

## Positive relationship of higher daily pedometer activity with active sexual behaviour and semen quality parameters of young Sahiwal bulls

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### ABSTRACT

The present investigation was conducted on newly developed pedometer under NAIP Project in collaboration with IIT Delhi, to correlate find association of activity of Sahiwal bulls (SW) with sexual behaviour and semen production performance at Artificial Breeding Research Centre, ICAR-National Dairy Research Institute, Karnal, Haryana, India. The average pedometer activity of seven bulls was 5421.34±1049.67 and the bulls were divided into two groups, i.e. Group 1 (Four bulls showed lower pedometer activity than average) and Group 2 (three bulls showed higher pedometer activity than average). The data were analyzed by T-test using SAS 9.3. It is evident from the results that pedometer activity (3361.06±482.69 vs. 8168.39±802.36), penile protrusion score (1.34±0.08 vs. 1.74±0.08), ejaculatory thrust score (1.48±0.16 vs. 2.38±0.15), mating ability score (70.78±3.23% vs. 83.08±4.58%), ejaculate volume (2.65±0.22ml vs. 4.37±0.26ml), mass activity on scale 1-5 (2.61±0.14 vs. 3.52±0.09), initial progressive motility (65.92±2.79% vs. 80.00±1.23%) and sperm concentration (966.50±55.37 million/ml vs. 1352.82±45.59 million/ml) differ significantly ( $p < 0.01$ ) between Group 1 and Group 2. Four bulls showed -48.37%, -42.38%, -11.71%, -49.55% less pedometer activity than average, whereas three bulls showed 21.77%, 70.65%, 59.59% higher pedometer activity, respectively. It can be concluded that the bulls showed higher pedometer activity performed better in terms of sexual behaviour and semen quality. Therefore, we can visualize the importance of the use of a pedometer for initial selection of the bulls during breeding soundness evaluation.

**Keywords:** Pedometer activity, Sexual behavior, Semen quality, Sahiwal bulls.

Sahiwal India, is one of the most popular milch breeds of India is gaining popularity in different parts of the country along with increasing demand of frozen semen of superior genetic merit pure Sahiwal bulls for Artificial Insemination<sup>14</sup>. To achieve the target, there is need of good numbers of elite

Sahiwal bulls, which is lacking as one of the major reasons of culling in Sahiwal bulls is poor libido<sup>6&9</sup> in the organized herd. Indigenous bulls are also known for their sexual sluggishness and shyness<sup>8</sup>. Therefore, we perceived the idea to monitor the activeness of Sahiwal bulls through pedometer activity and try to correlate with semen production performance. This is kind of the first study in male by using pedometer activity, till now researchers used the pedometer in heat detection<sup>4&11</sup> and to monitor disease condition<sup>7</sup> in dairy animals and to predict health issues of human beings<sup>2</sup>. Pedometers are devices that contain motion switches to detect activity and a recorder to quantify the activity. These devices are attached to the animals on the neck or leg or sometimes implanted subcutaneously. The

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foot activity is the reflection of the health status of the animal. The higher foot activity of the animal is depicting the sound feet and sign of getting optimum exercise, which intern helps to maintain the better vigour of the bull and prevent obesity, lameness and excess growth of feet. Higher foot activity helps to maintain healthy neuro-musculoskeletal and hooves system, which is essential for mounting and mating to maintain better libido. Therefore, the relationship of pedometer activity with sexual behaviour and semen quality reflects the reproductive efficiency of breeding bulls and is of paramount importance in breeding soundness evaluation. Keeping in view the importance to establish the relationship of pedometer activity with semen production performance the present study was undertaken in Sahiwal bulls.

## MATERIALS AND METHODS

### Pedometer system

A new sensor-based wireless electronic device (Moosense) was developed by IIT Delhi in collaboration with NDRI under World Bank funded National Agricultural Innovative Project (NAIP/C4/C2008) on “Development of wireless sensor network for animal management”. The device was an activity measuring rectangular wireless sensor node device which consisted of a two-dimensional accelerometer as a sensor that counts steps during 24 hr and accumulates these activities and sends every ten minutes to the base station as steps per hours. Wireless sensor device consisted of mainly two parts; the first part was a pedometer and the second part a receiver attached with a mini computer



Plate 1. Diagrammatic representation of data flow of pedometer

and software which collect the information into a database (Plate 1). Specially made software for data acquisition and database for data management was also developed in IIT Delhi, which runs on Ubuntu Server 12 Version in a Mini Laptop with 2 GB RAM and 1 GHz Atom processor. The sensor nodes were first connected with the base station by the software and once the connection was established, data from multiple nodes were flooded every 10 minutes and updated in the server database; which can be retrieved by date and time and can be exported to Excel worksheet for further processing in hourly basis i.e activity count per hours (ACPH)<sup>13</sup>.

