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Full Length Research Paper

Effect of feathering genes and mating pattern on short term egg production and egg quality traits of upgraded native chickens

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Abstract

The objectives of the study were (1) to evaluate effect of feathering genes and mating pattern on short term egg production, external and internal egg quality traits and laying mortality of F_2 main and reciprocal backcross progenies of Abor Acre broiler breeder (E) x Native normal feather (NF), naked neck (Na), and frizzle (F) chicken crosses, and (2) to compare the performance of these F_2 hybrids with their F_1 main and reciprocal crosses. The parental stock utilized consisted of mature normal feather, naked neck and frizzle native males and females and males and females of Abor Acre broiler breeder stock. The native chickens were mated to the broiler breeder cock using artificial insemination technique to generate the F_1 progenies. After assessment of short term egg production and egg quality traits, all surviving main and reciprocal F_1 hybrid layers namely, ExNF, ExNa, ExF and NFxE, NaxE, FxE, respectively were backcrossed to the broiler breeder cocks to produce F_2 main [Ex(ExNF), Ex(ExNa), Ex(ExF)] and reciprocal[(Ex(NFxE), Ex(NaxE), (ExFxE)] backcross progenies. Parameters evaluated included short term (90 days) egg production (EN_{90}), body weight at first egg (BWFE), weight of first egg (WFE), age at first egg (AFE), laying mortality, and various egg quality traits. Results showed that the reciprocal backcross individuals had higher BWFE, EN_{90}, Haugh unit and higher weight of yolk and albumin but lower AFE, than their main backcross counterparts. The F_2 main and reciprocal backcrosses surpassed their corresponding F_1 main and reciprocal crossbred groups in BWFE and EN_{90} but had lower AFE and laying mortality. No significant differences were observed between groups in WFE, EWT_{90}, shell thickness, yolk index and Haugh unit. It was concluded that reciprocal backcrossed individuals outperformed their main backcrossed counterparts in most of the measured parameters while the F_2 individuals generally surpassed the F_1 hybrids in most of the parameters except for AFE and laying mortality.

Keywords: Feathering genes, native chickens, backcrossing, egg traits, laying mortality.

INTRODUCTION

Tropical native chickens exhibit variations in feathering broadly classified as normal, naked neck and frizzle feathers (Adebamboet al., 2011). The origin of these local chicken varieties is not well known but their restructured plumages are believed to be adaptive features influenced by some plumage modifier genes (Nwachukwuet al., 2006; Adebamboet al., 2011). These modifier genes are plumage reducing in nature and are

Table 1: Mating scheme for generation of F_2 backcross progenies

Mating groups	Genotypes	Exotic blood (%)
Main backcross		
Exotic broiler breeder (E) x F_1 Exotic x Normal feather (NF) hen	Ex(ExNF)	75
Exotic broiler breeder (E) x F_1 Exotic x Naked neck (Na) hen	Ex(ExNa)	75
Exotic broiler breeder (E) x F_1 Exotic x Frizzle (F) hen.	Ex(ExF)	75
Reciprocal backcross		
Exotic broiler breeder (E) x F_1 Normal feather (NF) x Exotic hen	Ex(NFxE)	75
Exotic broiler breeder (E) x F_1 Naked neck (Na) x Exotic hen	Ex(NaxE)	75
Exotic broiler breeder (E) x F_1 Frizzle (F) x Exotic hen.	Ex(FxE)	75

