by the $Brr \times LC_2$ (46.90g). The least were the $PW \times LC_1$ and $PBL \times LC_2$ with mean eggweight of 42.85g and 42.61g respectively. The $Brr \times LC_2$ was the most superior in hen day rate and total egg mass respectively. The rest of the groups were not significantly different ($P > 0.05$) from one another in both traits. Highly significant ($P < 0.01$) differences were observed among the backcross groups in the egg production traits recorded (Table 4). The main backcross groups (MBX_1 , MBX_2 , MBX_3 and MBX_4) were superior to the reciprocal backcrosses (RBX_1 , RBX_2 , RBX_3 and RBX_4) in egg weight and total egg mass respectively probably because the main backcross groups had higher component of the exotic genes (75% of the exotic genes) which were improved in egg production traits compared to the reciprocal backcrosses which had only 25% of the exotic genes. The most superior group in hen day rate was the MBX_3 (45.77%) where as the least were the RBX_3 (33.35%) and RBX_4 (33.70%).

Tables 5 and 6 present the heterosis for egg production of the F_1 crossbred and the backcross groups respectively. The short term mean heterotic performance of the F_1 crosses indicate that all the crossbred groups recorded highly significant ($P < 0.01$) effect on hen day rate and total egg mass respectively (Table 5). The results

indicate that the highest heterosis in hen day rate was obtained by the $Brr \times LC_2$ (141.60%), followed by its reciprocal crossbred group ($LC_2 \times Brr$: 83.11%). The heterosis obtained by the F_1 crossbred groups on total egg mass followed the pattern of hen day rate with which it is correlated. The F_1 crossbred groups recorded heterosis in egg weight which were mostly negative and non significant except the $Brr \times LC_2$ which recorded positive and significant heterosis in this trait. The negative heterosis implies that the crossbred performance was less than the mid parent average in egg weight. A similar trend was observed for backcross heterosis in egg weight (Table 6). The heterosis exhibited by the backcross groups in henday rate and total egg mass were highly significant in most of the groups (Table 6). The main backcrosses recorded higher heterosis in both traits compared with the reciprocals. The only exception being the RBX_2 which recorded heterosis comparable with the main backcrosses.

Table 7 is a summary of the backcross heterosis in egg production traits expressed as a percentage of the F_1 and tabulated to ascertain the mode of gene action responsible for heterosis.

Discussion

The significant differences observed among the inbred lines of each exotic strain in some of these traits (Table 2) categorized them as distinct groups, each which will contribute to the improvement of the native chicken. Among the F_1 crossbred groups, significant differences ($P < 0.01$) were observed in all the traits measured. The data obtained by the crossbred groups indicate that while sire influenced the age at first egg of $LC_2 \times PBL$, non additive genetic effects were responsible for the inheritance of the trait in the other crossbred groups. Adenowo *et al* (1995) had earlier observed that sire influence

Table 3: Mean and standard error for short term egg production traits of the f_1 crossbred groups.

Traits	Crossbred groups							
	PW X LC ₁	LC ₁ X PW	PB ₁ X LC ₁	LC ₁ X PB ₁	PBL X LC ₂	LC ₂ X PBL	Brr X LC ₂	LC ₂ X Brr
Age at first egg (days)	170.10 ^{ab} (1.72)	171.70 ^b (1.37)	199.50 ^d (1.19)	196.20 ^d (1.41)	187.60 ^c (1.41)	163.20 ^a (0.81)	182.10 ^c (2.43)	197.90 ^d (4.05)
Hen day average (%)	50.09 ^a (4.03)	49.11 ^a (4.09)	42.67 ^a (2.17)	50.80 ^a (1.43)	42.95 ^a (3.57)	52.32 ^a (2.41)	64.53 ^b (2.33)	48.91 ^a (2.06)
Mean egg weight (g)	42.85 ^a (0.81)	44.70 ^{ab} (0.89)	44.56 ^{ab} (0.66)	44.18 ^{ab} (0.43)	42.61 ^a (1.01)	45.28 ^{ab} (0.68)	46.90 ^{bc} (0.58)	48.73 ^c (0.63)
Total egg mass weekly (kg)	0.15 ^a (0.01)	0.14 ^a (0.01)	0.13 ^a (0.01)	0.16 ^a (0.01)	0.14 ^a (0.01)	0.15 ^a (0.01)	0.22 ^b (0.01)	0.16 ^a (0.01)
No of hens providing datasets	44	36	40	48	46	40	48	36

