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Relationship between scrotal circumference and semen parameters in crossbred bulls

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Abstract

The relationship between the scrotal circumference and semen volume, sperm concentration and number of sperm per ejaculate of 12 crossbred bulls [4 Local × Friesian, 4 Local × Sahiwal] was studied. Semen of three consecutive collections at seven day intervals was evaluated. The age of bulls at first collection varied between 15 and 20 months. Soon after collection, volume, sperm concentration, number of spermatozoa per ejaculate and initial sperm motility of fresh semen were measured. Scrotal circumference was correlated with semen volume, sperm concentration and number of spermatozoa per ejaculate in both groups. A significant ($P<0.04$) positive correlation ($r = 0.72$) was observed between scrotal circumference and volume of semen, and between scrotal circumference and number of sperm production per ejaculate. Significant ($P<0.05$) variation was observed in different semen parameters between bulls within the same group, but no significant ($P>0.05$) variation was found between the two groups. It is suggested that crossbred bulls aged 18 months or over, with scrotal circumference more than 30 cm, yielded good quality semen. (*Bangl. vet*. 2009. Vol. 26, No. 2, 61–67)

Introduction

National programme for crossing local cattle with developed dairy breeds by artificial insemination (AI) has been in practice in Bangladesh since 1950 as a means for increasing milk production (Ahmed and Islam, 1987). AI has been regarded as the single most important technique for the genetic improvement of cattle (Hafez, 1993). A deficiency in a bull has a larger impact on herd productivity than fertility problems in a single female: a common saying is that the bull is half the herd. When AI is used, each ejaculate can produce 300 inseminations, representing at least 60,000 doses per bull per year (Rodriguez-Martinez, 2008). Therefore, it is extremely important in selection of breeding bulls to determine fertility.

For selection of superior sires, a progeny testing programme is crucial. Yearling bulls with larger scrotum at puberty had increased pregnancy rates in their heifer offspring (Werre and Brinks, 1986; Moser *et al*., 1996). Selection of young bulls at an early age is crucial for commercial semen producers. Qualitative semen traits improve with age from 12 to 16 months in *Bos taurus* (Cates *et al*., 1981) and 14 to 18

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months in *Bos indicus* bulls (Chenoweth *et al.*, 1996). Selecting AI bulls at early age decreases feeding and management costs, and more rapidly improves reproduction (Hafez and Hafez, 2000).

It is suggested that crossbred bulls having bigger scrotum and earlier puberty could produce better semen (Siddiqui *et al.*, 2008), but there is little reliable information on scrotal circumference and quality of semen. The present study was conducted to evaluate the relationship between scrotal circumference and volume of semen, sperm concentration and sperm number per ejaculate of young crossbred bulls in Bangladesh.

Materials and Methods

Animals and their management

Twelve crossbred bulls aged 15-20 months were selected from the Bangladesh Rural Advancement Committee (BRAC) Bull station, Shambhugonj, Mymensingh: 8 were Local × Friesian and 4 Local × Sahiwal. The date of birth was recorded from the registers in the Bull station. The bulls were reared in a separate clean, dry and regularly washed-floor shed at BRAC Bull station. Early every morning, the bulls were allowed to exercise in the field. A balanced diet was provided containing dry matter amounting to 2.8% of body weight. High quality roughage was a mix of one part of straw to three parts of green grass (napier, maize, sorghum, jumbo); concentrate was germinated gram 250g and BRAC Surma Special Cattle Feed® (BRAC Feed Mill, Gazipur, Bangladesh) @ 3.0 kg. Bulls had free access to fresh water. Routine health check was done before every collection.

Scrotal circumference measurements

Bulls were restrained in a squeeze chute and the scrotal content was held in the ventral scrotum from the cranial side of the scrotum. Scrotal circumference was measured in centimetres using measuring tape (Lane Manufacturing Co., Denver, CO, USA) as described by Foote (1969).