propagated naturally in native chicken populations in which they usually occur at low frequencies (Fayeyeet al., 2006; Warnoto and Triadi, 2009). Investigation into productive adaptability potentials of these genes is on-going and their usefulness in the mitigation of thermal stress especially in tropical poultry production system has been explored in broilers (Deep and Cahaner, 1999; Khatunet al.,2005; Islam and Nishibori, 2009) and egg-type chicken (El-Safty, 2006; El-Saftyet al*.,* 2006) birds. These genes often referred to as tropically-relevant major genes are particularly important especially in the current bid to biologically ameliorate the challenges of global warming on poultry production systems. The use of naked neck and frizzle males to improve growth rate, egg production and egg quality at ambient temperatures of 30^{o}C and above in some Asian countries and sub-tropical climates is well documented (Mathur, 2003; Cahaneret al., 2008) although with varying outcomes. For instance the performance of naked neck and frizzle chickens was better than normal feathered chickens at high temperatures (N'Driet al., 2007; Mahrouset al*.,* 2008) but there were large differences in the performance of these birds in terms of egg number, egg weight, body weight, and other productivity indices at different locations (Mathur, 2003). Evidently, sustained evaluation of the productive impact of major genes of naked neck and frizzle under different environments has been suggested by Nwachukwuet al., 2006. Additional information would include not only the performance of F_1 hybrids of these genotypes but also upgraded main and reciprocal F_2 backcross hybrids which provide useful information on vigour or otherwise in different genotype combinations. It was against this background that the present study was designed to evaluate the egg production, egg quality and laying mortality of F_2 main and reciprocal backcross populations of Abor Acre broiler breeder mated to native normal feather, naked neck, and frizzle chickens and to further compare their performances to those of F_1 main and reciprocal crossbred populations.

MATERIALS AND METHODS

The study was conducted at the Poultry Unit of College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State. The Umudike town is located in the rainforest zone of South East, Nigeria. It has a rainfall pattern that is bimodal depicting early and late rains. Annual rainfall ranges from1700-2100mm with ambient temperature range of 26C to 36C during the hot dry season (November-April) and minimum ambient temperature range of 18C to 25C during the cold rainy season (May-September). The production environment is well known to be hot–humid tropical environment.

Foundation stock and management of F_1 crossbred birds: The foundation stock (base population) utilized in the study were mature males and females of normal feather, naked neck and frizzle local chickens selected from a population of local chickens maintained at the Teaching and Research Farm of the college and males and females of Abor Acre broiler breeder parent stock procured from a reputable hatchery in Owerri in Imo state. These birds were mated to generate F_1 main and reciprocal crossbred populations. These birds were managed and evaluated for growth parameters, egg production, egg quality, rearing and laying mortality as reported by Nwachukwuet al*.* (2006).

Generation and management of F_2 main and reciprocal backcross groups: At the end of the short term egg production period (40 weeks of age), all surviving and healthy F_1 main and reciprocal hybrid hens were mated back to the Abor Acre broiler cock to generate F_2 main and reciprocal backcross groups used in the present study. The mating scheme adopted is shown in Table 1.

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Table 2: Egg production characteristics of F_2 backcrosses of Abor Acre broiler breeder x native chicken crosses

	F_2 main backcross			F_2 reciprocal backcross		
Parameter	**Ex(ExNF)**	**Ex(ExNa)**	**Ex(ExF)**	**Ex(NFxE)**	**Ex(NaxE)**	**Ex(FxE)**
BWFE (g)	1521.25±86.42^{bc}	1325.00±43.30^{c}	1067.50±26.10^{d}	2410.36±78.93^{a}	1766.67±91.03^{b}	2433.33±88.19^{a}
WFE (g)	27.33 ± 0.71^{c}	33.17 ± 1.35^{b}	28.67 ± 0.56^{c}	30.92 ± 0.52^{bc}	41.67 ± 0.84^{a}	32.33 ± 0.95^{b}
EWT_{90} (g)	30.12 ± 0.50^{d}	35.91 ± 3.30^{c}	36.79 ± 0.42^{c}	43.39 ± 0.64^{b}	47.31 ± 0.73^{a}	48.86 ± 0.38^{a}
AFE (day)	141.33 ± 8.45^{a}	147.00 ±1.73^{a}	144.00 ± 0.56^{a}	135.00 ± 0.52^{b}	146.00 ± 0.84^{a}	133.33 ± 0.95^{b}
EN_{90} (no.)	40.67 ± 1.45^{d}	44.33 ± 1.20^{cd}	41.60 ± 1.21^{d}	51.14 ± 1.63^{b}	53.00 ± 1.15^{ab}	59.10 ± 3.21^{a}
Mortality(%)	0.57 ± 0.00^{b}	5.28 ± 4.71^{a}	0.57 ± 0.00^{b}	0.57 ± 0.00^{b}	7.73 ± 4.13^{a}	0.57 ± 0.00^{b}