#### **Attachment of pedometer to experimental bulls**

Bulls were fitted with a pedometer on the front left or right legs in cannon region between knee and fetlock Joint using belt webbing with a Velcro fastener. The pedometer recorded the number of steps a bull taken continuously and sends the activity on hourly basis and these daily activities were collected by visiting the shed twice with the Mini Computer attached with the Base station (10:00 and 16:00) from day zero up to 14 days for collecting daily biorhythm of activities from dairy cows. The accelerometer records only specific activity (forward movement after lifting the leg) numbers. Attention was paid to the correct operating direction of the accelerometer sensors when the pedometer was affixed to the bull by marking in the plastic enclosure of the printed circuit board.

#### **Data acquisition, recording and export**

For completion of data transfer maximum waiting time required was 10 min. Once the connection was established, within a few seconds, all the data automatically transferred into the Linux Mysql database. These data could be analyzed with the help of Wireless Sensor Software developed by IIT Delhi and ICAR-NDRI Karnal. The pedometer collects data for every event with our set values for one activity and every hour cumulative values were calculated and stored in the system flash memory, and the flash memory in the board has capacity to keep 30 hours continuous data. And the new data replace the old data till we reset the pedometer, which will make it zero. To detect the high activity

and the duration and strength of the activity bouts, progressive steps were undertaken in the analysis. For the convenience of analyzing total activity steps taken by the bulls, we selected the node number and period from the menu to export the data to Microsoft office excel sheet and post-processing of data were made to remove the duplicate data and arrange the data according to time and activity with the help of filters and custom sort option on the Excel sheet.

#### **Sexual behaviour and semen quality**

The sexual behaviour like Penile protrusion score (PPS), Ejaculatory thrust score (ETS), Mating ability score (MAS) were recorded<sup>1</sup>. Semen was collected twice a week and ejaculate volume was recorded in graduated test tube. Immediately after collection the semen samples were kept at water bath at 32°C for further semen quality assessment. The semen was evaluated using DIC phase contrast microscope (Nikon Eclipse E600, Tokyo, Japan) with Tokoi heat thermal stage for mass activity (MA)<sup>16</sup>, individual progressive motility (IPM) and sperm concentration (Improved Neubauer's chamber method)<sup>12</sup>. Semen quality parameters like ejaculate volume, mass motility, initial progressive motility (%), and sperm concentration were recorded for the seven bulls with at least ten observations each during the experimental period of 01-11-2013 to 04-05-2014. The average pedometer activity of seven bulls was 5421.34±1049.67 and the bulls (34 to 56 months age) were divided into two groups, i.e. Group 1 (Four bulls showed lower pedometer activity than average; Low activity score bull) and Group 2 (three bulls showed higher pedometer activity than average; High activity score bull).

#### **Statistical analysis**

T-test was performed to compare sexual behaviour and semen quality with respect to pedometer activity using Sigma Plot 11 software package (Systat Software Inc., San Jose, CA, USA). Prior to the analysis arcsine transformation [ $\text{asin}(\sqrt{\text{value}/100}) * 180/\text{PI} (\text{°})$ ]<sup>15</sup> of proportionality data was carried out with adjustment to allow for zero values. Tukey's multiple pairwise comparison test was made to compare between different treatment groups.

## RESULTS AND DISCUSSION

The average pedometer activity of seven bulls was  $5421.34 \pm 1049.67$  per day. Two groups were formed based on pedometer activity, i.e. Group 1 (4 Sahiwal bulls: Lethargic bulls) in which the bulls showed lower pedometer activity ( $3361.06 \pm 482.69$ ) per day than average and Group 2 (3 Sahiwal bulls: Active bulls) in which bulls showed higher pedometer activity ( $8168.39 \pm 802.36$ ) per day than average. Group 1 bulls had -48.37, -42.38, -11.71, -49.55% lower pedometer activity and Group 2 bulls had 21.77, 70.65, 59.59% higher pedometer activity from average value of pedometer activity per day. The bulls are designated as a lethargic bull and active bull by the average activity of bulls which are fallen below average and which are above the average of the bull.