Semen collection

The semen was collected in graduated tubes at homosexual mount using artificial vagina (AV). Three ejaculates from each bull were collected at 7-day intervals. The teaser bull was calm and appropriate size for the bull and stood on non-slippery floor during semen collection. The collection tube was sent to the laboratory immediately for semen evaluation.

Semen evaluation

The volume, sperm concentration and initial motility of spermatozoa were recorded immediately after collection. The volume of semen was recorded by reading the graduation marks on the receptacle. To evaluate sperm motility (%), 10 µl of semen was placed on a pre-warmed (37^{o}C) slide, covered with a cover slip and

examined under phase-contrast microscope (400×). The concentration of spermatozoa was determined by using Density Spectrophotometer (SDM-5, Minitüb, Germany). Semen was diluted in cuvettes with 0.9% sodium chloride solution at the ratio of 1 : 100. The reading was recorded from the Density Spectrophotometer in million/ml.

Statistical analysis

The data were entered into Microsoft work sheet 2000. The relationship between scrotal circumference and volume, concentration and total number of spermatozoa were analysed by using pair-wise correlation test (STATA version SE-8, 2003). The data were transformed into the SPSS (Version-14, 2007) for analysis of variance (One way ANOVA) to detect variation between bulls (Anon, 1996). The variation between bulls or groups was considered statistically significant when $P<0.05$.

Results and Discussion

The data on semen parameters are shown in Table 1.

Table 1. Semen parameters of two groups of crossbred bulls

Breeds	Bull ID	Volume (ml)	Sperm concentration (million/ml)	Total number of spermatozoa (million/ejaculate)	Sperm motility of fresh semen (%)
Local × Friesian	69	5.2 ± 2.0 ^{ac}	960.0 ± 409.5 ^{b}	5494.0 ± 4470.6 ^{a}	71.6 ± 2.9 ^{a}
	73	3.6 ± 0.7 ^{b}	1257.0 ± 508.6 ^{ab}	4427.0 ± 2611.1 ^{ab}	71.6 ± 2.8 ^{a}
	77	5.2 ± 0.7 ^{ac}	1029.6 ± 448.8 ^{ab}	5413.0 ± 2840.9 ^{ab}	76.6 ± 2.8 ^{a}
	75	3.3 ± 0.3 ^{b}	531.0 ± 96.9 ^{c}	1763.0 ± 315.5 ^{bc}	71.6 ± 2.9 ^{a}
	74	3.7 ± 2.0 ^{bc}	620.0 ± 217.6 ^{c}	2088.0 ± 626.0 ^{ab}	71.6 ± 2.9 ^{a}
	78	6.0 ± 0.0 ^{a}	817.7 ± 177.7 ^{b}	4906.0 ± 1066.0 ^{ab}	72.5 ± 3.5 ^{a}
	76	5.7 ± 0.5 ^{a}	990.0 ± 216.5 ^{b}	5605.0 ± 1372.0 ^{a}	56.6 ± 5.7 ^{b}
	84	3.2 ± 0.5 ^{b}	827.0 ± 39.8 ^{b}	2634.0 ± 590.3 ^{ab}	36.6 ± 23.1 ^{c}
	Pooled	**4.5 ± 1.1**	**878.9 ± 232.7**	**4416.2 ± 2018.1**	**66.1 ± 13.3**
Local × Sahiwal	64	4.8 ± 1.5 ^{a}	695.0 ± 184.5 ^{b}	3497.0 ± 1565.6 ^{bc}	76.6 ± 7.6
	65	5.7 ± 2.0 ^{a}	996.6 ± 404.4 ^{ab}	5946.0 ± 3650.7 ^{ab}	76.6 ± 7.6
	66	2.5 ± 1.32 ^{b}	1150 .3± 3.5 ^{a}	2878.6 ± 1528.3 ^{bc}	80.0 ± 0.0
	72	1.8 ± 0.3 ^{b}	947.6 ± 283.7 ^{ab}	1791.0 ± 745.2 ^{c}	73.3 ± 2.8
	Pooled	**3.7 ±1.8**	**947.3 ± 189.0**	**3528.2 ± 1759**	**76.6 ± 2.7**

