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Effect of Genotype and Frequency of Semen Collection on Semen Characteristics of Local Chicken Cocks

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Abstract: This study reports the effect of genotype and frequency of semen collection on seminal traits of local chicken cocks. Semen was collected, using the back-lumbar massage method from Normal Feather (NOF), Naked Neck (NN), Frizzle (FR) and Naked Neck x Frizzle (NNxFR) cocks at two ejaculation frequencies, namely once and twice per week for nine weeks. Ejaculates were subjected to both physical and laboratory evaluations for quality. Results showed that there were significant ($p<0.05$) differences between the genotypes for semen volume with the NOF (0.15±0.009 mL) and NN x FR (0.13±0.013 mL) cocks having higher semen volumes than that of the NN (0.11±0.013 mL) and FR (0.08±0.013 mL) counterparts. Total spermatozoa was the only seminal trait significantly affected by the two frequencies of collection with once a week giving higher values than twice a week collection. Interaction effect was significant for sperm concentration and total spermatozoa. This effect was stronger when semen was harvested twice a week with the NN x FR and NOF cocks producing higher values. It was therefore concluded that NN x FR and NOF genotype were superior to their NN and FR counterparts in both semen output and frequency of semen collections and may be considered as potential candidates for use in natural mating and/or artificial insemination programmes aimed at improving the lot of the local chicken.

Key words: Semen characteristics, normal feather, naked neck and frizzle genes, interaction effect, local chicken cocks

INTRODUCTION

Good quality semen is an important factor determining fertility in cocks and indeed a prerequisite for successful hatchery operations. Infertility problems in poultry have often been blamed on the males[1]. This is so because most females normally contribute their ova in appreciable numbers based on their innate laying ability[2]. Improvement of reproductive capacity of local cocks by crossbreeding with exotic stock has been reported[3,4] and in recent past, the utilization of some tropically relevant major genes or gene complexes such as a naked neck and frizzle genes for the improvement of ejaculate characteristics of the local stocks has been investigated[5]. These investigators observed that naked neck and frizzle genotypes produced better ejaculates than their normally feathered counterparts.

Santayana[6] reported that sperm concentration decreases progressively with increase in frequency of ejaculation. Semen concentration appears to be the seminal trait that is most commonly affected by frequency of ejaculation[6]. There is paucity of information on interaction between genotype and frequency of ejaculation on semen characteristics of local chicken. This study therefore aims at investigating the effect of genotype and frequency of semen collection as well as optimal combination of genotype and frequency of semen collection that will result in good semen quality and hence improve the fertility of local chicken cocks.

MATERIALS AND METHODS

The experimental cocks were drawn from a population of Normal Feather (NOF), Naked Neck (NN), frizzle (FR) and naked neck x frizzle (NNxFR) F_1 crossbred cocks maintained at the poultry unit of Michael Okpara University of Agriculture Teaching and Research farm. The cocks were aged between 48 and 50 weeks and had been on *ad libitum* feeding on commercial layers mash ration containing 16% crude protein. All necessary vaccinations were administered to the birds in line with the vaccination schedules for the University poultry farm.
Semen collection and evaluation

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Table 1: Semen characteristics of the different genotypes of local chicken cocks

	Genotype			
Parameter	NOF	NN	FR	NnxFR
Semen vol. (mL)	0.15^{a}±0.009	0.11^{ab}±0.013	0.08^{b}±0.013	0.13^{a}±0.013
Sperm motility (%)	66.50^{b}±2.167	64.98^{b}±3.169	60.82^{c}±3.168	77.50^{a}±3.064
Sperm conc. (10^{6})	1542.58^{b}±158.959	1571.14^{b}±232.478	1323.69^{c}±232.478	1624.60^{a}±224.802
Total spermatozoa (10^{6})	317.11^{b}±102.346	386.82^{a}±149.681	1376.49^{a}±149.681	318.04^{b}±144.739
Sperm defect (%)	17.46±0.522	17.35±0.764	16.55±0.764	17.31±0.739
Dead sperm (%)	22.35± 0.687	20.501.005	23.42±1.005	20.89±0.972
Live sperm (%)	77.65±0.729	79.52±1.006	76.59±1.066	78.00±1.031

NOF = normal feather, NN = naked neck, FR= Frizzle and NNxFR = Naked neck x Frizzle. $^{a-b}$Means in the same row with different superscripts are significantly different ($p<0.05$)

The cocks were given preliminary training for two weeks to enable them produce enough semen during actual semen collection exercise. The back-lumbar massage method as described by Lake *et al.*[7] was adopted. During each collection, semen was gently squeezed into labelled test tubes. Two semen collection frequencies (once and twice per week) were carried out. All ejaculates were immediately evaluated for semen volume and colour. Sperm motility was determined under a microscope at a magnification of x 40. Semen concentration was estimated using haemocytometry count method while sperm morphology was examined after sample dilution using sodium citrate solution. Percentage live sperm, dead sperm and sperm defects such as damaged tail or head were determined.

