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Influence of age on semen quality of large white yorkshire boars

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Abstract

A study was done to assess the influence of age on semen quality of Large White Yorkshire boar. It was recorded that the overall mean reaction time and ejaculation time of boar was 165.85 ± 7.87 and 509.81 ± 9.67 seconds. The overall mean semen volume in Large White Yorkshire boar was 208.92 ± 2.52 ml and it was observed that age had a significant influence on semen volume. The semen volume had increased from 14 months of age up to 30 months. The overall mean spermatozoa concentration and total spermatozoa count were 314.99 ± 3.58 million/ml and 65.84 ± 0.94 billion respectively. Age had a significant influence ($P < 0.01$) on spermatozoa concentrations and total spermatozoa count. The overall mean abnormal spermatozoa percentage was 8.49 ± 0.16 . This study showed that age of boar had a significant impact on semen quality.

Keywords: Semen collection, semen volume, spermatozoa, large white yorkshire pig

Introduction

Successful artificial insemination in pigs without affecting the reproductive performance necessitates training the boars for semen collection and to study the quality of the semen before insemination. Boars can be easily trained to mount on dummy for semen collection. King and Macpherson (1973)^[6] collected semen using the "gloved - hand" method for routine collection of boar semen. Outcome of AI is greatly influenced by volume, sperm concentration and gross sperm morphology. It has been reported by Wolf and Smital (2009)^[18] that the semen volume increased until an age of about 2 year and remained more or less constant thereafter. The spermatozoa concentration increased until 11 months of age, followed by a long term moderate decrease until 3 years of age and relative stabilization thereafter and the abnormal sperm increased over the productive lifetime of the boar, achieving a difference of nearly 4 per cent between the youngest (8 months) and the oldest (48 months) boars. Such studies on volume and sperm quality were available in developed countries where AI is practiced. In India, pig farming is recently developing into an organised sector and not much report were available. Hence, the present study was undertaken to standardize the technique of semen collection and to study the influence of boar age on semen quality under farm conditions.

Materials and Methods

Large White Yorkshire pigs maintained at the pig breeding unit of Post Graduate Research Institute in Animal sciences were utilized for the study. Four boars of 12 months age and body weight between 110.0 and 125.0 kg were selected and trained to donate semen by hand glove technique. Immediately after the semen was collected the gel free portion of the semen was measured using a graduated cylinder (Cheon *et al.*, 2002)^[2] of 500 ml capacity. Hemocytometer was used to assess the spermatozoa concentration. The semen was diluted with the semen extenders at 1:5 ratio and then a drop of diluted semen was placed on the slide and viewed under high power objective of the microscope to record the percentage of sperms with rapid progressive movement (Stancic *et al.* 2011)^[15]. Live spermatozoa sperm count was done using eosin and nigrosin stain. Then smears were made from the semen stain mixture and viewed under oil immersion by placing a drop of Cedar wood oil on the smear. Spermatozoa which stained pink either fully or partially was counted as dead and the spermatozoa that had not taken up the stain was counted as live sperm (Oberlender, 2012)^[10]. 200 spermatozoa were counted and they were expressed in percentage.

The sperm abnormality was recorded by using Rose Bengal stain. The semen sample was diluted with Trixcell extender in 1:10 ratio and a drop of diluted semen was placed on a clean dry glass slide. A smear was made with the help of another slide. The smear was allowed to dry in air and then stained with 3% Rose Bengal stain (Oberlender, 2012) [10] for 15 minutes. The slide was washed in tap water and dried. The slide smear was examined under oil immersion and 200 sperms were observed. Spermatozoa with normal heads and tails were recorded as normal spermatozoa, and, those with broken, coiled, bent, or detached tails, spermatozoa with proximal and distal droplets and sperms with an abnormal head shape as abnormal sperms. The data viz. semen volume, progressive motility, spermatozoa concentration, live

spermatozoa percentage, normal spermatozoa percentage and abnormal spermatozoa percentage were analysed using the least-squares methods and means were compared using Duncan Multiple Range Test (DMRT).

Result and Discussion

The trained boars were used for semen collection and reaction time and ejaculation time were recorded in table 1. After collection of semen the physical parameters of semen viz. volume, progressive motility, sperm concentration, total sperm count and abnormal sperm count were determined and tabulated in table 1. The effect of age of boars and its influence on semen parameters were recorded and tabulated in table 2.

