Effect of Thermal Stress on Sexual Behaviour of Superovulated Bharat Merino Ewes

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ABSTRACT : The present study was undertaken to study the effect of thermal stress on sexual behaviour of superovulated ewes. Fourteen adult Bharat Merino ewes with an average body weight of 29.4±2.34 kg were randomly allocated into two groups of 7 each. All the animals were grazed on natural pasture in the morning and evening hours and housed in shed during night. Animals of Group-1 were housed in shed from 10:00 to 16:00 h while the animals of Group-2 were exposed to thermal stress in a hot chamber (40°C /6 h/day). All the animals were offered drinking water once a day at 16:30 h. Meteorological observations i.e. dry bulb, wet bulb, minimum and maximum temperature were recorded daily inside the shed as well as in hot chamber throughout the experimental period. For superovulation of animals, standard protocol developed at the Institute, using FSH (Ovagen 5.4 mg in eight injections) and PMSG (200 IU) was followed. Various sexual behaviour parameters (circling, tail fanning, head turning, standing and approaching to ram) and estrus incidence (onset of estrus and estrus duration) were observed in both the groups. The different estrus symptoms were graded subjectively on arbitrary scale of 0-5 where 0 representing no sexual behaviour (0%) and 5 representing maximum intensity in sexual behaviour (100%). Estrus was detected with the help of a marked aproned ram of proven vigor at six hourly intervals. The average percent values for sexual behaviour parameters recorded in Group-1 and Group-2 animals were 53.7±3.76 vs. 41.1±2.18 for circling, 71.8±5.42 vs. 49.0±4.41 for tail fanning, 64.7±3.30 vs. 44.5±4.34 for head turning, 90.1±3.16 vs. 75.8±4.02 for standing and 63.8±4.8 vs. 41.9±4.58 for approaching to ram. Animals exposed to thermal stress had significantly lower values of these sexual behaviour parameters. The animals kept in shed exhibited estrus earlier (25.4±1.12 h) and duration was higher (37.7±1.59 h) as compared to animals exposed to thermal stress i.e. 30.6±1.16 h and 31.7±3.57 h, respectively. The findings of the study indicate that thermal stress reduces the intensity of sexual behaviour in ewes and may result in failure of the animal to mate and conceive. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 10 : 1403-1406)***

Key Words : Sheep, Synchronization, Estrus, Thermal Stress, Sexual Behaviour

INTRODUCTION

Sheep, which has a vital economic importance in India, are mostly raised under harsh environmental conditions (high ambient temperature, scarcity of feed and water). There are about 58.8 million (M) sheep in India, which ranks fourth in the world and contributing meat (230.4 M kg), wool (53.7 M kg) and skin (52.4 M kg) (FAO, 2002). The reproductive efficiency of different breeds of sheep in India is relatively low (Arora and Garg, 1998), because they are raised mostly under unfavourable management and environmental conditions. Season of the year (Naqvi et al., 1998) influence the superovulatory response of ewes. It is noted that the ewes treated with gonadotrophin, a proportion of ewes had good superovulatory response (<4-5 CL) but did not exhibit estrus symptoms and therefore could not be bred/mated naturally. This leads to wastage of drug and increase in cost of embryo production. Thermal stress can markedly impair reproductive success by disrupting those events occurring at the time of ovulation. The pre ovulatory release of LH and the expression of estrus behaviour seems to be especially sensitive to stress (Braden and Moule, 1964; Dutt, 1964; Ehnert and Moberg, 1991; Dobson et al., 2001). The thyroid gland also plays a role in decreasing the reproductive activity during thermal stress (Farghaly, 1984) with a decrease in the level of triiodothyronine (T3) and thyroxin (T4) hormone. Heat stress is reported to increase incidence of weak estrus, silent heat, ovulation failure and number of service per conception in buffaloes (Mohamed, 1974). Estrus behaviour in sheep is a part of a continuum of interaction between the sexes, which includes mutual sniffing and licking as well as neuro-endocrine pattern which influences activities of both pituitary and hypothalamus and leads to manifestation of different sexual behaviours (Fabre-Nys et al., 1993). The behavioural manifestation of estrus ranges from a phase of low intensity to a phase of high intensity occurring 8 to 12 h after commencement and ends with another phase of low intensity with gradual disappearance as ewes enter in the diestrus stage. The incidence of estrus and receptivity of ewes are important factors, which can affect over all embryo production (Tompkins and Bryant, 1974). The proper assessment of sexual behaviour and receptivity before breeding of ewes treated for super ovulation may increase the possibility of fertile mating which can

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influence the overall success rate of embryo transfer performance. The present investigation was carried out to examine the estrus responses and sexual behaviour of Bharat merino ewes treated for superovulation and exposed to thermal stress.

