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Short Communication

Studies on Semen Morphology and Effects of Artificial Insemination on Hatchability in Turkeys (*Meleagris gallopavo*)

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Authors' Contributions
Irfan collected and analysed the data. AJ, M Ashraf and AM supervised the work. M Altaf, MS and KJI helped in management of birds. SMH prepared sketches.

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Insemination, Morphological defects, Hatchability, Incubation, Semen.

ABSTRACT

Morphological characteristics of turkey *Meleagris gallopavo* semen were recorded and hatchability percentages of the artificially inseminated hens were assessed. To study the effect of natural mating on hatchability 15 (3♂, 12♀) *M. gallopavo* were randomly selected, were kept separately and were allowed to mate through stud mating. For artificial insemination, male (n = 3) and female (n = 12) birds were kept separately. Semen of the male birds was collected on weekly basis to record morphological characteristics and to inseminate the female birds. Mean abnormal spermatozoa rate was 14.61±1.61% with most common acrosome defects 39.67±3.80 % followed by defects in mid-piece 29.61±0.24%, head defects 10.15±1.21% and tail defects 20.57±1.97%. Laid eggs were collected, stored and were incubated for hatching. Hatchability percentage in artificially inseminated hens was greater 88.30% than natural mating 80.51%.

Success of poultry industry depends on hatchability of the eggs. Therefore, the eggs laid by the hens should be fertilized. Fertilization of eggs is greatly dependent on the quality of semen and its successful injection into the female genital tract. Semen morphology, spermatozoa motility and live-dead ratio are the characteristics that reflect semen quality and this is known as potential fertility (Etches, 1996). Ramamurthy *et al*. (1998) documented positively significant correlation between body weight and seminal volume, pH, and abnormal spermatozoa rate, whereas a negative correlation exits between body weight and motility, spermatozoon concentration and live spermatozoon rate in poultry. To determine fertility it is important to know the proportion of abnormal spermatozoa in a semen sample. Motility and size of spermatozoa significantly affect fertilization rates not only in single pair mating (Vladic et al., 2002) but also in sperm competition during multi male mating across a range of taxa (Gage *et al*., 2004). Primary aim of artificial insemination (AI) in poultry is to enhance the efficacy of breeding in birds.

In Pakistan, poultry industry is flourishing but existing poultry breeds are facing many challenges like disease outbreak and environmental stresses. Turkeys are hardy birds and can be reared in controlled and free-range rearing systems (Alkan *et al*., 2002; Irfan *et al*., 2016). However, there is scanty of knowledge regarding management and AI techniques in turkeys in Pakistan. Present experiment was therefore planned to study semen morphology and effects of artificial insemination on hatchability in turkeys *M. gallopavo*.

Materials and methods

An experiment was conducted to study semen morphology and effect of AI on hatchability in turkeys

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Meleagris gallopavo. At the initiation of experiment, the age of the male and female turkeys was eight months. To study the hatchability, fifteen (12♀, 3♂) birds were randomly selected for each of the method *i.e.* natural mating and AI. These birds were kept separately and for every four females, one male bird was earmarked. The female and male birds were allowed to mate through stud mating for natural mating. For AI, male *M. gallopavo* were conditioned and trained for semen collection through abdominal massage and semen was collected on weekly basis for six weeks and analyzed (Burrows and Quinn, 1937) for determination of volume, morphology, sperm count, live-dead ratio and mass motility (Sastry, 2002).

AI was achieved following 'venting'; the females were turned upside down, pressure applied on the right side of the abdomen until the vent everted, a pipette containing fresh semen was inserted to a depth of about 1.5-2 cm into the cloacae and then 0.02 ml of semen was dispensed on weekly basis for a period of six weeks. The laid eggs were collected from each cage and cage number and weight of each egg was noted. The eggs were then transferred to the incubators and hatchability percentage was recorded for natural and artificially inseminated birds.

The collected data was subjected to statistical software SAS 9.1 and analysis of variance was applied to compare the means.

