International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:11, No:10, 2017

The Effect of Mist Cooling on Sexual Behavior and Semen Quality of Sahiwal Bulls

Khalid Ahmed Elrabie Abdelrasoul

***Abstract*—**The present study was carried out on Sahiwal cattle bulls maintained at the Artificial Breeding Complex, NDRI, Karnal, Hayana, India, to assess the effect of cooling using mist cooling and fanning on Sahiwal bulls in the dry hot summer season. Fourteen Sahiwal bulls were divided into two groups of seven each. Sexual behavior and semen quality traits considered were: Reaction time (RT), Dismounting time (DMT), Total time taken in mounts (TTTM), Flehmen response (FR), Erection Score (ES), Protrusion Score (PS), Intensity of thrust (ITS), Temperament Score (TS), Libido Score (LS), Semen volume, Physical appearance, Mass activity, Initial progressive motility, Non-eosinophilic spermatozoa count (NESC) and post thaw motility percent. Data were analyzed by least squares technique. Group-1 was the control, whereas group-2 (treatment group) bulls were exposed to mist cooling and fanning (thrice a day 15 min each) in the dry hot summer season. Group-2 showed significantly ($p < 0.01$) higher value in DMT (sec), ES, PS, ITS, LS, semen volume (ml), semen color density, mass activity, initial motility, progressive motility and live sperm.

***Keywords*—**Mist cooling, Sahiwal bulls, semen quality, sexual behavior.

I. Introduction

EVALUATION of males for breeding soundness depends on semen quality and its fertility rate. Selection is primary force for hanging the genetic composition within the population if the trait is highly heritable; then the selection on the phenotypic is useful. Selection on the basis of individual merit is strictly phenotypic.

Sexual behavior of bulls marks the beginning of successful copulation, which includes sexual arousal, courtship, erection protrusion, mounting, intromission, ejaculatory thrust and dismounting; this sequence of events takes only a few minutes in cattle. The manifestation of these patterns in bulls varies from full to no expression of these behavioral patterns; hence, it carries special importance in the productive life of males. Proper assessment of factors such as libido and mating ability before breeding can greatly reduce the possibility of reproduction performance from a single sire.

The hot dry summer season affects farm animals by influencing its activity and performance due to heat stress. Although Sahiwal breed is known for their remarkable power of endurance for hot climate of tropics. The body surface cooling by water sprinkling and fanning was done during the summer (April-June) and rainy (July-October) seasons, showed significant increase in mass activity, sperm concentration, motility and a decrease in the percentage of dead sperm, sperm abnormality and acrosomal damage was observed in the cooled group as compared to the non-cooled group, during summer. On the other hand, during the rainy season, a significant increase in the percentage of live sperm and a decrease in the percentage of sperm abnormality were observed in the cooled group. Thus, results suggested that the body surface cooling of bulls during the hot-dry season, by fanning and water sprinkling with increased frequency keeping space with the increase in temperature, reduce the adverse environmental effect on reproductive performance of the animals [12].

Abdelrasoul Khalid is with the Faculty of Agriculture, Misurata University, Libya (e-mail: khalidrab@gmail.com).

II. Material and Methods

The study was carried out during a six weeks period (1st May-15th June 2007) on 14 Sahiwal bulls at the Animal breeding complex, NDRI, Karnal. The bulls were divided into two groups, seven in each group; in group-1 bulls were exposed to the cooling by mist cooling and fanning (three times a day, 15 min each) in dry hot summer season and group-2 was the control. All bulls were in good health, free from genital disorders and kept under identical condition of care and management and the nutrition requirement has standardized.

Sexual behavior traits were recorded at the time of semen collection by using time stopwatch and cards. RT, DMT and TTTM were measured by time stopwatch. ES, PS and ITS score card were measured by using (0-4) scale cards developed by [7], TS (0-5) scale card by [28], LS by using (1-9) scale by [4] and the frequency of Flehman response was recorded [22].

Semen ejaculates were collected by AV technique once a week (two ejaculates), semen samples tested for volume (ml), color density visually *viz.* watery (1), Limon (2), milky (3), and creamy (4), mass activity in five grades (0 to +5), initial motility and progressive motility (The slide sample was tested under phase contrast microscope), and NESC (live sperm %) by the stain mixture of eosin and nigrosin added to the semen sample.