MATERIALS AND METHODS

Location of study

The study was conducted at sheep farm of the Central Sheep & Wool Research Institute, Avikanagar. This area is located in a semi-arid region of sub tropical India at a longitude 75°-28°E, latitude of 26°-26°N and an altitude of 320 m above sea level. The mean annual rainfall of this area is 400-600 mm. The minimum and maximum ambient temperatures ranges from 17 to 37°C and 25.0 to 46.0°C, respectively, while the mean relative humidity varies between 15 to 90%.

Animals, management, diet and environment

Bharat Merino strain of sheep has been evolved by crossing the native ewes of Chokla, Nali, Malpura and Jaisalmeri with Rambouillet/Soviet Merino rams and stabilising the population at 75% of exotic inheritance. The strain has the potential to act as an import substitute for Rambouillet/Soviet Merino. This breed has performed similar to the improved exotic fine wool sheep in terms of wool quality and better with respect to reproduction and survivability. For this study, 14 non-pregnant and cycling Bharat Merino ewes, 4-7 years of age and weighing 29.8±0.70 kg were randomly allocated into two groups of 7 ewes in each group. All the animals were grazed in the morning and evening daily on the natural pasture of the Institute, which is dominated by *Cenchrus ciliaris*. The fresh drinking water was offered once daily at 16:30 to all the ewes. The ewes in Group-1 were maintained in shed during 10:00 to 16:00 while ewes in Group-2 were subjected to thermal stress for four weeks for six hours (10:00 to 16:00) per day at 40°C during the study in a hot chamber. All the ewes were kept under the shed during the night hours. No thermal treatment was given after synchronized estrus/mating.

Synchronization of estrus and superovulation

Estrus was synchronized by administering 2 injections of PGF2α (PGF) (Lutalyse, Navarting, Check), 10.0 mg each at 10 days interval in all the ewes. Superovulatory treatment was same for all the ewes and commenced two days prior to the second PGF injection. Each ewe in the two groups received a total dose of 5.4 mg FSH (Ovagen, ICP, New Zealand) twice a day (morning and evening) at a constant dose over a period of 4 days. The ewes also received a 200 IU pregnant mare serum gonadotropin (PMSG) (Folligon, Intervet-Netherlands) once as intramuscular injection at the commencement of the superovulation treatment as described by (Naqvi et al., 2001).

Observation of sexual behaviour of superovulated ewes

Each individual sexual behaviour response was graded as follows. a) Circling: 0 = no circling, 1 = very slow circling, 2 = slow circling, 3 = medium circling, 4 = fast circling, 5 = very fast circling; b) Head turning: 0 = no head turning, 1 = ewe looking towards the ram without bending her neck, 2 = ewe turning her head towards the ram for a moment, 3 = ewe turns her head towards the ram but neck does not touch her flank, 4 = ewe turning her head towards the ram and neck touching her flank, 5 = ewe turning her head towards the ram and neck touching her flank for a longer time; c) Tail Fanning: 0 = no tail fanning, 1 = very slow movement of tail of ewe in the presence of ram, 2 = slow movement of tail of ewe in the presence of ram, 3 = medium movement of tail of ewe in the presence of ram, 4 = fast movement of tail of ewe in the presence of ram, 5 = very fast movement of tail of ewe in the presence of ram; d) Standing: 0 = no standing, 1 = fast movement of ewe when the ram mounts, 2 = slow movement of ewe when the ram mounts, 3 = very slow movement of ewe when the ram mounts, 4 = no movement of ewe but her legs were stretched when the ram mounts, 5 = no movement of ewe and it stands in her normal posture when the ram mounts; e) Approaching to ram: 0 = no approaching to ram, 1=ewe makes only the eye contact with the ram and does not move towards the ram, 2 = ewe moves towards ram very slowly, 3 = ewe moves rapidly towards the ram, 4 = ewe moves very rapidly towards the ram, 5 = ewe starts running towards the ram. The value 0, 1, 2, 3, 4 and 5 represents 0, 20, 40, 60, 80 and 100% sexual intensity, respectively (Maurya et al., 1998). The onset of estrus was recorded as described earlier (Naqvi et al., 2001).

