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Semen quality characteristics of White Pekin, Kuttanad *(Anas platyrhynchos domesticus)* and Muscovy *(Cairina moschata momelanotus)* drakes

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ABSTRACT

An experiment was conducted in drakes of Kuttanad, White Pekin and Muscovy breeds to study the macroscopic and microscopic parameters of semen quality. Manual massage method was used for the collection of semen. There was no significant difference in the semen volume between the breeds and also between the drakes within breeds. Majority of the semen samples were white and the appearance score was similar in the 3 breeds. Semen pH was slightly alkaline in all the breeds. The density of spermatozoa differed significantly between the breeds with a significantly lower value in Muscovy drakes. The percentage of live, dead, normal and abnormal sperms did not differ significantly between breeds and also between drakes of the same breed. Methylene blue reduction time (MBRT) was higher in Muscovy when compared to White Pekin and Kuttanad. But, MBRT showed no significant difference when estimated using 2 different extenders, viz. lake poultry semen extender (LPSE) and Beltsville poultry semen extender (BPSE) in White Pekin and Muscovy. The spermatozoa of the 3 breeds were able to withstand heat shock for 10 min and cold shock for up to 1 h.

Key words: Characteristics, Drakes, Extenders, Semen

In a breeding system, economic role of a male bird is equally important to that of female in reproduction. Low fertility is an important problem that retards the progress of duck rearing and the role of males in this problem has not been studied significantly (Kamar 1962). Though semen collection and artificial insemination are common in chicken it is not practiced widely in ducks. Semen collection and artificial insemination in ducks are gaining importance as ducks are now reared in cages for breeding purpose and also for selection programmes. Semen evaluation is required in artificial insemination for 2 reasons. Firstly, information about the quality of semen from each male is needed as the males producing spermatozoa likely to possess high fertilizing capacity are to be kept in the stud. Secondly, as subsequent ejaculates are collected, the concentration of spermatozoa and the volume of semen are required to calculate the appropriate dilution to obtain the required number of cells for insemination. Besides these, semen evaluation ensures semen quality and helps to evaluate potential breeders before hatching season. The selection of males based on semen evaluation will improve fertility in the population. Besides this, frequent evaluation of males for semen quality help in proper and efficient culling practices. Hence, a study involving collection of semen and its evaluation in 3 different breeds of ducks, viz. Kuttanad, White Pekin and Muscovy was contemplated with the objective of studying the microscopic and macroscopic parameters of semen quality in the 3 different breeds of ducks.

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MATERIALS AND METHODS

An experiment was conducted in 24 adult drakes of 36 weeks age, 8 each from White Pekin, Kuttanad and Muscovy breeds, which were housed in individual cages without any artificial lighting. All drakes were provided with a diet containing 23% crude protein and 2800 kcal metabolisable energy / kg diet and water for *ad lib.* consumption. The method of semen collection followed was the massage procedure outlined by Lake and Stewart (1978a). The drakes were trained once a week for 3 months and semen was routinely collected once a week during the experimental period.

Semen volume was measured by drawing semen from the glass funnel into a tuberculin syringe graduated up to an accuracy of 0.01 ml. The colour and consistency were judged

by visual examination. The appearance of semen was scored from 1 to 5 by visual examination following the method as described by McDaniel and Craig (1959). pH of fresh semen was estimated by using pH paper. The semen sample was examined for the presence of possible contaminants like blood, faecal matter or uric acid crystals. The scoring system suggested by Wheeler and Andrews (1943) was used for estimating the initial motility of spermatozoa. The sperm concentration was estimated as per Taneja and Gowe (1961). To estimate the percentage of live and dead spermatozoa, the staining method described by Lake and Stewart (1978b) was adopted with some modifications. The smears as prepared for live sperm estimation were used to study the percentage of abnormal spermatozoa. Pooled, fresh semen from each breed diluted with semen extenders (Lake poultry semen extender and Beltsville poultry semen extender) were used to estimate the methylene blue reduction time as per Beck and Salisbury (1943). The capacity of the spermatozoa to resist heat and cold shock was assessed as per Roberts (1986).

