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Auto-sexing potential and growth performance in Rhode Island, Nigerian local chickens and their reciprocal crosses

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Abstract

This study was conducted to determine auto-sexing potential in Rhode Island, Nigerian local chicken and their reciprocal crosses. A total of 241 eggs were set in the incubator to determine the fertility, hatchability, % Hatch, % dead in shell, % dead in cell and % deformed chicks in the four genotypes (Rhode Island Red (RIR) x Rhode Island White (RIW), Rhode Island Red (RIR) x Rhode Island White (RIW), Nigerian Local Red (NLR) x Rhode Island White (RIW) and Nigerian Local Red (NLR) x Nigerian Local White (NLW). Only 94 eggs were hatched. RIRXRIW crossbred chicks had the highest percentage fertility of 88.89% followed by RIRxRIW (86.27%), NLRXRIW (77.36%) and NLRxNLW (72.31%), respectively. RIRxNLW had the highest percentage hatchability of 65.19%, followed by RIRxRIW (51.56%), NLRxNLW (51.06%) and NLRxRIW (24.39%). It was observed in the hatch-out analysis that the cross between NLRxRIW had the highest percentage of dead in shell (29.27%) followed by RIRxRIW (17.19%), NLRxNLW (17.02%) and RIRxNLW (11.36%), respectively. The highest percentage of dead in cell was recorded in NLRxRIW crossbred (43.33%), followed by NLRxNLW (31.92%), RIRxRIW (28.13%) and RIRxNLW (15.91%). The observed deformed chicks were highest in NLRxNLW (20.85%) followed by RIRxNLW (10.34%), RIRxRIW (6.06%) and NLRxNLW (0%), respectively. Also observed was the occurrence of bangers with NLRxRIW, having the highest occurrence of bangers (9.08%) and with NLRxNLW having no occurrence of bangers. The records of weekly body weight were taken on the 94 chicks and chi square analysis was used to test colour inheritance of chicks. Significant ($P<0.05$) difference was observed among genotypes in body weight of chicks at hatch and from weeks 1 to 8 weeks of age. The observed changes on body weight from 0 to 8^{th} week of age of chicks showed significant difference across the four different genetic crossed groups ($P<0.05$) and weight at the 8^{th} week showed that the cross between RIRxRIW (216.93g) had better in growth as compared to the cross between NLRxRIW (202.75g) and NLRxNLW (193.17g) which were statistically similar ($P>0.05$) and RIRxNLW (179.75g) crossbred chicks which had the lowest bodyweight at 8 weeks of age. The chi square (X^2) analysis revealed that both RIRxRIW and NLRxRIW crossbred chicks were autosexed. The study concluded that selection for plumage colour showed great potential in determining the probability of chicks being autosexed. Also, pure bred of RIRXRIW and reciprocal cross of NLRXRIW showed great potential of producing autosexed chicks, while results on the direct crosses of NLRXNLW and RIRXNLW suggest that the pattern of inheritance of plumage colour is not simple. The study recommends further investigation to further ascertain the mode of plumage colour inheritance in the Nigerian Local Chickens.

Keywords: Auto-sexing, plumage, growth performance

Introduction

Poultry production is one area of animal production with significant contribution to human food production. Poultry products provide protein of high biological value (Epstein, 1990). Nigeria is endowed with many poultry species which are indigenous to the country. They have lived, adapted and reproduced for several years in the Nigeria environment. With the ever growing population and improvement in the living standard of Nigerians, the demand for egg and other poultry products will continue to grow. In Nigeria, local Chicken production constitutes a significant portion of the chicken industry which is a major contributor of animal protein in the national diet (Ayorinde, 1986). Neither local, nor exotic chickens possess clear-cut superiority in the combination of productivity, adaptability, and resistance to local diseases which is desirable. The Nigerian Local Chicken exhibits higher fertility and hatchability under natural incubation, and better adaptation to the prevailing diseases, physical conditions and local management practices than exotic chickens. In addition, its meat is perceived to have superior gustatory qualities. It is however less productive (meat and eggs) than its exotic counterparts.

