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Seasonal Variations in Seminal Characteristics of Shikabrown Breeder Cocks

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Abstract: The seasonal influence on the seminal characteristics of Shikabrown breeder cocks was evaluated weekly during the three seasons in Northern Guinea Savannah zone of Nigeria. Semen samples were analyzed by gross and routine laboratory methods for volume, motility, concentration, colour, percent dead and percent total abnormality. The highest volume and concentration values of 0.50 ± 0.03 ml and $3.60 \pm 0.16 \times 10^9$ /ml, respectively, were obtained from Shikabrown White breeder cocks during the rainy season, while the lowest volume and concentration values of 0.39 ± 0.01 ml and $2.90 \pm 0.04 \times 10^9$ /ml, respectively, were obtained for the same strain during the hot-dry season. Spermatozoa motility of $80.5 \pm 1.1\%$ and $82.3 \pm 0.5\%$ were obtained during the harmattan and rainy seasons, respectively, in Shikabrown White breeder cocks. Percent dead sperm values of $4.6 \pm 8.3\%$ and $6.40 \pm 0.5\%$ were recorded during the rainy and hot-dry seasons, respectively; which were lower ($P < 0.05$) than the value of $9.0 \pm 1.0\%$ obtained during the harmattan season in Shikabrown White breeder cocks. For the Shikabrown Red breeder cocks, spermatozoa volume and concentration were 0.44 ± 0.02 ml and $3.44 \pm 0.05 \times 10^9$ /ml; while 0.45 ± 0.05 ml and $3.53 \pm 0.09 \times 10^9$ /ml were recorded for the harmattan and rainy seasons, respectively. These values were significantly ($P < 0.01$) different from the corresponding values of 0.30 ± 0.02 ml and $2.50 \pm 0.08 \times 10^9$ /ml obtained for volume and concentration, respectively, during the hot-dry season in the Shikabrown Red breeder cocks. Percent dead sperm in the Shikabrown Red cocks during the rainy and hot-dry seasons ($5.50 \pm 1.0\%$ and $6.20 \pm 1.2\%$, respectively) were not statistically ($P < 0.05$) significant, but were significantly lower ($P < 0.01$) than the value of $8.40 \pm 0.5\%$ obtained during the harmattan season. The ejaculate trait for percent abnormality in Shikabrown Red cocks was not significantly different from that of the Shikabrown White strains. In conclusion, spermatozoa were recovered throughout the year and optimal gamete quality was observed during the rainy and harmattan seasons.

Key words: Shikabrown breeder cocks, rainy season, hot-dry season, dead sperm

INTRODUCTION

The influence of season on seminal characteristics of domestic animals reared in the temperate regions of the world has been documented (Mahmoud *et al.*, 1996; Penfold *et al.*, 2000). It has been established that the tropical environment of high ambient temperature and relative humidity have adverse effects on livestock and poultry species (McDonald *et al.*, 1995; McDaniel *et al.*, 1996; Bah *et al.*, 2001; Ayo *et al.*, 1996, 2007; Ayo and Sinkalu, 2007). Onuora (1982) reported that the hot-humid environment of South-Eastern Nigeria has negative effects on semen characteristics in the guinea fowl. The detrimental impact of high ambient temperature on sperm quality in breeder cocks was reported by Rekwot *et al.* (2005) in the Northern Guinea Savannah zone of Nigeria.

Heat stress is one of the most obvious limitations to poultry production in areas with hot-humid climate. It has been shown that it evokes a series of drastic changes in the body functions of birds, leading to significant impairment of production and reproduction (Mahmoud *et al.*, 1996; Bah *et al.*, 2001; Surai, 2002). Such

detrimental effects, which are more pronounced during the hot-dry season, limit optimum reproductive (seminal) characteristics of breeder cocks (Bah *et al.*, 2001; Rekwot *et al.*, 2005).