III. Results and Discussions

A. Sexual Behavior Traits

1) Reaction Time (RT)

Least square means and analysis of variance of RT are presented in Tables I and II, respectively. It is evident from the tables that RT was not significantly influenced by the cooling using mist cooling and fanning. The overall mean was 27.73, however, significantly difference ($p<0.01$) had been found

between bulls. The overall mean was (27.73±2.10), which indicated that the bulls were active in the control group in spite of the fact that these were not exposed to cooling treatment; this might be due to good adaptation of Sahiwal bulls to the stress of heat, with consideration of the individual variation of RT. Slightly lower estimates (24.61 s) were found by [10]. Similar records of RT (29.80±2.97) were obtained by [13] in Sahiwal bulls, whereas higher values were found in summer (2.78±0.41 min), and winter (2.75±0.52 min) by [1] in Sahiwal bulls and by [27] in Murrah bulls. This might be due to well controlled management factors.

2) Dismounting Time (DMT) (Seconds)

Least square means and analysis of variance of DT are presented in Tables I and II, respectively. Perusal of the tables revealed that there was a significant effect of cooling (mist cooling + fanning) on DMT. The overall mean of DMT was 4.74±0.25. However, the estimates reported earlier were slightly lower (3.22±0.09) in Sahiwal bulls [13] and still lower values (2.1 seconds, 2.8 seconds, 2.4 seconds) in Ongole, Jersey and Jersey x Ongole bulls [21]. Similar values (5.63± 0.36) in Surti buffalo bulls were reported by [20].

3) Total Time Taken in Mounts (TTTM) (Seconds)

Least square means and analysis of variance of TTTM are presented in Tables I and II, respectively. It is evident from tables that TTTM was significantly influenced ($p<0.01$) by the effect of the cooling using mist cooling and fanning. The overall mean TTTM was 29.77±2.03. The values of the present study were lower than values (3.39 ± 0.089 min) in cross bulls reported by [19], (59.67±5.10s) in Sahiwal bulls reported by [13], (5.14 minutes) in Tharparkar bulls by [15] and (47.48 and 40.50 s) in Murrah and Sahiwal bulls, respectively, reported by [10]. The results of the present study indicated that all bulls reacted quickly and took little time in ejaculation than values reported by other workers, which might be due to genetic and management factors.

4) Flehmen Response (FR)

Least square means and analysis of variance of FR are presented in Tables I and II, respectively. It has been observed that Sahiwal bulls did not usually show FR at the time of semen collection and no significant differences were observed between groups of cooling treatment. The overall mean of FR for different types of cooling treatment was 0.058± 0.02. Higher values were reported by [9], [10], [17], [18] in Sahiwal and Murrah bulls. Similar findings were reported by [23], which indicated the scarcity of this trait in bulls of our present study.

5) Erection Score (ES)

Least square means and analysis of variance of ES are presented in Tables I and II, respectively. It was found to be significantly ($p<0.01$) the influence by cooling using mist cooling and fanning in dry summer season. Bulls exposed to the cooling treatment by mist cooling and fanning showed significantly higher values of ES (2.77±0.08) than control group which was not exposed to cooling with value (1.80±0.19). The overall mean of ES was 2.63±0.081, which observed between fair to good.

The findings obtained in the present study were similar to the values (2.49±0.03) reported by [13] in Sahiwal bulls. Higher ES as (2.91 ± 0.089, 2.90 ± 0.057) in Sahiwal and Murrah bulls respectively, reported by [9] in Sahiwal bulls, and still higher score for erection was reported by [7] in crossbred. That might be due to the effect of the stress heat of the dry hot summer**.**

TABLE I
LEAST SQUARE MEANS FOR SEXUAL BEHAVIOR CHARACTERS OF BULLS FOR DIFFERENT COOLING GROUPS

Groups of cooling	RT (sec)	DMT (sec)	Total time take in mounting (sec)	Flehmen's response
Group 1	27.07±2.04	5.80±0.25[a]	32.95±2.14[a]	0.08±0.04
Group 2	28.38±3.66	3.68±0.43[b]	26.58±3.46[b]	0.03±0.02
Overall mean	27.73±2.10	4.74±0.25	29.77±2.03	0.058± 0.02