The data were analyzed statistically as per Snedecor and Cochran (1994). A nested analysis with the following model was employed to test for the differences between breeds and drakes within breeds.

$$Y_{ijk} = \mu + b_i + d_{ij} + e_{ijk}$$

where, Y_{ijk}, observations on the k^{th} collection in the j^{th} drake in the i^{th} breed; B_i , i^{th} breed (i = 1 to 3); D_{ij}, j^{th} drake in i^{th} breed (j = 1 to 8), and e_{ijk}, random error. All the tests of differences between means were conducted at 5% probability level.

RESULTS AND DISCUSSION

Semen collection: The phallus, the male reproductive organ in poultry, was not protruded out in White Pekin and Kuttanad whereas in Muscovy, the phallus protruded out on application of pressure on the vent region at the time of semen collection. Semen was collected from the base of the engorged phallus using glass funnels. But in Muscovy, the semen flowed through the ejaculatory groove region of the phallus. The presence of a clear transparent fluid was noticed in all the 3 breeds. Manual Massage method of semen collection revealed that the copulatory organs of drakes were much larger than those of gallinaceous birds, and the extended phallus – like folds could protrude several centimeters from cloaca in these species. This was clearly observed in Muscovy drakes whereas in White Pekin and Kuttanad the phallus was not always extruded out during collection as reported by Humphreys (1972) who collected semen from the base of engorged phallus. The transparent fluid observed during semen collection might be the lymphatic exudates from the phallic folds. In White Pekin, a molting period of around 8 to 10 weeks was observed and there was complete cessation of semen production during this period. During molting period, the testes appeared to be completely regressed and so the functions of testes, viz. the production of spermatozoa and secretion of testosterone also ceased during this period.

Macroscopic evaluation: The results of the macroscopic evaluation of semen are presented in Table 1. There was no significant difference in semen volume between breeds and also between drakes within breeds. The volume of semen is important in determining the number of inseminations per ejaculate and also the rate of dilution. Since the volume and concentration in the present study were similar to that reported by Etches (1996), similar number of inseminations might be possible with the undiluted semen of White Pekin, Kuttanad and Muscovy drakes. The semen volume observed in White Pekin drakes in the present study was lower than that observed by Kamar (1962). Etuk *et al.* (2006) reported a semen volume of 0.20 ml in Muscovy ducks under intensive system without wallow which was in agreement with the present finding. Tan (1980) and Samour *et al.* (1985) reported a higher semen volume in Muscovy when semen was collected by artificial vagina method and electrical stimulation respectively. But there are no reports about the semen volume in Kuttanad drakes so far. The present findings indicated that the volume of semen in Kuttanad drakes was comparable with other duck breeds.

Majority of the semen samples were white and hence could be considered to be of good quality. The likelihood of obtaining good fertility is maximized if pearly white semen is collected (Etches 1996). Semen colour observed in the present study was in agreement with the reports of Samour *et al.* (1985) in Muscovy and Mallard drakes. Majority of the semen samples from White Pekin and Kuttanad drakes were medium thick in consistency and this was in agreement with the findings of Humphreys (1972) and Nair (2003). Contrary to this, the semen of Muscovy drakes was watery in consistency. This might be because of the mixing of semen with the transparent fluid from the phallic folds. The consistency of semen determines the semen appearance score which inturn indicates the quality of semen and this could be used to determine the rate of dilution. The appearance of semen sample depends on the concentration of spermatozoa and volume of the seminal fluid. In the present study, Muscovy semen showed a lower appearance score than White Pekin and Kuttanad and this might be due to the presence of transparent fluid. The appearance score of the semen samples from White Pekin and Kuttanad in the present study was in agreement to that observed by Stunden (1996) in Mallard drakes.

The semen pH of all the 3 breeds showed no significant difference and was similar with the findings of Humphreys (1972) in passerine birds. There are no reports for the pH of Kuttanad drakes so far. Gvaryahu (1984) observed semen pH in Muscovy drakes which was similar to that obtained in the present study. Contrary to this, Etuk *et al.* (2006) reported higher pH in Muscovy under different management systems, viz. semi intensive, intensive system with wallow and

Table 1. Macroscopic quality characteristics of White Pekin, Kuttanad and Muscovy drake semen

Characteristics	White Pekin	Kuttanad	Muscovy
Semen volume	0.16±0.02	0.18±0.02	0.15±0.02
Semen appearance score	3.29	3.29	2.46
Semen pH	7.48±0.06	7.33±0.06	7.27±0.05

intensive system without wallow.