In the Northern Guinea Savannah zone of Nigeria, three seasons—the cold-dry (harmattan), hot-dry and rainy seasons are recognized (Igono *et al.*, 1982). Each of the seasons has its positive or negative effects on livestock production. For example, the harmattan season has been described as thermally stressful to cattle, sheep and goats (Ayo *et al.*, 1998), while the effect of heat stress on poultry is minimal during the rainy season (Onuora, 1982; Bannor and Ogunsan, 1987).

Seasonal factors exert significant influence on domestic birds reared in the tropics. Direct climatic factors acting on the birds include high ambient temperature and relative humidity, resulting in severe heat stress. In Nigeria, indigenous avian species are predominantly subjected to heat stress because they are reared mainly under the free-range management system. The little protection provided against heat is usually in form of temporary light shade and radiation shield (Bannor and Ogunsan, 1987; Ayo *et al.*, 1996).

Shikabrown breeder stock is a heavy breed brown egg layer, developed at the National Animal Production Research Institute, Ahmadu Bello University, Shika-Zaria, Kaduna State, Nigeria. It is hardy and highly adapted to the harsh tropical environment with a high genetic (reproductive) potential that is acceptable for commercial production.

There is paucity of information on environment-reproduction interactions in poultry particularly in Shikabrown chicken reared in the Northern Guinea Savannah zone. The aim of the present study was to determine variations in seminal characteristics of Shikabrown breeder cocks during the seasons prevailing in the Northern Guinea Savannah zone of Nigeria.

MATERIALS AND METHODS

The experimental cocks comprised 20 each of Shikabrown White and Shikabrown Red breeders, maintained at the Poultry Breeding Unit of National Animal Production Research Institute, Shika-Zaria, located in the Northern Guinea Savannah zone of Nigeria (11°12' N, 7°8' E). Two strains of breeder cocks-Shikabrown White and Shikabrown Red served as subjects of the experiment. They were 52 weeks old and their live weights were 2.30±0.2kg and 2.45±0.3kg, respectively. All the cocks were subjected to weekly semen collection for twelve months from October, 2005 to September, 2006 by abdominal massage as described by Lake (1978).

Four hundred and seventy six ejaculates were collected and evaluated for colour, volume, motility and concentration as described by Zemjanis (1970). The percentage dead sperm was calculated using the eosin-nigrosin vital staining technique. The technique was based on the principle that eosin-nigrosin penetrates and stains dead sperm cells, while the live sperm cells repel the stain (Burrows and Quinn, 1939). The slides were examined under a light microscope at the magnification of X430. At least 100 each of stained and unstained cells were counted and percentage of each group of cells was estimated.

RESULTS

The results of the variations in ejaculate quality of the two strains of Shikabrown breeder cocks during each season are presented in Figs. 1-5.

The ejaculate volume was lowest during the hot-dry season compared to the corresponding volumes obtained during the harmattan and rainy seasons in both strains. The ejaculate volume of 0.39±0.01ml obtained in the Shikabrown White cocks during the hot-dry season was significantly ($P < 0.01$) lower than that recorded either during the harmattan or rainy season (Fig. 1). There was no significant ($P > 0.05$) difference in ejaculate volumes obtained in the Shikabrown White

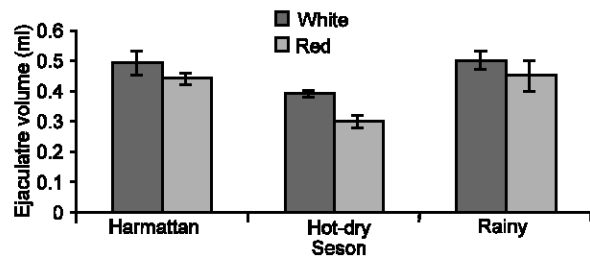


Fig. 1: Effects of season on ejaculate volume (ml) of Shikabrown Breeder Cocks (Mean±SEM, n = 40).

strain during the harmattan and rainy seasons (Fig. 1). In the Shikabrown Red, the ejaculate volume of 0.30±0.02ml obtained during the hot-dry season was significantly ($P < 0.01$) lower than the values of 0.44±0.02ml and 0.45±0.05ml recorded during the harmattan and rainy seasons, respectively (Fig. 1). Seminal volume in the Shikabrown Red, during the harmattan season, was not significantly different ($P > 0.05$) from that obtained in the rainy season. During the hot-dry season, semen volume was lower ($P < 0.01$) in Shikabrown Red than Shikabrown White (Fig. 1).