* Significant ($p<0.05$); * * Significant ($p<0.01$)

TABLE II
ANALYSIS OF VARIANCE OF SEXUAL BEHAVIOR CHARACTERS FOR DIFFERENT GROUPS OF COOLING TREATMENT

Source	df	RT	DMT	TTTM	Flehmen's response
Between groups	1	52.01	134.41**	1216.03*	0.08
SE		527.20	7.39	496.05	0.06

* Significant ($p<0.05$); * * Significant ($p<0.01$)

6) Protrusion Score (PS)

Least square means and analysis of variance of PS are presented in Tables I and II, respectively. It was found that PS to be significantly ($p<0.01$) influenced by cooling using mist cooling and fanning in dry summer season. Bulls exposed to the cooling treatment by mist cooling and fanning showed significantly higher values of PS as 2.73±0.08 than control group which was not exposed to cooling with PS value as1.78±0.19. The overall mean of PS was 2.26±0.104, which observed between fair to good in bulls.

The results obtained in the present study were similar to estimates (2.52±0.03) in Sahiwal bulls by [13], higher than values (1.83 ± 0.133 and 1.24 ± 0.068) in Sahiwal and Murrah bulls respectively, by [9] and lower than ES (3.950 ± 0.28) by [7].

7) Intensity of Thrust (ITS)

Least square means and analysis of variance of ITS are presented in Tables I and II, respectively. ITS was found significantly ($p<0.01$) influenced by cooling using mist cooling and fanning in dry summer season. Bulls exposed to the cooling treatment by mist cooling and fanning showed significantly higher values of ITS (2.73 ±0.08) than control group which was not exposed to cooling with value (1.80±0.19). The overall mean of ITS score was 2.27±0.10, which ranged between fair to good in bulls.

The findings obtained in the present study were similar to the values reported by [9] in Sahiwal (2.22 ± 0.115) and in Murrah bulls (1.68 ± 0.071) and by [13] in Sahiwal bulls (2.38±0.04). Higher values reported by [11] in Nagauri bulls (3.98) and by [7] in crossbred (3.867 ± 0.044).

8) Temperament Score (TS)

Least square means and analysis of variance of TS are presented in Tables I and II, respectively.

TS was not found to be significantly influenced by cooling. The overall means was 0.13±0.03. This low TS indicated that Sahiwal bulls were well adapted to the controlled management conditions.

Different values of behavioral temperament were observed by [17] in Sahiwal bulls and [9] in Sahiwal and Murrah bulls.

9) Libido Score (LS)

Least square means and analysis of variance of LS are presented in Tables I and II, respectively.

LS was found to be significantly ($p<0.01$) influenced by the effect of cooling treatment. Bulls exposed to the mist cooling and fanning showed significantly higher values of LS (7.75±0.20) than the control group which was not exposed to cooling (4.05±0.44). The overall mean of LS was 5.90±0.24, which varied between fair to good in bulls. The present results were in conformity with the findings of [10], [17] in Sahiwal bulls.

TABLE III
LEAST SQUARE MEANS FOR SEXUAL BEHAVIOR CHARACTERS FOR DIFFERENT GROUPS COOLING

Groups of cooling	ES (0-4) scale	PS (0-4) scale	ITS (0-4) scale
Group 1	2.77±0.08[a]	2.73±0.08[a]	2.73±0.08[a]
Group 2	1.80±0.19[b]	1.78±0.19[b]	1.80±0.19[b]
Overall mean	2.28±0.10	2.26±0.104	2.27±0.10

* Significant ($p<0.05$); * * Significant ($p<0.01$)

TABLE IV
LEAST SQUARE MEANS FOR SEXUAL BEHAVIOR CHARACTERS OF BULLS FOR DIFFERENT COOLING GROUP

Groups of cooling	TS	LS
Group 1	0.17±0.05	7.75±0.20a
Group 2	0.10±0.04	4.05±0.44b
Overall mean	0.13±0.03	5.90±0.24

