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ORIGINAL RESEARCH ARTICLE

Semen qualities of normal and frizzle feather strains of domestic cocks treated with or without tocopherol

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ABSTRACT

The study was conducted to evaluate the effect of tocopherol on the semen characteristics of two genotypes of indigenous Nigerian cocks. Seventeen (17) indigenous breeding cocks comprising of 9 frizzle and 8 normal feathered cocks selected randomly from their natural breeding habitat in Ilorin, Kwara State were treated with or without tocopherol to improve reproductive potential of the birds. The tocopherol was administered intramuscularly at 0.02ml/kg body weight. Semen was collected twice weekly for six weeks post treatment from the cocks using the abdominal massage technique and analysed for semen characteristics. Sperm concentration was significantly ($p<0.05$) higher in cocks treated with tocopherol; $2.31\times10^9\pm0.25$/ml for frizzle feathered and $2.72\times10^9\pm0.42$/ml for Normal feather than those without tocopherol; $0.72\times10^9\pm0.30$/ml (frizzle feathered) and $0.44\times10^9\pm0.03$/ml (Normal feathered). Semen volume was significantly higher for normal feathered cocks treated with tocopherol ($p<0.05$) than frizzle feathered cocks treated with tocopherol. There was no significant effect ($p>0.05$) of genotype and tocopherol treatment on sperm motility, live sperm cells, dead sperm cells and abnormality. There were generally very poor correlations between semen characteristics of cocks (those treated with tocopherol and those without tocopherol) except for live sperm and motility which consistently correlated negatively with dead sperm cells. Tocopherol treatment improved the semen quality of indigenous cocks.

Keywords: Semen quality, domestic cocks, Frizzle and Normal feathered fowls, Tocopherol

INTRODUCTION

The contribution of rural poultry to the national economy of developing countries and the nutritional status and income levels of many smallholder farmers and landless communities has been very significant, contributing 34.8% of Gross Domestic product in Nigeria. This potential seems unexploited since no intensive research has been done to improve the production of local chickens to the benefit of the people living in rural areas. Studies on growth and management of indigenous chickens have primarily been surveys (Van Veluw, 1987; Awuni, 2002; Osei-Amponsah *et al*., 2007). In spite of the mirage of problems involved in poultry keeping, almost all poor households in the villages keep poultry; therefore, poultry production is considered an excellent tool in poverty alleviation due to its quick turn over and low investment. Thus, if production could be improved, village poultry production would create an opportunity for the development of the poor segments of society (Quisumbing *et al*., 1995, 1998; Todd, 1998; Permin *et al.*, 2000).

One of the ways to improve the productivity of poultry birds is by assessing their reproductive potentials. The reproductive potential of cocks is determined to a large extent by the quality of the semen produced. The assessment of semen quality characteristics of Nigerian local chicken gives excellent indices of its reproductive potential and has been reported to be a major determinant of fertility and subsequent hatchability of eggs (Peters *et al*., 2004). Several reports on semen characteristics of the domestic fowls have indicated that breed and strain significantly affect semen quality and quantity (Schneider, 1992; Bah *et al*., 2001; Tuncer *et al*., 2006; Peters *et al*., 2008). The semen of the domestic fowls, according to Hafez (1978), varies from a dense opaque suspension to a watery fluid with a relative high density. The author further stated that the differences in volumes and sperm concentrations 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. Breed and seasonal differences on semen production of cocks have been

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.

Nigerian local chickens constitute between 80 and 90 percentage of the local population of chickens in Nigeria. Three major genes had been identified in these local chickens: 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). These indigenous Nigerian breeds have been reported to have many advantageous gene complexes or gene marker; that could be harnessed in the development of meat or egg type chicken suitable for use in the tropics (Machebe and Ezekwe, 2004). According to Ibe (1998), the frizzle and naked neck gene are tolerant to heat stress, disease resistance and increased productive capacity. Contributions of Nigerian indigenous birds to survival, adaptability and biodiversity, have been established in the reports of Ebozoje and Ikeobi (1995) and Machebe and Ezekwe (2004). The merits of semen evaluation in selecting breeding males for breeding or routine monitoring of their reproductive performance cannot be overemphasized. Exogenous antioxidant sources for breeding stock may provide improvement to their reproductive potential and efficiency. It was therefore, the aim of this study to evaluate the effect of tocopherol on the semen characteristics of two genotypes of indigenous cocks (frizzle and normal feathered) of Nigeria

MATERIALS AND METHODS

Experimental Site

This experiment was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan. The site lies within 7°43′16″ North and 3°88′47″ East within the tropical rain forest zone with mean annual rainfall exceeding 1500mm.