Results

Mean morphological defect rate of sperms was recorded 14.61±1.61%. Acrosome defect rate was highest 39.67±3.80% having most frequent defects of acrosome detachment (without acrosome), hooked shaped acrosome, acrosome swelling and rounded acrosome (Fig. 1A). Mid-piece abnormalities (Fig. 1B) were the second most common defects 29.61±0.24%. Head abnormalities were recorded 10.15±1.21% with most common abnormalities

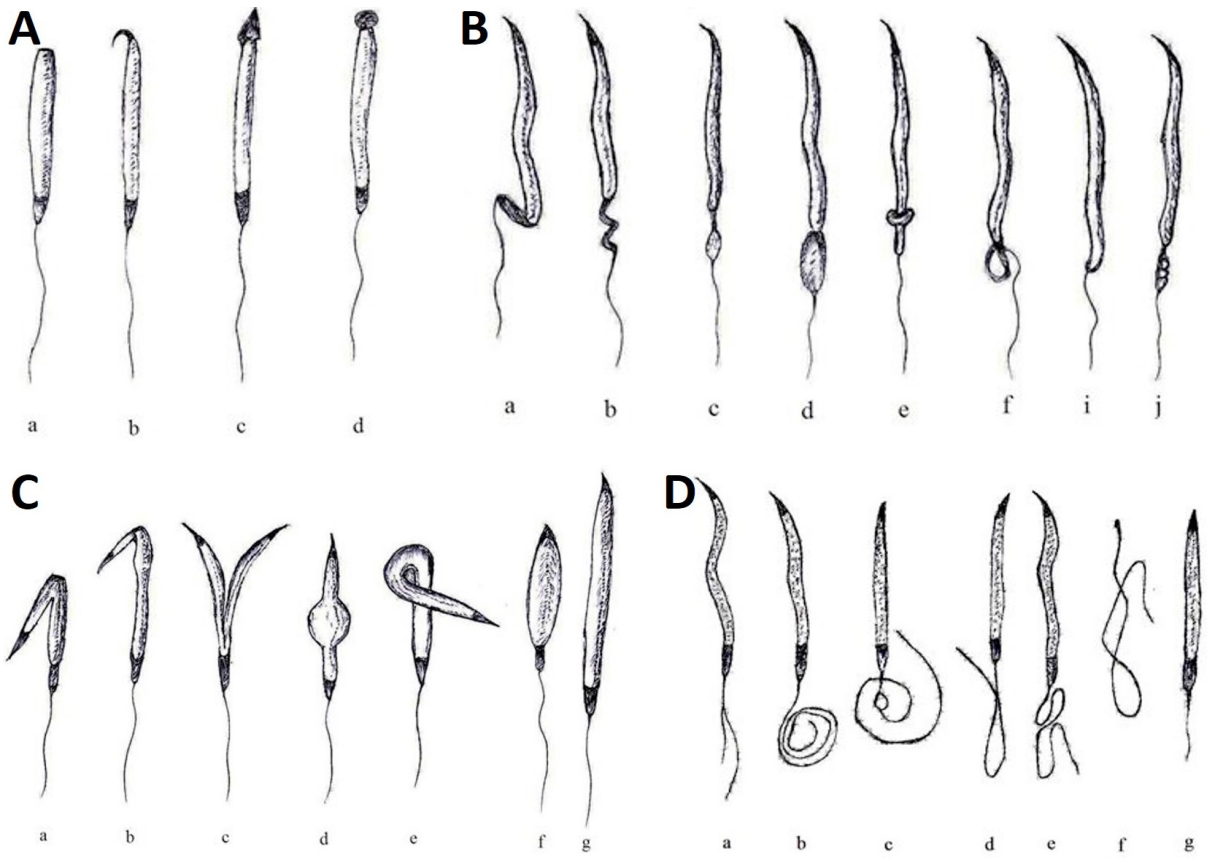

Fig. 1. Morphology of sperms of *Meleagris gallopavo*; **A,** showing acrosome defects (a) without acrosome, (b) hooked shaped acrosome, (c) acrosome swelling and (d) rounded acrosome; **B,** showing mid piece defects (a) bent mid piece, (b) irregular mid piece, (c) partially detached mid piece, (d) swelled mid piece, (e) mid piece swelled near neck region, (f) knotted mid piece, (i) without mid piece and (j) spiral mid piece; **C,** showing head defects (a) bent head, (b) hook shape head, (c) twin head, (d) swelled head, (e) knotted head, (f) short head and (g) larger head; **D,** showing tail defects (a) double tail, (b) coiled tail, (c) knotted tail, (d) bent tail, (e) curled tail, (f) detached tail and (g) short tail.

of bent head, hooked shape head, twin head, swelled head, knotted head, short head and larger head (Fig. 1C). Tail defects were recorded 20.57±1.97% having frequent defects as double tail, coiled tail, knotted tail, bent tail, curled tail, detached tail and short tail (Fig. 1D).