Table 1: Overall mean (\pm S.E.) value of semen parameters in LWY boars

Sl. No.	Parameters	Overall mean
1	Reaction time (seconds)	165.85 \pm 7.87 (177)
2	Ejaculation time (seconds)	509.81 \pm 9.67 (177)
3	Semen volume (ml)	208.92 \pm 2.52 (177)
4	Progressive motility (per cent)	88.00 \pm 0.22 (177)
5	Spermatozoa concentration (millions/ml)	314.99 \pm 3.58 (177)
6	Total spermatozoa count	65.84 \pm 0.94 (177)
7	Live spermatozoa per cent	91.70 \pm 0.21 (177)
8	Abnormal spermatozoa per cent	8.49 \pm 0.16 (177)

Figures in parentheses indicate the number of observations

King and Macpherson (1973) [6] reported that the "gloved – hand" method provided adequate tactile stimulus to achieve optimum sperm output and was satisfactory for routine collection of boar semen. This method was successfully used for semen collection in our study. "The overall mean reaction time of boar was 165.85 \pm 7.87 seconds (Table 1). The average reaction time in Large White Yorkshire boars recorded in the present study was lesser compared to that of 192.0 \pm 29.2 seconds recorded by Estienne and Harper (2004) [4] in Lean-type, terminal-line boars. The overall mean

ejaculation time of Large White boar was 509.81 \pm 9.67 seconds (Table 1). Age had no significant effect on ejaculation time (Table 2). The average ejaculation time recorded in the present study was comparable to those reported by King and Macpherson (1973) [6] in Yorkshire boars (440 seconds). However, Estienne and Harper (2004) [4] reported a lesser time of 280.4 \pm 43.15 seconds in Lean-type, terminal-line boars. The difference observed in the ejaculation time might be due to breed differences and the variation in environmental conditions.

Table 2: Least-squares means (\pm S.E.) for effect of age on semen quality in LWY boars

Parameters	Age of the boar (months)				P value
	14 to 17	18 to 23	24 to 29	30 and above	
Reaction time (seconds)	161.49 \pm 11.32 (57)	178.46 \pm 9.77 (68)	138.25 \pm 14.31 (38)	199.00 \pm 23.84 (14)	NS
Ejaculation time (seconds)	533.63 \pm 13.93 (57)	539.31 \pm 12.02 (68)	500.37 \pm 17.60 (38)	470.63 \pm 29.32 (14)	NS
Volume (ml)	177.76 ^a \pm 3.63 (57)	203.31 ^b \pm 3.31 (68)	220.95 ^{bc} \pm 4.59 (38)	227.63 ^c \pm 7.65 (14)	**
Spermatozoa concentration (million/ml)	295.65 ^a \pm 85.15 (57)	313.235 ^{ab} \pm 4.45 (68)	324.227 ^b \pm 6.51 (38)	322.25 ^b \pm 10.85 (14)	**
Total number of spermatozoa (billion)	52.08 ^a \pm 1.35 (57)	63.89 ^b \pm 1.17 (68)	71.33 ^c \pm 1.71 (38)	73.30 ^c \pm 2.85 (14)	**
Progressive motility	83.39 \pm 0.31 (57)	87.64 \pm 0.27 (68)	87.94 \pm 0.39 (38)	88.10 \pm 0.67 (14)	NS
Live spermatozoa (per cent)	92.20 \pm 0.30 (57)	91.18 \pm 0.26 (68)	91.51 \pm 0.37 (38)	91.40 \pm 0.62 (14)	NS
Abnormal spermatozoa (per cent)	8.19 \pm 0.24 (57)	8.62 \pm 0.20 (68)	8.61 \pm 0.30 (38)	8.46 \pm 0.50 (14)	NS

^{NS} - Not significant; ** - Means bearing different superscripts differ significantly (P<0.01)

Figures in parentheses indicate the number of observations

Semen volume

The overall mean semen volume in Large White Yorkshire boar was 208.92 \pm 2.52 ml (Table 1). The volume obtained was similar to that reported by Rusu *et al.* (2009) [11] in Large White boar (198 ml) and Stancic *et al.* (2009) [13] in Duroc boar (212 ml). The volume obtained in the present study was higher compared to that of the volume reported by Lee *et al.* (2004) [8] in Yorkshire boars (154 ml), Masenya, *et al.* (2011) [9] in Large White boar (170 ml), Umesiobi (2012) [17] in Large White boars (133.3 ml). The semen volume obtained in the present study was lower compared to that of the volume reported by King and Macpherson (1973) [6] in Yorkshire boars (302 ml), Wolf and Smital (2009) [18] in Large white and

Pietrain boars, (270 and 275 ml respectively) and Stancic *et al.* (2009a) [13] in Hampshire, Large White and Sweddisch Landrace boars, (308, 289 and 291 ml respectively) and Oberlender *et al.* (2012) [10] in high performance boars (286.90 \pm 88.59 ml). The difference in volume might be due to breed differences and difference in the management conditions. Age had a significant effect on semen volume. Semen volume was maximum at the age of 30 months and above (Table 2). The semen volume had increased from 14 months of age to 30 months of age and above. The results were in concurrence with the results of Wolf and Smital (2009) [18].