The major contaminant in semen was faeces. The presence of a common passage for the secretions from reproductive tract and digestive tract in birds could contribute to this. In ducks, the droppings are more watery when compared to that of chicken and hence the chance of contamination of semen at the time of collection is also high. Uric acid crystals also caused contamination to some extend in semen of Kuttanad and Muscovy drakes. The results of the present study agree with that reported by Kasai *et al.* (2001).

Microscopic evaluation

The results of microscopic evaluation of semen of the three breeds are presented in Table 2. The mean initial motility score of spermatozoa was 3.38, 3.42 and 3.54 in White Pekin, Kuttanad and Muscovy drakes, respectively. Though the motility estimation could be used to detect gross differences in semen quality, they have limited value in determining small fertility differences (Nair 2003). In the present study, semen of White Pekin and Kuttanad drakes showed almost similar motility (3.38 and 3.42). Similar results were reported by Kamar (1962) in Pekin drakes, Stunden (1996) in adult Mallard drakes and Kasai *et al.* (2001) in Osaka drakes. The motility in Muscovy semen was slightly higher and this might be due to the watery consistency of Muscovy semen and also because of the lower spermatozoa concentration in Muscovy drake semen. Gvaryahu (1984) and Etuk *et al.* (2006) reported a motility score of 3.59 and a motility of 68.58% in Muscovy drakes which was in agreement with the present findings. Ghonim *et al.* (2010) reported higher motility score for Domyati drake semen and this suggest that breed differences have an influence on the motility of spermatozoa. In drakes, the semen is thicker when compared to that of chicken and this could be the reason for the lower motility of spermatozoa in drakes when compared to chicken.

Table 2. Microscopic quality characteristics of White Pekin, Kuttanad and Muscovy drake semen

Characteristics	White Pekin	Kuttanad	Muscovy
Initial motility of spermatozoa (%)	57.50^{a}±2.35	58.33^{a} ±2.06	60.83^{a}±2.40
Concentration* (billions/ml)	3.03^{a}±0.19	3.22^{a}±0.20	1.94^{b}±0.08
Live spermatozoa (%)	96.45^{a}±0.43	94.27^{a}±0.52	94.74^{a}±1.05
Dead spermatozoa (%)	3.55^{a}±0.43	5.73^{a}±0.52	5.26^{a}±1.05
Normal spermatozoa (%)	88.78^{a}±0.90	87.96^{a}±0.66	89.54^{a}±0.91
Abnormal spermatozoa (%)	11.22^{a}±0.90	12.04^{a}±0.66	10.46^{a}±0.91

***** Mean value of sperm concentration between breeds with different superscripts (a, b) differ significantly (P<0.05).

The concentration of spermatozoa was significantly (P<0.05) lower in Muscovy drakes when compared to Kuttanad and White Pekin. This might be due to the dilution of semen caused by the presence of transparent fluid in Muscovy drakes. But there was no significant difference in the spermatozoa concentration between drakes of the same breed. Even though there are no reports for the spermatozoa concentration in Kuttanad drakes so far, the present findings revealed that concentration in Kuttanad was similar to that in White Pekin. Kamar (1962) observed a higher spermatozoa concentration (5.85 millions/mm^3) in Pekin drakes. The findings of Humphreys (1972) in Mallard drakes and Kasai *et al.* (2001) in Osaka drakes agree with that of the present findings in White Pekin and Kuttanad drakes. The spermatozoa concentration reported by Gvaryahu *et al.* (1984) and Etuk *et al.* (2006) (1.35×10^9 cells/ml and 1700 million/ml respectively) was in close agreement with that of the present finding in Muscovy drakes (1.94×10^9 cells/ml). Samour *et al.* (1985) observed a higher spermatozoa concentration in Mallard drakes when semen was collected by electrical stimulation and this shows the effect of method of semen collection on spermatozoa concentration.