Values are mean ± SD; ^{a,b,c} Values with different superscripts in the same column differ significantly ($P<0.05$)

In Local × Friesian bulls, the volume of semen varied from 3.2 ± 0.5 to 6.0 ± 0.0 ml. The semen volume of bull 78 (6.0 ml) and 76 (5.7 ml) was significantly ($P<0.05$)

higher than that of bull 73 (3.7 ml), 75 (3.3 ml) and 84 (3.2 ml). The sperm concentration varied from 531.0 ± 96.9 to 1257.0 ± 508.6 million/ml and the total number of spermatozoa per ejaculate varied from 1763.0 ± 315.5 to 5605.0 ± 1372.0 million. Among eight Local × Friesian bulls, sperm concentration of bull 73 (1257.0 million/ml) and 77 (1029.6 million/ml) was significantly ($P<0.05$) higher than bull 75 (531.0 million/ml) and 74 (620 million/ml). Total number of spermatozoa per ejaculate of bull 76 (5605 million) and 69 (5494 million) was significantly ($P<0.05$) higher than bull 75 (1763 million). The sperm motility in Local Friesian bulls varied from 36.6 ± 23.1 to 76.6 ± 2.8 %. Sperm motility of bull 76 (56.6%) and 84 (36.6%) was significantly ($P<0.05$) lower than that of other Local Friesian bulls (71.6 to 72.5%; Table 1).

In Local × Sahiwal bulls the volume of semen varied from 1.8 ± 0.3 to 5.7 ± 2.0 ml. The semen volume of bull 64 (4.8 ml) and 65 (5.7 ml) was significantly ($P<0.05$) higher than that of bull 72 (1.8 ml) and 66 (2.5 ml). The sperm concentration varied from 695.0 ± 184.5 to 1150.3 ± 3.5 million/ml and total number of spermatozoa per ejaculate varied from 1791.0 ± 745.2 to 5940.0 ± 3650.7 million. Sperm concentration of bull 66 was significantly ($P<0.05$) higher (1150 million/ml) than bull 64 (695 million/ml). Total number of spermatozoa per ejaculate of bull 72 was significantly ($P<0.05$) lower (1791 million) than bull 65 (5946 million). The sperm motility varied from 73.3 ± 2.8 to 80.0 ± 0.0%. No significant variation was found in initial sperm motility between Local × Sahiwal bulls (Table 1).

When the data were pooled, the semen volume (4.5 vs. 3.7 ml), sperm concentration (878.9 vs. 947.3 million/ml), total number of spermatozoa (4416.2 vs. 3528.2 million/ejaculate) and initial sperm motility (66.1 vs. 76.6 %) did not vary significantly ($P>0.05$) between Local Friesian and Local × Sahiwal bulls (Table 1).

In the present study, more than half of the crossbred bulls can be regarded as normal based on fresh semen evaluation. However, individual bulls differed with respect to semen volume, sperm concentration, total spermatozoa per ejaculate and initial sperm motility. The differences in semen parameters among bulls may be due to variations in secretary activities of the sex glands, scrotal circumference, breed, age, body size and body weight (Graves, 1978; Leon *et al*., 1991; Sharma *et al*., 1991). Moreover, collection frequency, pre-collection stimulation, feeding regime and weather can also influence the semen parameters (Graves, 1978; Al-Hakim *et al*., 1986). Siddiqui *et al*. (2008) obtained lower volume of semen, total number of spermatozoa per ejaculate and initial sperm motility in similar aged crossbred bulls than in present study.

The scrotal circumference had a positive correlation with semen volume and total number of sperm in both groups (Figs. 1, 2 and 3), which is statistically significant ($P<0.05$; $r = 0.72$).

