ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 7 (10): 949-953, 2008
ISSN 1682-8356

Semen Quality Traits of Seven Strain of Chickens Raised in the Humid Tropics

S.O. Peters, O.D. Shoyebo, B.M. Ilori, M.O. Ozoje, C.O.N. Ikeobi and O.A. Adebambo
Department of Animal Breeding and Genetics, University of Agriculture, Abeokuta,
PMB 2240, Abeokuta 110001, Ogun State, Nigeria

Abstract: This research was conducted to investigate variation in semen quality traits of seven chicken strains. A total of 42 cocks belonging to 7 sire strains comprising of 3 Nigerian indigenous (Naked-neck, Frizzle and Normal feathered) cocks, 3 Exotic cocks (Nera Black, White Leghorn and Giriraja) and an improved indigenous crossbred (Alpha) cock developed at the Poultry Breeding Unit of the Teaching and Research Farm, College of Animal Science and Livestock Production, University of Agriculture, Alabata Road, Abeokuta, Ogun State between March, 2002 and April, 2003. Strain effect significantly affected semen volume ($P < 0.05$), sperm concentration ($P < 0.001$), motility ($P < 0.05$), colour ($P < 0.01$), active ($P < 0.05$) and sluggish ($P < 0.05$) spermatozoa but not on semen pH ($P > 0.05$). The White Leghorn had the highest semen volume, while the Naked neck had the least. The observed semen volume ranged from 0.37±0.02 to 0.73±0.01 ml. Naked neck birds had the highest value for sperm concentration followed by the Normal feathered strain, Nera black, White Leghorn, Alpha, Frizzle feather and Giriraja with corresponding values of 4.21±1.45 x 10^9/ml, 4.05±0.65 x 10^9/ml, 3.89±0.83 x 10^9/ml, 3.53±1.00 x 10^9/ml, 3.45±0.46 x 10^9/ml, 3.40±0.31 x 10^9/ml respectively. Naked neck had the highest value for motile spermatozoa while the Giriraja had the least value. The Pearson correlation coefficients between semen volume and other quality traits were generally low with positive values ranging from 0.01-0.35 between semen volume and percentage sluggish spermatozoa and semen pH and sperm motility respectively. It is concluded that large genetic variation existed in semen quantity and quality traits in cocks used for the study and that indigenous cocks had comparable results with the exotics and can therefore be included in A.I for genetic improvement as contributors of rare genes.

Key words: Cocks, chicken strains, variation, semen quality, poultry breeding

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. The semen of the domestic fowl according to Hafez (1978), varies from a dense opaque suspension to a watery fluid with a relative high density. He further stated that the differences in volumes and sperm concentration of the domestic fowl semen 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. It is important to note that many researchers have worked on semen production and quality on a variety of poultry breeds and strains. Breed and seasonal differences in semen production of cocks was reported by Saeed and Al-Soudi (1975) while Egbunike and Oluyemi (1979) showed that breed and time of semen collection affects cock semen. Omeje and Marine (1990) observed that significant genotype differences affected body size and semen characteristics of cocks, except the PH value. In addition, age by genotype interaction effect was important only for semen volume. Although, the results of several studies on semen characteristics of the domestic fowls has been published, little or none has been reported on the Nigeria local chicken with particular emphasis on the influence of major genes. The Nigerian local chickens constitute between 80 and 90 percent of the local population of chickens in Nigeria. Three Major genes had been identified in these local chickens. These are: Frizzle, naked neck and sex-linked dwarfism. Each of these genes plays a significant role in the productive adaptability of the Nigerian local chicken (Ozoje and Ikeobi, 1995). This study therefore focuses on the comparative evaluation of semen quality traits of seven chicken genotypes raised in the humid tropics

Materials and Methods

The research was carried out at the Poultry Breeding Unit of the University of Agriculture, Abeokuta, Nigeria. The University is located in the South-Western part of Nigeria and lies on an undulating plane on longitude 7°10'N and latitude 3° 2'E with an average annual rainfall of about 1037 mm. The mean ambient temperature ranges from 28°C in December-36°C in February with a yearly relative humidity of about 82%. The vegetation

represents an interphase between the tropical rainforest and the derived savannah. The Population of chicken used for this study consisted six mature sires each from seven sire strains maintained at the Poultry Breeding Unit. Three strains of the cock were exotic in origin (Black Nera, White Leghorn and Giriraja), another three were indigenous (Naked necked, Frizzled and Normal Feathered) and the last cock strain (Alpha) is a cross between Shaver and the Normal feathered indigenous chicken developed at the Poultry Breeding Unit, UNAAB.