For each trait, mean values with different superscript letters are significantly different ($P < 0.01$)

Note: Standard errors are in parentheses.

Table 3: Mean and standard error for short term egg production traits of the F_1 crossbred groups.

Traits	Crossbred groups							
	PW X LC ₁	LC ₁ X PW	PB x LC ₁	LC ₁ X PB ₁	PBL X LC ₂	LC ₁ X PBL	Br x LC ₂	LC ₁ X Br
Age at first egg (days)	170.10 ^{ab} (1.72)	171.70 ^b (1.37)	199.50 ^d (1.19)	196.20 ^d (1.41)	187.60 ^c (1.41)	163.20 ^a (0.81)	182.10 ^c (2.43)	197.90 ^d (4.05)
Hen day average (%)	50.09 ^a (4.03)	49.11 ^a (4.09)	42.67 ^a (2.17)	50.80 ^a (1.43)	42.95 ^a (3.57)	52.32 ^a (2.41)	44.53 ^a (2.33)	48.91 ^a (2.06)
Mean egg weight (g)	42.85 ^a (0.81)	44.70 ^{ab} (0.89)	44.56 ^{ab} (0.66)	44.18 ^{ab} (0.43)	42.61 ^a (1.01)	45.28 ^{ab} (0.60)	46.90 ^{ac} (0.58)	48.73 ^a (0.63)
Total egg mass, weekly (kg)	0.15 ^a (0.01)	0.14 ^a (0.01)	0.13 ^a (0.01)	0.16 ^a (0.01)	0.14 ^a (0.01)	0.15 ^a (0.01)	0.22 ^b (0.01)	0.16 ^a (0.01)
No of hens providing data sets	44	36	40	48	46	40	48	36

For each trait, mean values with different superscript letters are significantly different ($P < 0.01$)
 Note: Standard errors are in parentheses.

Table 4. Short-term egg production characteristics of the backcross progeny groups

Traits	Backcross groups							
	MBX ₁	MBX ₂	MBX ₃	MBX ₄	RBX ₁	RBX ₂	RBX ₃	RBX ₄
Age at first egg (days)	169.61 ^b (0.92)	188.00 ^d (1.91)	158.78 ^a (1.28)	192.50 ^d (2.09)	159.44 ^c (0.81)	169.94 ^b (1.26)	170.83 ^b (1.60)	185.50 ^c (1.10)
Hen day rate (%)	40.33 ^{ab} (2.18)	38.13 ^{ab} (0.77)	45.17 ^b (1.68)	38.35 ^{ab} (2.54)	38.49 ^{ab} (1.44)	37.50 ^{ab} (2.76)	33.35 ^a (1.86)	33.70 ^a (1.13)
Mean egg weight (g)	45.67 ^c (0.53)	46.97 ^d (0.43)	45.60 ^{bc} (0.62)	45.66 ^c (0.54)	40.59 ^a (0.47)	44.68 ^b (0.45)	40.25 ^a (0.40)	40.08 ^a (0.38)
Total egg mass, weekly (kg)	0.13 ^b (0.007)	0.13 ^b (0.004)	0.15 ^b (0.008)	0.13 ^b (0.01)	0.11 ^a (0.006)	0.12 ^{ab} (0.01)	0.09 ^a (0.007)	0.10 ^a (0.004)
No of hens providing data sets	38	40	40	42	42	40	50	42

Mean values along the same row with different superscript are significantly different ($P < 0.01$)

Note: Standard errors are in parentheses.