TABLE V
ANALYSIS OF VARIANCE (MS) FOR SEXUAL BEHAVIOR CHARACTERS (MS) OF BULLS FOR DIFFERENT COOLING GROUPS

Source	df	Mean sum of squares		
		ES	PS	ITS
Between groups		28.03**	21.08**	26.13**
Error		1.29	1.29	1.30

* Significant ($p<0.05$); * * Significant ($p<0.01$)

TABLE VI
ANALYSIS OF VARIANCE (MS) FOR SEXUAL BEHAVIOR CHARACTERS (MS) OF BULLS FOR DIFFERENT COOLING GROUPS

Source	df	Mean sum of squares	
		TS	LS
Between groups		0.13	410.70**
Error		0.12	6.49

* Significant ($p<0.05$); * * Significant ($p<0.01$)

B. Seminal Attributes

1) Volume (ml)

Least square means and analysis of variance of volume are presented in Tables VII and IX, respectively. The volume was found to be significantly ($p<0.01$) influenced by exercise. The daily exercised group showed significantly higher values of volume (3.59±0.17 ml) than the once a week exercised group (3.08±0.25 ml), which indicated the effect of continuous exercise on the bulls. The overall means of volume value was 3.33±0.15.

The estimated semen volume values were similar to the average values varying from 3.36±0.14 to 4.57±0.32 with the range 3-7ml, reported in literature [2], [8], [9], [21]-[25]. Slightly higher values (3.48 ± 0.31 and 5.13 ± 0.18 ml) were reported by [5] and lower values (1-3 ml) reported by [16].

2) Physical Appearance

Least square means and analysis of variance of semen color are presented in Tables VII and IX, respectively. The results indicated that color of semen was significantly ($p<0.01$) influenced by exercise. Daily exercised group showed significantly higher values of color appearance (2.95±0.09) than once a week exercised group (2.27±0.17), which revealed the effect of continuous exercise on the semen color of the bulls. The overall means of color of semen was (2.61±0.10), which is milky to creamy.

The estimated semen color values of present study were similar to the records reported by [9], [16] in Sahiwal bulls. However, [28] did not find significant differences.

3) Mass Activity

Least square means and analysis of variance of mass activity are presented in Tables VII and IX, respectively. Mass activity of semen was found significantly ($p<0.01$) influenced by mist cooling. The group exposed to mist cooling showed significantly higher values of mass activity (2.53±0.08) than the non-exposed group (1.96±0.15), which indicated the effect of mist cooling on semen mass activity of the bulls.

The overall means was 2.24±0.09 of which was in close agreement with the values (2.18 ± 0.266) reported by [9]. Higher average values (2.80 -3.57) were reported in Sahiwal bulls by various workers [2], [15], [26], [6].

4) Initial Progressive Motility (IPM) %

Least square means and analysis of variance of IPM are presented in Tables VIII and X, respectively. No significant effect was found due to the effect exercise. The overall means of IPM was 54.42±2.80, which similar to the observations (52.71±1.31) reported by [12] and lower than the value (73.56±0.61) reported by [14] in Sahiwal bulls.

5) Non-Eosinophilic Spermatozoa Count (NESC) %

Least square means and analysis of variance of NESC are presented in Tables VIII and X, respectively. On perusal of data given in the table, no significant effect was found due to the effect exercise. The overall means of IPM was 64.25±3.27.

The estimated NESC values in the present study was lower than values recorded by [27] in Sahiwal bulls and [18] in Ongole bulls.

6) Post Thaw Motility (PTM) %

Least square means and analysis of variance of PTM are

presented in Tables VIII and X, respectively. No significant effect was found due to the effect of exercise. The overall means of PTPM was 40.33±2.08.

The estimated values of present study were in close agreement with the records reported by [3]. Slightly higher values were reported by [12], [13], [28] in Sahiwal bulls.

