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EFFECTS OF BREED AND SEASON ON THE SEMEN CHARACTERISTICS OF THE COCK IN THE HUMID TROPICS

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Target audience: Animal Scientists, poultry farmers and breeders, veterinarians.

ABSTRACT

The effects of breed and season on the semen characteristics of the cock were studied using adult cocks of two breeds, barred Plymouth Rock (exotic) and the Nigerian indigenous breeds (local). Breed significantly influenced body weight and the semen quality characteristics in favour of the exotic cocks except semen pH, which remained slightly alkaline and total sperm abnormality. Generally sperm concentration and output were depressed in the rainy season. Neither breed nor season affected sperm AChE, total protein and phospholipid content while sperm LDH tended to be higher in the rainy season. Also AChE was significantly related to semen volume, sperm motility and sperm output while sperm protein was related to sperm LDH. The increase in the semen quality characteristics in the dry season could be related to the increase in daylength although the results generally indicate a successful all-year-round mating of breeder hens in our environment.

Key words: Cock; breed; season; semen characteristics

DESCRIPTION OF PROBLEM

It is known that qualitative and quantitative evaluation of the semen together with the factors affecting it will enhance the assessment of the reproductive status of the male. With the obvious increase in the use of artificial insemination world-wide in animal production, the demand by breeding organisations for spermatozoa from outstanding sires has increased tremendously even in the poultry industry. The level of poultry production in the tropics, including Nigeria, is indeed low because, apart from the harsh environment, the managemental know-how is still rudimentary.

Spermatozoal output and semen characteristics tend to vary with individual birds/breeds and seasons. Thus it is expected that not all

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poultry breeds can perform well under tropical climatic conditions as has been implied by Obioha (1) since high temperatures have been shown by Zupraisal et al. (2) to depress digestibility especially of amino acids in poultry. Close and Stanier (3) and Christon (4) had also shown that the tropical environmental temperatures markedly affect metabolism in animals. Also, in assessing the seasonal changes in the semen of cocks, Atanasov, Georgiev and Dimitrov (5) observed that spring was the best season with respect to ejaculate volume, sperm motility and sperm concentration in agreement with the results of Saeid and Al-Soudi (6) using Iraqi and exotic birds.

Given this knowledge of the degree of genetic and seasonal diversity and the desire to improve poultry production at a rate consistent with market demand in Nigeria, we decided to study the effects of breed and season on the semen characteristics of the cock. We expect that results emanating therefrom will contribute, in no small way, to the development of a suitable artificial insemination programme for regular use in our developing poultry industry.

MATERIALS AND METHODS

Animals and management. Forty adult cocks, consisting of 20 barred Plymouth Rock (exotic) and 20 non-descript Nigerian indigenous breeds (local) were used. The exotic cocks were 8.00 ± 0.50 months old and weighed between 1.84 and 2.48 kg while the local birds were adults but of no known ages and weighed 1.04 to 1.85 kg. Five birds per breed per season were individually housed in standard cages in an open-sided poultry house with asbestos roofing and fed standard breeders' ration containing 18 % crude protein and given cool clean water *ad libitum*.

Seasons. The study was carried out in the University of Ibadan with an equatorial, humid and semi-hot climate (7) and the year was divided into four seasons, each comprising three months designated as late dry season (January to March), early rainy season (April to June), late rainy season (July to September) and early dry season (October to December) as per Egbunike and Steinbach (7, 8).

Ejaculate assessment. Five animals per breed were selected at random each time and ejaculated by the lumbar massage method of Burrows and Quinn (9) between 0900 and 1000 h in February, May, August and November at 48 hourly intervals. Thereafter, semen volume was read to the nearest 0.01 ml, while sperm progressive motility, sperm concentration, semen pH, live:dead ratio and sperm abnormality were estimated as per standard methods used in our laboratory.

After qualitative and quantitative assessment of the semen, the remnant was noted and centrifuged at 3,000 g for ten minutes and the pellet (sperm) was then resuspended in 1.0 ml of deionized distilled water and stored at -20 ^{o}C until analysed for total sperm protein, acetylcholinesterase (AChE),

lactate dehydrogenase (LDH) and phospholipids. The total sperm protein, LDH, and phospholipids were colorimetrically determined using Boehringer Mannheim (Germany) test kits while sperm AChE was assayed by the method of Ellman et al (10) as used by Egbunike (11).

