Blood profile and semen characteristics of FUNAAB-alpha breed and crossbred Nigerian indigenous chickens under intensive management system

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Abstract

The overall improvement of indigenous chicken to maximize production potentials of chicks for meat and eggs, demands that a ready alternative such the application of Artificial Insemination (AI) be encouraged. Moreover, achieving good result and performance through AI is a function of semen quality which requires constant evaluation as the chickens are being improved upon. Therefore, a study was conducted to evaluate the semen quality and the blood profile of three crossbred Nigerian indigenous chickens and FUNAAB-alpha. A total of 16 cocks, comprising of three Nigerian indigenous chicken genotypes (Naked Necked, Frizzled and Normal feather) crossed with Marshall (exotic) and FUNAAB-alpha were used for the study. Semen samples were collected from the cocks by abdominal massage and examined for semen volume, colour, concentration, pH, motility, mass activity, live sperm and normal sperm. Blood samples were collected from the cocks for Red Blood Cell (RBC), White Blood Cell (WBC), Packed Cell Volume (PCV), Haemoglobin (Hb) and WBC differentials were analysed. Data generated were subjected to one-way analysis of variance in R. Genotype significantly (P < 0.05) affected semen parameters with FUNAAB-alpha having the highest semen volume, while the crossbred frizzled feather had the least value. For semen concentration, motility and mass activity, the crossbred normal feather and naked neck performance was significantly (P < 0.05) higher than FUNAAB-alpha. Haematological parameters were not significantly (P>0.05) different among the genotypes and FUNAAB-alpha. In conclusion, all chicken genotype produced semen of acceptable quality. However, apart from semen volume, the crossbred naked neck and normal feather indigenous produced relatively better quality semen than FUNAAB-alpha. Therefore, in order to improve semen characteristics of indigenous chickens under intensive management, crossbreeding is a viable strategy.

Key words: Crossbred, Indigenous, Chicken, Semen quality, Haematology

Profil sanguin et caractéristiques du sperme de la race FUNAAB-alpha et des poules indigènes nigérianes croisées sous un système de gestion intensive

Résumé

L'amélioration globale des poules indigènes pour maximiser le potentiel de production de poussins pour la viande et les œufs nécessite des alternatives telles que l'application de l'Insémination Artificielle (IA). De plus, obtenir de bons résultats et performances via l'IA dépend de la qualité du sperme, qui doit être évaluée régulièrement pendant l'amélioration génétique des poules. Ainsi, une étude a été menée pour évaluer la qualité du sperme et le profil sanguin de trois croisements de poules indigènes nigérianes et de la race FUNAAB-alpha. Au total, 16 coqs, comprenant trois génotypes de poules indigènes nigérianes (cou nu, plumage frisé et plumage normal) croisés avec la race Marshall (exotique) et la FUNAAB-alpha, ont été utilisés. Des échantillons de sperme ont été collectés par massage abdominal et analysés pour le volume, la couleur, la concentration, le pH, la motilité, l'activité de masse, la viabilité et la morphologie des spermatozoïdes. Des échantillons sanguins ont également été prélevés pour analyser les globules rouges (GR), les globules blancs (GB), l'hématocrite (Ht), l'hémoglobine (Hb) et la formule leucocytaire. Les données ont été soumises à une analyse de variance à un facteur sous R. Le génotype a significativement (P < 0,05) influencé les paramètres spermatiques, la FUNAAB-alpha présentant le volume spermatique le plus élevé, tandis que le croisement à plumage frisé avait la valeur la plus faible. Pour la concentration spermatique, la motilité et l'activité de masse, les performances des croisements à plumage normal et à cou nu étaient significativement (P < 0,05) supérieures à celles de la FUNAAB-alpha. Les paramètres hématologiques ne différaient pas significativement (P > 0,05) entre les génotypes. En conclusion, tous les génotypes ont produit un sperme de qualité acceptable. Cependant, à l'exception du volume spermatique, les croisements à cou nu et à plumage normal ont

produit un sperme de meilleure qualité que la FUNAAB-alpha. Ainsi, pour améliorer les caractéristiques spermatiques des poules indigènes en système intensif, le croisement est une stratégie viable.