Semen collection: The semen collection from the sires were accomplished by abdominal massage technique (Lake, 1962). Each cock was massaged at the back and stroked close to its tail while the inseminator also applied a slight finger pressure around the base of the tail. The phallus then become erect 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 it's 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 of the semen per ejaculate. The volume of the semen was recorded to the nearest 0.1 ml. During collection, the semen tube was maintained at 38-40^{o}C with an insulated jacket. A water bath and a slide warmer were used to maintain the samples at this temperature until sperm motility were assessed. The variation between strains with respect to semen characteristic were examined using the following parameters:

Semen volume: Semen volume from each of the sire strain were measured with the use of a collection tube graduated in ml.

Semen colour: Semen colour score (Where 1 = creamy white, 2 = between opaque and creamy-white and 3 = opaque) were recorded within 3 minutes of collection. The semen colour per sire strain was assessed visually.

Semen motility: A drop of semen with the aid of a micro-pipette was placed on a microscope slide, which was then covered with a glass cover slip to spread the semen in other 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.

Semen concentration: The semen concentration was measured using the direct cell count method. Here, the hemocytometer which is used for counting blood cells was used. It consists of specially designed slides that contains two counting chambers and two dilution pipettes. The counting chambers are 0.1 mm in depth and have a ruled area on the bottom of the chambers that is 1.0 mm^{2}, the square is sub-divided into 25 smaller squares. 0.5 normal saline was mixed with 1 ml of semen at the dilution rate of 1:250. The diluted semen was then picked up using a micropipette. 1 drop of the diluted semen was then dropped on one end of the hemocytometer and also on the other end, this was allowed to settle. The loaded hemocytometer was then placed on the microscope at a magnification of x 400. 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 of bird is found based the judgment of the individuals making the determination. The concentration of sperm per volume was found using the formula:

$$C = 50,000 \times N \times D.,$$

Where C = Concentration of semen per volume (ml), N = Number of spermatozoa counted, D = Dilution rate.

Semen pH: This was determined with the aid of a calibrated pH meter.

Data analysis: All data collected were subjected to analysis of variance to investigate the effect of strain on the quantity and quality traits. Pearson correlation estimates for semen quality trait were also performed.

Results

The summary of the analysis of variance indicated that sire strain had significant effect on semen volume ($P < 0.05$), sperm concentration ($P < 0.01$), sperm motility ($P < 0.05$), colour ($P < 0.01$), active ($P < 0.05$) and sluggish ($P < 0.05$) spermatozoa but not ($P > 0.05$) on semen pH. The least square means as presented in Table 1 revealed that the White Leghorn strain had the highest semen volume followed by Giriraja, Frizzled feathered, Normal feathered, Nera black, Alpha and then Naked neck with corresponding mean values of 0.73±0.01, 0.65±0.04, 0.60±0.02, 0.56±0.04, 0.47±0.02, 0.40±0.03 and 0.37±0.02 respectively. The Least square means for semen concentration as affected by strain of sire did not follow a similar pattern with that of semen volume. The Naked necked indigenous strain had the highest semen

Table 1: Least Squares Means of the seven chicken genotypes as affected by cock strain

Strains	N	Volume (ml)	Conc. 10^9 ml	pH	Motility%	Colour	Active (%)	Sluggish (%)
Giriraja	6	0.65±0.04^{b}	3.11±0.42^{d}	7.04±0.01	62.55±10.26^{e}	1.00±0.02^{a}	90±0.03^{ab}	10±0.05^{d}
White Leghorn	6	0.73±0.01^{a}	3.53±1.00^{c}	7.02±0.01	82.5±10.26^{b}	2.00±15^{b}	75±0.02^{c}	25±0.10^{b}
Frizzled feathered	6	0.60±0.02^{bc}	3.40±0.31^{c}	7.02±0.01	73.22±10.01^{c}	1.00±0.01^{a}	85±0.01^{b}	15±0.20^{c}
Nera Black	6	0.47±0.02^{d}	3.89±0.46^{b}	7.01±0.01	70.00±9.88^{d}	1.00±0.02^{a}	95±0.01^{a}	5.0±0.20^{e}
Naked Neck	6	0.37±0.02^{e}	4.21±1.45^{a}	7.07±0.01	87.35±10.12^{a}	1.00±0.03^{a}	90±0.02^{ab}	10±0.10^{d}
Normal Feathered	6	0.56±0.04^{c}	4.05±0.65^{a}	7.04±0.02	72.56$_{0}$10.92^{c}	1.00±0.01^{a}	85±0.02^{b}	15±0.15^{c}
Alpha	6	0.40±0.03^{de}	3.45±0.46^{c}	7.02±0.02	82.50±10.00^{b}	3.00±0.02^{c}	65±0.00^{d}	35±0.04^{a}

Means in the same column with different letters are significantly different (P < 0.05), N = Number of cocks used.

concentration followed by the Normal feathered strain, Nera black, White Leghorn Alpha, Frizzled feathered and Giriraja with corresponding values of 4.21±1.45 x 10^9/ml, 4.05±0.65 x 10^9/ml, 3.89 ± 0.83 x 10^9/ml, 3.53 ± 10^9/ml, 3.45±0.46 x 10^9/ml, 3.40±0.31 x 10^9/ml and 3.11±0.42 x 10^9/ml respectively. On sperm motility, the Naked neck strain had the highest value for motile spermatozoa with a value of 87.35±10.12% followed by White Leghorn and Alpha, Frizzled feathered, Normal feathered, Nera black and finally Giriraja with corresponding values of 82.54±10.26%, 82.50±10.00%, 73.22±10.01%, 72.56±10.92%, 70.00±9.88% and 62.55±10.26%, respectively. Strain difference was also observed in the percentage of spermatozoa that are active and sluggish. Percentage of active spermatozoa ranged from 90±0.02% for Naked neck and Giriraja to 65±0.00% for the Alpha. Percentage of sluggish spermatozoa followed a reversed order when compared to percentage active spermatozoa. Least square means of semen pH as affected by sire strain presented in Table 1 revealed that there was no significant (P > 0.05) difference between the strains. The semen pH for all the strains was slightly alkaline and ranged from 7.01±0.01 for Nera black to 7.04±0.02 for Normal feathered and Giriraja sire strains. Semen colour was affected by sire strain (P < 0.05). The Alpha had an opaque colour followed by the White Leghorn, which had an intermediate colour between the opaque and the white (milky) while the Giriraja, Frizzled feathered, Naked neck, Nera black and normal feathered had creamy white colour (Table 1).

Correlation of semen characteristics: The Pearson correlation coefficients between the semen quantity and quality traits are presented in a matrix (Table 2). The coefficients are generally very low to medium with positive values ranging from 0.01-0.35 for correlation between semen volume and percentage sluggish spermatozoa and semen pH and motility respectively. Significant and positive correlation existed between sperm concentration and motility (r = 0.25) and between concentration and percentage active spermatozoa (r = 0.27). The correlation between sperm concentration and semen volume though low was significant (r = 0.09). The correlation coefficient between sperm concentration and pH and sperm concentration with percentage sluggish spermatozoa were low and not significant (r = 0.06) and (r = -0.03) respectively. The correlation coefficient between sperm motility and sperm concentration (r = 0.25), semen volume (r = 0.16) and semen pH (r = 0.35) were positive and significant.