The sperm motility during the harmattan and rainy seasons did not differ significantly in both strains (Fig. 2). The values of 79.2±0.2% and 78.0±0.2% recorded during the hot-dry season in the Shikabrown White and Shikabrown Red, respectively, were significantly ($P < 0.01$) lower than the corresponding values of 80.5±1.1% and 82.3±0.5% obtained during the harmattan and rainy seasons, respectively, for the Shikabrown White. Similarly percent sperm motilities during the hot-dry season in both strains (79.2±0.2% and 78.0±0.2% for the Shikabrown White and Shikabrown Red, respectively, were lower ($P < 0.01$) than the corresponding values of 81.3±1.1% and 82.3±0.5% recorded during the harmattan and rainy seasons, respectively.

Sperm concentration per ml in the Shikabrown White strain was highest during the rainy season with the value of 3.60±0.2x10⁹/ml. The value fluctuated between seasons and was lowest ($P < 0.01$) during the hot-dry period. Although sperm concentration was not significantly different ($P > 0.05$) between the two strains during the harmattan and rainy seasons, the concentration obtained in Shikabrown White was higher ($P < 0.01$) than that of Shikabrown Red breeder cocks during the hot-dry season (Fig. 3).

As shown in Fig. 4, the percentage of dead sperm cells in the ejaculate was significantly ($P < 0.01$) higher during the harmattan season than during the rainy or hot-dry season in both strains. Percent dead sperm during the hot-dry and rainy seasons were not significantly ($P > 0.05$) different in both strains. In both strains the percent dead spermatozoa was highest during the harmattan season but lowest during the rainy season. The percent

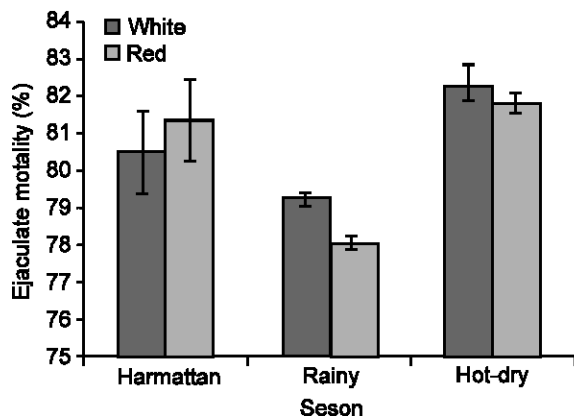


Fig. 2: Effect of season on percent ejaculate motility of Shikabrown Breeder Cocks (Mean±SEM, n = 40).

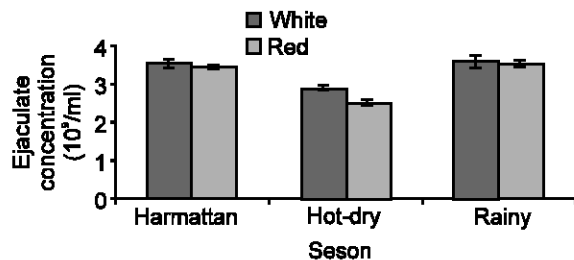


Fig. 3: Effect of season on ejaculate concentration (10 /ml) of Shikabrown Breeder Cocks (Mean±SEM, n = 40).

dead spermatozoa in the Shikabrown Red during the hot dry season was $6.20 \pm 1.2\%$ and the value did not differ significantly ($P > 0.05$) from that of $5.50 \pm 1.0\%$ obtained during the rainy season. The overall mean percent dead spermatozoa was highest during the harmattan season in the Shikabrown Red breeder cocks, while the lowest value of 4.60 ± 0.80 was obtained during the rainy season (Fig. 4).