Experimental Animals

A total of 17 local cocks aged between 40 and 45 weeks with average live weight of 1.2±0.01 kg comprising two strains of Nigerian indigenous cocks (9 frizzle feathered and 8 normal feathered) purchased from the same community in Ilorin, Kwara State, Nigeria.

Experimental Layout and Management of the Birds

The birds were replicated twice within strain and each replicate of 4 birds were housed together in a pen unit. Each cock within a replicate was tagged for proper identification. Two weeks prior to the arrival of the experimental birds, pens, feeders, drinkers and other experimental materials were thoroughly washed and cleaned with detergent and disinfected. Dried wood shavings were provided as litter material. Upon arrival of the cocks, anti-stress and antibiotic were administered for three days and they were fed commercial grower mash containing 17.5% crude protein and 2800Kcal/kg Metabolisable energy throughout the experimental period, while clean drinking water was provided *ad libitum*. The birds were acclimatized for four weeks. After the period of acclimatisation, the birds were trained for semen collection. The cocks were treated with tocopherol intramuscularly at 0.2ml/kg body weight weekly.

Semen collection and evaluation

The semen collection was done twice weekly for six weeks from the cocks through abdominal massage technique. Each cock was massaged at the back in small squares with stroking close to the tail and slight finger pressure applied around the base of the tail, the phallus becomes 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 right thumb was pressed on the bird's abdomen directly beneath its vent. This caused semen to be released from the ducts deferens almost immediately and the semen was gently squeezed from the swollen papillae at the base of the phallus into an eppenduf tube.

Semen evaluation

The semen evaluation for colour was determined and recorded and a tuberculin syringe was used to drain the semen from the eppenduf tube to determine the volume of the semen per ejaculate. The volume of the semen was recorded to the nearest 0.01ml and semen was diluted with 1ml of normal saline solution. The semen colour per cock was assessed through visual appraisal immediately after collection. Semen volume from each of the cock strain was measured with the use of a tuberculin syringe graduated in 0.01 ml. Mass activity of spermatozoa was determined by putting a drop of undiluted fresh semen from each animal on a glass slide and examined with microscope under low power. The mass activity of spermatozoa from each animal was scored according to the intensity of the wave motion from absence of wave motion (+) to very turbulent motion (+++) characterized by appearance of dark prominent wave in a very rapid motion. Sperm motility, spermatozoa concentration of the semen and live:dead

Table 1: Effect of tocopherol on semen characteristics of frizzle and normal feather cocks

	Cocks without tocopherol		Cocks treated with tocopherol	
Characteristics	Frizzle feather	Normal feather	Frizzle feather	Normal feather
Volume (ml)	0.16±0.06^{ab}	0.35±0.13^{ab}	0.14±0.03^{b}	0.42±0.02^{a}
Semen Colour	Creamy white	Creamy	Creamy white	Creamy
Mass Activity	+++	+++	+++	+++
Sperm Motility (%)	78.40±2.66	83.75±3.75	83.33±4.41	86.67±1.67
Sperm Concentration (x10^{9})	0.72±0.30^{b}	0.44±0.03^{b}	2.31±0.25^{a}	2.72±0.42^{a}
Live Sperm Cells (%)	92.18±1.84	95.25±1.97	97.33±0.67	96.50±1.04
Dead Sperm Cells (%)	7.82±1.84	4.75±1.97	2.67±0.67	3.50±1.04

ab: Means with the same superscript are not significantly different (P<0.05).

ratio were determined as outlined in Ewuola and Egbunike (2010).

Statistical analysis

Data collected were subjected to a one-way analysis of variance considering the strain of cocks and means were separated using new Duncan's Multiple Range Test (nDMRT). Correlations between live weight and semen characteristics were determined for both strains. All Analysis was performed using the Statistical Analysis Systems (SAS, 1999) programme.

RESULTS

Semen characteristics of frizzle and normal feather strains of domestic chicken with or without tocopherol

The semen characteristics of frizzle and normal feather cocks treated with or without tocopherol are shown in Table 1. The analysis of the semen characteristics indicated that the mass activity, motility, sperm concentration, live sperm cell and dead sperm cell examined in frizzle feather birds were not significantly different from that of normal feather cocks. However, the sperm concentration of both frizzle and normal feather cocks treated with tocopherol were significantly higher compared to those without tocopherol treatment. The semen volume observed in normal feather was significantly (p<0.05) higher than that from frizzle feather with tocopherol treatment. The semen colour was creamy-white for frizzle feather and creamy for normal feather birds.