[a, b, c, d] Means on the same row with different superscripts are significantly different ($P < 0.05$); BWFE: body weight at first egg; WFE: weight of first egg; EWT_{90}: egg weight at 90 days of lay; AFE: age at first egg; EN_{90}: egg production to 90 days of lay.

Artificial insemination was adopted to overcome the limitation of disproportionate body size of the F_1 hybrid females and the exotic broiler breeder cocks. After a 2 week pre-trial period for assessment of fertility, hatching eggs were thereafter collected twice daily and incubated in a locally made incubator to hatch. A total of 360 chicks (60/genetic group) were produced in three weekly hatches. The chicks were identified according to their genetic group, brooded and reared in batches in deep litter pens. They were fed a commercial starter mash containing 23 % CP, 2875 Kcal ME/kg *ad libitum* during the brooding phase (0-6 wk of age) and a grower mash (16 % CP, 2675 Kcal ME/kg) during the growing phase (7-18 wk). At point of lay (≥ 18 wk), the birds were fed layers mash (20 % CP, 2750 Kcal ME/kg). Water was provided *ad libitum* to the birds. Health management followed the routine vaccination schedules and prophylaxis against endemic bacterial and parasitic diseases in the study area. Birds were on deep litter in flock sizes of 10 per pen.

Parameters measured: These included body weight at first egg (BWFE) which was calculated as the average flock weight when the first egg was laid in each group; short term (90 days) egg production (EN_{90}) as number of eggs laid by a genetic group from the day of first egg to 90 days. Average egg weight (EWT_{90}) as average weight of all eggs laid by a genetic group from first to last eggs on day 90, average age of first egg (AFE) as age of birds at first egg (sexual maturity), average weight of first eggs (WFE) for each genetic group, and egg quality parameters namely shell thickness (measured with Ames micrometer screw gauge), yolk weight, albumen weight, yolk index (ratio of yolk height to yolk width) and Haugh unit (calculated from albumen height and egg weight using an interior egg quality calculator-USDA chart for scoring broken-out egg).

Data Analysis: Data collected were subjected to analysis of variance in Completely Randomized Block Design. Genetic group was major factor of interest while hatches were the blocking factor. Significantly different means were detected using Duncan's New Multiple Range Test (Steel and Torrie, 1980). Correlations between pairs of measured variables were determined by means of Pearson Correlation Analysis.

RESULTS AND DISCUSSION

The egg production characteristics of F_2 main and reciprocal backcross groups are shown in Table 2. The reciprocal backcross individuals namely Ex(FxE), Ex(NFxE), and Ex(NaxE) with BWFE of 2433.33 ± 88.19g, 2410.36 ± 78.93g and 1766.67 ± 91.03 g, respectively were heavier than their main backcross counterparts namely Ex(ExNF), Ex(ExNa) and Ex(ExF) with BWFE of 1521.25 ± 86.42g, 1325.00 ± 43.30g and 1067.50 ± 26.10g, respectively . This observation indicated that the influence of the exotic broiler grandparent dam on reciprocal backcross individuals persisted and was more pronounced than the effect of the exotic broiler grandsire in the main backcross individuals with had local chicken dam.