In the Shikabrown White cocks, the highest percent dead spermatozoa was recorded during the harmattan season with the value of $9.0 \pm 1.0\%$, while the lowest value of $4.60 \pm 0.80\%$ was obtained during the rainy season. Although the percent dead spermatozoa obtained during the harmattan season was higher than that of the hot-dry or rainy season, the values during the hot-dry and rainy season were not significantly ($P > 0.05$) different (Fig. 4).

In the Shikabrown White strain, the highest mean sperm total abnormality was recorded during the harmattan season. Similarly in the Shikabrown Red strain, the percent total abnormality of $10.1 \pm 0.6\%$ was obtained during the harmattan season, which was significantly ($P < 0.01$) higher than the values of $8.0 \pm 0.4\%$ and $7.8 \pm 2.6\%$ recorded in the hot-dry and rainy seasons, respectively (Fig. 5).

During the harmattan and hot-dry seasons between-strain percent sperm abnormalities were not significantly different ($P > 0.05$). The percent sperm abnormality of $6.50 \pm 0.1\%$ obtained in Shikabrown White was lower ($P < 0.01$) than the value of $7.80 \pm 2.6\%$ recorded in the Shikabrown Red during the rainy season, but the difference was not significant (Fig. 5).

DISCUSSION

The results obtained on the ejaculates collected from the Shikabrown breeder cocks demonstrated that seasons have significant influence on semen characteristics and this corroborates similar findings Rhode Island Red breeder cocks (Rekwot *et al.*, 2005) and in bulls (Rekwot, 1986. Rekwot *et al.*, 1987). The volume of semen was lowest during the hot-dry season relative to the rainy and harmattan seasons. This may be due to deleterious effects of high ambient temperature causing germ cell destruction as reported by Wettermann and Bazer (1985) in Duroc boars; Rekwot (1986) in bulls; Penfold *et al.* (2000) in Northern Pintail ducks; and Machebe and Ezekwe (2005) in local breeder cocks in South-eastern rain forest region of Nigeria.

The effect of season on semen volume further supports the findings of Nayak and Misra (1991) that the hot-dry season, characterized by elevated ambient temperature and high relative humidity causes a temporary decrease in sperm production and fertility. Similar results were obtained by Bah *et al.* (2001) in local breeder cocks in the Sahel region of Nigeria.

The semen volume collected in the present study varied with seasons in both strains of breeder cocks. The results of the semen volume in both strains showed that the White breeder cocks had higher semen volume than the Red breeder cocks, regardless of the season of the year. This contradicts the findings of Nwagu *et al.* (1996), who reported a higher semen volume in the Red strain. The difference between the results of the present study and those of Nwagu *et al.* (1996) may be attributed to the short duration (four weeks). Nwagu *et al.* (1996) carried out the study, a period that may be too short to draw significant conclusion on the difference between the two strains in semen volume.

The present study showed that sperm concentration per ml in the Shikabrown breeder cocks varied with season, and that the highest spermatozoa concentration was obtained during the rainy season. This apparently, was due to the favourable meteorological conditions prevailing during the season, rather than management techniques, including nutrition.

The study further confirmed that one of the most important factor adversely affecting poultry production in the tropics is season, not only in those reared under extensive management system, but also in poultry intensively kept without artificially regulated micro-climatic conditions (Mahmoud *et al.*, 1996; Ayo *et al.*,

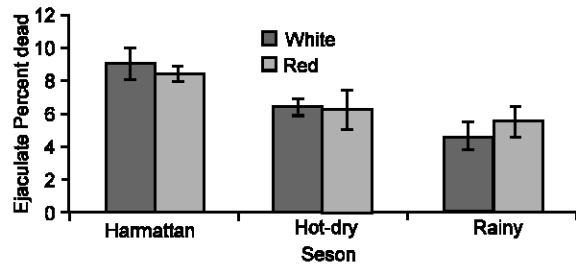


Fig. 4: Effect of season on ejaculate percent dead of Shikabrown Breeder Cocks (Mean±SEM, n = 40)

