TURKEY HEN FERTILITY AFTER INSEMINATION WITH VARIED SEMEN DOSAGE OR NATURAL MATING

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ABSTRACT
The study was carried out to assess the fertility of locally adapted turkey hens after artificial insemination with varied semen dosage or natural mating. Sixty white – feathered local turkey hens were grouped into five treatments of twelve hens each in a completely randomised design. Semen was harvested from seventeen toms, pooled and inseminated into hens in groups one to four each with 0.02 mL ($SD_{0.02}$), 0.04 mL ($SD_{0.04}$), 0.06 mL ($SD_{0.06}$) and 0.08 mL ($SD_{0.08}$) of undiluted semen, containing approximately $80x10^6$, $160x10^6$, $240x10^6$ and $320x10^6$ motile sperm cells, respectively. Hens in group five (NM) were mated naturally with three other toms at a mating ratio of one tom to four hens. Insemination and mating were done once daily for two successive days only, after which eggs were collected and incubated weekly for 10 weeks. Candling was done at day 25 of incubation and candling clears were broken out to separate infertile eggs from fertile eggs with embryonic deaths to determine percentage fertility. Data was collected on weekly fertility. Analysis was done on square root transformed data using ANOVA at $\alpha_{0.05}$. Average fertility at the first three weeks post-insemination / mating in $SD_{0.02}$ (94.2%), $SD_{0.04}$ (95.1%), $SD_{0.06}$ (98.0) and $SD_{0.08}$ (93.8%) were significantly ($p<0.05$) higher than NM (70.4%). The efficient duration of fertile period of the turkey hens was three weeks while their maximum duration of fertile period was eight weeks. Semen insemination dosage of 0.02mL containing approximately $80x10^6$ motile sperm cells was an economic dose for insemination.

Keywords: Artificial insemination, Fertile period, Natural mating, Semen dosage, Turkey fertility.

Introduction
Artificial insemination (AI) is employed in turkeys to ameliorate the challenge of low fertility that may arise from difficulty in mating and also to improve the breeding efficiency of the toms. Over the years, several studies have been carried out on AI in turkeys; the bulk of which are not done locally and birds utilised are improved or exotic breeds. Results therefore may or may not apply directly to the local strains. Christensen *et al.* (2005) observed that breed differences in turkey may cause differences in fertility. Zaharadeen *et al.* (2005) also reported lower range of values of sperm concentration of semen from toms of the local strain when compared with the exotic and this may affect the semen insemination dosage required for optimal fertility.

There is paucity of information on research in AI in the local turkeys in Nigeria (Yahaya *et al.*, 2013). Related studies are limited to semen evaluation (Zaharadeen *et al.*, 2005; Ngu *et al.*, 2013), and preliminary AI studies (Yahaya *et al.*, 2013). Adopting AI in the indigenous turkeys in Nigeria will help maximize their potentials and serve as a basis for their improvement as AI is known to be a vital tool in the improvement of animal productivity. A step in establishing AI schedule for the local turkeys is to determine their sperm storage potential and the minimum semen dose required for optimal fertility.

The objective of this study was therefore to assess the sperm storage potential of the white- feathered local turkeys in Nigeria using duration of fertile period and the effect of insemination semen dosage or natural mating on fertility.

Results
The mean spermatozoa characteristics of pooled semen inseminated on the two successive days prior to egg collection are shown in Table 1. This implied that 0.02 mL, 0.04 mL, 0.06 mL and 0.08 mL semen inseminated contained approximately $80x10^6$, $160x10^6$, $240x10^6$ and $320x10^6$ motile sperm cells, respectively.

Table 1: Characteristics of Pooled Turkey Semen Inseminated on Two Successive Days

Semen Parameters	Mean Values (± Standard Deviation)	Range
Spermatozoa concentration ($x10^9$/mL)	4.48±0.26	4.20 – 4.81
Spermatozoa Liveability (%)	93.53±3.57	87.50 – 97.26
Progressive Spermatozoa Motility (%)	92.50±2.89	90.00 -95.00

The effect of semen dosage on post – insemination / mating weekly fertility levels is presented in Table 2. During the first three weeks after insemination, percentage fertility was similar among the inseminated groups. It ranged from 90.6±2.4% to 100.0±0.0% and was significantly ($p<0.05$) higher than NM (70.4±93.4%). Fertility in $SD_{0.06}$ was significantly ($p<0.05$) lower than $SD_{0.04}$ and $SD_{0.08}$ at the 4th week. Significant differences were not observed among all groups at subsequent weeks. They were all infertile between the 8th and 9th week.