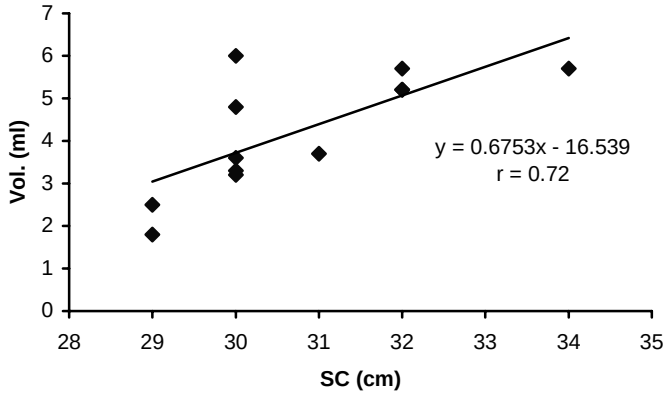

Fig. 1. Scrotal circumference and volume of semen

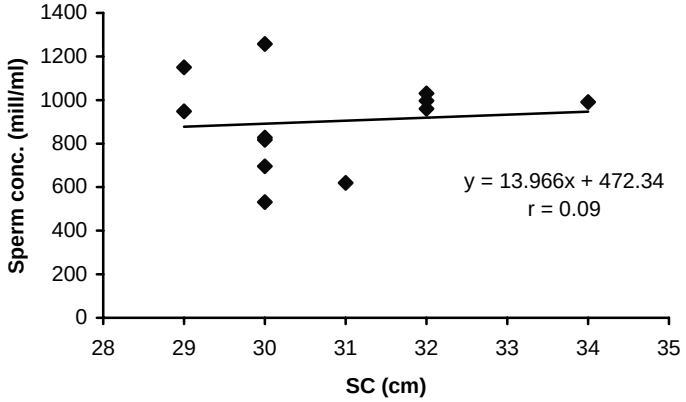

Fig. 2. Scrotal circumference and sperm concentration of semen

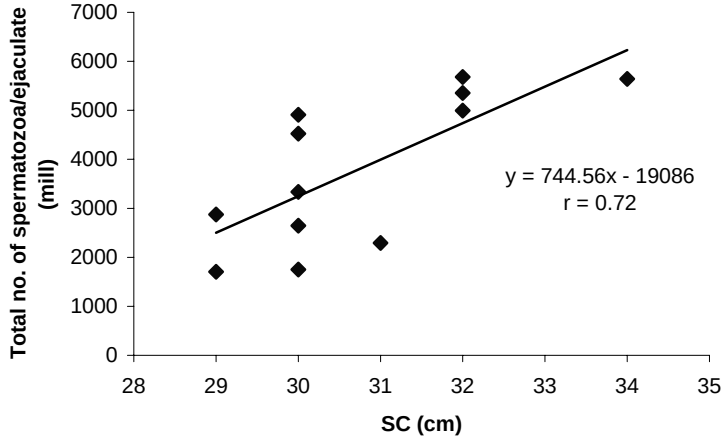

Fig. 3. Scrotal circumference and total number of spermatozoa/ejaculate

Crossbred bulls of 18.0 – 18.5 months age with scrotal circumference >30 cm produced good quality freezable semen (Siddiqui *et al.,* 2008). Scrotal circumference is moderately to highly heritable and serves as a useful predictor of puberty in bulls

(Bourdon and Brinks, 1986; Smith *et al.,* 1989). Ball *et al.* (1983) reported that minimum scrotal circumference for bull irrespective of breeds should be 31 cm at 15 – 18 months, and 32 cm at 18 – 21 months. Young bulls with higher scrotal circumference with larger testes produced greater semen volume with more spermatozoa during the first ejaculation (Randel *et al.,* 1994; Sundararaman *et al.,* 2002). Bulls with smaller testes produced lower quality semen and poor calving rate when used for natural service (Randel *et al.,* 1994). These reports in conjunction with the findings of the present study emphasize the value of measuring scrotal circumference in selecting bulls for an AI programme.

In conclusion, crossbred bulls aged 18 months or more, with scrotal circumference over 30 cm, yield good quality semen. This study may help the AI industry in Bangladesh in selection of crossbred bulls for inclusion in an AI programme.

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