Statistical analysis

The values reported in percentages were subjected to an arc sin transformation. The sexual behaviour data was analysed by two-way analysis of variance (Snedecor and Cochran, 1989). The Duncan's multiple range test as modified by Kramer (1956) was used to determine the difference between two means. The significant differences between means were determined at $p<0.05$.

RESULTS

The incidence of estrus in superovulated Bharat Merino ewes has been presented in Table 1. All the ewes kept in shed and hot chamber exhibited oestrus during the observation period of 72 h after second injection of PGF.

Table 1. Effect of thermal stress on estrus response of super ovulated Bharat Merino ewes

Attributes	Shed (Group-1)	Hot chamber (Group-2)
Onset of estrus (h)	25.4±1.12^{B}	30.6±1.16^{A}
Estrus duration (h)	37.7±1.59^{A}	31.7±2.11^{B}

$^{A, B}$ With different superscript in same row differ significantly (p< 0.05).

The mean duration of estrus 37.7±1.59 in Group-1 ewes was significantly (p<0.05) higher as compared to ewes of Group-2 (31.7±3.57 h). The onset of estrus after second PGF was delayed significantly (p<0.05) in ewes of Group-2 than of Group-1.

The data on sexual behaviour of superovulated Bharat Merino ewes of both the groups are presented in Table 2. The percent circling behaviour in both the groups was significantly (p<0.05) influenced with the stage of estrus. In Group-1, this behaviour decreased consistently up to 24 h whereas in Group-2 the decrease was up to 18 h. In both the groups the percent circling increased thereafter. However, the percent circling was significantly (p<0.05) higher at each 6 hourly interval in ewes maintained in shed as compared to ewes exposed to thermal stress. The percent tail fanning and percent head turning of ewes in both the groups were also significantly (p<0.05) influenced by the stage of estrus. Like circling these attributes were also higher in Group-1 as compared to that in Group-2 ewes. However, there was an inverse relationship between circling and tail fanning or circling and head turning. The effect of stage of estrus on percent standing of ewes and percent approach to ram was similar to percent tail fanning and percent head turning in both the groups.

DISCUSSION

High environmental temperatures or the rapid and sudden fluctuations of temperature often occur in arid and semi-arid region, cause unfavourable effect on reproductive function of sheep. The implication is that even if an ewe has normal ovarian development leading to ovulation, thermal stress reduces the full expression of estrus behaviour and resulting in a failure of animal to mate and conceive.

Dutt (1964) reported that exposure of Rambouillet cross bred ewes to severe heat stress from day 12 of the estrus cycle extended the length of the cycle significantly. In this context (Doney et al., 1973; Maurya et al., 2004), reported that severe heat stress and nutritional stress delays the estrus duration. In the present experiment thermal stress imposed on ewes of Group-2 had significant effect on onset of estrus. The reason for delay may be due to alteration in the pulsatile release of LH and decrease in secretion of estrogens in the Group-2 ewes. The normal pulsatile patterns on Gn RH release (and consequently frequency and amplitude of LH pulses secreted from the pituitary) are reduced by exposure to thermal stress, which results in abnormal ovarian function, and hence delay in the on set of estrus. Recent study indicates that the dominant follicle in cows is susceptible to heat stress (Wolfeson, et al., 1995). Further they reported that heat stress alters follicular development and dominance, which leads to decrease in estrogen secretion. Badinga, et al. (1993) found that follicular dominance was altered in cows that were heat stressed during the first 8 days of the estrus cycle. However, Gangawar et al. (1965) also reported that the duration of estrus averaged 20 h from cows maintained in cool condition, but 11 and 14 h for cows maintained in hot psychrometric chamber and natural summer, respectively. The intensity of estrus was greater under cool than under hot condition (as in present study, shed and hot chamber). The frequency of ovulatory estrus, fertilization rate and neonatal survival may decrease as a function of heat stress (Mohamed, 1974).