Table 2: Fertility (%) of Eggs from Turkey Hens Inseminated with Different Semen Dosage or Natural Mating (Mean±SE)

Weeks post Insemination	Semen dosage				Natural mating (NM)
	0.02 mL ($SD_{0.02}$)	0.04 mL ($SD_{0.04}$)	0.06 mL ($SD_{0.06}$)	0.08 mL ($SD_{0.08}$)	
1	95.6 ±2.6^a	94.3 ±0.7^a	98.3 ±1.7^a	98.6 ±1.4^a	71.8 ±3.6^b
2	95.8 ±4.2^a	97.4 ±2.6^a	100.0 ±0.0^a	90.6 ±2.4^a	68.5 ±9.3^b
3	91.1 ±4.5^a	93.8 ±6.3^a	95.6 ±4.4^a	92.1 ±4.8^a	71.1 ±6.3^b
4	75.5 ±5.2^{ab}	83.1 ±8.6^a	58.9 ±4.8^b	79.9 ±4.2^a	72.6 ±1.2^{ab}
5	63.4 ±1.9	58.2 ±10.0	56.7 ±8.8	65.1 ±8.3	45.8 ±4.1
6	17.9 ±9.0	22.9 ±2.9	20.2 ±11.6	17.0 ±5.2	20.0 ±6.7
7	3.3 ±3.3	7.8 ±4.2	4.2 ±4.2	3.0 ±3.0	7.4 ±7.4
8	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0	4.2 ±4.2
9	0.0 ±0.0	3.6 ±3.6	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0
10	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0	0.0 ±0.0

a, b – means across same row with different superscripts are significantly ($p<0.05$) different;
SE - Standard Error

The duration of fertile period and the effect of oviductal spermatozoa age on fertility of the inseminated groups of hens are presented in Figure 1. Fertility declined in the hens as the stored spermatozoa stayed longer in the oviduct. Fertility was above 90% in the first 3 weeks after insemination but declined significantly ($p<0.05$) to 74.3±13.1% at the fourth week, 60.9±12.3% at the fifth week, 19.4±11.9% at the sixth week, 4.6±5.8% at the seventh, and finally down to 0.0±0.0% at the eight week.

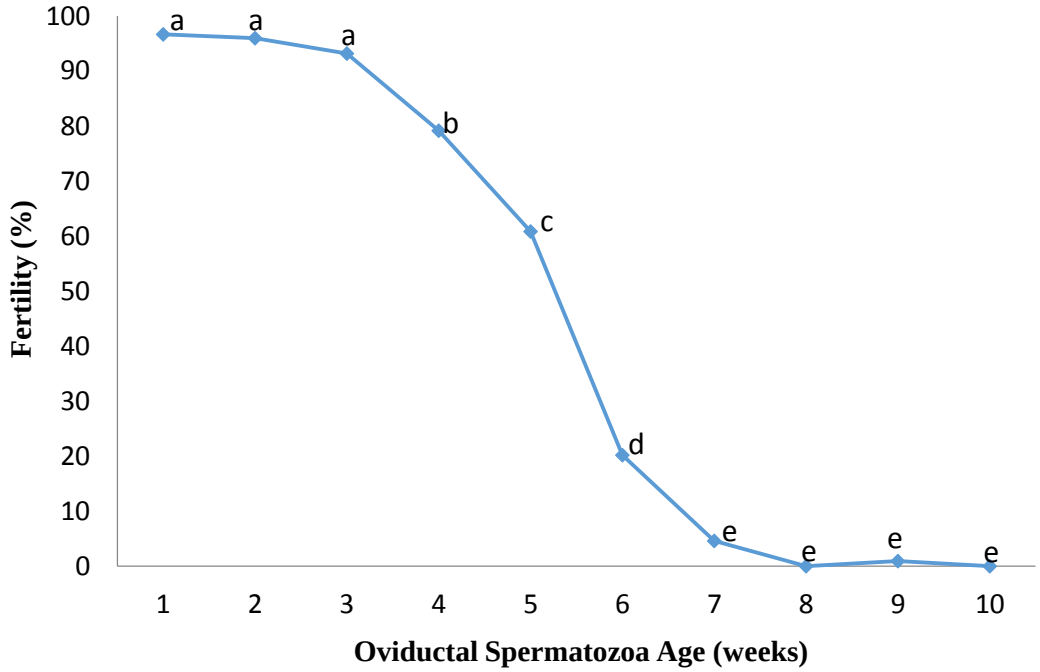

Figure 1: Duration of Fertile Period and the Effect of Oviductal Spermatozoa Age on Fertility of Eggs from Turkey Hens

a,b,c… Means with different letters are significantly ($p<0.5$) different

Discussion

The duration of fertile period in turkey hens is a function of the ability of its sperm storage tubules to store sperm cells. Bakst *et al.* (2010) reported that the duration of fertility in broilers and turkeys are directly related to the number of sperm storage tubules (SST) in their respective uterovaginal junction folds. It was assumed that the multiplicative dose of semen would mean more sperm cells available for storage in the SST. Therefore, higher fertility levels could have being sustained for a longer period after insemination or the duration of fertile period may be lengthened. This assumption was at variance with the result obtained from the study (Table 2). Compton and Van Krey (1979) suggested that only a finite number of sperm cells are capable of entering the SST within a given period. Despite the multiplicative semen dose administered across the treatment groups, the absence of a significant difference among the inseminated groups suggests that insemination in excess 0.02mL (approximately $80x10^6$ motile cells) is in excess of the maximum number of spermatozoa which can be accepted by the SST at a given period. Thus, increasing the dose therefore resulted in semen wastage. The relatively lower fertility from the naturally mated hens may be an indication that the volume of semen ejaculated by the toms did not contain sperm cells that was sufficient to fill the SST. This reduced volume may have resulted from semen wastage from improper cloacal contact or it was the actual volume ejaculated naturally during a single mating that was low.