This result also indicated that reciprocal backcrossing was a preferred mating scheme to achieve rapid growth and body development leading to production of heavier meat type or dual purpose hybrid birds while main backcrossing resulted in the development of light bodied or egg type chickens. The wide difference in BWFE between main and reciprocal backcross individuals was fascinating given that both crosses were derived from the exotic broiler breeder sire and they had equal proportion of the exotic broiler blood of 75 %. This phenomenon seem to corroborate evidence of parent – of – origin effects in which breeding groups tend to maintain the body weight of their grand dam similar to the findings of Tuiskula-Haavistoet al. (2002; 2004). However, the advantage of small body size (as seen in the main backcross groups) in poultry breeding has been explored in both meat and egg-type chicken by incorporating the dwarfing gene (dw) found in local chicken population into the germplasm of new strains of chicken to reduce maintenance requirements and increase their feed efficiency (Haaven-Krisoet al., 1995). Also, it is a known practice in practical animal breeding to utilize complementarities between improved sire and dam lines by crossbreeding to improve desired traits in farm animals and poultry (Fairfull and Gowe,1990; Rosso, et al., 2005). The values of BWFE obtained in this study for the main backcross pullets were on the average similar to those reported for purebred Lohman Brown and Olympia Black exotic pullets by Udeh (2010) while values for the reciprocal backcross individuals were generally higher and tended to body weight of heavy type chicken.

Age at first egg (AFE) was significantly lower in the reciprocal backcross groups (138.11 days) compared to the main backcross groups (144.11 days on the average). Within the main backcross groups, AFE did not differ statistically unlike the situation among the reciprocal backcross individuals where pullets of Ex(NFxE) and Ex(FxE) with the heaviest BWFE had the lowest AFE of 135.00 ± 0.52 and 133.33 ± 0.95 days, respectively. Age at sexual maturity in poultry is usually influenced by the rate of growth. Thus between and within genotypes, fast growing birds attain sexual maturity earlier than slow growing ones. This explains why efforts are made to avoid precoecious growth of pullets and the small sized eggs that results and tend to persist (Omejeet al.,1987;Fairfull and Gowe, 1990). It was obvious that combined exotic sire and dam effects in the reciprocal crossbred groups enhanced their growth performance more than the double exotic sire effects in the main backcross groups. This showed that the dam line is very important in practical poultry breeding as reported by Nwachukwuet al.,(2006)

Table 2 showed also that weight of first eggs (WFE) from the heaviest birds at sexual maturity (Ex(NFxE) and Ex(FxE) belonging to the reciprocal backcross group were among the least in weight (30.92 ± 0.52 and 32.33 ± 0.95g, respectively). The same trend was observed for average egg weight at 90 days (EWT_{90}) in the main backcross groups where pullets of Ex(ExNF) with highest BWFE of 1521.25±86.42g had the least EWT_{90} of 30.12 ± 0.50 g. These variable relationships between BWFE and WFE tend to confirm that progenies of the broiler breeder chicken and the native fowl need be selected and developed for egg production characteristics. It was evident that main backcross groups generally had lower EWT_{90} compared to their reciprocal backcross counterparts. This observation is consistent with the report of Duplessis and Erasmus (1972) that within the same level of management, bigger birds normally laid larger eggs than those with smaller body weight.

Some positive influence of the major genes of Na and F on egg production characteristics of these crossbred birds were observed in Table 2. Generally, effects of Na and F genes on performance characteristics are known to be more pronounced under sub-optimal environmental conditions such as under thermal stress (Rauenet al., 1986; Mathurs, 2003; Mahrouset al., 2008). The frizzle (ExFxE) and naked neck (ExNaxE) individuals in the reciprocal backcross groups outperformed their normal feathered counterparts in that group and in the main backcross groups in EWT_{90} and EN_{90}. The ExFxE individuals had outstanding performance of all the genotypes considering their highest average BWFE (2433.33±88.19g), largest EWT_{90} (48.86 ± 0.38 g) and highest EN_{90} (59.10 ± 3.21g). This genotype holds some promise as possible candidates for meat-type or dual purpose chicken in humid tropical environment.

The F_2 main backcross pullets significantly surpassed their F_1 main cross counterparts in BWFE and EN_{90} but were lower in AFE while no statistical differences existed between them in WFE and EWT_{90} (Table 3).

The higher BWFE of main backcross groups were as result of increased exotic blood to 75 % in the F_2 individuals compared to 50 % in the F_1 genotypes. This increase in genetic profile of the F_2 individuals also resulted in early attainment to sexual maturity hence the lower average AFE of 146 days as against 178 days in the F_1 main cross individuals. This trend also, was observed in the F_2 main backcross group for $EN_{90.}$ Mortality was generally low in the F_2 main backcross group with the naked neck genotypes [(ExNa and Ex(ExNa)] in both crosses recording the highest mortality. The improved liveability of F_2main backcross individuals showed evidence of stability of the combining genes in these hybrids. However, observed mortality in naked neck individuals still confirm survivability issue associated with raising this genotype (Horst, 1989; Peters et al, 2004).

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Table 3: Egg production performance of F_1 main cross and F_2 main backcross progenies of Abor Acre broiler breeder x native chicken genotypes

	F_1 main cross			F_2 main backcross		
Parameter	ExNF	ExNa	ExF	Ex(ExNF)	Ex(ExNa)	Ex(ExF)
BWFE (g)	960.00±29.15^{de}	812.50±55.43^{e}	1030.91±39.98^{cd}	1521.25±86.42^{a}	1325.00±43.30^{b}	1067.50±26.10^{c}
WFE (g)	26.44 ± 0.53	27.50 ± 1.50	28.13 ± 0.71	27.33 ± 0.71	33.17 ± 1.35	28.67 ± 0.56
EWT_{90} (g)	36.27 ± 0.86	38.13 ± 1.05	35.33 ± 0.94	30.12 ± 0.50	35.91 ± 3.30	36.79 ± 0.42
AFE (day)	178.00 ± 2.30^{b}	162.00 ± 8.82^{b}	186.18 ± 2.02^{a}	141.33 ± 8.45^{c}	147.00 ±1.73^{c}	144.00 ± 0.56^{c}
EN_{90} (no.)	25.40 ± 1.10^{d}	29.95 ± 0.55^{c}	31.50 ± 3.50^{c}	40.67 ± 1.45^{b}	44.33 ± 1.20^{a}	41.60 ± 1.21^{ab}
Mortality(%)	0.59 ± 0.01^{c}	28.79 ± 2.82^{a}	0.58 ± 0.00^{c}	0.56 ± 0.00^{c}	5.28 ± 4.71^{b}	0.57 ± 0.00^{c}

$^{a, b, c, d, e}$ Means on the same row with different superscripts are significantly different ($P < 0.05$).

Table 4: Egg production performance of F_1 Reciprocal backcross and F_2 Reciprocal backcross progenies of Abor Acre broiler breeder x native chicken genotypes

	F_1 Reciprocal cross			**F_2 Reciprocal backcross**		
Parameter	**NFxE**	**NaxE**	**FxE**	**Ex(NFxE)**	**Ex(NaxE)**	**Ex(FxE)**
BWFE (g)	1891.61±76.60^{c}	1576.67±43.33^{d}	2072.50±49.56^{b}	2410.36±78.93^{a}	1766.67±91.00^{c}	2433.33±88.19^{a}
WFE (g)	32.10 ± 0.27^{b}	34.33 ± 1.73^{b}	33.88 ± 0.50^{b}	30.92 ± 0.52^{b}	41.67 ± 0.84^{a}	32.33 ± 0.95^{b}
EWT_{90} (g)	41.89 ± 0.88^{b}	42.54 ± 2.67^{b}	44.52 ± 1.39^{b}	43.39 ± 0.64^{b}	47.31 ± 0.73^{a}	48.86 ± 0.38^{a}
AFE (day)	158.33 ± 1.26^{b}	157.00 ± 1.73^{b}	182.75 ± 2.21^{a}	135.00 ± 0.52^{d}	146.00 ± 0.84^{c}	133.33 ± 0.95^{d}
EN_{90} (no.)	39.15 ± 2.78^{c}	41.75 ± 1.32^{c}	32.83 ± 0.91^{d}	59.14 ± 1.63^{a}	51.00 ± 1.15^{b}	53.00 ± 3.21^{ab}
Mortality(%)	0.57 ± 0.00^{b}	4.97 ± 0.37^{a}	0.57 ± 0.00^{b}	0.57 ± 0.00^{b}	7.73 ± 4.13^{a}	0.57 ± 0.00^{b}

$^{a, b, c, d}$Means on the same row with different superscripts are significantly different ($P < 0.05$).

The comparative egg production performance of F_1 reciprocal and F_2 reciprocal backcross pullets are shown in Table 4. There was significantly higher BWFE, EWT_{90}, EN_{90} and lower AFE for F_2 reciprocal backcross birds. The superior BWFE and some egg production traits of the reciprocal backcross group was due to increased exotic genes received by this group compared to the F_1 reciprocal crossbred genotypes. Considering the values of BWFE, EN_{90}, EWT_{90} and AFE, the reciprocal backcross individuals appeared to be heavy type birds and would be suitable as broiler breeder or dual purpose birds. Improved performance of F_2 reciprocal backcross chickens over F_1 individuals have been reported by other workers (Leduret al., 2002; Udeh and Omeje, 2005) involved in upgrading productivity of both improved and local chickens.

Table 5presents egg quality characteristics of F_2 main and reciprocal backcross groups. Shell thickness and yolk index did not differ significantly within and between backcross groups and ranged from 0.29 l ± 0.02 to 0.35 ± 0.03 for shell thickness and 0.51 ± 0.02 to 0.54 ± 0.03 for yolk index. On the other hand, yolk weight, albumen weight and Haugh unit were generally higher in the reciprocal backcross groups compared to their main backcross counterparts. For instance, yolk weight ranged from 12.00 ± 0.17 to 12.27 ± 0.05 g in reciprocal backcross groups but from 7.48 ± 0.04 to 11.62 ± 0.17 g in main backcross groups while Haugh unit ranged from 103.56 ± 0.57 to 106.95 ± 0.29 and 97.89 ± 2.90 to 102.75 ± 0.63 in the two groups, respectively.

These results showed that the reciprocal backcross individuals produced on the average higher values and as such better egg quality indices than their main backcross counterparts. Egg quality is a maternal attribute of fitness in chickens and it is influenced by the maternal genotype as well as the environment

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Table 5: Egg quality characteristics of F_2 backcross populations of Abor Acre broiler breeder x native chicken crosses

	F_2 main backcross			F_2 reciprocal backcross		
Parameter	**Ex(ExNF)**	**Ex(ExNa)**	**Ex(ExF)**	**Ex(NFxE)**	**Ex(NaxE)**	**Ex(FxE)**
ST (mm)	0.29 ± 0.02	0.33 ± 0.06	0.34 ± 0.04	0.34 ± 0.03	0.34 ± 0.03	0.35 ± 0.03
YWT (g)	7.48 ± 0.04^{d}	11.07 ± 0.40^{c}	11.62 ± 0.17^{bc}	12.01 ± 0.17^{ab}	12.27 ± 0.05^{a}	12.20 ± 0.04^{a}
YI	0.51 ± 0.02	0.54 ± 0.01	0.53 ± 0.04	0.52 ± 0.04	0.54 ± 0.01	0.54 ± 0.03
AWT (g)	17.12 ± 0.04^{c}	20.30 ± 0.30^{b}	19.55 ± 0.41^{b}	20.49 ± 0.38^{b}	23.49 ± 1.12^{a}	24.92 ± 0.87^{a}
HU	97.89 ± 2.90^{c}	102.75 ± 0.63^{b}	102.56 ± 0.55^{b}	103.56 ± 0.57^{b}	105.71 ± 0.68^{a}	106.95 ± 0.29^{a}

[a, b, c, d]Means on the same row with different superscripts are significantly different (P < 0.05); ST: shell thickness, YWT: yolk weight, YI: yolk index, AWT: albumen weight, HU: Haugh unit.