It is clear form the results presented in Table 2 that the advancement of estrus leads to a consistent pattern in increasing or decreasing the sexual behaviour. The variation in trend of sexual behaviour as the stage of estrus advances in the present investigation was supported by Banks (1964). He observed two major components in the sexual behaviour pattern of ewes i.e. perceptivity (the active search for and attraction towards the ram) and receptivity (acceptance of

Table 2. Variation in sexual behaviour of superovulated Bharat Merino ewes at different stage of estrus

Stage of estrus (h)	% Circling		% Tail fanning		% Head turning		% Standing		% Approaching to ram	
	Shed (Group-1)	Hot Chamber (Group-2)	Shed (Group-1)	Hot chamber (Group-2)	Shed (Group-1)	Hot chamber (Group-2)	Shed (Group-1)	Hot chamber (Group-2)	Shed (Group-1)	Hot chamber (Group-2)
0	65.7±3.47^{Aa}	48.3±4.98^{Ba}	72.7±3.50^{Ab}	51.4±5.58^{Ba}	62.9±3.24^{Aab}	50.2±3.90^{Ba}	91.4±5.94^{Aa}	79.5±6.80^{Ba}	69.4±5.42^{Aa}	51.6±4.57^{Aa}
6	60.0±3.78^{Aa}	44.6±4.58^{Bab}	88.6±3.74^{Aa}	59.3±3.22^{Ba}	77.1±4.48^{Aa}	54.7±3.66^{Ba}	94.3±3.68^{Aa}	81.7±4.71^{Ba}	71.4±4.23^{Aa}	54.3±3.47^{Bab}
12	57.1±4.24^{Aab}	39.6±4.14^{Bab}	90.7±3.93^{Ab}	65.4±3.50^{Ba}	76.4±4.91^{Aa}	58.4±3.83^{Bab}	97.1±2.85^{Aa}	83.7±4.19^{Ba}	75.7±5.43^{Aa}	53.9±3.08^{Bb}
18	48.6±4.78^{Ab}	32.1±3.48^{Bb}	75.7±5.78^{Ab}	55.0±4.68^{Ba}	60.0±4.90^{Aab}	42.9±4.83^{Bab}	97.1±2.85^{Aa}	82.9±5.21^{Ba}	73.4±4.04^{Aa}	44.9±2.82^{Bc}
24	37.1±4.48^{Ab}	34.3±5.29^{Ab}	70.0±3.08^{Ab}	45.7±3.65^{Bab}	62.8±4.40^{Aab}	48.6±3.74^{Bb}	95.6±5.94^{Aab}	80.0±4.36^{Ba}	65.7±4.14^{Aa}	40.0±3.72^{Bb}
30	47.2±3.41^{Ab}	41.1±4.81^{Aab}	57.1±3.78^{Ab}	37.1±4.83^{Bb}	60.6±3.74^{Aab}	34.3±5.29^{Bc}	91.4±5.94^{Aa}	71.4±5.37^{Ba}	54.3±4.41^{Aa}	25.7±3.68^{Bc}
36	62.9±3.29^{Aa}	47.4±3.74^{Ba}	48.6±4.83^{Ab}	29.4±5.50^{Bb}	54.2±4.65^{Ab}	22.8±2.64^{Bc}	71.4±4.57^{Ab}	51.4±3.37^{Bb}	37.1±3.08^{Ab}	22.9±2.85^{Bc}
Mean	54.1±3.57	41.1±2.18	71.9±5.37	49.0±4.41	64.9±3.02	44.6±4.34	91.2±3.16	75.8±4.03	63.9±4.80	41.9±4.58

$^{a, b, c}$ With different superscript in same column differ significantly (p<0.05).

$^{A, B}$ With different superscript in same row differ significantly (p<0.05) for the individual behaviour.

mating attempts by ram). However, Lynch et al. (1992) stated that the estrus behaviour in sheep is part of continuum of interaction between the sexes which includes circling, head turning, tail fanning, standing and approaching to ram as well as motor pattern that are conducive to the mating act. In addition to these reports our finding was also supported by others (Tompkins and Bryant, 1974; Fabre-Nys and Venier, 1989; Fabre-Nys and Martin, 1991; