COMPARATIVE STUDIES OF THE REPRODUCTIVE CAPACITY OF NIGERIAN AND EXOTIC POULTRY BREEDS

1. TESTIS AND SEMEN CHARACTERISTICS

By

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SUMMARY

THE study involved 48 adult cocks from four breeds namely, White Rock (WR), Rhode Island Red (RIR), White Leghorn (WL) and Nigerian indigenous breed (NIB). They weighed between 1 — 2.6 kg at the beginning of the experiment.

The WR cock had the heaviest paired testis weight (25.06g) while NIB had the lightest (16.54g). These weights accounted for 1.04% and 1.22% of the liveweight respectively while the specific gravity of the testis from these two breeds was 1.048.

The volume (0.63ml vs 0.33ml) and progressive motility of the spermatozoa (63.34 vs 58.12%) were highest in the WR and lowest in the NIB while sperm concentration (3.03×10^9 vs 2.43×10^9) was highest also in the WR but lowest in the WL. These semen characteristics were significantly influenced by breed and time of ejaculation except with the volume in which the time effect was insignificant.

The WR semen had the lowest sperm abnormalities (10.13%) while RIR had the highest (13.14%). The results however indicate that the WR cocks ejaculated the largest quantity and best quality semen, followed in order by RIR, NIB and WL.

INTRODUCTION

MORE poultry breeders, like breeders of the bigger farm animals, are now exploiting the advantages of Artificial Insemination in the reproduction of their breeding stock. It has therefore become necessary to understand and then improve the semen of cocks towards an improved AI programme in poultry. It is also necessary that any such programme should always include indigenous breeds as these are known to possess some innate resistance to certain local disease in addition to a high degree of adaptability to the prevailing climatic conditions.

There has been an appreciable amount of work on semen production and quality in a variety of poultry breeds. Semen production is highly correlated with breed (Boone and Hughes, 1969; Saeid and Al-Soudi, 1975), body weight (Williams and McGibbon, 1956) and testis size (Burrows and Titus, 1939) while seasonal variations have been reported (Wheeler and Andrews, 1943; Polge, 1951; Karmar and Badreldin, 1959 and Saeid and Al-Soudi, 1975). Also similarity in semen quality between local Iraqi cocks and some popular imported breeds has been reported by Saeid and Al-Soudi (1975).

This study is thus aimed at collecting data on the testis and semen characteristics of the Nigerian indigenous breed and to compare these to those of the three most popular exotic breeds.

MATERIALS AND METHODS

Forty-eight adult cocks consisting of twelve of each of four breeds, Rhode Island Red (RIR), White Rock (WR), White Leghorn (WL) and the Nigerian indigenous breed (NIB) were used. They were all raised in the Teaching and Research Farm of the University of Ibadan, where they were housed individually in cages (46 x 46 x 25 cm) and fed *ad libitum* on normal breeders' ration containing 18% crude protein. The mean age of the animals was nine months (Range: 8–9.5 months) while their liveweight ranged from 1.0 to 2.6 kg.

Semen was collected by the massage method (Lake, 1962) from three cocks per breed in the morning (0900 — 1000 hr.) and another three in the afternoon (1400 — 1500 hr.) in a random rotation (between the AM and PM collections) such that every cock was ejaculated at 48-hourly intervals. The birds were so treated for two weeks prior to the experiment. The semen was collected directly into a graduated collection tube from which the volume was read directly to the nearest 0.1 ml. From the 244 successful ejaculations, sperm counts were done haemocytometrically while the abnormalities were determined from eosin — nigrosin — stained smears according to McNitt and First (1970) and classified according to Blom (1948).

After the last ejaculation, all the cocks were killed and their testes were quickly removed. These testes were then weighed and their volume determined by water displacement. The data were subjected to analysis of variance and correlation analysis according to the standard procedures (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

The mean liveweight and testis characteristics for each breed are summarised in Table 1. The WR cocks were the heaviest ($P < 0.05$) and had the largest paired testes weight ($P < 0.05$) while the NIB cocks, which had the smallest testes, were

the lightest. On the other hand, when the testes were considered in relation to the liveweight, it was observed that the NIB testes accounted for 1.22% of the liveweight while for WR, RIR and WL the respective values were 1.04, 1.02 and 0.98. These differences were however not significant. Although the specific gravity of the testis was similar in all four breeds, the daily output of spermatozoa per gram testis weight was highest in the WR with 75.02×10^6 sperm and lowest in the WL cocks with 48.25×10^6 sperm. That the heaviest birds had the greatest sperm output suggests that sperm output was dependent on liveweight.

