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Impact of different rearing systems and frequency of semen collection on semen characteristics of Turkeys

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***Target Audience:** Local turkey farmers*

Abstract

The study evaluated the impact of rearing system and frequency of semen collection on semen quality indices of local turkeys. Twenty four toms were randomly assigned to two management systems (intensive and semi-intensive) and four frequencies of semen collection (once, twice, thrice and four times) weeklyin a 2 x 4 factorial arrangement of treatments in a completely randomized design. Ejaculates from each treatment group were assessed for quality using standard procedures. Semen quality indices of the toms under the two management systems were comparable ($p > 0.05$). Ejaculate quality characteristics were highly influenced ($p < 0.01$) by the frequency of collection. Semen volume, sperm progressive motility, sperm concentration, total sperm in ejaculate and percentage normal sperm were higher ($p < 0.01$) at once and twice per week collections. Also, lower and high significant ($p < 0.01$) variations in percentage abnormal sperm were observed at twice per week ejaculation frequency. It was concluded that local breeder toms can be reared under both management systems (semi-intensive and intensive) for production of good quality semen. Similarly, for the collection of good quality semen for Artificial Insemination, twice per week ejaculation frequencyis recommended for toms reared as semen donors.

***Key words:** Artificial insemination, Turkey spermatozoa, genotype, climate, phytochemicals*

Description of problems

Nigerians struggle for food in social gatherings which indicate that Nigeria is a hungry country. About 30% of fish and 60% of cattle, sheep and goats slaughtered in Nigeria are imported from neighbouring countries (1). Livestock and poultry production in Nigeria is less than halve the national demand (1). Thus, Nigeria lags in terms of meat production (2), resulting in many families living with chronic animal protein deficiency since post-independence. Massive production of animals with short reproduction cycles such as pigs, rabbits and poultry has been prescribed as the only remedy to the acute animal protein shortage in Nigeria (3). This however, has undoubtedly spurred research efforts in the direction of these animals, especially poultry that offer the highest turn-over rate and the quickest return on investment (3).

One of the major challenges facing turkey production in Nigeria and other developing countries is low capability of the species to reproduce by natural mating. Breeders who rely on natural mating often encounter poor results due to the clumsy nature of the toms as a reproductive partner. The development of artificial insemination technology over the past decades has

resulted in some significant advances in poultry breeding. The practice of selecting breeder toms based on appealing phenotypic characteristics without recourse to their inherent breeding value appears to be responsible for the apparent small poult-hatch at the end of the laying cycle. This has however continued to wreak monumental economic havoc to both small and large-scale turkey farms.

There is few documented literatures (4) on semen quality indices of local turkeys from the two major systems of operation adopted by turkey farmers in Nigeria. Thus, the fertilizing ability of these turkeys especially the toms for on-farm artificial insemination programmes under the different management systems is yet to be fully established. This may have accounted for the infertility problems witnessed in local turkey breeder flock in Nigeria.

This study therefore was aimed at evaluating the impact of rearing system and frequency of semen collection on semen quality indices of local breeder turkeys in the humid tropics.

Materials and methods

Experimental Site and Management of Birds

The study was carried out at the Poultry Unit, Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Twenty-four mature local breeder toms of 36 weeks of age and average 9kg live body weight were randomly assigned into two management groups – intensive and semi-intensive and four frequencies of semen collection (Once – B1, twice – B2, three – B3 and four – B4 times per week) in a 2 x 4 factorial arrangement of treatments in a completely randomized design. Three toms were assigned to each treatment groups. Toms assigned to semi-intensive rearing system were allowed to scavenge for food daily in a fenced area of the farm and fed with supplements made up of maize chaff and palm kernel cake. Feeders for the semi-intensive toms were positioned at strategic locations in the runs. Fresh clean water was provided for the toms in line with the method adopted by rural farmer in the study location. The intensively managed groups of toms were housed in a well-ventilated and netted pen of 5ft x 5ft dimensions with the floor covered with high absorbent litter material (wood shavings) and fed formulated diet having 17% crude protein and 12.16 MJ/kg Metabolizable Energy (ME) (Table 1). Water was provided ad libitum.

Table 1: Composition of the Breeder Diet per 100kg

Ingredient	g/kg
Maize	425
Cassava chips	110
Wheat offal	50
Groudnut cake	230
Palm kernel cake	100
Palm oil	20
Limestone	15
Bone meal	40
Vitamin/Mineral premix	2.50
Salt	2.50
Lysine	2.50
Methionine	2.50
Total	1000%
Proximate composition	
Crude protein	17.34
Ether extract	4.50
Crude fibre	5.51
Ash	5.03
Nitrogen-free extract	58.94
Moisture	8.68
Metabolizable energy	12.16 MJ/kg

Semen collection

Before actual semen collection and analysis, toms in each treatment group were trained for semen collection two times weekly for three weeks using abdominal massage technique as described by (5) and

modified by (6). Ejaculates were collected from each tom in line with the ejaculation frequencies under study and subjected to physical evaluation: semen colour, semen volume, progressive motility, sperm concentration, total sperm, dead and live sperm, normal and abnormal spermatozoa in ejaculate (7; 8).