Experimental design and data analysis: The experimental design was a two factor factorial in Completely Randomised Design (CRD). The factor of interest were genotype, Namely Normal Feather (NNF) Naked Neck (NN), Frizzle (FR) and Naked Neck x frizzle (NN x FR) and frequencies of semen collection were (either once or twice per week).

The statistical model used is as in expression (1).

$$Y_{ijk} = \mu + G_i + F_j + (GF)_{ij} + e_{ijk}, \quad (1)$$

Where Y_{ijk}= a single observation on a semen characteristics.

μ = Fixed overall mean
G_i = the main effect of genotype (i = 1, …, 4)
F_j = the main effect of frequency of semen collection (j = 1,2)
$(GF)_{ij}$ = The effect of interaction between genotype and frequency of semen collection.
eijk = random error assumed to be independently and identically normally distributed with zero mean and constant variance.

Analysis of variance (ANOVA) procedure appropriate for a two factor factorial was used to analyse the data. Mean separation of significant effects was done using Duncan's Multiple Range Test[8].

RESULTS AND DISCUSSION

Semen characteristics of the four local chicken genotypes are presented in Table 1. There was significant ($p<0.05$) genotype effect on semen volume with the Normal Feather (NOF) and Naked Neck x Frizzle (NN x FR) individuals producing larger volume of semen than their Naked Neck (NN) and Frizzle (FR) counterparts. This results is at variance with the reports of Ezekwe and Machebe[5] who observed that naked neck and frizzle cocks produced more semen than the normal feathered cocks in the humid tropics. The range of semen volume (0.11±0.13 to 0.15±0.009 mL) recorded in this study falls below the range of values (0.25 to 0.35 mL) reported by Burke[9]. Differences of this sort have been associated with variations among breeds or strains and even among individuals within breeds or strains. The superior seminal volume exhibited by the NOF and NN x FR cocks showed that differences exist among different genotypes as similarly reported by Butswat *et al.*,[10]. The performance of the naked neck x frizzle F_1 crossbreds in this respect suggests that theses crossbreds benefited from complementary genes resulting from parental epitasis as reported by Sheridan[11].

Percentage sperm motility was significantly highest for the NNxFR genotype (77.50±3.06), followed by NOF and NN cocks (66.50±2.17 and 64.98±3.17%), respectively and least for the FR cock (60.82±3.17%). Sperm

Table 2: Effect of frequency of collection on semen characteristics of local chicken cocks (pooled samples)

	Frequency	
Parameter	Once	Twice
Semen vol. (mL)	0.11±0.009	0.12±0.009
Sperm motility (%)	64.15±2.014	67.75±2.027
Sperm conc. (10^{6})	1546.27±154.403	1634.73 ±148.693
Total spermatozoa (10^{6})	530.61^{a}±99.412	243.60^{b}±95.74
Sperm defect (%)	17.57±0.507	16.76±0.489
Dead sperm (%)	22.60±0.668	20.98±0.643
Live sperm (%)	72.42±0.708	78.47±0.682

$^{a-b}$Means in the same row with different superscripts are significantly different ($p<0.05$)

Table 3: Effect of interaction between genotype x frequency of collection on semen characteristics of local chicken cocks

Parameter	Frequency	NOF	NN	FR	NnxFR
Semen vol. (mL)	Once	0.14±0.13	0.12±0.19	0.08±0.19	0.11±0.19
	Twice	0.16±0.13	0.11±0.19	0.08±0.19	0.14±0.19
Sperm motility	Once	63.06±3.06	63.73±4.62	58.48±4.62	71.33±4.33
	Twice	69.94^{a}±3.06	66.22^{b}±4.33	63.17^{b}±4.33	71.67^{a}±4.33
Sperm conc.	Once	1312.22±224.80	1239.45±339.23	1144.52±339.28	1288.89±317.92
(10^{6})	Twice	1772.93^{a}±224.80	1302.83^{c}±317.92	1502.86^{b}±317.92	1960.31^{a}±3192
Total spermatozoa	Once	260.76±144.74	220.60±218.45	292.54±218.44	248±204.69
(10^{6})	Twice	373.45^{a}±144.74	253.04^{b}±204.69	260.37^{b}±204.69	287.54^{ab}±204.69
Sperm defect	Once	17.17±0.74	19.37±1.12	16.82±1.12	17.00±1.05
(%)	Twice	17.75±0.74	15.39±1.05	16.28±1.05	17.61±1.05
Dead sperm	Once	23.67±0.97	20.94±1.47	21.72±1.38	21.11±1.38
(%)	Twice	21.03±0.97	20.06±1.48	21.72±1.38	21.11±1.38
Live sperm	Once	76.33±1.03	79.09±1.56	74.90±1.56	79.33±1.46
(%)	Twice	78.97±1.03	79.94±1.46	78.28±1.46	79.67±1.46

Genotype code = Same as in Tables 1 and 2 $^{a-b}$Means in the same row with different superscripts are significantly different ($p<0.05$)

concentration was significantly more for the NNxFR crossbred cocks and followed similar trend as sperm motility for the various genotypes. This result indicates that crossbreeding the naked neck and frizzle genotypes produced cocks with marked improvement in most seminal properties.