Reports have shown that the indigenous fowl possesses great potentials for genetic improvement through breeding programme such as selection and or cross breeding (Omeje and Nwosu, 1983; Nwosu *et al.,* 1985; Ikeobi *et al.*, 1996; Adebambo *et al.,* 1999; Peters, 2000; Adedeji *et al.,* 2008, Adebambo *et al.*, 2009). Cross breeding of the local stock with an exotic commercial stock could take advantage of artificial selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds (Adebambo*et al.,* 2009). Moreover, birds with better production performance can result from the combining ability of best performing exotic lines and the indigenous chicken. The constraints for improving productivity are related to breeds unsuitable for the environment and to diseases, bad management, lack of supplementary feeding and predators (Bagust, 1994). Crossbreeding of local stocks with exotic commercial stocks will take advantage of systematic scientific selection for productivity in the exotic birds and natural selection for hardiness in the indigenous birds. The economic significance is the need to evaluate the performance of hybrids reciprocal crossbred chicks. With most animals it is relatively easy to tell the sex of the new-borns. The male reproductive organs are located on the outside of the body and are relatively easy to see, even in new-borns. This is not the case with poultry. In male birds the reproductive organs are inside the body cavity. This makes sexing newly hatched chicks difficult. Hence the sex of chick at hatching came into existence as a result of specialization in the poultry industry. In modern commercial hatcheries, a variety of birds are used which allow them to know the sex of every chick from the moment it hatches. The most common way to do this involves cross breeding of birds with particular colours which result in male chicks having different colour down from the female chicks (Davies, 1999), which is known as sex-linked crossing. Sex identification is very important in poultry production; enormous benefits have resulted from the ability to sex day-old chickens, not only for hatcheries but for the poultry industry in general. The procedure has reduced the cost of rearing chickens by 50% which in turn has reduced labour and feed expenses. The advent of feather sexing has allowed the meat chicken industry (broilers) to separate males from females for a quicker turn around. However, mode of inheritance of plumage colour of our

indigenous local birds that shared marked difference from their parents has not been reported in most indigenous birds and their reciprocal crosses with the exotic birds. The inability to sex day old chicks of indigenous strains of chickens stands as a major huddle to their commercialization. Therefore, early sexing of indigenous chicken will lead to improved productivity of indigenous chicken. Hence, the research was aimed to determine sex-linked colour sexing potential in Nigerian local chicken and to determine if the chicks can be auto-sexed.

Materials and methods

Location of the study

The rearing of parent birds and hatching of eggs were carried out using the poultry facilities at the Department of Animal Production, University of Ilorin. Ilorin is located between rainforest of the Southwest and Savannah grassland of Northern Nigeria with co-ordinates of 8° 30' 0" North, 4° 33' 0" East. It lies on an altitude of 305m, 1001' above sea level, with annual rainfall, relative humidity and day temperature of 600-1200 mm, 65-80% and 33-37^0 C, respectively.

Experimental animals and management

A total of 241 eggs produced from different crosses of Rhode Island and Nigerian chickens (Table 1) were used for the determination of fertility, hatchability and analysis of un-hatched eggs. The parent birds from which eggs were obtained were kept in cages, the female birds were artificially inseminated with fresh semen and the eggs were hatched in electric incubator. A total of 94 chicks produced from the hatchability experiment were put in cages in a completely randomized design to evaluate the effect of genotype on body weight performance over a period of 8 weeks and to obtain estimates of correlation and prediction equations for bodyweight in the four chicken genotypes. The Nigerian local chicken used as parent stock was a mixed population of Yoruba and Fulani chickens. A commercial chick marsh with a calculated Crude Protein content of 21.09% (CP) and Metabolizable Energy (ME) of 2795 kcal/kg was fed to the birds for a period of 8 weeks and water was supplied *ad-libitum* to all the birds. Other management practices such as routine medication and sanitation were as recommended for chicken by NRC (1994).

Data collection

% fertility, Hachability of fertile eggs and hatchability of total eggs sets were calculated using the methods of Mauldin (2003). The breakout analysis of culled eggs wasdone by visual appraisal as described by Lourens *et al.* (2006). Body weights of birds were recorded on weekly basis for eight weeks.

Statistical analysis

Microsoft excel program was used to record all the data before preliminary statistical analysis were done. All the data collected were subjected to Analysis of Variance (ANOVA) using SPSS package (version 17.0, 2008). Chi square (X^2) analysis was used to test whether the result obtained in the colour of chicks differed from expectation.

The following statistical model was used to partition the variance components used for the analysis.

$Y_{ijk} = \mu +_I +_{ijk}$

Where;

Y_{ij}= records of *j*th chick belonging to the *i*th genotype.

μ= Common mean

i = effect of *i*th genotype

ij = Random error

Table 1: Mating plan and number of chicks produced from different crosses of Rhode Island and Nigerian local chickens

Sire	Dam	Number of eggs	Chicks
RIR (4)	RIW (8)	72	32
RIR (4)	NLW (8)	51	28
NLR (4)	NLW (8)	65	23
NLR (4)	RIW (8)	53	11
	Total	241	94

Number of birds in parenthesis, RIR = Rhode Island Red, RIW = Rhode Island White, NLR = Nigeria Local Red, NLW = Nigeria local White

Results

Fertility, hatchability and hatch-out analysis

The Fertility, Hatchability and Hatch-out Analysis of eggs from Rhode Island, Nigerian local and their reciprocal crossbreds are presented in Table 2. The fertility of eggs ranged from 72-89 percent while the hatchability of fertile eggs and hatchability of egg set were 24-65 and 19-57 percent, respectively. Eggs from Rhode Island Red x Rhode Island White chickens were better in fertility, hatchability of fertile eggs and hatchability of set eggs than those from purebred local and crossbred chicken. The lowest hatchability was obtained in the crossbred NLRXRIW. The most common cause of un-hatched eggs was dead in cell; this was followed by dead in shell. Both % deformed and % banger accounted for only 6-22 percent of un-hatched eggs in the four genotypes (Table 2).

Table 2: Fertility, hatchability and hatch-out analysis of eggs from Rhode Island, Nigerian local and their crossbreds

	Genetic groups			
Parameters	RIRXRIW	RIRXNLW	NLRXNLW	NLRXRIW
Number of eggs set	72.00	51.00	65.00	53.00
% Fertility	88.89	86.27	72.31	77.36
% Hatchability	51.56	65.19	51.06	24.39
% Hatch/egg set	45.83	56.86	36.92	18.87
% Dead in Shell	17.19	11.36	17.02	29.27
% Dead in Cell	28.13	15.91	31.92	43.33
% Deformed	6.06	10.34	20.85	0.00
% Banger	0.00	1.96	1.54	9.08

RIRXRIW = Rhode Island Red Male x Rhode Island White Female, RIRXNLW = Rhode Island Red Male x Nigeria local White Female, NLRXNLW= Nigeria Local Red Male x Nigeria local White Female, NLRXRIW = Nigeria Local Red Male x Rhode Island White Female

Weekly body weight

The results of weekly body weight (g) of chicks from the four genotypes are presented in Table 3. The results showed significant difference ($P<0.05$) among the four genotypic groups in weekly body weight of chicks. RIRXRIW chicks were significantly higher ($P<0.05$) in body weight than other genotypic groups at hatch and at 1-8 weeks of age. NLRxRIW chicks were significantly higher ($P<0.05$) in body weight than RIRxNLW at hatch and at 8 weeks of age. NLRxNLW chicks had the lowest body weight at hatch and at weeks 1, 2 and 3.

Table 3: Mean body weight of Rhode Island, Nigerian local and their crossbreds chicken

Genetic groups	Weekly weight (g)								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RIRXRIW	36.36±0.47^{a}	64.23±1.12^{b}	82.07±1.56^{b}	104.58±3.23^{a}	132.88±2.61^{a}	152.66±3.27^{a}	176.85±3.38^{b}	198.41±3.73^{b}	216.93±3.40^{b}
RIRXNLW	27.62±0.32^{a}	42.51±1.15^{ab}	56.32±1.36^{b}	71.63±2.12^{a}	91.41±2.07^{a}	113.11±2.30^{a}	132.39±2.41^{a}	154.04±2.30^{a}	179.75±2.63^{a}
NLRXNLW	28.62±0.82^{a}	38.33±1.92^{a}	49.32±1.52^{b}	69.83±2.37^{a}	95.83±3.39^{a}	122.33±2.42^{a}	144.83±2.73^{b}	167.67±3.52^{b}	193.17±2.94^{b}
NLRXRIW	36.06±0.35^{b}	44.50±1.04^{b}	56.50±3.79^{b}	75.00±3.34^{a}	97.50±2.39^{a}	123.75±3.77^{a}	153.75±3.30^{b}	180.25±3.35^{b}	202.75±2.32^{b}

^{abc}Means in the same column bearing same superscript are not significantly (P>0.05) different.

RIRXRIW = Rhode Island Red Male x Rhode Island White Female, RIRXNLW= Rhode Island Red Male x Nigeria local White Female, NLRXNLW= Nigeria Local Red Male x Nigeria local White Female, NLRXRIW= Nigeria Local Red Male x Rhode Island White Female

Plumage colour inheritance

Sex linkage in plumage colour inheritance

The results in Table 4 shows that at a degree of freedom of 1 (*df =1*) and with an α level of 0.05 the crosses of both the direct and reciprocal crosses were segregated based on the decision rule.

The crosses between RIRXRIW (0.00) and NLRXRIW (1.66) were auto-sexed, while crosses between RIRXNLW (17.10) and NLRXNLW (9.56) are therefore rejected (H_1) since the cross group of the Chi Square calculated is greater than Chi Square Tabulated.

Table 4: Chi square (X^2) of pure bred and cross bred

	Chi Square	
Genotypes	**Calculated**	**Tabulated**
RIRXRIW	0.00	3.841
RIRXNLW	17.10	3.841
NLRXNLW	9.56	3.841
NLRXRIW	1.66	3.841

RIRXRIW = Rhode Island Red Male x Rhode Island White Female, RIRXNLW= Rhode Island Red Male x Nigeria local White Female, NLRXNLW= Nigeria Local Red Male x Nigeria local White Female, NLRXRIW= Nigeria Local Red Male x Rhode Island White Female

Discussion

The fertility of eggs of the four genotypes were higher than 21.49-66.68 percent obtained by Bobbo *et al.* (2013) in their work on comparative assessment of fertility and hatchability traits of nine genotypes of pure and cross bred local chickens in Adamawa State. Fayeye *et al. (*2005) had obtained a fertility of 76 percent in an earlier work on Fulani-ecotype chicken. The hatchability of fertile eggs in this study was however higher than 48 percent obtained by Fayeye *et al.* (2005) for Fulani-ecotype chicken. According to Brillard (2003), the fertility of an egg depends directly on the ability of the hen to mate successfully, store sperm, ovulate and support the formation and development of embryo. It also depends on the ability of cock to mate successfully and deposited adequate quantity of high quality semen (Wilson *et al.,* 1979). Such variation in results of fertility and hatchability is common in literatures because fertility and hatchability are influenced by a large number of genetic and non-genetic factors such as feed variation (Mussaddeq *et al.,* 2002; Lariviere *et al*., 2009), genotype of embryo (King,ori, 2011), egg size, age and shell quality (King,ori, 2011). The hatch weight of RIRXNLW and NLRXNLW chicks in the present study were close to 27-28grammes obtained by Fayeye *et al.* (2005) in their work on Fulani ecotype chicken. However, Bobo *et al.* (2013) reported lower hatch weight of 7.00-25.62 g for straight and crossbred local chicks obtained from Adamawa state. Such a wide range in hatch weight is common with studies involving animals of different genetic groups. For instance, Khawaja *et al.* (2012) reported hatch weights of 20.9g to 31.3g in their work on Rhode Island, Fayoumi and their reciprocal crosses. Weekly body weights of chicks were lower than the values reported by Fayeye *et al.* (2005) at weeks 6, 7 and 8 for Fulani chicken. They were also lower than the mean bodyweight reported by Sola-Ojo *et al.* (2012) for Dominant Black, Fulani Ecotype and their crossbred chick**s.** The result of direct cross of the Nigerian local chicken (NLRXNLW) is in line with earlier research of Nwosu and Ahana (1987) that the local Nigerian chickens in Nigeria cannot be autosexed as autosexing characteristics has not been developed in

them, however the cross between the Rhode Island Red male and Rhode Island White females can produce auto-sexed chicks at hatch as reported by ISA (2010). However, the reciprocal cross (NLRXRIW) showed great potential to be autosexed and findings was similar to that reported by Pricop (2009) that new gene theory of sex determination based on the gene mechanism demonstrates that the females have the gene responsible for the inheritance of plumage colour located simultaneously in chromosome Z.

Conclusion

In conclusion the cross evaluation of the pure breed and their reciprocal crosses collectively observed that the cross between RIRXRIR had the percentage highest fertility, while the cross between the RIRXNLW had the highest percentage hatchability among the four crossed breeding groups. Results on dead in cell, shell may be due to genetic factor, temperature, breed, individual difference, some pathological conditions, frequent power failure and proper hygiene. Chickens with superior live weight were those which resulted from the cross between RIRXRIW and NLRXRIW, respectively while the chi square analysis used in determining the probability of chicks being auto-sexed revealed that the pure bred of RIRXRIW and reciprocal cross of NLRXRIW had a great potential of producing auto-sexed chicks, while the results on the direct of NLRXNLW and RIRXNLW suggest that the pattern of inheritance of plumage colour is not simple, hence the study recommends further investigation to further ascertain the mode of plumage colour inheritance in the Nigerian Local Chickens.

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