Table 6: Egg quality characteristics of $F_1$and F_2 reciprocal crossbred populations of Abor Acre broiler breeder x native chicken crosses

	F_1 reciprocal cross			F_2 reciprocal backcross		
Parameter	**NFxE**	**NaxE**	**FxE**	**Ex(NFxE)**	**Ex(NaxE)**	**Ex(FxE)**
ST (mm)	0.31 ± 0.04	0.34 ± 0.07	0.31 ± 0.07	0.34 ± 0.03	0.34 ± 0.03	0.35 ± 0.03
YWT (g)	10.80 ± 0.66^{b}	10.79 ± 0.79^{b}	11.90 ± 0.48^{ab}	12.01 ± 0.17^{a}	12.27 ± 0.05^{a}	12.20 ± 0.04^{a}
YI	0.53 ± 0.02	0.59 ± 0.03	0.54 ± 0.06	0.52 ± 0.04	0.54 ± 0.01	0.54 ± 0.03
AWT (g)	25.12 ± 0.70^{ab}	26.17 ± 1.85^{a}	27.22 ± 1.21^{a}	20.49 ± 0.38^{c}	23.49 ± 1.12^{b}	24.92 ± 0.87^{ab}
HU	104.94 ± 0.67	104.00 ± 0.78	106.29 ± 0.62	103.56 ± 0.57	105.71 ± 0.68	106.95 ± 0.29

[a, b, c, d] Means on the same row with different superscripts are significantly different (P < 0.05); ST: shell thickness, YWT: yolk weight, YI: yolk index, AWT: albumen weight, HU: Haugh unit.

(Leduret al., 2002; Islam and Dutta, 2010). The higher egg quality indices observed for the reciprocal backcross groups could be related to the larger eggs laid by this group compared to the main backcross counterparts (Table 2). It was obvious that the influence of exotic grand dam (parent – of – origin) as reported by Tuiskula-Haavistoet al*;* (2004) on the reciprocal backcross groups played out positively on egg quality traits of this group. The frizzle (ExFxE) and naked neck (ExNaxE) genotypes in this backcross group had significantly higher values of the egg quality parameters than their normal feather counterpart (ExNFxE). This observation seem to confirm the view of Peters et al; (2004) that these major genes confer some egg traits advantages on birds possessing them.

The egg quality characteristics of F_1 and F_2 reciprocal backcross groups were shown in Table 6. These egg quality traits in both generations did not show obvious differences in their values. However, the Haugh unit, which is the most reliable index of egg quality was numerically higher (106.29 versus 106.95) in the frizzle genotypes [FxE and Ex(FxE)], respectively.

CONCLUSION

This study revealed that the reciprocal backcrossed individuals namely (Ex(NFxE), Ex(NaxE), and (ExFxE)had higher BWFE, EN_{90}, Haugh unit and higher weight of yolk and albumin but lower AFE, than their main backcross[Ex(ExNF), Ex(ExNa) and Ex(ExF)] counterparts. These F_2main and reciprocal backcrosses surpassed their F_1 main and reciprocal crossbred counterparts in BWFE and EN_{90} but had lower AFE and laying mortality. The frizzle individuals in both generations outperformed other genotypes in most parameters measured while the naked neck groups had higher mortality of all the genotypes. It was evident also that reciprocal backcrossing was better and preferred mating pattern than main backcrossing in terms of improving egg

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production and egg quality parameters of broiler breeder x native chicken crossbred populations.

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