Statistical analysis. Data obtained were subjected to analyses of variance after which the means were compared using Students' t test (12). Also the linear coefficients between the semen physical and biochemical characteristics were assessed.

RESULTS

The results of the qualitative and quantitative physical characteristics of cock semen as affected by breed and season are summarised in Table 1. The body weight, semen volume and sperm concentration were significantly ($P < 0.05$) influenced by breed in favour of the exotic birds. In the case of sperm motility and sperm output the exotic birds with values of 80.80 ± 0.77 and $1.36 \pm 0.15 \times 10^9$ sperm were very significantly superior ($P < 0.01$) to their local counterparts whose respective values were 74.51 ± 0.92 % and $0.81 \pm 0.08 \times 10^9$ sperm. However, while semen pH remained stable and slightly alkaline regardless of breed, there were more ($P < 0.05$) dead cells in the semen of the local cocks.

As regards season, only in semen volume and sperm concentration, and hence sperm output, were significant ($P < 0.05$) seasonal trends shown. The exotic birds produced less semen in the rainy season unlike their local counterparts. Also, there was a general depression in sperm concentration and output in the rainy season.

As shown in Table 2, neither breed nor season significantly influenced sperm AChE, total protein and phospholipid contents while sperm LDH content tended to be higher, especially in the exotic cocks, in the rainy season. Of all these biochemical parameters studied, it was only sperm AChE that was highly significantly ($P < 0.01$) related to some of the other seminal characteristics i.e. semen volume ($r = 0.54$), sperm motility ($r = 0.41$) and sperm output ($r = 0.48$). Also, sperm protein was significantly related ($r = 0.48$) to sperm LDH (Table 3).

DISCUSSION

That the exotic cocks were heavier and hence produced larger volumes of semen with higher sperm concentration and output than the local birds is not unexpected (13) especially when Nkanga (14) had observed high correlations between live weight and semen volume, sperm concentration and sperm output. In addition to this is the fact that there is a three-fold difference in daily sperm production in the exotic cock compared to its local counterpart (15). This is an indication that the exotic cock can produce more insemination doses than its local counterpart in a given

Table 1. Breed and seasonal influences on the qualitative and quantitative physical characteristics of cock semen.

Parameters	Breed	Seasons				Means ± sem
		Late dry	Early rain	Late rain	Early dry	
Body weight (kg)	Exotic	2.17±0.03	2.23±0.02	2.01±0.03	2.04±0.05*	2.11 ± 0.05 *
	Local	1.58±0.02	1.64±0.03	1.59±0.03	1.50±0.03	1.58±0.03
Semen volume (ml)	Exotic	0.42±0.06[a]	0.25±0.02[b]	0.28±0.02[b]	0.41±0.05[a]	0.34±0.04*
	Local	0.28±0.04[a]	0.22±0.02[a]	0.25±0.03[a]	0.23±0.04[a]	0.25±0.01
Sperm motility (%)	Exotic	79.26±1.54	81.46±1.43	78.83±1.40	83.80±1.45	80.80±0.77**
	Local	72.68±1.78	73.26±2.01	74.75±1.56	76.75±2.10	74.51±0.92
Semen pH	Exotic	7.22±0.07	7.23±0.08	7.17±0.09	7.23±0.06	7.21±0.10
	Local	7.39±0.10	7.48±0.12[a]	7.33±0.07	7.50±0.09	7.43±0.03
Sperm concentration(x 10^9/ml)	Exotic	4.21±0.46a	3.28± 0.46a	3.08±0.27a	3.88±0.43a	3.64±0.21*
	Local	3.40±0.31a	2.16±0.21b	2.64±0.30a	3.79±0.32a	3.04±0.32
Sperm output (x 10^9)	Exotic	2.04±0.43a	0.95 ±0.19b	0.95±0.15b	1.53±0.22a	1.36±0.15**
	Local	1.00±0.18	0.48±0.09	0.78±0.15	0.93±0.22	0.81±0.08
Total abnormality (%)	Exotic	10.99±1.98	10.20±0.98	10.17±0.73	10.25±0.28	10.66±0.24
	Local	13.11±2.01	12.33±1.04	12.13±1.52	13.63±1.85	12.80±0.30
Total dead (%)	Exotic	3.40±0.52	2.65±0.41	2.43±0.46	3.62±0.83	3.03±0.28*
	Local	8.15±0.63	6.63±0.50	6.59±0.51	7.85±0.65	7.31±0.45.

