Evaluation of Semen Quality of Five Different Cockerel Breed used in Poultry Industry in Nigeria

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ABSTRACT

This experiment is conducted to evaluate semen quality of five different cockerel breeds used in poultry industry in Nigeria. The ultimate aim is to improve the production efficiency of meat and egg in the poultry industry. The differences between breeds were determined by evaluating the semen, microscopically checking for motility, sperm concentration, and sperm morphology and life to dead ratio. Five different chickens namely Hubbard, Dominant brown, Isa white, Yoruba Ecotype and Fulani Ecotype were used. Comparative evaluation of the semen was performed in 25 cockerels (Five per breed). Semen was collected twice per week for seven weeks. The eosin-nigrosin staining techniques were used microscopically to evaluate the morphology of the sperm from the different breeds. The fresh semen parameters evaluated were ejaculate volume, sperm concentration, the percentage live and dead sperm, sperm motility and sperm abnormalities. The study shows a significant difference ($P < 0.05$) between the ejaculated volumes, sperm concentration, active and sluggish sperm cells. There is no significant difference ($P > 0.05$) in all the semen abnormalities and sperm motility. Hence, Fulani Ecotypes were significantly different in terms of body weight, low sperm abnormalities; high ejaculate volume of semen and high relative motility. Despite the fact that it is an indigenous local breed of poultry found in Nigeria, Fulani Indigenous breeds are recommended for semen production if adequate management practices are in place. This will reduce the cost of importing exotic breeds used for breeding.

Keywords: *Semen, Cockerels, Industry, Breed*

INTRODUCTION

The assessment of semen quality characteristics of poultry birds gives an excellent indicator of their reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (Peters *et al*., 2004). Fertility and hatchability on the other hand are the major determinant of profitability in the hatchery enterprise. Semen quality remains one of the most important characteristics that determine fertility in the male. It is important to characterize the quality parameters in terms of semen volume, semen colour, sperm concentration, sperm motility, sperm viability and morphology. In all poultry species, semen quality parameters vary with the age of the male, leading to a progressive

decline in fertility with age (Kotlowska *et al*., 2005).This study focuses on the comparative evaluation of semen quality (using standard techniques) in different breeds of cockerels commonly used in poultry Industry in Nigeria**,** with the ultimate aim of improving the production efficiency (meat and egg).

MATERIALS AND METHOD

This study was carried out in Ladoke Akintola University of Technology Teaching and Research Farm Ogbomoso and Fol Hope Farm Limited Breeders Farm, Kilometer 3, Old Ife Road, Hope Road Alakia, Ibadan. The evaluation and analysis of the semen was done at Ladoke Akintola University of Technology Health centre and D'AlAmeen Medical Laboratory Elekuro Ibadan. Different poultry cockerel breeds namely; Dominant brown, Hubbard, Isa white, Fulani ecotype and Yoruba ecotype (their body weight was determined) were used for the collection of semen at regular intervals overtime for microscopic sperm evaluation. All cockerels were kept in individual battery cages (Plate 1, 2 and 3) and some were raised under deep litter system provided with a diet of breeder mash and water *ad libitum*.

Semen was collected from each cockerel twice weekly, using the massage method. Each cock was massaged at the back and stroked close to its tail while the inseminator applied a slight finger pressure around the base of the tail. The phallus then becomes erected within the cloaca. Pressure was applied around the cloaca and the tail flattened towards the back of the bird, causing the phallus to protrude from the cloaca. The inseminator's thumb was then pressed on the birds' abdomen directly beneath its vent. This caused semen to be released from the ductus deferens almost immediately and the inseminator gently squeezes the semen from the swollen papillae at the base of the phallus into a conical graduated collection tube to read up the volume semen per ejaculate. During semen collection, the semen collection tubes were maintained between 38 - 42°C, until microscopically evaluated for semen quality. The semen of all the strains was analyzed for their quality and evaluation by examining the following:

Motility: A drop of semen with the aid of a micropipette was placed on a microscope slide, which was then covered with a glass cover slip to spread the semen in order to have a uniform thickness and to prevent drying. It was then placed on a microscope for examination. A magnification of x 400 was used. Several fields were examined and an estimate to the nearest 10% of motile sperm was made. The motility determination was carried out by taking into consideration subjective measurements based on the judgment of individuals making the determination and finding the average motility for each strain of chicken. Motility of semen sample is expressed as the percentage of cells that are motile under their own power.