TABLE VII
LEAST SQUARE MEANS FOR SEMEN QUANTITY CHARACTERS OF THE BULLS FOR DIFFERENT COOLING GROUPS

Cooling Group	Semen volume (ml)	Semen color	Mass activity
Group1	4.85±0.23a	2.83±0.10a	2.44±0.10a
Group 2	2.98±0.37b	1.37±0.17b	1.18±0.16b
Overall mean	3.91±0.22	2.10±0.10	1.81±0.09

* Significant (p<0.05); * * Significant (p<0.01)

TABLE VIII
LEAST SQUARE MEANS FOR SEMEN QUANTITY CHARACTERS OF THE BULLS FOR DIFFERENT COOLING GROUPS

Source	df	Mean sum of squares		
		Semen volume	Semen color	Mass activity
Between groups	1	105.47**	64.50**	47.50**
Error		5.61	1.22	1.04

Significant (p<0.05); * * Significant (p<0.01)

TABLE IX
ANALYSIS OF VARIANCE FOR SEMEN QUALITY CHARACTERS OF THE BULLS FOR DIFFERENT COOLING GROUPS

Cooling Group	Initial progressive motility %	Non eosinophilic sperm %	Post thaw motility %
Group1	61.00±4.07a	71.50±4.69a	46.50±3.08a
Group 2	40.00±3.27b	47.33±3.80b	30.17±2.50b
Overall mean	50.50±2.61	59.41±3.02	46.50±1.98

* Significant (p<0.05); * * Significant (p<0.01)

TABLE X
ANALYSIS OF VARIANCE FOR SEMEN QUALITY CHARACTERS OF THE BULLS FOR DIFFERENT COOLING GROUPS

Source	df	Mean sum of squares		
		Progressive motility	Non-eosinophilic sperm	Post thaw motility
Between groups	1	3307.50**	4.009**	4.241**
Error		0.051	0.014	0.026

Significant (p<0.05); * * Significant (p<0.01)

IV. CONCLUSIONS

Study outcome concluded better libido and seminal attributes of bulls that were exposed to mist cooling and fanning in summer season.

REFERENCES

[1] Ahmad, M; Asmat, M. T and Najibur-Rehman (2005) Relationship of testicular size and libido to age and season in Sahiwal bulls. Department of Animal Reproduction, University of Agriculture, Faisalabad, Pakistan. Pakistan-Veterinary-Journal. 2005; 25(2): 67-70.

[2] Bhosrekar, M and Nagpual, P. K. (1972). Studies on effect of exercise on the reaction time and semen production. Ind. j. Dairy Sci, 25(3) 194 - 195.

[3] Chauhan, R. A. S., Bhandari, N. and Mathew. A. (1992). Studies on deep freezing of buffalo semen. Indian J. Anim. Res., 12(2):123-125.

[4] Chenoweth, P. J., Abbiff, B.; Malnernaj, M. J. and Brinks, J. S. (1977) Libido serving capacity and breeding soundness in beef bulls. Expt. Sta. Gener4al series no.966. Theriogenology, 16(2):155-177.

[5] Gupta, H. P., Saxena, V. B. and Tripathi, S. S. (1990). A rapid method for evaluation of semen quality in bulls. Indian J. Anim. Sci., 60(3)329-330.

[6] Hearnshaw, H. and Morris, C. A. (1979). Genetic and environmental effects on temperament score in beef cattle. Aust. J. Agric. Res., 35(5):723-733.

[7] Joshi, V. K. and Krache, K. G. (1992). Assessment of sexual behavior of crossbred bulls. Livestock Advisor, 17(2):38-41.

[8] Kashava, P. (1996), Studied on seminal attributes and their association with expected breeding value of dairy bulls. M.sc thesis, NDRI. Karnal.

[9] Kumar, M and Nagpaul P. K. (1993). Sexual behavior pattern in Sahiwal and Murrah bulls. M.sc thesis, N. D. R. I. Karnal.

[10] Kumar; M. (1995). Assessment of sexual behaviour in Sahiwal and Murrah bulls. NDRI, Karnal - 132001, India. Indian-Journal-of-Animal-Production-and-Management. 1995; 11(4): 217-221.

[11] Mandal, D. K & Tyagi, S. (2004). Pre-copulatory behavior of Sahiwal bulls during semen collection and effects of age and season on their sexual performance. Project Directorate on Cattle, Indian-Journal-of-Dairy-Science. 2004; 57(5): 334-338.