It is evident from **Table 1** and **Fig. 1 to 3** that Group 2 showed significantly ( $p < 0.01$ ) higher PPS ( $1.34 \pm 0.08$  vs.  $1.74 \pm 0.08$ ), ETS ( $1.48 \pm 0.16$  vs.  $2.38 \pm 0.15$ ), MAS ( $70.78 \pm 3.23$  vs.  $83.08 \pm 4.58\%$ ), Ejaculate volume ( $2.65 \pm 0.22$  vs.  $4.37 \pm 0.26$ ml), mass

activity ( $2.61 \pm 0.14$  vs.  $3.52 \pm 0.09$ ), initial progressive motility ( $65.92 \pm 2.79$  vs.  $80.00 \pm 1.23\%$ ) and sperm concentration ( $966.50 \pm 55.37$  vs.  $1352.82 \pm 45.59$  million/ml). It is always a great concern of semen banks the volume and concentration of ejaculate because it will decide the number of frozen semen dose to be harvested. Very interestingly the bull showed higher pedometer activity has greater volume and concentration along with better semen quality. This may be due to better hormone levels, and their gonads undergo healthier spermatogenesis processes as it is evident in human<sup>17</sup> and concluded that physically active persons display better semen values in their study. In another study<sup>5</sup>, a 73% higher sperm count was reported in men who were physically most active than the least active. Contrary, they also reported that there was no impact on sperm motility and volume. Further, the higher physical activity results in better physical health<sup>10</sup> and thus in better welfare and high reproductive success. The findings of the research in humans are supporting our results.

**Table 1. Least squares means ( $\pm$ S.E.) for effect of pedometer activity on sexual behavior and semen quality parameters of young Sahiwal bulls**

Group	Pedometer activity / per day	Sexual behaviour			Semen quality			
		PPS	ETS	MAS	Volume (ml)	MA	IPM (%)	Conc. (million/ml)
Group 1	$3361.06^A \pm 482.69$	$1.34^A \pm 0.08$	$1.48^A \pm 0.16$	$70.78^A \pm 3.23$	$2.65^A \pm 0.22$	$2.61^A \pm 0.14$	$65.92^A \pm 2.79$	$966.50^A \pm 55.37$
Group 2	$8168.39^B \pm 802.36$	$1.74^B \pm 0.08$	$2.38^B \pm 0.15$	$83.08^B \pm 4.58$	$4.37^B \pm 0.26$	$3.52^B \pm 0.09$	$80.00^B \pm 1.23$	$1352.82^B \pm 45.59$
Overall mean	$5421.34 \pm 1049.67$	$1.51 \pm 0.06$	$1.86 \pm 0.12$	$75.99 \pm 2.74$	$3.52 \pm 0.19$	$3.07 \pm 0.09$	$73.05 \pm 1.70$	$1161.95 \pm 41.89$

Group 1: Low activity score bull, Group 2: High activity score bull; Penile Protrusion Score (PPS), Ejaculatory Thrust Score (ETS), Mating Ability Score (MAS), Mass Activity (MA), Individual progressive motility (IPM), Concentration (Conc.); Means bearing different superscript in the column differ significantly ( $p < 0.01$ ).

Higher activity is also associated with better feet, legs and back strength which are essential for better serving and exhibition of sexual behaviour. The bulls showing less pedometer activity have a negative impact on semen quality may be due to compromised thermoregulation for more hours of lying down. Higher pedometer activity may be the reflection of the better nutritional status of the bulls, which is necessary for good reproductive

performance. Our results are close consonance with the previous study<sup>3</sup> of improving semen quality parameter by the bull exercise. Therefore, pedometer activity can be utilized as a tool during Breeding Soundness Evaluation of bulls to increase its accuracy. Usually, the animal's foot activity is an indication of its health. The animal's greater foot activity is a sign of healthy feet and optimal exercise, which helps to preserve the bull's vigour and avoid