Mots-clés : croisement, indigène, poule, qualité du sperme, hématologie

Introduction

Reproductive performance is critical for efficient production in poultry and suitable selection criteria for males based on semen characteristics in roosters (McDaniel *et al*., 1998). The male chicken is known to be responsible for fertilizing the eggs of a number of females and most studies concerning the reproductive efficiency of breeder birds have centered on the cocks and artificial insemination (AI) of large breeder hens for the production of hatching eggs (Almahdi *et al*., 2014). Over the years, maintenance of fertile cocks in most poultry breeding farms has been difficult in hot humid tropical environments. Cocks with high semen producing capacity are often few and they degenerate due to changes in factors such as age, poor nutrition, unfavorable climatic conditions, and poor management. In other to achieve good results in artificial insemination of chickens, the quality of semen should be ensured (Alkan *et al.*, 2002). Cheng *et al.* (2002) noted the importance of semen evaluation in poultry breeding for selection of breeding males or for routinely monitoring their reproductive performance.

Semen quality of cocks determines the fertility of the male chicken while the female contributes the eggs (Liu *et al.*, 2008). The assessment of semen quality characteristics of poultry birds gives an excellent indication of their reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (Peters *et al.*, 2004). The semen of the domestic chickens according to Hafez (1978), varies from a dense opaque suspension to a watery fluid with a relative high density. According to the author, the difference in semen volumes and semen concentration of the domestic cocks depends largely on the relative contribution of the various reproductive glands, the number of spermatozoa that could be obtained from a breed/strain and the extent to which the genetic potentials can be exploited. Peters *et al.* (2008) noted that there were differences in strain with respect to semen volume, concentration, and motility, active and sluggish spermatozoa.

The use of blood examination as a way of assessing the health status of animals has been documented (Owoyele *et al.,* 2003; Muhammad *et al.,* 2004). This is because it plays a vital role in physiological, nutritional and pathological status of organisms (Muhammad *et al.,* 2000; Muhammad *et al.,* 2004) and it also acts in regulatory, protective and homeostatic tissue of an organism (Nasyrova *et al.,* 2006; Eze *et al.,* 2010).

Haematological parameters provide valuable information on the immune status of animals (Kral and Suchy, 2000). This information ranges from giving the level of the blood to detecting ailment or disorders through them. Such information, apart from being useful for diagnostic and management purposes, could equally be incorporated into breeding programmes for the genetic improvement of indigenous chickens. Haematological parameters of different chickens have been evaluated by various researchers (Oladele *et al*., 2001; Ihekwemere *et al*., 2001 and Adejumo, 2004). From the foregoing, it is obvious that researchers have done extensive work on the semen quality trait of variety of chicken breeds and strains. However, information on semen quality characteristics of crossbred indigenous chicken especially in Nigeria is rare. Therefore, this study seeks to fill that gap.

Materials and methods

This research work was carried out at the Poultry Breeding Unit of the Teaching and Research Farms, Directorate of University Farms (DUFARMS) of the College of Animal Science and Livestock Production (COLANIM), Federal University of Agriculture, Alabata Road, Abeokuta, Ogun State, Nigeria. Semen was collected from 12 crossbred indigenous (normal feather x Marshall, naked neck x Marshall and frizzled feather x Marshall) and four FUNAAB-alpha. The FUNAAB-alpha was the improved dual purpose indigenous breed sires at 20 - 24 weeks of age. Semen collection was by abdominal massage technique according to Hafez (1978). All birds were housed in a deep litter system.