[12] Mandal, -D-K; Tyagi, -S; Mathur, -A-K (2005). Semen production performance of Sahiwal bulls. Project Directorate on Cattle, Grass Farm Road, Post Box No. 17, Meerut Cantt, Uttar Pradesh 250 001, India. Indian-Journal-of-Animal-Sciences. 2005; 75(1): 17-19

[13] Mathur, B. S. and Vyas, K. K. (1969). A study on variations in the sexual behavior of Nagauri bulls. Indian J. Anim. Sci., 40(5):478-483.

[14] Mishra, H. R.; Parasad, R. J.; Singh, S. D. and Bishwas, S. C. (1972). A Study on breeding behavior and some economics characters of Tharparkar bulls under progeny testing programme. Ind. J. Anim. Prod. 3(3): 99-101.

[15] Mostari, -M-P; Rahman, -M-G-M; Khandoker, -M-A-M-Y; Husain, -S-S. (2004). Evaluation of bulls based on semen quality and herd fertility. Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Pakistan-Journal-of-Biological-Sciences. 2004; 7(12): 2177-2181.

[16] Panwar, P. S. and Nagpaul, P. K. (1989). Behavior temperament and Libido studies in KS bulls. M.sc thesis, Kurukshetra University.

[17] Panwar, P. S and Nagpaul, P. K. (1994). Behavioral temperament and libido studies in Murrah buffalo bulls. Dairy Cattle Breeding Division, National Dairy Research Institute, Karnal 132001, Haryana, India. Proceedings, -4th-World-Buffalo-Congress,-Sao-Paulo,-Brazil,-27-30-June,-1994:-Volume-3. 1994; 600-602.

[18] Pathkar, N.; Bunzamin, B. R.; Mohan, G. and Sahni, K. L. (1990). Libido in relation to other reproductive traits among the crossbred bulls. Indian J. Anim. Sci. 60(11)52-54.

[19] Purohit, G. N; Bachchu Singh; Vyas, S. K; Yadav, S. B. S. (2000). Studies on sexual behaviour and seminal quality characteristics of Surti buffalo bulls and their interrelationships. All India Coordinated Research Project on Buffaloes, Livestock Research Station, Vallabhnagar, Udaipur, Rajasthan, India. Indian-Journal-of-Animal-Reproduction. 2000; 19(1): 62-63.

[20] Rao, A. V. N., Sreemanarayana, O. and Rao, C. V. (1996). Studies on sex behavior and seminal traits in Ongole, Jersey, Ongole x Jersey and Murrah bulls. Indian Vet J.,73:284-287.

[21] Ramachandran (2000) studies on fertility performance of Sahiwal bulls. M. Sc. thesis. NDRI Karnal.

[22] Salvador, D. F; Andrade, V. J; Vale. Filho, V. R; Dias, J. C; Silva, A. S; Costa-e-Silva, E. V and Bumlai, F. (2003). Frequency of events related to sexual behavior in mature Nelore bulls observed in libido tests. Revista-Brasileira-de-Reproducao-Animal. 2003; 27(2): 180-182.

[23] Shukla, D. D, and Battacharya, P (1949) studies on semen characteristics of indian livestock. Indian J. vet. sci and Anim. Hlth., 19 :161-169.

[24] Singh, D. M. and Pangawkar, G. R. (1990). Studies on some characteristics of exotic and crossbred bulls Spermatoza. Indian J. Anim. Res., 11(2):92-95.

[25] Tomer, N. S. (1964). Artificial insemination and repr4oduction of cattle and buffaloes, 2nd Edn. SorajPrakashan. Allahabad.

[26] Tomar, S. S & Singh, S. P. (1998). Studies on reaction time and some of the seminal attributes and their inter-relationships in Murrah buffalo bulls. Indian-Journal-of-Animal-Research. 1996; 30(1): 49-54.

[27] Tullah, N. M. (1961) Behavior of cattle in yards. II. A study of temperament. Anim.Behav. 9:25-30.

[28] Ulfina G; Raina V. S; Mohanty T. K; and Gupta A. K. (2003) Seminal attributes related to age and scrotal circumference in dairy bulls. Indian. Dairy sci.