Correlation between live weight and semen characteristics of frizzle feather with or without tocopherol

The Pearson correlation coefficient between live weight and semen characteristics of frizzle feather cocks without tocopherol is shown in Table 2. A positive correlation existed between dead sperm cells and live weight (r = 0.64), sperm concentration and live weight (r = 0.56) whereas negative correlations were observed between semen motility and live weight (r = -0.58), live sperm cells and live weight (r = -0.64). Relatively high correlation coefficients values were observed but they were not significant. Significant correlations were observed between sperm motility and live sperm cell (r = 0.88) while negative significant correlations existed between sperm motility and dead sperm cells (r = -0.88). The correlation between live weight and semen characteristics of frizzle feather with tocopherol is shown in Table 3. As with frizzle feather cocks not treated with tocopherol, non significant positive

Table 2: Correlation between live weight and semen characteristics of frizzle feather birds

Parameter	Live weight	Volume	Motility	Live sperm	Dead sperm	Sperm concentration
live weight	1.00	0.19*	-0.58^{ns}	-0.64^{ns}	0.64^{ns}	0.56^{ns}
		(0.76)	(0.31)	(0.24)	(0.24)	(0.32)
Volume		1.00	-0.78^{ns}	-0.49^{ns}	0.49^{ns}	0.08^{ns}
			(0.12)	(0.41)	(0.41)	(0.08)
Motility			1.00	0.88	-0.88	0.42^{ns}
				(0.05)	(0.05)	(0.48)
live sperm				1.00	-1.00***	0.37^{ns}
					(0.0001)	(0.54)
Dead sperm					1.00	-0.37^{ns}
						(0.54)
Sperm concentration						1.00

*=Correlations significant (p<0.05). **=Correlations significant (p<0.01). ***=Correlations significant (p<0.001). ^{ns}=No Significance. P-values are in parenthesis.

Table 3: Correlation between live weight and semen characteristics of frizzle feather treated with tocopherol

Parameter	Live weight	Volume	Motility	Live sperm	Dead sperm	Sperm concentration	Abnormality
Live weight	1.00	0.99 ^{ns} (0.09)	-0.79^{ns} (0.42)	0.19^{ns} (0.88)	-0.19^{ns} (0.88)	0.64^{ns} (0.56)	0.14^{ns} (0.91)
Volume		1.00	-0.87^{ns} (0.33)	0.33^{ns} (0.79)	-0.33^{ns} (0.79)	0.52^{ns} (0.65)	0.00^{ns} (1.00)
Motility			1.00	-0.76* (0.45)	0.76^{ns} (0.45)	-0.02^{ns} (0.99)	0.50^{ns} (0.67)
Live sperm				1.00	-1.00* (<0.0001)	-0.64^{ns} (0.56)	-0.94^{ns} (0.21)
Dead sperm					1.00	0.64^{ns} (0.56)	0.94^{ns} (0.21)
Sperm concentration						1.00	0.85^{ns} (0.35)
Abnormality							1.00

*=Correlations significant (p<0.05). **=Correlations significant (p<0.01). ***=Correlations significant (p<0.001). ^{ns}=No Significance. P-values are in parenthesis.

correlation were observed between live weight and sperm concentration (r = 0.64), live weight and semen volume (r = 0.99) while negative correlation were observed between live weight and dead sperm cells (r = -0.19), and between live weight and semen motility (r = -0.79) of frizzle feather. A negative unity correlation exited between live sperm cells and dead sperm cells (-1.00).

Correlation between live weight and semen characteristics of normal feather with or without tocopherol

The Pearson correlation coefficient between the live weight and semen characteristics of normal feather chickens without tocopherol is shown in Table 4. A positive correlation existed between live weight and semen volume (r = 0.79), live weight and sperm concentration (r = 0.32), live weight and semen motility (r = 0.09), live weight and live sperm cells (r = 0.04) of the normal feather cocks. There was a negative correlation between the live weight and dead sperm cells (r = -0.04) of normal feather birds though not significant. The correlation between live weight and semen characteristics of normal feather cocks treated with tocopherol is shown in Table 5. The summary of the correlation analysis between live weight and semen characteristics of normal feather birds treated with tocopherol showed positive correlation between the semen volume (r = 0.94), motility (r = 0.24), live sperm cells (r = 0.85), semen concentration (r = 0.67), abnormality (r = 0.99) and the live weight of normal feather cocks treated with tocopherol and a negative correlation existed between the dead sperm cells and the live weight (r = -0.85).