Feed and water were given fresh and in *ad libitum* throughout the study period. All birds were trained to produce semen prior to actual semen collection. Semen collection was done two times a week and lasted for eight weeks. Semen samples collected were subjected to microscopic examination and physical evaluation. Observations were made and records taken for semen volume, semen pH, motility, mass activity, semen colour (appearance), semen concentration. Semen volume for cocks was read off the collection tube graduated in ml. Semen colour was visually observed from a transparent collecting vials and expressed as creamy, milky or watery, and scored as 3, 2 or 1, respectively as described by kabir, *et al.* (2007). The semen pH was obtained using the pH meter strip. Colour change on the strip will be read using the pH meter (Chemo craft®) as indicated by the manufacturer. Concentration of the spermatozoa was determined as described by Rekwot *et al.* (1994). Mass activity was evaluated by the method described by Tarif *et al.* (2013).

Blood samples were collected from the jugular vein of the birds using a 2mL disposable syringe and directly transferred into a labelled test tube containing EDTA (Ethylenediamine tetra acetic acid) anticoagulant. It was immediately used for measuring the haematological parameters such as red blood cells (RBC), white blood cells (WBC), haemoglobin (Hb), packed cell volume (PVC), neutrophil, eosinophil, basophil and lymphocytes.

Statistical analysis

The data collected for both semen and blood were subjected to one way analysis of variance (ANOVA) using R version 4.0.2 (R Core Team, 2020). Separation of significant means was done using least square difference.

Results and Discussion

In table 1 is presented the mean values of semen colour, volume, concentration, motility, live sperm, mass activity, normal sperm and pH. Semen colour is commonly used to evaluate the quality of semen. It varies from densely opaque suspension to a watery fluid. The colour of semen generally should be creamy, which may be an indication of high sperm concentration (Kalita *et al*., 2017). The creamy white ejaculates found in this study were consistent with the report of Mothbedi et al. (2016). The average semen colour score obtained in the study is comparatively higher than the average score of 2.21 reported by Adamu et al. (2018) and the values reported by Hu *et al*. (2013). However, they were lower than 2.96 ± 0.11 in Rhode Island Red and White breeder cocks and 3.58 ± 0.25 for Rhode Island Red cockerels reported by Kabir *et al.* (2007) and Churchil *et al.* (2014), respectively. According to Kalita *et al*. (2017), the colour of semen depends on the species of birds used. But Etches (1998) submitted that semen colour may arise partly due to the presence of contaminants or a result of low sperm concentration.

In the present study, the mean values obtained for semen volume was significantly different among the different genotypes of chicken studied. The values ranged from 0.39 to 0.73 ml. these values are in agreement with the works of Peter *et al.* (2008) whose values range from 0.37 ml to 0.73 mL and the report of Ajayi *et al.* (2011) who obtained values ranging from 0.10 ml to 0.83 mL for 3 strains of local chicken studied. However, these values are higher than 0.21 and 0.20 reported by Usman *et al.* (2018) for Nigerian indigenous cockerels and Amo cockerels. The variation could be as a result of crossbreeding of chickens used in the present study which has led to improved performance. The FUNAAB-alpha and crossbred naked neck had the highest values of 0.73 ± 0.03 and 0.64 ± 0.04, respectively. This was followed by 0.52 ± 0.03 for normal feather and 0.39 ± 0.04 for frizzled feather. The differences could be attributed to difference in body weight, based on data not reported here. And according to Ajayi *et al.* (2014) semen output is a function of body size.

The concentration of semen obtained in the present study was significantly different among the chicken genotypes used. The corresponding values were 3.18 ±0.35, 3.49 ± 0.39, 4.21 ± 0.48 and 4.38 ± 0.34 for FUNAAB-alpha, frizzled feather, naked neck and normal feather, respectively. The values obtained were in agreement with the work of Usman et al. (2018) and the range (3.11 to 4.21 × 10^9/ mL) reported by Peter *et al.* (2008), but higher than 2.26 × 10^9/ ml and 2.42 × 10^9/mL reported by Bah *et al.* (2001) and Tuncer *et al.* (2008). The variation could be attributed to different genetic make-up. The higher sperm concentration in crossbred indigenous cocks compared to FUNAAB-alpha which is an improved dual purpose indigenous could be as a result of

favourable effect of heterosis or increased heterozygosity on reproduction traits according to Mothbedi *et al.* (2016).