Table 2 shows the correlation between the liveweight and both the semen and testis characteristics. Liveweight and semen volume were highly significantly correlated thus confirming earlier reports (Boone and Hughes, 1969 and Saeid and Al-Soudi, 1975). Also paired testes weight was highly related to semen volume. These facts therefore buttress the view of Kamar and Badreldin (1959) that heavier birds are able to produce larger amounts of semen partly because they possess larger reproductive organs. However, sperm concentration was unrelated to semen volume and progressive motility but was negatively related to sperm abnormality, suggesting that large ejaculates do not necessarily contain more abnormal sperm than smaller ones.

TABLE 1
Liveweight and testis characteristics of chickens

Characteristics	BREEDS			
	White Rock	Rhode Island Red	White Leghorn	Nigerian Breed
Liveweight (kg)*	2.42	2.09	1.87	1.35
s.e.	0.27	0.12	0.20	0.05
Paired testes weight (g)*	25.06	21.36	18.24	16.54
s.e.	2.52	2.72	2.40	2.32
Testes/Liveweight (%)	1.036	1.022	0.975	1.223
Testis volume (ml)*	11.96	10.29	8.62	7.89
s.e.	1.23	1.28	1.14	1.20
Testis specific gravity	1.048	1.038	1.058	1.048
Daily sperm output per gram testis weight ($\times 10^6$)*	75.02	71.63	48.25	55.74

s.e. denotes standard error.
* ($P < 0.05$)

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TABLE 2

Correlation coefficients for liveweight and testis and semen characteristics in chickens

Independent characteristics	Dependent characteristics					
	1	2	3	4	5	6
1. Liveweight	—	0.20	0.57**	0.25	-0.05	—
2. Paired testes weight	—	—	0.71**	-0.19	-0.17	—
3. Ejaculate volume	—	—	—	0.13	0.22	-0.05
4. Progressive motility	—	—	—	—	0.39	-0.15
5. Sperm concentration	—	—	—	—	—	-0.47*
6. Sperm abnormalities	—	—	—	—	—	—

** $P < 0.01$

* $P < 0.05$

The effects of breed and time of ejaculation on semen characteristics and sperm output are summarised in Tables 3 and 4. Both semen volume and the progressive motility of the spermatozoa followed a similar trend in which the heavier birds recorded higher values than the lighter birds. In addition to their large semen

volume, the WR cocks produced more concentrated semen which however contained the least amount of abnormal sperm compared to the other breeds. This implies a greater and more efficient spermatogenic ability of the WR cocks which would apparently further account for the larger semen produced by these

TABLE 3

Influence of breed and time of ejaculation on semen characteristics and daily sperm output in chickens

Characteristics	Time	BREEDS +					P <
		White Rock	Rhode Island Red	White Leghorn	Nigerian Indigenous Breed	Mean	
Volume (ml)	AM	0.76±0.07	0.67±0.06	0.35±0.04	0.29±0.03	0.52±0.12	B—0.010 T—ns
	PM	0.49±0.05	0.53±0.06	0.36±0.05	0.37±0.03	0.44±0.04	
	Mean	0.63±0.06	0.60±0.05	0.35±0.03	0.33±0.02	0.48±0.08	
Progressive Motility (%)	AM	65.00±7.63	66.43±7.12	59.29±9.65	61.23±7.45	62.99±1.65	B—0.025 T—0.001
	PM	61.67±8.91	59.17±12.27	59.17±11.79	55.00±8.36	58.75±1.38	
	Mean	63.34±5.58	62.80±6.61	59.23±7.19	58.12±5.40	59.81±1.36	
Sperm Constriction (X109)/ml	AM	3.17±0.25	2.62±0.1	2.59±0.21	2.96±0.64	2.84±0.14	B—0.010 T—0.010
	PM	2.88±0.57	2.56±0.43	2.27±0.16	2.54±0.33	2.56±0.12	
	Mean	3.03±0.30	2.59±0.29	2.43±0.13	2.75±0.35	2.70±0.13	
Daily Sperm Output (X109)	AM	2.47±0.34	1.80±0.44	0.93±0.15	0.91±0.24	1.53±0.38	B—0.025 T—0.050
	PM	1.29±0.18	1.26±0.20	0.83±0.15	0.92±0.12	1.08±0.12	
	Mean	1.88±0.25	1.53±0.24	0.88±0.10	0.92±0.13	1.30±0.24	
Sperm Abnormality (%)	AM	10.78±3.09	12.05±1.73	11.17±3.12	10.89±3.40	11.22±0.29	B—ns T—ns
	PM	9.57±1.60	14.22±2.71	10.29±1.61	13.52±2.98	11.90±1.16	
	Mean	10.13±1.59	13.14±1.58	10.69±1.61	12.31±2.17	11.57±0.70	