MBX₁: PW x (LC₁ x PW)
 MBX₂: Br x (LC₂ x Br)
 MBX₃: PBL x (LC₃ x PBL)
 MBX₄: PBr x (LC₄ x PBr)
 RBX₁: LC₁ x (PW x LC)
 RBX₂: LC₂ x (Br x LC)

RBX₃: LC₃ x (PBL x LC)
 RBX₄: LC₄ x (PBr x LC)

Table 5: Heterosis of egg production traits among the F_1 crossbred groups (%)

Traits	PWxLC ₁	LC ₁ x PW	PBBr x LC ₁	LC ₁ x PBBr	PBLxLC ₂	LC ₂ x PBL	BrxLC ₂	LC ₂ x Br
Hen day rate of Lay	56.56** (5.11)	52.88** (4.47)	50.78** (2.83)	79.51** (2.98)	32.98** (2.27)	62.02** (2.83)	141.63** (2.39)	83.11** (2.54)
Mean egg weight	1.86 ^{NS} (1.17)	-2.34 ^{NS} (0.97)	-2.42 ^{NS} (1.20)	-1.96 ^{NS} (1.38)	-0.71 ^{NS} (0.82)	-6.94** (0.92)	7.30** (0.92)	3.52 ^{NS} (0.56)
Total egg mass	76.56** (23.42)	65.54** (21.59)	78.95** (19.51)	134.54** (34.85)	38.05** (13.43)	69.57** (17.59)	205.60** (31.05)	126.21** (25.29)

NB: Standard errors are in parentheses.
 ** P < 0.01.
 NS: Not significant (P > 0.05).

Table 6: Mean and standard error for heterosis in egg production traits of the backcross progeny groups I

Traits	Back cross groups							
	MBX ₁	MBX ₂	MBX ₃	MBX ₄	RBX ₁	RBX ₂	RBX ₃	RBX ₄
Hen day rate of lay	9.09** (2.67)	11.22** (2.18)	10.08** (2.49)	11.35** (1.39)	7.50** (1.56)	10.97** (1.44)	4.07** (0.77)	4.56* (1.81)
Mean egg weight	-0.67 ^{NS} (0.96)	0.20 ^{NS} (0.63)	-2.78** (0.87)	-1.37 ^{NS} (1.02)	0.27 ^{NS} (0.63)	1.44** (0.28)	-1.05 ^{NS} (0.48)	-0.65 ^{NS} (0.60)
Total egg mass	0.02 ^{NS} (0.01)	0.04** (0.01)	0.03** (0.01)	0.03** (0.004)	0.02** (0.01)	0.04** (0.003)	0.01** (0.003)	0.01* (0.004)

NB: Standard errors are in parentheses

* P<0.05

** P<0.01

NS: Not significant (P>0.05).

1 Measured in actual deviation from the average additive merit (EBX) expected of each back cross.

Table 7: Summary of the backcross heterosis in egg production traits expressed as percent of the F_1 to ascertain modes of gene action I

Mating scheme (Type of cross)	Henday rate of lay			Egg weight			Total egg mass		
	Complete dominance	Parental 2loci	epistasis 3loci	Complete dominance	Parental 2loci	epistasis 3loci	Complete dominance	Parental 2loci	epistasis 3loci
F_1 crosses	100	100	100	100	100	100	100	100	100
Back crosses									
MBX_1	53.72			53.60			50.00		
MBX_2	50.55					13.33		44.38	
MBX_3	50.32			90.06			49.50		
MBX_4	50.39			80.38				46.70	
RBX_1		44.41		42.86				38.80	
RBX_2		29.00		44.68				30.80	
RBX_3		38.17		-90.44					16.46
RBX_4		31.70		42.76					23.91