Sperm motility among chicken genotypes used in the present study was significantly (P<0.05) different. The values ranged from 74.00 ± 1.68 to 80.30 ± 2.30 with the FUNAAB-alpha having the lowest and the naked neck having the highest. According to Mothbedi *et al.* (2016), high sperm motility is a good indication of high semen quality with acceptable fertilizing ability. The difference observed in this experiment may be due to breed differences or individual performance. Other researchers have reported similar semen motility. For instance, Tarif *et al.* (2013) reported 71.1% to 83.3% in four lines of cocks, Chalah *et al*. (1999) observed a sperm motility of 73.9% to 83.2%. However, Mosenene (2009) reported lower values ranging from 58.8% to 63.8% motility in fresh semen of cocks. According to Kennedy *et al.* (2003), sperm motility across breeders has been reported to be due to their genetic tendencies.

Mass activity was significantly different among genotypes. The crossbred indigenous had higher values than FUNAAB-alpha. This can be attributed to their genetic make-up or crossbreeding effect. In which case, the crossbreds have inherent potential for high fertility. The values in the present study agreed with the report by Mkpughe and Bratte (2015) for Nigerian indigenous cocks and Isa white (exotic chickens). There was no significant (P>0.05) difference in semen pH. The pH obtained in this study are slightly lower than what is reported by most researchers. Peter *et al.* (2008) reported a range of 7.01 ± 0.01 to 7.04 ± 0.02; Mothbedi *et al.* (2016) reported a mean value of 7.24. Others reported 7.02 ± 0.01 and 7.68 ± 0.01 (Bah *et al.*, 2001; Tuncer *et al*., 2008). However, Siudzinska and Lukaszewicz (2008) in their experiment indicated that spermatozoa can tolerate a pH range of 6.0 to 8.0.

The percentage of live sperm recorded in this study ranged from 79.6 ± 1.61 to 84.5 ± 2.20 and these values were not significantly (P>0.05) different. In contrast, Mothbedi et al., (2016) obtained lower values (75.2 ± 33.3% and 76.8 ± 29.4%) for purebred naked neck and crossbred cockerels which were not significantly different. The values in this report are similar to the reports of Tarif *et al*. (2013); Kalita *et al* (2017) and Goger et al. (2018). These authors also reported non-significance live sperm percentage. The percentage normal sperm in the present study was not significantly different. However, the proportion of normal sperm was within the range reported by Siudzinska and Lukaszewicz (2008) and is also consistent with report of Mosenene *et al.* (2009). But higher values were reported by Tarif *et al*. (2013). Normal sperm percentage could be affected by environmental temperature, humidity and semen collection techniques (Usman *et al*., 2018).

Table 1: Comparison of some semen parameters in crossbred Nigerian indigenous chicken genotypes and FUNAAB - Alpha

	Genotypes			
Parameters	**Funaab-alpha**	**Naked neck**	**Normal feather**	**Frizzle feather**
Colour	2.63 ± 0.13	2.75 ± 0.17	2.50 ± 1.21	2.46 ± 0.14
Volume (mL)	0.73 ± 0.03^{a}	0.64 ± 0.04^{a}	0.52 ± 0.03^{b}	0.39 ± 0.04^{c}
Concentration (10^9/mL)	3.18 ± 0.35^{b}	4.21 ± 0.48^{ab}	4.38 ± 0.34^{a}	3.49 ± 0.39^{ab}
Motility (%)	74.00 ± 1.68^{b}	80.30 ± 2.30^{a}	78.50 ± 1.63^{ab}	78.00 ± 1.88^{ab}
Live sperm (%)	79.60 ± 1.61	84.50 ± 2.20	82.70 ± 1.55	81.60 ± 1.80
Mass activity (+)	2.93 ± 0.11^{b}	3.38 ± 0.15^{a}	3.34 ± 0.10^{a}	3.25 ± 0.12^{ab}
Normal sperm (%)	75.00 ± 1.68	75.60 ± 2.30	73.90 ± 1.63	72.90 ± 1.88
pH	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00	7.00 ± 0.00

^{a,b,c} means for each parameter within the same column with different superscript are significantly (P < 0.05) different.