Discussion

The results showed that there were differences in strain with respect to semen volume, concentration, motility, active and sluggish spermatozoa. These observations were consistent with the report of Egbunike and Oluyemi (1979); Ezekwe and Machebe (2004). The exotic strain of White Leghorn and Giriraja had the highest semen volume probably because they had been selected for high reproductive efficiency The Frizzled feathered and Normal feathered cocks had values for semen volume that are comparable with exotic strains in the humid tropical environment. The values obtained for all the cocks in semen volume were within the acceptable range for artificial insemination (Hafez, 1978). The concentration of spermatozoa in the indigenous cocks (Naked neck and Normal feathered) was higher than 1.2 billion (Nwagu *et al.*, 1996) 2.0 billion sperm/ml semen by Keskin *et al.* (1995); Sarka *et al.* (1996) but lower than 4.3 billion sperm/ml reported by Moya *et al.*, 1996. in broiler cocks and 7.0 billion sperm/ml (Hafez, 1978) The differences in the semen concentration can only be attributed to the fact that the strains are from different genetic backgrounds and that the indigenous chicken are fully adapted to this environment. It also appeared that the higher sperm concentration in the indigenous cocks compensated for the relatively lower volume of semen. The value of semen motility for Frizzled feathered birds and active spermatozoa obtained for naked neck strain are similar to values reported for the Deshi fowl and its hybrids (Sarka *et al.*, 1996) but lower than 93.8 and 97% reported by Holeppagol *et al.* (1994) and Bapjai (1963) respectively. The values obtained for semen motility for all the strains were within the range reported for Normal cock semen (Lake, 1966; Egbunike and Nkanga, 1999) and therefore barring any anatomical defect in the hen, fertility is expected to be high. The values obtained for semen pH for all the strains were also within the range reported for poultry semen (Etches, 1998). The most obvious evaluation of semen quality is colour. The results of semen colour as affected by strain in this study indicated that the further away from creamy white colour the semen of the chicken strain is, more likely is the presence of contaminations (Etches, 1998).

Table 2: Correlation coefficient matrix of semen characteristics of the seven sire strains

	Conc.	Volume	pH	Motility	Active	Sluggish
Conc.	1.00					
Volume	0.09*	1.00				
PH	0.06	0.12*	1.00			
Motility	0.25*	0.16*	0.35*	1.00		
Active	0.27*	0.10	0.17*	0.28*	1.00	
Sluggish	-0.03	0.01	0.02	0.13	-0.42*	1.00

Legend: Conc = Sperm concentration, Volume = Semen volume, pH = Semen pH, Motility = Sperm motility, Active = %active sperm, Sluggish = % sluggish sperm. *P < 0.05

Semen evaluation is an essential aspect in the assessment of the breeding soundness of any male animal. The relationship between semen volume, sperm motility, sperm concentration, pH and colour are very important since they, to a large extent determine the fertility potential of the semen. The positive correlation between semen volume and sperm concentration in this study is consistent with the reports of Schneider (1992). The positive but low and insignificant correlation value obtained for semen volume and sperm concentration indicated that increase in the volume may not necessarily translate to higher sperm concentration. The correlation estimates obtained for semen volume and sperm motility was expected because the more the volume of fluid, the more space is available for sperm cells to move easily. Also selecting cocks for higher semen volume could also mean selecting them for high sperm motility. The positive and significant correlation coefficient between sperm motility and concentration, sperm motility and semen pH in this study agrees with earlier report by Tomar *et al*. (1966) who reported that poor initial sperm motility caused low semen pH which ranged from slightly acidic to slightly alkaline. In conclusion, Sire strain variation was found to be significant on semen volume, sperm concentration, sperm motility and percentage of active and sluggish spermatozoa in this study. The semen from the indigenous cocks had comparable results to that of exotics after examination. This means they can compete favourably with the exotics in an A.I program. There was a positive correlation between semen volume and sperm concentration and between sperm concentration and sperm motility.

Acknowledgement

The Authors wish to acknowledge the technical assistance of Prof. O.A. Osinowo during the semen quality analysis. We also want to appreciate the effort of all Poultry Breeding Unit Staff.