± Values are means and standard errors.

*B and T are breed and time effects respectively.

ns signifies non-significant differences.

TABLE 4

Influence of breed and time of ejaculation on the amount and type of abnormality of sperm cells in chicken ejaculates

Type of Abnormality	Time	B R E E D				Mean	Relative frequency (%)
		White Rock	Rhode Island Red	White Leghorn	Nigerian Breed		
HEAD (%)	a.m.	7.22±1.22	9.56±1.24	7.56±1.46	6.72±2.29	7.77±0.58	71.39
	p.m.	6.67±1.23	10.33±1.78	7.48±1.55	10.52±2.42	8.75±0.98	
	X	6.92±0.83	9.95±1.04	7.51±1.02	8.77±1.70	8.26±0.61 ^a	
TAIL (%) *	a.m.	2.39±1.54	1.67±1.22	2.61±1.71	2.61±1.11	2.32±0.22	16.16
	p.m.	1.57±0.46	1.06±0.26	1.86±0.91	1.33±0.54	1.46±0.17	
	X	1.95±0.73	1.36±0.60	2.21±0.89	1.92±0.59	1.87±0.35	
Mid piece (%)	a.m.	1.34±0.76	1.00±0.33	1.00±0.55	1.55±0.74	1.22±0.14	12.45
	p.m.	1.33±0.64	2.83±1.17	0.95±0.33	1.67±0.68	1.70±0.41	
	X	1.26±0.48	1.91±0.64	0.97±0.28	1.61±0.48	1.44±0.24 ^c	
TOTAL (%)	a.m.	10.78±3.09	12.05±1.73	11.17±3.12	10.89±3.40	11.22±0.29	100.00
	p.m.	9.57±1.60	14.22±2.71	10.29±1.61	13.52±2.98	11.90±1.16	
	X	10.13±1.59	13.14±1.58	10.69±1.61	12.31±2.71	11.57±0.87	

* Time of ejaculation significantly influenced the tail abnormalities ($P < 0.01$)

a,b,c: These values differ significantly ($P < 0.005$).

birds. Thus the daily sperm output per gram testicular weight was highest in the WR birds with a mean of 75.02 million sperm as compared to 71.63, 55.74 and 48.25 for RIR, NIB and WL cocks respectively. Progressive motility, sperm concentration and daily sperm output were significantly influenced by both breed and time of ejaculation. While semen volume was highly affected by breed, neither breed nor time of ejaculation had any effect on the total sperm abnormality of the ejaculated semen, the most common of which were primary and consisted of small, large and malformed heads.

Closer observation, however, revealed that the head, tail and mid-piece abnormalities occurred at different frequencies ($P < 0.005$). Only the tail abnormalities were however affected ($P < 0.01$) by the time of ejaculation, with there being more tail abnormalities in the mornings than in the afternoons (Table 4). The values of the different abnormality types were within the ranges found to be compatible with good fertility by Lagerlof (1934), Blom (1948) and Rollinson (1951).

It is worth mentioning that the variability in all the characteristics, as evidenced by the standard errors of the means, was low and uniform among all the breeds. This suggests that the three exotic breeds had become adapted to the humid tropical condition. The results have also shown that the Nigerian indigenous cocks produce less semen than the much heavier White Rock and Rhode Island Red cocks. However, when compared with the White Leghorns, which are in the same liveweight range, the NIB cocks were similar in daily sperm output but better in the efficiency of sperm output and daily sperm output per gram testicular tissue.

It can thus be concluded that the Nigerian indigenous cocks under good management can produce good quality semen comparable with that from exotic poultry breeds.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Messrs Elemo, Buari and Akwobi for their technical assistance.

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