DISCUSSION

Assessment of semen characteristics is an important index in determination of reproductive potential in

Table 4: Correlation between live weight and semen characteristics of normal feather birds

	Live weight	Volume	Motility	Live sperm	Dead sperm	Sperm concentration
Live weight	1.00	0.79 ^{ns} (0.21)	0.09 ^{ns} (0.90)	0.04 ^{ns} (0.96)	-0.04 ^{ns} (0.96)	0.32 ^{ns} (0.68)
Volume		1.00	-0.49 ^{ns} (0.50)	-0.57 ^{ns} (0.43)	0.57 ^{ns} (0.43)	0.73 ^{ns} (0.27)
Motility			1.00	0.91 ^{ns} (0.09)	-0.91 ^{ns} (0.09)	-0.88 ^{ns} (0.12)
Live sperm				1.00	-1.00* (<0.0001)	-0.73 ^{ns} (0.27)
Dead sperm					1.00	0.73 ^{ns} (0.27)
Semen concentration						1.00

*=Correlations significant (p<0.05). **=Correlations significant (p<0.01). ***=Correlations significant (p<0.001). ^{ns}=No Significance. P-values are in parenthesis.

Table 5: Correlation between live weight and semen characteristics of normal feather birds treated with tocopherol

	Live weight	Volume	Motility	Live sperm	Dead sperm	Sperm concentration	Abnormality
Live weight	1.00	0.94^{ns} (0.23)	0.24^{ns} (0.84)	0.85^{ns} (0.36)	-0.85^{ns} (0.36)	0.67^{ns} (0.54)	0.99* (0.05)
Volume		1.00	-0.12^{ns} (0.93)	0.61^{ns} (0.59)	-0.61^{ns} (0.59)	0.36^{ns} (0.77)	0.96^{ns} (0.19)
Motility			1.00	0.72^{ns} (0.49)	-0.72^{ns} (0.49)	0.89^{ns} (0.31)	0.17^{ns} (0.89)
Live sperm				1.00	-1.00* (<0.0001)	0.96^{ns} (0.18)	0.81^{ns} (0.40)
Dead sperm					1.00	-0.96^{ns} (0.18)	-0.81^{ns} (0.40)
Sperm concentration						1.00	0.61^{ns} (0.58)
Abnormality							1.00

*=Correlations significant (p<0.05). **=Correlations significant (p<0.01). ***=Correlations significant (p<0.001). ^{ns}=No Significance. P-values are in parenthesis.

breeding animals. The results of this study showed that treatment of indigenous cock semen with vitamin E (tocopherol) play an important role in improving semen quality of the birds especially sperm concentration. Marin- Guzman *et al*. (1997) reported that tocopherol play an important role in spermatogenesis. There were differences in semen volume of normal feather and frizzle feather strains in response to tocopherol treatment. The values obtained for semen volume in all the cocks were within the acceptable range for artificial insemination (Hafez, 1978). Adeyemo *et al*. (2007) opined that higher body weight will mean higher volume of ejaculate with a low sperm concentration. In indigenous birds (frizzle and normal feather) treated with tocopherol, it was observed that the spermatozoa concentration was higher than 1.2 to 2.0 billion spermcells/ml reported by Keskin *et al*. (1996) but lower than 4.3 billion sperm/ml reported by Moya *et al*. (1996). The observed difference in the mean values reported may have been due to differences in the breed size and management systems.

The values obtained for semen motility for the two strains were within the accepted range for artificial insemination and the motility value and live spermatozoa observed in the frizzle and normal feather treated with tocopherol and without treatment were within the range reported for normal cock semen (Lake, 1966; Egbunike and Nkanga, 1999). Semen colour was neither affected by genotype nor treatment with tocopherol in this study. However semen colour can be a measure of the presence of contaminants (Etches, 1998). As the colour moves father away from white/creamy white, it could be an indication of blood stains, infection in the reproductive tract and urine contamination. The correlation between live body weight and semen quality indicated that the live body weight increase will not yield significant increase or decrease in semen quality of the cocks. Although positive correlation existed between semen volume and sperm concentration, they were however not significant. Keskin (1996) reported positive correlations coefficients between semen volume and sperm concentration. In a related study, Oke and Ihemeson (2010) reported negative correlations between semen volume and semen concentration for Normal feather cocks (-0.98) and Naked neck cocks (-0.97). In this present study, correlation coefficients were generally not significant for both genotypes treated with tocopherol. These observed non significant correlation coefficients may be due to low sample size as the coefficients were mostly above ±0.40.

CONCLUSION

Treatment of domestic cocks with tocopherol could make an important contribution to the improvement of semen quality and reproductive potential of indigenous strains of domestic chickens. It is however important to increase the sample size in future studies in order to draw relevant conclusions as to the effect of genotype and treatment with tocopherol.

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