Table 2. Breed and seasonal influences on the biochemical parameters of the spermatozoa of the domestic fowl.

Season	Breed	AChE (μmole/10⁹cells)	Total Protein (mg/10⁹cells)	Phospholipid (μmole/10⁹cells)	LDH (μ/10⁹cells)
Late dry season	Exotic	2.58±0.51	1.55±0.37	1.68±0.29	4.36±0.82
	Local	4.27±0.88	1.54±0.30	2.07±0.36	6.00+1.75
Early rainy season	Exotic	4.50±0.80	3.62±0.66	2.18±1.11	10.71±2.42
	Local	3.03±0.03	2.11±1.03	1.87±0.33	9.91±1.72
Late rainy season	Exotic	4.09±0.76	3.40±0.80	1.11±0.20	9.63+1.97
	Local	4.98±0.79	4.80+0.88	1.60±0.35	10.80+1.26
Early rainy season	Exotic	4.69±069	1.00+0.18	2.35±0.39	5.91+1.01
	Local	4.66±061	1.04+0.21	1.28±0.15	5.64+0.63
Overall Mean±sem	Exotic	4.49±0.47	2.48+0.35	1.81±0.25	10.43+1.69
	Local	4.24±0.41	2.31+0.53	1.71±0.15	7.82+0.80

Table 3. Relationship between physical and biochemical cock semen characteristics

Semen characteristics	Biochemical characteristics of sperm			
	Protein	AChE	LDH	Phospholipids
Progressive motility	0.20	0.41**	0.21	0.22
Semen volume	0.12	0.54**	0.08	0.13
Semen pH	-0.04	-0.12	0.23	0.02
Sperm concentration	0.01	0.18	0.25	0.03
Sperm output	0.04	0.48**	0.19	0.09
Sperm protein	-	0.02	0.48**	0.13
Sperm AChE	-	-	0.25	0.25
Sperm LDH	-	-	-	0.19

** ($P < 0.01$)

insemination programme. Moreover, the superiority of the sperm motility of the former cock shows that fertilization will be higher in artificial insemination using semen from these cocks than from the local cocks and may be a reflection of the diversity in the ages of the two breeds in this study and the greater incidence of total sperm abnormalities and dead spermatozoa in the semen of the local cocks. This superiority of the fertility of the exotic birds compared to the local birds based on the evaluation of their seminal characteristics is a confirmation of the views of Woelders (16) that the majority of semen characteristics are related to viability.

Although daily sperm production appeared to be favoured by the rainy season (14), semen volume, sperm concentration and sperm output were significantly ($P < 0.05$) reduced in the rainy season in partial agreement

with the results of Saeid and Al-Soudi (6). As postulated by Nkanga and Egbunike (13) this increase in these semen characteristics in the dry season could be related to the increase in daylength at this period which is known to activate an increased output of the gonadotropic hormones of the anterior pituitary that leads to an increase in spermatogenic activity.

The pH values obtained in this study fall within the range for maximal sperm motility and the retention of fertilizing capacity (17). Also, the percentage of dead and abnormal spermatozoa is within the normal range even in our centre (18). The stability of the biochemical seminal characteristics, regardless of the breed and season, may be due to the fact that avian spermatozoa spend little time in the epididymis (19) compared to mammalian spermatozoa and so do not undergo massive cell surface changes. However, the tendency of the sperm LDH content to be lower in the dry season may imply the accumulation of lactic acid and a concomitant lowering of the pH of the semen although these were not observed in our study.

The significant relationship between semen volume and sperm AChE reported here is, as of now, hard to explain but that between this enzyme activity in the sperm and sperm progressive motility and sperm output may be an indication of the role of the enzyme in sperm motility. It may be worthy to note that sperm AChE was found to be negatively related to the development of sperm motility in mammals (bull, boar and rat) during sperm maturation (11) and to the motility of ejaculated caprine sperm (20). This may be an implication of some differences in the physiological responses of mammalian and avian spermatozoa to various elements in extension media during preservation and will await further studies.

CONCLUSIONS AND APPLICATIONS

Judging from the views of Woelders (16) as mentioned earlier, these results are in conformity with our earlier findings (21) that fertility and hatchability were similar in exotic and local birds indicating an all-year-round mating of breeder hens in our environment without any losses in chick production.

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