In the present study, Pekin drakes had the least percentage of dead spermatozoa (3.55%). Semen samples with less than 60% live sperms cannot be used for artificial insemination purpose. In the present study, the mean per cent of dead sperms was less than 10% and hence can be considered to be of superior quality. The percentages of dead spermatozoa observed in the 3 breeds were similar to that recorded by Ghonim *et al.* (2009) in Domyati drakes. Contrary to this, Kamar (1962) and Ghonim *et al.* (2010) reported a higher per cent of dead spermatozoa for Pekin and Domyati drakes, respectively.

No significant difference was observed in the percentage of normal and abnormal spermatozoa between breeds and also between drakes within breeds. If the head abnormalities are more than 3 to 5%, the semen sample is not suitable for artificial insemination and the total abnormalities permitted are 15 to 20%. From our results, it was evident that the per cent of abnormal spermatozoa was within normal levels and hence the samples are suitable for artificial insemination. The abnormalities affect the movement and livability of the sperms in the reproductive tract of female and thereby result in fertilization failure. The results observed in the present study were in close agreement with that reported by Kamar

Table 3. Methylene blue reduction time (sec) for White Pekin, Kuttanad and Muscovy semen using Lake poultry semen extender (LPSE) and Beltsville poultry semen extender (BPSE)

Characteristics		White Pekin	Kuttanad	Muscovy
MBRT	LPSE	282.33[a]± 36.29	208.33[b]± 24.45	958.17[a]± 84.70
	BPSE	329.67[a]± 38.55	337.00[a]± 14.79	1260.60[a] ± 112.98

Means bearing different superscripts (a, b) within breeds differ significantly (P<0.05).

(1962) in Pekin drakes, Gvaryahu *et al.* (1984) in Muscovy drakes and Ghonim *et al.* (2009, 2010) in Domyati drakes.

On estimation of the metabolic activity of spermatozoa by Methylene blue reduction time test, the time was higher in Muscovy drakes (Table 3) and this might be due to the lower concentration of spermatozoa in Muscovy semen. The time differed significantly (P<0.05) between the 2 extenders only in Kuttanad semen. The values similar to that observed in White Pekin and Kuttanad were reported by Kundu and Panda (1990) and Nair (2003) in various breeds of chicken. Contrary to this, Ogasawara *et al.* (1966) reported higher values for low fecundity male domestic birds.

The ability to withstand heat shock only for 10 min showed the importance of maintaining proper temperature while transporting and storing semen. Similar results were reported by Ashisawa and Okauchi (1984) in chicken. The spermatozoa of the 3 breeds were able to withstand cold shock for up to 1 h, which was indicated by the presence of motile sperms after 1h (Fig.1). There is good correlation with the motility of sperms which withstand cold shock and the motility after 5 days of preservation under chilled condition. Maintenance of fertilizing capacity also requires the provision of oxygen, a diluent that supplies fructose or glucose as a substrate for the production of ATP and sufficient buffering capacity to maintain pH in addition to an ambient temperature (Etches 1996).

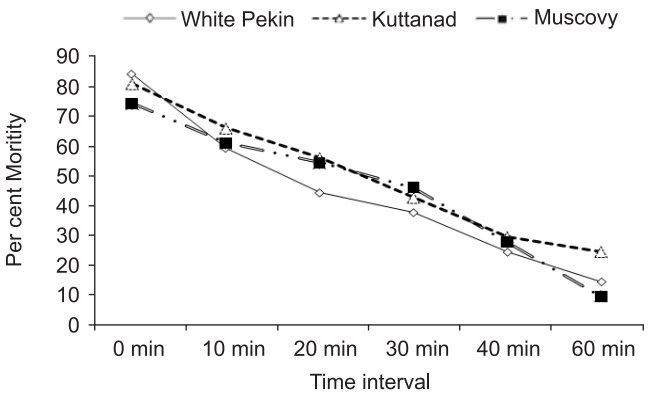

Fig. 1. Cold shock resistance (% motility) of White Pekin, Kuttanad and Muscovy spermatozoa

From the study, it could be concluded that manual massage method could be employed for collection of good quality semen from drakes as evident from the results obtained. Collection of semen from the base of engorged phallus rather than from the apex helped to avoid contamination and wastage. Methylene blue reduction time test can be used to predict the fertility potential of breeder drakes. Resistance to heat shock and cold shock showed the importance of maintaining proper temperature while transporting and storing semen.

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