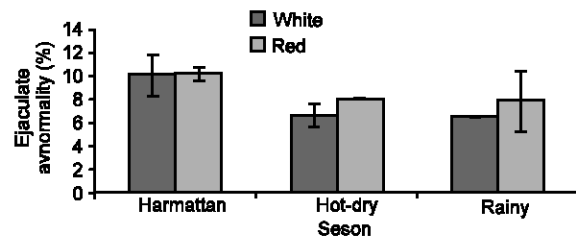


Fig. 5: Effect of season on percent ejaculate total abnormality of Shikabrown Breeder Cocks (Mean±SEM, n = 40)

2005; Ayo *et al.*, 2007). The results of the present study corroborate the findings of Bah *et al.* (2001) in the Sahel region of Northern Nigeria, who recorded highest sperm counts in local breeder cocks during the rainy season, between July and September. Similar findings were obtained by Rekwot *et al.* (2005), who recorded a higher concentration per ml of spermatozoa during the rainy season.

The lower value of sperm concentration obtained in local cocks in Nigeria during the hot-dry season by Machebe and Ezekwe (2005) agrees with the findings of the present study. Similar results of lower values of seminal concentration were obtained by Cheon *et al.* (2002) in the boar and Christopher *et al.* (1996) in broiler breeders due to heat stress. The observed genotypic effect that seminal concentration was higher in Shikabrown White than the Shikabrown Red in the present study agrees with the findings of Egbunike and Oluyemi (1979), that genotypic differences exist in seminal characteristics in poultry but contradicts that of Nwagu *et al.* (1996) who obtained a higher concentration per ml of spermatozoa in the Red strain. Again, the observed differences in the results may be due to the short-term duration of the study conducted by Nwagu *et al.* (1996).

The percentage gross motility of $78.0 \pm 0.2\%$ and $82.0 \pm 0.2\%$, recorded in the present study fell within the range values of 75-85% obtained by Rekwot *et al.* (2005) in the Red strain of Shikabrown breeder cocks. The findings of Nwagu *et al.* (1996) on gross motility also agreed with the results obtained in the present study. However, the values were higher than those recorded by

Machebe and Ezekwe (2005), who reported percent gross motility of $70.11 \pm 0.6\%$, $70.05 \pm 0.89\%$ and $67.92 \pm 0.5\%$ in the Nigerian local cocks during the harmattan, rainy and hot dry seasons, respectively. This difference may be due to genetic factors.

The findings that the ejaculates of both breeder cocks had the highest and lowest abnormality during the harmattan and rainy seasons, respectively agreed with the findings of Bah *et al.* (2001) in Sahelian cocks and Rekwot *et al.* (2005) in the Red strain of Shikabrown breeder cocks who showed that the rainy season is favourable to spermatogenesis. The rainy season is associated with high semen volume and total sperm count and, consequently, high fertility (Rekwot *et al.*, 2005). Machebe and Ezekwe (2005) recorded an average of 8.0% sperm abnormality in two genotypes of local breeder cocks during the rainy season and this value was close to 7.2% obtained in the present study in the two strains of breeder cocks during the rainy season. Seasonal impact on sperm abnormality has also been reported in the Northern Pintail duck (Penfold *et al.*, 2000).

The results of the present study demonstrated seasonal variations in percent dead ejaculates obtained in both strains of breeder cocks. The finding is in agreement with the results obtained by Bah *et al.* (2001) and Rekwot *et al.* (2005) that the hot-dry season adversely affects semen quality, leading to a high percent dead sperm. The results further indicated that maximum fertility in breeder cocks for natural mating or artificial insemination should be obtained in breeder cocks during the rainy season (wet months) of the year. Further studies are required on the effect of season on percent dead sperm involving larger number of breeder cocks. The causes of these changes in seminal quality are not fully understood, but may likely be by hormonal mechanism controlled by environmental factors.

The difference between Shikabrown White and Shikabrown Red breeder cocks in some seminal traits in the present study is an excellent example of two strains of chicken conforming in principle but differing in detail. The reason for this difference is subject to further investigation.

In conclusion, optimum breeding in breeder cocks should be carried out during the wet season of the year, and for optimum fertility the Shikabrown White, rather than the Shikabrown Red cocks is recommended.

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