Live to dead ratio: A drop of the semen with the aid of a micropipette was placed on a microscope slide, and a drop of eosin-negrosin stain was added and smeared and air dried immediately and viewed under microscope at 400 magnifications.

Morphology: This is used to check for abnormalities of the spermatozoa whether both primary and secondary abnormalities are present (Head abnormalities, Tail abnormalities,

Mid pieces abnormalities and other abnormalities). These were examined under microscope at 400 magnifications.

Sperm count/ sperm concentration: The semen concentration was measured using the direct cell count method. Here, hemocytometer which was used for counting blood cells was used. It consists of specially designed slides that contain two counting chambers and two dilution pipettes. The counting chambers are 0.1mm and have a ruled area on the bottom of the chambers that is $1.0mm^2$, the square is sub divided into 25 smaller squares. The dilution rate of semen and forma-saline was 1 in 19 drops. The diluted was then picked using a micropipette. One drop of the diluted semen was them dropped on one end of the hemocytometer and also on the other end and this was allowed to settle. The loaded hemocytometer was then placed on the microscope at a magnification of x400. The spermatozoa's head that falls within the sub-divided smaller squares at the four edges and centre of the hemocytometer is counted and the average per strain/breed was found based on the judgment of the individuals making the determination. The concentration of sperm/semen was found using the formula:

$$\text{Concentration} = \frac{\text{Cells Counted } x \text{ Dilution Rate } x \text{ Depth of Hemocytometer}}{\text{Number of Squares Counted}}$$

All data collected were subjected to analysis of variance using the general linear Model procedure of the statistical analysis system version 6 (SAS, 2002).

RESULTS AND DISCUSSION

The evaluation of semen quality is of utmost importance from the point of implementing Artificial Insemination (AI) to obtain fertility. It is known that semen originated from different breeds of chicken which vary in many respects. Semen characteristics of the 5 breeds of chicken are set out on tables 1, 2 and 3. The differences in the body weight for the different breeds of cockerel, ejaculate volume, sperm concentration, estimated sperm motility, percentage live sperm and dead sperm, active sperm cell, sluggish sperm cell and abnormal sperm (head, mid-piece, and tail) between all collected semen samples were statistically different ($P < 0.05$). The mean set out on table 1 reveal significant differences between the body weight of the Dominant Brown, Hubbard, ISA White, Yoruba Ecotype and Fulani Ecotype. Hubbard and Yoruba Ecotype were the heaviest and lightest breeds respectively when compared to the other breeds of chicken (with corresponding values of 2.35 ± 0.05kg, 5.06 ±0.09kg, 2.59 ±0.06kg, 1.78 ± 0.04kg, 2.07 ± 0.07kg respectively). Similarly, Hubbard produced the highest ejaculate volume followed by the Fulani Ecotype, ISA White, Dominant Brown, and Yoruba Ecotype respectively (0.59 ± 0.04ml, 0.50 ± 0.05ml, 0.42 ± 0.02ml, 0.32 ± 0.03ml, 0.24 ± 0.02ml). The results on table 2 reveal no significant difference in sperm motility, live sperm cells, dead sperm cells while ejaculate concentration, active and sluggish motile sperm cell were significantly ($p < 0.05$) different between breeds. Table 3 reveals that there is no significant difference in sperm head, mid piece and tail abnormality between the breeds. Hubbard was highest in sperm head abnormalities followed by Dominant Brown, Fulani Ecotype, ISA White and Yoruba Ecotype (with corresponding values of 56.67 ± 6.80, 55.83 ± 7.80, 53.33 ± 3.17, 49.17