This study did not detect any genotype effect on sperm morphology (i.e. sperm defect, dead and live sperms). Percentage sperm defect reported here is lower than the 20% defect reported by Hafez[12]. Percentage live sperm for the four genotypes were also high exceeding 75% in all. The implication of these findings is that high fertility can be achieved with these local chicken cocks. This is likely so, since Donaghue and Waker Simmons[13] have shown that high positive correlation exist between sperm motility (an index of live sperm) and fertility in the chicken.

Table 2 gives the effect of frequency of semen collection on semen characteristics. Apart from total spermatozoa which was significantly ($p<0.05$) affected by the two frequencies of semen collection, with once a week ejaculation given higher spermatozoa values than twice a week, all other parameters (Semen volume, sperm motility, sperm concentration, sperm defect, dead and live sperm) were not significantly affected by frequency of collection. Progressive decline in sperm concentrations with increase in frequency of ejaculation is expected as reported by Santayana[6]. However, reports by Noirault and Brillard[14] working with male turkeys showed no evidence of decrease in sperm concentration following increase in ejaculation frequency. Discrepancies in the result herein reported as compared to some previous reports are not unconnected with the kind of animal species used, the ejaculation methods and the severity of the frequency of semen collection.

Table 3 presents result of interactions between genotype and frequency of collection on seminal characteristics. Only two seminal traits namely sperm concentration and total spermatozoa showed significant interaction effect. The effect of genotype in these parameters became strong when semen was harvested twice with the NNxFR and NOF cocks producing larger values. This seems to suggest that these two genotypes are more suitable for frequent semen collections and therefore, could be considered as potential candidates for use in either natural mating or artificial insemination programmes aimed at improving the reproductive performance of the local chicken cocks.

REFERENCES

1. Etches, 1996. Reproduction in Poultry. Cab International, Wallingford, UK, pp: 241-250.
2. Omeje, S.I. and I. Ude, 1998. Effect of feed restriction on body weight and semen characteristics of native and exotic (broiler) cocks. J. Applied Anim. Res., 14: 18-86.
3. Egbunike, G.N. and J.A. Oluyemi, 1979. Comparative studies of the reproductive capacity for Nigerian and exotic poultry breeds. Nigeria J. Anim. Prod., 6: 47-57.
4. Egbunike, G.N and E.E. Nkanga, 1999. Effect of breed and season on semen characteristics of cocks in the humid tropics. Tropics. J. Anim. Sci., 1: 127-134.
5. Ezekwe, A.G. and N.S. Machebe, 2004. Effect of dry season on the ejaculate characteristics of three genotype of local cocks in the humid tropics. Proc. 9th Ann. Conf. ASAN. Sept. 13th-16th, 2004. Ebonyi State University, Abakiliki, Nigeria, pp: 239-241.
6. Santayana, G., 1985. Artificial insemination. In: The science of Animals that serve humanity. 3rd Ed. J.R. Campbell and J. Lastey (Ed). McGraw Hill Inc. U.S.A., pp: 295.
7. Lake, P.E, O. Ravie and D. Naddington, 1985. Some effects of the composition of inseminated semen and the site of its deposition and fertility in Gallus domesticus. Anim. Reprod. Sci., 9: 273-284.

8. Duncan, D.B., 1955. Multiple range and multiple F-tests. Biometrics, 11: 1-42.
9. Burke, W.H., 1984. Arian Reproduction. In: Dukes Physiology of domestic animals. 10th Ed., M.J. Swenson (Ed) Cornel University Press. New York, pp: 847-862.
10. Butswat, I.S.R, D.J.U. Kalla and B.S. Dafur, 2002. Effect of variety and season on semen characteristics and estimates of some genetic parameters in helmeted guinea fowl (Numida meleagris galata). Bull. Anim. Health and Prod. Afr., 49: 289-291.
11. Sheridan, A.K., 1981. Crossbreeding and heteriosis. Animals Breeding Abstracts, 49: 131-144.
12. Hafez, 1995. Artificial insemination In: E.S.E, Hafez (Ed). Reproduction in farm animals 6th Ed. Lea and Lebiger, Philadelphia. U.S.A., pp: 424.
13. Donaghue, A.M. and M.K. Walker Simons, 1999. The influence of wheat dehydration-induced proteins on the function of turkey spermatozoa after 24 h in istro storage. Poultry Sci., 78: 235-241.
14. Noirault, J. and J.P. Brillard, 1999. Effect of frequency of semen collection on quantitative and qualitative characteristics of semen in turkey breeder males. Poultry Sci., 78: 1034-1039.