Progressive motility

The overall mean progressive motility was 88.00 ± 0.22 per cent (Table 1). The results obtained in the present study were in concurrence with Stancic *et al.* (2009a) [13] in Duroc (82 per cent), Hampshire (85 per cent), Large White (84 per cent) and Swedish Landrace (85 per cent) boars; and Oberlender *et al.* (2012) [10] in high performance boars (83.97 ± 6.87 per cent). However, a higher overall mean progressive motility was obtained by Masenya *et al.* (2011) [9] for Kolbroek (95 per cent) and Large White boars (91 per cent) and a lower overall mean progressive motility rate observed by King and Macpherson, (1973) [6], Rusu *et al.* (2009) [11], Wolf and Smital (2009) [18], Wolf (2010) [19] and Umesiobi (2012) [17] in Large White Yorkshire boars (79.4, 72, 76.6, 76.2 and 72.5 percent) respectively; Dimitrovs *et al.* (2009) and Wolf and Smital (2009) [18] in Duroc boars (76.66 and 73.6 per cent) and Wolf (2010) [19] in Landrace boars (75.8 per cent). The higher progressive motility recorded in the present study when compared to most of the literature cited might be due to the use of high select group of boars in genetic merit. Age had no significant influence on progressive motility.

Spermatozoa concentration

The overall mean spermatozoa concentration in Large White Yorkshire boar was 314.99 ± 3.58 million/ml (Table 1). This was in close agreement with the findings of Estienne and Harper (2004) [4] in Lean-type, terminal-line boars who reported a spermatozoa concentration of 310 million/ml. The overall mean spermatozoa concentration observed in the present study was higher than that reported by Stancic *et al.* (2009b) [14] who observed 224, 174, 190 and 211 million spermatozoa/ml, in Duroc, Hampshire, Large White and Swedish Landrace boars, respectively. Kommissrud *et al.* (2002) [7] reported a spermatozoa concentration of 117 ± 35 million/ml in Yorkshire boars which was very low when compared to the present findings. In contrary, a higher spermatozoa concentration was reported by King and Macpherson (1973) [6] in Large White Yorkshire boars (381 ± 277 million/ml), Lee *et al.* (2004) [8] in Yorkshire boars (600 ± 1.1 million/ml), Rusu *et al.* (2009) [11] in Large White boars (346 ± 0.11 million/ml), Wolf (2010) [19] in Large White and Landrace boars (428 million/ml and 418 million/ml respectively) and Umesiobi (2012) [17] in Large White boars (411.9 ± 63.2 million/ml). Age had significant influence on spermatozoa concentrations. The spermatozoa concentration was significantly lower during 14 to 17 months of age than during 18 to 29 months. The spermatozoa concentrations increased from 18 to 29 months and thereafter a slight decrease was noticed.

Total spermatozoa count

The overall mean total spermatozoa count in Large White Yorkshire boar was 65.84 ± 0.95 billion (Table 1). This was higher compared to 54 billion and 50.8 ± 2.9 billion reported by Stancic *et al.* (2009b) [14] and Umesiobi (2012) [17], respectively in Large White Yorkshire boar. Also the total spermatozoa count observed was higher than that of 45, 52 and 59 billion sperms reported by Stancic *et al.* (2009b) [14] in Duroc, Hampshire and Swedish Landrace boars respectively. Borg *et al.* (1993) reported total spermatozoa counts of 53.3 ± 2.9 and 45.5 ± 3.8 billion per ejaculate in Duroc and Minzhu boars respectively which was also lower than that observed in the present study. The overall total spermatozoa count in Large White Yorkshire boar was found to be lower compared

to that of 101.3 and 111.0 billion reported by Wolf and Smital (2009) [18] and Wolf (2010) [19] respectively in Large White boar. This variation might be due to differences in the environmental and management conditions. Age had a highly significant influence ($P < 0.01$) on total spermatozoa count (Table 2). The sperm count increased from 14 to >30 months of age.

Live sperm per cent

The overall mean live spermatozoa per cent observed was 91.70 ± 0.21 (Table 1). In concurrence with the present findings Sutkeviciene *et al.* (2009) [16] reported the spermatozoa viability of 90.6 ± 2.3 per cent in Landrace and Yorkshire breed and Oberlender *et al.* (2012) [10] reported 90.19 ± 6.32 per cent in high performance boars. Even though age had no significant influence on live spermatozoa percentage of Large White Yorkshire boars, the highest live spermatozoa per cent was found at the age of 14 to 17 months (92.20 ± 0.30 per cent).

Abnormal spermatozoa per cent

The overall mean abnormal spermatozoa per cent was 8.49 ± 0.16 (Table 1). In contrary to the present findings Frydrychova *et al.* (2011) [5] in Czech Republic reported a higher abnormal spermatozoa per cent (14.40 ± 7.81 per cent) in hybrid boars of one to three years of age. Age had no significant effect on abnormal spermatozoa per cent in Large White Yorkshire boars. However, the lowest abnormal spermatozoa per cent found in young boars (14 to 17 months) than older boars (more than 17 months). Similarly, Wolf and Smital (2009) [18] reported that the percentage of abnormal spermatozoa increased over the productive lifetime of the boar, achieving a difference of nearly 4 per cent between the youngest (8 months) and the oldest (48 months) boars.

Conclusion

The present study indicated that boars belonging to age group of 18 to 29 months will be ideal for semen collection which will provide good quality semen parameters for AI. This will enhance successful AI in swine without compromising of reproductive performance.

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