The maximum duration of fertile period of 8 to 9 weeks recorded for all the groups is similar to that reported by Bakst (1988) for large white turkey hens inseminated with 75 million and 200 million sperm cells for two successive days. Although, his results indicated that fertility levels was still as high 88.1% to 98.0% at 5 weeks post insemination, and then, a sharp drop to 0% at the 8th to 9th week after insemination. The reason for the high fertility sustained for a longer period may be due to the fact that the semen inseminated in that study was extended while for this study, unextended semen was used for insemination. The extender may have sustained the cells better in the storage tubules. However this only seemed to sustain high fertility for longer and not lengthen the duration of fertile period. Despite the assumed low volume of semen in the naturally mated hens, their duration of fertile period was similar to the inseminated groups. This therefore

could be an indication that the maximum duration of fertile period is more related to the oviductal sperm age rather than the number of spermatozoa in the SST once probably a threshold is reached.

The results presented in Figure 1 is a pool of fertility of all inseminated groups of hens to assess the effect of oviductal sperm age on fertility and the sperm storage potential of the hens. Maximum fertility of 93.1% to 96.7% observed at the first 3 weeks and without significant differences among the weeks considered it an efficient duration of fertile period as described by Liu *et al.* (2008). It was reported as a better way to assess the sperm storage potential of a hen. Although efficient duration of fertile period was described as the day after insemination to the first infertile egg observed (this can also be assumed to be the period of maximum fertility). It was therefore observed in this study that efficient duration of fertile period was three weeks.

Conclusion and Recommendation

Based on results obtained from this study, the indigenous turkey hens have an efficient duration of fertile period of at least 3 weeks. This implies that their oviduct has the capacity to support sperm storage for maximum fertility for at least 3 weeks post insemination while their maximum duration of fertile period was 8 to 9 weeks. Semen insemination dosage of 0.02mL containing approximately $80x10^6$ sperm cells can be recommended as an economic dose for insemination of undiluted semen, while the volume of semen ejaculated by toms into the oviduct of hens during natural mating may be lower than 0.02mL.

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Temperature	Extract	Extender			Extract subgroup effect
		A	B	C	
Hypo thermic $\bar{X}$ = 67.57^{NS}	T1	67.28^{a}±17.70	71.62^{a}±13.32	69.95^{a}±15.01	**69.62^{a}±14.63**
	T2	56.17^{a}±31.85	76.17^{a}±15.82	66.50^{a}±23.37	**66.28^{a}±24.56**
	T3	65.80^{a}±25.79	71.50^{a}±20.07	64.67^{a}±25.38	**67.41^{a}±22.44**
	T4	60.20^{a}±26.24	72.43^{a}±16.98	66.43^{a}±23.30	**67.00^{a}±21.32**
	Extender subgroup effect	**62.31^{a}±24.4**	**72.91^{a}±15.77**	**66.87^{a}±20.84**	
Hyper thermic X = 65.59 ^{NS}	T1	55.25^{a}±21.42	55.00^{a}±21.82	56.00^{a}±22.35	**55.43^{c}±20.16**
	T2	67.75^{a}±23.89	73.40^{a}±18.05	72.40^{a}±19.37	**71.43^{ab}±18.80**
	T3	49.25^{a}±30.70	62.75^{a}±15.76	61.75^{a}±17.58	**57.92^{bc}±21.22**
	T4	73.75^{a}±23.89	76.17^{a}±17.98	75.00^{a}±18.95	**75.13^{a}±18.51**
	Extender subgroup effect	**61.50^{a}±24.6**	**67.50^{a}±19.28**	**66.95^{a}±19.82**	
					Extract main effect
Harmonized main effect	T1	62.47^{a}±19.12	64.06^{a}±18.83	63.61^{a}±19.12	**63.41^{a}±18.41**
	T2	60.80^{a}±28.10	74.91^{a}±16.05	69.18^{a}±20.80	**68.53^{a}±20.04**
	T3	58.44^{a}±27.61	68.00^{a}±18.08	63.50^{a}±21.52	**63.48^{a}±22.07**
	T4	66.22^{a}±24.69	74.15^{a}±16.81	70.39^{a}±21.00	**70.71^{a}±20.22**
	Extender main effect	**61.97^{a}±24.2ss**	**70.50^{a}±17.42**	**66.90^{a}±20.16**	