Presented in table 2 is the mean values of PCV, Hb, RBC and WBC. The values obtained for PCV, Hb, WBC, RBC and white blood cell differentials were not significantly (P>0.05)

different. This is in contrast to the report of Ajayi et al. (2014) who reported significant result for all these values. The non-significant difference may be further explained by the fact that the chicken have been exposed to the same environmental condition and possess inherently similar response to the environment. These haematological parameters are used to assess the health status of the chickens. The average values obtained in the present study for PCV, Hb and RBC are higher than the values reported by Ajayi *et al*. (2014). However, WBC had lower values in comparison with their report. According to Adejumo (2004), low PCV and Hb are a function of poor nutrition and especially protein deficiency. Peter et al. (2011) reported a normal avian PCV to range from 35% to 50%. A value less than 35% may be detrimental to the individual animal. Except for FUNAAB-alpha, all other genotypes had PCV within normal ranges. Since WBCs are mainly responsible for defence against infections, the values obtained in the experiment could indicate that the chickens were free from infection. The value of RBC were similar to those reported by Peter et al. (2011) and higher than what was reported by Ajayi *et al.* (2014) except for Harco that had 3.50%. According to Ikhimioya *et al.* (2002), this could be attributed to the system of management.

Table 2: Haematological parameters of crossbred Nigerian indigenous chicken genotypes and FUNAAB-Alpha

	Genotypes			
Parameters	**Funaab-alpha**	**Naked neck**	**Normal feather**	**Frizzle feather**
RBC (10^3/mL)	3.23 ± 0.69	4.10 ± 0.97	3.77 ± 0.69	3.50 ± 0.79
WBC (10^3/mL)	3.20 ± 0.49	1.90 ± 0.69	2.20 ± 0.49	2.93 ± 0.56
PCV (%)	32.5 ± 3.86	44.0 ± 5.46	43.5 ± 3.86	37.0 ± 4.46
Hb (g/dL)	10.8 ± 1.25	14.5 ± 1.77	14.2 ± 1.25	12.3 ± 1.45
BAS (%)	0.50 ± 0.26	0.00 ± 0.37	0.25 ± 0.26	0.33 ± 0.30
EOS (%)	1.25 ± 0.33	1.50 ± 0.47	1.75 ± 0.33	2.00 ± 0.39
HET (%)	37.8 ± 3.45	45.5 ± 4.88	43.0 ± 3.45	44.3 ± 3.98
LYMPH (%)	55.5 ± 2.79	52.0 ± 3.95	52.5 ± 2.79	51.3 ± 3.22
MON (%)	2.50 ± 0.47	1.00 ± 0.67	2.50 ± 0.47	2.00 ± 0.54

RBC – red blood cells; WBC – white blood cells; PCV – packed cell volume; Hb – haemoglobin; BAS – basophil; EOS – eosinophil; HET – heterophil; LYMPH – lymphocytes; MON – monocytes

Conclusion

From the different physical characteristics of semen studied in FUNAAB-alpha and crossbred indigenous chickens, it was noted that all chicken genotype produced semen of acceptable quality. However, apart from semen volume, the crossbred produced better quality semen in terms of semen concentration, motility and mass activity, than FUNAAB-alpha. Therefore, in order to improve semen characteristics of indigenous chickens under intensive management, crossbreeding is with Marshall cock is encouraged.

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