Mean semen volume during the trial was 0.19±0.04 ml, live-dead ratio 71.66±11.72% while mass motility was recorded 81.41±7.19%. Statistically significant ($p<0.05$) variations were recorded for semen volume during 4th and 6th week (Table I) while non-significant variations in live-dead ratio were recorded from 1st to 6th week of trial. Maximum mass motility was recorded 86.50±6.35% during 1st week and minimum 71.25±3.30 % during 6th week of trial (Table I). Mean hatchability percentage for artificially inseminated eggs was recorded as 88.30% (Table II).

Table I.- Weekly variations in semen characteristics of turkeys (*Meleagris gallpavo*).

Week	Semen volume(ml)	Semen count ($\times10^9$ cell/ml)	Live dead ratio (%)	Mass motility (%)
1	0.19±0.04^{ab}	6.02±0.73^{a}	70.50±10.14^{a}	86.50±6.35^{a}
2	0.19±0.03^{ab}	5.59±0.77^{a}	63.25±16.17^{a}	83.75±6.60^{ab}
3	0.195±0.03^{ab}	5.75±0.94^{a}	70.50±7.94^{a}	72.50±11.21^{bc}
4	0.21±0.04^{a}	6.48±0.47^{a}	68.75±20.74^{a}	72.25±6.29^{bc}
5	0.19±0.02^{ab}	5.66±1.59^{a}	66.25±6.89^{a}	77.01±7.26^{abc}
6	0.16±0.02^{b}	5.33±0.32^{b}	85.39±10.41^{a}	71.25±3.30^{c}

Means with similar superscript in a column are statistically non-significant.

Table II.- Hatchability percentages of eggs from artificially inseminated and naturally matted hens of *Meleagris gallopavo*.

Insemination types	Hens/ cage No.	Mean (eggs)		Hatchability %
		Incubated	Hatched	
Natural mating	A	15	13	86.67
	B	11	9	81.82
	C	14	11	78.57
	D	12	9	75.0
Artificial insemination	E	16	14	87.50
	F	15	14	93.33
	G	14	12	85.71
	H	15	13	86.66

Discussion

During present study, mean morphological defect rate of sperms was recorded 4.61±1.61%. Alkan *et al.* (2002) documented slightly higher percentages 17±0.06% of morphological defects in turkey sperms. Similarly, Tsukunaga (1987) recorded higher values for tail defects. These differences might be attributed to ambient temperature, season of collection, humidity, body weight of the birds and semen collection techniques. Mean semen volume recorded during the experiment was 0.19±0.04 ml and it was in line with the findings of Zahraddeen *et al.* (2005) and Yahaya *et al.* (2013) who documented semen volumes as 0.17±0.02 ml and 0.19±0.010 ml, respectively.

During present investigation, mean semen count was 6.35±0.87 ($\times10^9$ cells/ml), mean live-dead ratio 71.66±11.72% while mass motility was recorded 81.41±7.19%. These findings are in line with the results of Yahaya *et al.* (2013) while Zahraddeen *et al.* (2005) recorded lower semen concentrations 2.81±74.93 ($\times10^9$ cells/ml) and Rekwot *et al.* (2005) reported higher live-dead ratio of 85.2±2.56% in confined turkeys and these differences might be due to rearing systems.

Statistically significant ($p<0.05$) variations were recorded for semen volume during 4th and 6th week of trial (Table I). Similar findings have been documented by Noirault and Brillard (1999).

Non-significant variations were recorded in live-dead ratio from 1st to 6th while maximum semen motility was recorded 86.50±6.35% during 1st week and minimum 71.25±3.30% during 6th week of trial (Table I). Yahaya *et al.* (2013) documented non-significant variations in live-dead ratio and semen motility from 1st to 6th week. Similarly, Zahraddeen *et al.* (2005) reported non-significant variations for semen of exotic and local turkeys.

After incubation, the mean hatchability percentage for artificially inseminated eggs was 88.30% and it was higher than eggs laid by the females after natural mating with mean hatchability percentage of 80.51% (Table II). Yahaya *et al.* (2013) documented hatchability rate of 84.75% in eggs from artificially inseminated females.

Conclusion

It can be concluded from the present study that acrosome and mid-piece defects are amongst common morphological semen defects and artificial insemination is feasible and rewarding with higher egg hatchability percentage in in *Meleagris gallopavo*.

Statement of conflict of interest

Authors have declared no conflict of interest.

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