± 15.83, and 49.17 ± 8.00 respectively). ISA White was highest in mid piece abnormalities followed by Dominant Brown, Yoruba Ecotype, Fulani Ecotype and Hubbard (with corresponding values of 10.83 ± 2.39, 9.17 ± 2.39, 8.33 ± 3.33, 8.33 ± 2.47, and 8.33 ± 2.11). ISA White was highest in tail abnormalities followed by Yoruba Ecotype, Fulani Ecotype, Hubbard and Dominant Brown (with corresponding values of 43.33 ± 7.15, 41.67 ± 5.87, 38.33 ± 8.91, 35.83 ± 8.31 and 35.83 ± 7.46).

Body weight may be a good indicator of semen volume and semen concentration in some cockerel breeds. Generally, poultry breeds with heavier body weight have been found to have larger testes and produce more sperm cell during spermatogenesis and thus resulting in a higher semen concentration (Adeyemo, Longe and Adejumo, 2007). However, it was also observed that cockerel with a higher body weight produce ejaculate of greater volume but a lower sperm concentration. In this study, the body weight showed effect on semen volume, as the Hubbard with the heaviest body weight (5.06 ± 0.09kg) recorded a higher ejaculate volume when compared to the Yoruba Ecotype with the lightest body weight (1.78 ± 0.04kg) that recorded the least ejaculate volume. The overall reported average ejaculate volume of cockerels have been quoted as 0.7ml for different poultry breeds (Tuncer, Kinet, Ozdogan and Demiral, 2006; Tuncer, Kinet and Ozdogan, 2008). All the breeds of ejaculate volumes recorded in this current study were less than this 0.7ml and there may be many reasons contributing to these lower semen volumes, for example, breeds, age, individual differences, excessive stimulation, body weight, season and many environmental factors including management and human factor.

The significant differences in the semen concentration of the ejaculates may be attributed to the fact that the breeds used were from different genetic lines and differ in production traits. The general sperm concentration may further depend on the factors such as breed, age, season, individual performance and semen collecting frequency. The significant differences between the active and sluggish sperm cells were probably due to season, light intensity and relative humidity as reported by (Machebe and Ezekwe, 2005) and (Obidi *et al.*, 2008). Sperm motility was found to be lower when semen was diluted with the cryoprotectants like egg yolk, dimethyl sulfoxide (DMSO) or dimethyl acetamide (DMA) prior to freezing. This shows that the deleterious effects of a diluents and cryoprotectant can have on sperm motility and viability of cockerel semen prior to cryopreservation (Baguio and Capitan, 2008). Other researchers have reported the percentage of motile sperm to vary between 70.1 ± 0.6% and 67.9 ± 0.5% for cockerels, which is very similar to the findings of this study. Season affects semen production, so for example the rainy season has been shown to favour the rate of spermatogenesis. The percentage of live sperm recorded was high, ranging between 67.00 ±3.30% and 73.40 ± 2.04%. The most frequent sperm abnormality recorded in this study was in the sperm mid-piece (8 to 11%), followed by the sperm head (49 to 57%), and tail (39 to 43%) Tselutin, Seigneurin and Blesbois (1999) report that the number of live sperm without any abnormality in cockerel semen varied from 91 to 94%, which is contrary to the results of this study. However, Siudzinska and Lukaszewicz (2008a) recorded 58 to 70% live, morphologically normal sperm while Lukaszewicz (2002), Lukaszewicz and Kruszynski

(2003); Lukaszewicz, Jersey, Partyka and Siudzinska (2008) 70 to 80% live normal sperm, which is again more consistent with the results obtained in this study. The percentage dead sperm recorded during semen collection of 5 poultry breeds ranged between 14 to 27%, which was high, and is more consistent with the 13 to 30% in this study (Suidzinska and Lukazsewicz, 2008b). The higher number of dead sperm recorded in this study may be attributed to season (cold weather and high relative humidity) and light intensity, and temperature changes.