References

Bapjai, P.K., 1963. The effect of photoperiodicity on semen characteristics of poultry. Poult. Sci., 42: 462-465.

Egbunike, C.N. and J.A. Oluyemi, 1979. Comparative studies of the reproductive capacity of the Nigerian and Exotic poultry breeds. Nig. J. Anim. Prod., 6: 47-51.

Egbunike, G. and E.E. Nkanga, 1999. Effects of breed and season on the semen characteristics of the cock in the humid tropics. Trop. J. Anim. Sci., 1: 127-134.

Etches, R.T., 1998. Reproduction in poultry. CAB Int., Wallingford, pp: 318.

Ezekwe, A.G. and N.S. Machebe, 2004. Ejaculate characteristics of two strains of local (cocks Naked-neck and frizzle) in Nigeria. In: Sustaining livestock production under changing economic features. Proceeding of the 29th NSAP conference, Sokoto, March, 21-25, pp: 92-95.

Hafez, E.S.E., 1978. Reproduction in farm animals. 2nd ed., Pg: 237.

Holeppagol, S.S., N.S. Sidhu and G.S. Bisht, 1994. Genetic group comparisons in live (normal) and dead (included abnormal) percentages of poultry spermatozoa. Ind. Vet. Med. J., 18: 88-91.

Keskin, O., E. Tekin and N. Kgaye, 1995. The principal spermatological characteristics of Denizil cocks. Hay Vancilik Arastirma Ens. Derg., 35: 87-99.

Lake, P.E., 1962. Artificial Insemination in poultry. In: Maile, J.P. (eds). The semen of animals and A.I. Commonwealth Agri. Bureau, Bucks, England, pp: 331- 335.

Lake, P.E., 1966. Physiology and biochemistry of poultry semen. In: Advances in Reproductive physiology, 1. Anne Mclaren ed. Academic Press, N.Y., PP: 93-123.

Moya, A., M. Gonzalez and M. Capote, 1996. Selection of White leghorn Cocks for artificial insemination 1: sire semen evaluation. Poult. Sci., 75: 1112-1119.

Nwagu, B.I., P.I. Reroot, B.Y. Abubakar, O.O. Oni, I.A. Adeyinka and U.C. Egbuedo, 1996. Semen characteristics of Rhode Island Red and white breeder cocks. Nig. J. Anim. Prod., 23: 1-4.

Omeje, S.S.I. and B.N. Marine, 1990. Evaluation of semen characteristics of adult cocks of different genetic background. Theriogenology, 24: 1111-1118.

Ozoje M.O. and C.O.N. Ikeobi, 1995. Productive performance and occurrence of major genes in the Nig. Local chicken. Nig. J. Genetics, 67-77.

Peters, S.O., E.A. Omidiji, C.O.N. Ikeobi, M.O. Ozoje and O.A. Adebambo, 2004. Effect of Naked Neck and Frizzled Genes on Egg Traits, Fertility and Hatchability in Local Chicken. In: Self Sufficiency of Animal Protein in Nigeria. Proceedings of the 9th Annual Conference of Anim. Sci. Assoc. Nig., Ebonyi State Univ., Abakaliki, Nig. September 13-16th, pp: 262-264.

Saeed, J.M. and K.A. Al-Soudi, 1975. Seasonal Variation in Semen Characteristics of White Leghorn, New Hamphire and indigenous chickens in Iran. Br. Poult. Sci., 16: 91-102.

Sarka, R., B.B. Ghosh, S.K. Bandopadhyay, R.R. Choudhury and R.D. Gupta, 1996. A study on the physical character of semen of hybrid (broiler and layer) and Deshi cross fowl. Ind. J. Anim. Reprod., 17: 55-57.

Schneider, K.K.H., 1992. Effect of strain and spermtologic protection on ejaculate, production and semen quality of young gander. 9th int. symposium. Pisa Italy. World Poult. Ass., pp: 130-139.

Tomar, N.S., B.S. Misra and C.B. Johair, 1966. Semen characteristics from Native bulls in Southern India. Ind. J. Dairy Sci., 19: 87-93.