I After Sheridan (1981)

as well as additive effects were important in the inheritance of age at first egg in crossbred chicken. On hen day average and total egg mass, the Brr x LC₂ main cross was the most superior compared with other groups. Similarly the LC₂ x Brr reciprocal crossbred group produced the heaviest eggs. The superiority of these reciprocal crossbred groups to others may be linked to the Barred (Brr) segregate group which favoured the traits for egg production. The superior performance of the main backcross groups over the reciprocals in egg production may be as a result of the acquisition of additional loci valid for egg production by the dominant genes from the exotic parents while the reciprocal crosses with additional loci predominated by 'null genes' (i.e genes of no significant effect) inherited from the native sires were made inferior in egg production. The highly significant heterosis recorded by the F₁ crossbred groups in henday rate is consistent with the reports of Flock *et al* (1991) and Groen *et al* (1998) that heterosis for egg number is high. This indicates that significant improvement in this trait would be achieved by the reciprocal mating of the native and exotic chicken. In earlier studies, Nwosu and Omeje (1985) reported positive and significant heterosis in a cross between the exotic cocks and the native hens but not in the reciprocal crossbred. The researchers inferred that crossing the exotic cocks with the native hens would yield rapid improvement especially when the crossbreds are housed in cages. The F₁ crossbred groups differed in their heterotic performance on egg production traits which was mainly due to the nature and the degree of gene frequency differences between the parental lines since heterosis is directly proportional to heterozygosity (Falconer, 1989). The PW x LC₁ and Brr x LC₂ crossbred groups exhibited higher heterosis for egg production traits compared with their reciprocal crosses (LC₁ x PW and LC₂ x Brr) suggesting that the barred (Brr) and pure

white (PW) segregate groups may contain sex linked genes for higher rate of lay. On the other hand, the LC₁ x PBr and LC₂ x PBL reciprocal cross groups recorded higher heterosis than their main cross counterparts (PBr x LC₁ and PBL x LC₂) implying that maternal influence was more important than sex linkage effect in the inheritance of rate of lay in these groups. The presence of these reciprocal cross differences will be useful in making decision either to use the sire or dam of the superior strain in the improvement of rate of lay in the native chicken. The relatively low heterosis for egg weight traits could suggest that the egg weight of the base flocks used were mostly governed by additive and residual gene effects. This is consistent with the reports of Fairfull and Gowe (1986), Fairfull (1990) and Groen *et al* (1998) that heterosis for egg weight was low and ranged from 0 to 5%. The results in Table 7 indicate that most of the main backcross groups retained about 50% of the F₁ heterosis in hen day average, egg weight and total egg mass. On the other hand, the reciprocal backcross groups retained less than 50% of the F₁ heterosis in these traits. This means that egg production heterosis of the main and reciprocal backcross groups were influenced by complete dominance of allelic genes and parental epistasis involving complementary genes. This is in agreement with the reports of Sheridan (1986), Fairfull and Gavora (1993) and Groen *et al* (1998) that heterosis for egg production was substantial and mostly influenced by dominance and epistatic gene effects.

Conclusion

From this preliminary report we conclude as follows:

1. That substantial heterosis for hen day rate and total egg mass was observed in the crosses between the native and exotic

chicken which was more in some groups (especially the Brr x LC₂ and LC₂ x Brr) compared to others.

2. That heterosis for eggweight was low and mostly non significant.
3. That the heterosis recorded in the backcross groups were residual and higher in the main than the reciprocal back cross groups.
4. That egg production performance in the native by exotic crosses were influenced by maternal, sex linked, dominance and epistatic gene effects.

Based on these results, we recommend as follows

1. It may be necessary to expand the scope of the research by involving at least four ecotypes of the native chicken and equivalent number of exotic strains.
2. The F₁ and backcrosses of these groups should be evaluated for growth rate and egg production traits. Those groups with higher heterotic potential should be selected to contribute to the next generation.
3. The selected native and exotic backcross groups should be intercrossed to generate intercross progenies which should as well be evaluated on performance traits before criss crossing the groups.

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