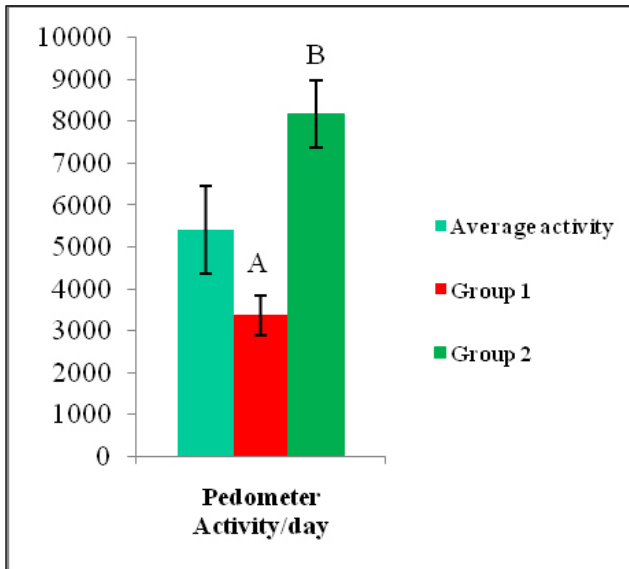


Fig. 1. Daily pedometer activity of Sahiwal bulls

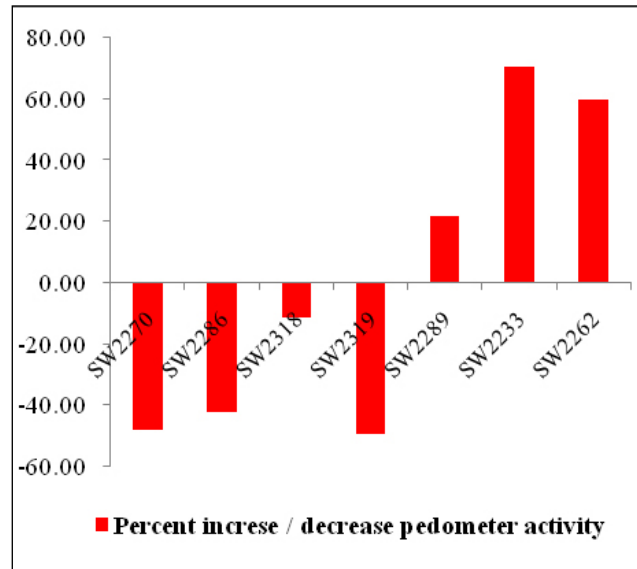


Fig. 2. Pedometer activity increase and decrease of Active and Slow Sahiwal bulls

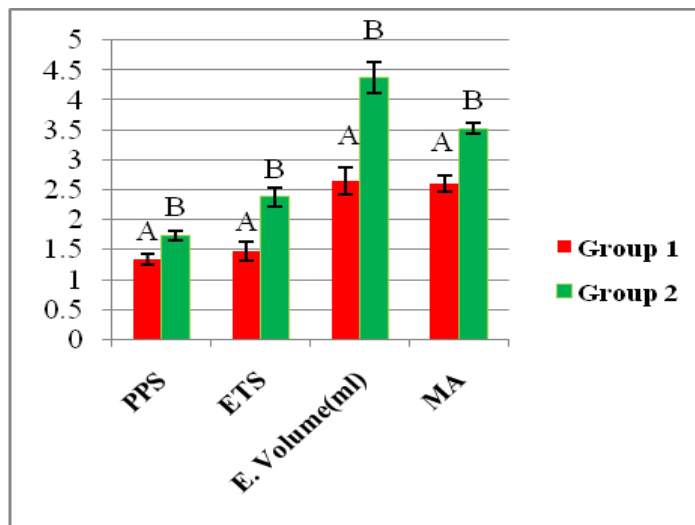


Fig. 3. Sexual behaviour and semen quality of Active and Slow Sahiwal bulls

obesity, lameness, and excessive hoof growth in the animal's feet. Also, greater foot movement helps to maintain a healthy neuro-musculoskeletal and hoof system, which is essential for mounting and mating. To the best of our knowledge, no data is available to compare our findings with observations of other research. Despite the sample, the population is not very large and this a kind of the first study to assess the relationship of pedometer activity with semen quality although more studies are needed to confirm these findings.

### CONCLUSION

The outcome of the work indicates the importance of the pedometer activity as a measure for detecting sexual behaviour as well as semen production performance of breeding bulls. There is need of further study in a large number of bulls for developing as a tool for accurate BSE of bulls, which further emphasizing the need to experiment with a large number of animals for better accuracy but, this is a clue and kind of the first report in male animals.

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