Statistical analysis

At the end of the field trial, data were analysed in accordance with one-way analysis of variance (ANOVA) in completely randomized design (CRD) using SAS computer analytical package. The statistical model used in the analysis was:

$Y_{ijk} = \mu + T_i + B_j + (TB)_{ij} + e_{ijk}$

Where:

Y_{ijk} : Individual observation of dependent variables

μ : Overall mean

T_i : Effect of rearing system on ith individual males

B_j : Effect of frequency of semen collection on jth individual males

$(TB)_{ij}$: Interaction effect of management system and frequency of semen collection on the ith and jth individual males

e_{ijk} : Random error associated with individual observation

Significant differences found between treatment means were separated using the Duncan Multiple Range procedure (9) and accepted 5 or 1% level of probability.

Results

A total of 286 ejaculates out of 300 ejaculation attempts were evaluated for quality indices. The results are presented in Table 2. Rearing systems had positive influence on semen volume and total spermatozoa in ejaculates. Toms reared semi-intensively yielded higher semen volume with greater number of total spermatozoa in ejaculate ($p < 0.05$) compared to the intensively reared toms. The other semen quality traits – progressive motility, spermatozoa concentration, live spermatozoa, normal spermatozoa and abnormal spermatozoa in ejaculates of toms under both management systems were similar ($p > 0.05$).

Significant variations were observed in all the semen traits of the toms at various ejaculation frequencies ($p < 0.01$). Higher values in these traits with the exception of abnormal spermatozoa were shown by toms under twice a week frequency of semen collection and these differed ($p < 0.01$) highly from the quality of semen collected from toms in other frequencies of collection.

Semen volume of toms under once and three times per week collection were equal ($p > 0.05$) but was highly different ($p < 0.01$) when compared with those of toms ejaculated four times per week. Also, progressive sperm motility of toms ejaculated three and four times per week were higher ($p < 0.01$) in toms that were subjected to once-a-week semen collection. There were no significant differences ($p > 0.05$) in the spermatozoa concentration of toms ejaculated once or twice weekly. However, spermatozoa concentration in toms under twice per week ejaculation was better ($p < 0.01$) than those that were ejaculated three and four times weekly. Results also showed that an increase in the frequency of ejaculation of toms up to three and four times weekly caused a significant decline in spermatozoa concentration and total spermatozoa in ejaculates. These traits (spermatozoa concentration and total spermatozoa in ejaculates) were lower ($p <0.01$) compared to those of toms ejaculated once and twice weekly. There was a marked drop in the total spermatozoa in ejaculates of toms ejaculated four times weekly.

Some ejaculates collected from toms

under four times weekly were bad and not used in the analysis. The number of live spermatozoa in ejaculates of toms under two, three and four times a week ejaculation frequency were greater than ($p < 0.01$) values observed in toms that were ejaculated once a week. On the other hand, total abnormal spermatozoa in ejaculates of toms ejaculated once, three and four times weekly were higher ($p < 0.01$) than those of toms ejaculated two times weekly. Abnormal spermatozoa in ejaculates of toms that were subjected to two times per week were quite very low. Interaction effects of rearing systems and ejaculation frequency were significant ($p < 0.05$) only in semen volume and spermatozoa concentration. Ejaculate volume was higher and differed ($p < 0.05$) from other treatment combinations when semen was collected two times weekly under both systems of rearing. Whereas spermatozoa concentration in ejaculates of toms was higher ($p < 0.05$) compared to other treatment combinations when ejaculates were collected once and twice weekly in the two rearing systems.

Table 2: Semen quality traits of turkey toms ejaculated at various frequencies under intensive and semi-intensive systems of management

Parameters	Volume (cm)	PM (%)	SC (x 10^9/ml)	TS (x 10^9)	LS (%)	NS (%)	AS (%)
Management system (A)							
A_1	0.24^b	92.48	9.76	2.36^b	93.25	91.37	8.81
A_2	0.26^a	92.97	9.66	2.53^a	93.69	93.69	8.38
S.E.M	0.01	0.52	0.16	0.09	1.66	0.71	0.72
P	0.05	0.28	0.35	0.05	0.84	0.57	0.64
Ejaculation frequency (B)							
B_1	0.24^b	89.20^c	10.48^a	2.58^b	82.23^b	88.40^b	11.60^a
B_2	0.29^a	97.47^a	10.43^a	3.02^a	91.71^a	98.59^a	1.43^b
B_3	0.24^b	92.60^b	9.00^b	2.33^c	98.37^a	90.42^b	10.42^a
B_4	0.20^c	91.77^b	8.94^b	1.69^d	98.28^a	89.08^b	10.92^a
S.E.M	0.01	0.44	0.15	0.10	1.49	1.22	0.59
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interaction (AB)							
A_1 B_1	0.22^c	87.73	10.51^a	2.98	64.13	88.13	11.87
A_1 B_2	0.28^a	97.92	10.42^a	2.48	92.10	98.50	1.53
A_1 B_3	0.22^c	92.67	9.24^b	2.30	98.47	90.30	10.37
A_1 B_4	0.21^c	91.89	8.90^b	1.68	98.30	88.53	11.47
A_2 B_1	0.26^b	90.67	10.44^a	2.68	80.33	88.67	11.33
A_2 B_2	0.29^a	97.03	10.43^a	2.59	97.90	98.67	1.33
A_2 B_3	0.26^b	92.53	8.77^b	2.36	98.27	90.53	10.47
A_2 B_4	0.19^c	91.77	8.99^b	1.69	98.26	89.63	10.37
S.E.M	0.01	0.47	0.16	0.10	1.58	0.98	0.66
P	0.03	0.15	0.05	0.19	0.42	0.99	0.66

^{a,b,c,d} Means in the same column with different superscripts are significant at 1 or 5% ($p < 0.01$; $p< 0.05$); SV: Semen volume; PM: Progressive sperm motility; SC: Sperm concentration; LS: Live sperm; DS: Dead sperm, NS: Normal sperm; AS: Abnormal sperm; TS: Total sperm in ejaculate; A_1: Intensive rearing system; A_2: Semi-intensive rearing system; B_1, B_2, B_3 and B_4: once, twice, thrice and four times a week semen collection frequencies, respectively; E.E.M: Standard error of the mean; P: Probability levels.

Discussion

Ejaculate volume and total spermatozoa in ejaculates were higher for toms reared semi-intensively compared to their

intensively reared group of toms. The superiority of toms under semi-intensive system over their intensive counterparts in ejaculate volume and total sperm in ejaculates could be attributed to their freedom to forage which gave them the opportunity to pick various insects and plants from the range, some of which may contain sex-stimulating phytochemicals.

(10) reported that phytochemicals have some beneficial effects on gametogenic and androgenic functions of the testis and seminiferous tubules that positively influence semen volume and total sperm in ejaculates. Increasing frequency of semen collection caused marked decrease in ejaculate volumes, progressive motility, sperm concentration, normal sperm, live sperm, abnormal sperm and total sperm in ejaculate irrespective of the rearing systems under which the toms were managed. This agrees with the reports of (11, 12) who reported that semen quality traits declined with increasing frequency of ejaculation. These ejaculate characteristics were higher and better when toms were ejaculated two times a week. These findings are in consonant with the reports of (13), (11), (14) and (12). On the contrary, (4) reported no significant effect of ejaculation frequency on sperm motility, percentage live sperm, normal sperm and total sperm in ejaculates of exotic and local toms. However, their report on sperm concentration in ejaculates of these toms is consistent with the result of this study.

In addition, values of ejaculate characteristics (semen volume, progressive motility, sperm concentration, live sperm, normal sperm, abnormal sperm and total sperm in ejaculates) reported in this study were higher than those reported by (4).

Significant variations in ejaculate characteristics could occur due to breed and genotype differences, variations in climatic variables, nutrition, age of tom, expertise of semen collector and analytical procedure. For instance, (15) reported that variations in components of climatic environment such as solar radiation, air temperature and relative humidity could cause visible changes in reproductive performance of males leading to changes in ejaculate characteristics.

(4) carried out their work in Sudan Savanna region of Northern Nigeria while our study was conducted in the humid tropical climate of south east Nigeria. Results of ejaculate characteristics of toms in this study were within the ranges reported in literature for local and exotic toms. It appears that if semen is collected once and twice per week, local toms will give maximum sperm output in terms of ejaculate volume and concentration. This is based on the significant interaction between rearing system and ejaculation frequency shown only in the semen volume and spermatozoa concentration of toms used in the study.

The high sperm concentration recorded in both management systems appears to suggest that high fertility could be achieved with the toms when used in artificial insemination programmes. This is because ejaculates with low sperm concentration have been associated with low fertility (8). The mean percentage live spermatozoa of the toms under both systems of rearing were high, exceeding the 75% minimum base line value reported by (7). Also, the values for percentage abnormal sperm were below the 20% reported by (7) and (8) as baseline value beyond which fertility may be impaired.

This is an indication that higher fertility could be achieved with active use of local toms that have adapted to the humid tropical environment in planned breeding programme since high correlation have been reported to exist between sperm viability, morphological defects and fertility (16).

Conclusion and Application

From the results of the study, it was concluded that:

1. Local turkey toms can adapt to Artificial Insemination programme under both intensive and semi-intensive rearing systems.
2. Toms under intensive system should be supplemented with or allowed access to fresh forage to improve semen quality.
3. For the collection of good quality semen from breeder toms for AI, farmers should adopt twice per week collection as a method of choice.

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