CONCLUDING REMARKS

The evaluation of semen quality is of utmost importance from the point of implementing Artificial Insemination (AI) to obtain fertility. It is known that semen originated from different breeds of chicken which vary in many respects. This study evaluated semen quality of five different cockerel breeds used in poultry industry in Nigeria. The sperm evaluation of the semen samples of the five breeds were ejaculate volume ranging from 0.24±0.02 to 0.59 ±0.04ml, sperm motility from 66.67 ±2.47 to 74.17 ±3.00%, sperm concentration ($x10^9$ sperm/ml) 333.67 ±9.55 to 666.17 ±70.16, percentage live sperm from 67.00 ±3.30 to 73.40 ±2.04%, percentage dead sperm 13.00 ±0.30 to 30.00 ±0.47%. Head, mid piece and tail abnormalities of the fresh semen of the five breeds ranged from 49.17 ±8.00 to 56.67 ±6.80, 8.33 ±2.47 to 10.83 ±2.39, and 35.83 ±7.46 to 43.33 ±7.15% respectively. Generally, it was observed that poultry breeds with heavier body weight have been found to have larger testes and produce more sperm cell during spermatogenesis and thus resulting in a higher semen concentration. Hence, Fulani Ecotypes were significantly different in terms of body weight, low sperm abnormalities; high ejaculate volume of semen and high relative motility. Despite the fact that it is an indigenous local breed of poultry found in Nigeria, Fulani Indigenous breeds were recommended for semen production if adequate management practices are in place. This will reduce the cost of importing exotic breeds used for breeding.

Table 1: The mean (±SD) seminal characteristics of semen collected from 5 cockerel breeds

Parameters/Breeds	Dominant Brown	Hubbard	ISA White	Yoruba Ecotype	Fulani Ecotype
Body Weight (kg)	2.35±0.05 ^{c}	5.06 ±0.0^{a}	2.59±0.06^{b}	1.78±0.04^{e}	2.07±0.07^{d}
Ejaculate Volume (ml)	0.32±0.03^{c}	0.59±0.04^{a}	0.42±0.02^{b}	0.24±0.02^{c}	0.50±0.05^{ab}

$^{a-e}$: Means within each column with different superscripts differ significantly (P<0.05).

Source: Experimentation, 2013

Table 2: The mean (±SD) seminal characteristics of cockerel semen collected from 5 different chicken breeds

Parameters/Breeds	Dominant Brown	Hubbard	ISA White	Yoruba Ecotype	Fulani Ecotype
Estimated sperm Motility (%)	73.33 ±3.80	72.50 ±3.82	74.17±3.00	66.67 ±2.47	66.67 ±2.47
Active Motile Sperm Cells (%)	84.17 ±3.01^{a}	90.50 ±2.14^{a}	74.17±2.3^{b}	68.33±3.33^{b}	68.33±3.33^{b}
Sluggish Motile Sperm Cells (%)	15.83 ±3.01^{bc}	9.50 ±2.14^{c}	20.83±3.01^{b}	35.00±3.65^{a}	35.00±2.65^{a}
Ejaculate Concentration ($x10^9$ sperm/ml)	555.33±45.4^{a}	666.17±70.1^{a}	333.67±9.5^{b}	539.67±59.4^{a}	539.67±59.9^{a}
Live SpermCells (%)	69.00 ±2.20	73.40 ±2.04	72.00 ±2.46	67.00 ±3.30	67.00 ±3.30
Dead SpermCells (%)	30.00 ±0.47	26 ±0.22	27.00 ±0.46	13.00 ±0.54	13.00 ±0.30

$^{a-c}$: Means within each column with different superscripts differ significantly (P<0.05).

Source: Experimentation, 2013

Table 3: Sperm Abnormalities of Fresh Cockerel Semen Collected From The 5 Chicken Breeds

Parameters/Breeds	Dominant Brown	Hubbard	ISA White	Yoruba Ecotype	Fulani Ecotype
Sperm Head (%)	55.83 ±7.80	56.67±6.80	49.17±15.83	49.17±8.00	53.33±3.17
Mid Piece (%)	9.17 ±2.39	8.33 ±2.11	10.83 ±2.39	8.33 ±3.33	8.33 ±2.47
Tail (%)	35.83 ±7.46	35.83±8.31	43.33 ±7.15	41.67±5.87	38.33±8.91

Source: Experimentation, 2013

Plate1: Dominant Brown Cockerel Used for Semen Collection

Plate 2: Hubbard Cockerel used for semen Collection

Plate 3: ISA White Cockerel used for semen Collection

REFERENCES

Adeyemo G.. O., Longe O. G. and **Adejumo D. O.** (2007). The reproduction performance of breeder cocks fed cottonseed cake-based diets. *International Journal of Poultry Science,* 6.140-144.

Baguio, S. S. and **Capitan, S. S.** (2008). Motility, livability and fertility of cock spermatozoa as influenced by day of collection, diluent and cryopreservation. *Journal of Veterinary Medicine,* 45, 109-117.

Kotlowska M., Glogowski J., Dietrich G.J., Faruga A., Jankowski J. and **Ciereszko A.** (2005).

Biochemical characteristics and sperm production of turkey semen in relation to strain and age of the males. *Poultry Science*, 84, 1763-1768.

Lukaszewicz, E. (2002). An effective method for freezing white Italian gander semen. *Theriogenology,* 58, 19-27.

Lukaszewicz E., Jersey A., Partyka A. and **Siudzinska, A.** (2008). Efficacy of evaluation of rooster sperm morphology using different staining methods. *Research of Veterinary Science,* 85, 583-588.

Lukaszewicz, E. and **Kruszynski, W.** (2003). Evaluation of fresh semen and frozen-thawed semen of individual ganders by assessment of spermatozoa motility and morphology. *Theriogenology,* 59, 1627-1640.

Machebe, N. S. and **Ezekwe, A. G.** (2005). Ejaculate characteristics of three genotypes of local cocks in the humid tropics. *Journal of Agriculture, Food, Environmental Extension*, 3, 33-37.

Obidi J. A. Onyeanusi B. I., Rekwot P.I., Ayo J. O. and **Dzenda T.** (2008). Seasonal variations in seminal characteristics of Shikabrown breeder cocks. *International Journal of Poultry Science,* 7, 1219-1223.

Peters S. O., Omidiji E. A., Ikeobi C. O. N., Ozoje M. O. and **Adebambo, O. A.** (2004). Effect of Naked Neck and Frizzled Gene on Egg Traits, Fertility and hatchability in Local Chicken. In: Self Sufficiency of Animal Protein in Nigeria. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria at Ebonyi State University, Abakaliki, on September 13-16th, pp: 262-264.

Siudzinska, A. and **Lukaszewicz, E.** (2008a). The effect of breed on freezability of semen of fancy fowl. *Animal Science,* 26, 331-340.

Siudzinska, A. and **Lukaszewicz, E.** (2008b). Effect of semen extenders and storage time on sperm morphology of four chicken breeds. *Applied Poultry Research,* 17, 101-108.

Tselutin K., Seigneurin F. and **Blesbois E.** (1999).Comparison of cryoprotectants and methods of cryopreservation of fowl spermatozoa. *Poultry Science,* 78, 586-590.

Tuncer P. B., Kinet H., Ozdogan N. and **Demiral O.** (2006). Evaluation of some spermatological characteristics in Denizli cocks. *Journal of Factulty of Veterinary Medicince University,* 3, 37-42.

Tuncer P. B., Kinet H. and **Ozdogan N.** (2008). Evaluation of some spermatological characteristics in Gerze cocks. *Ankara University Vet.Fak.Derg.* 55, 99-102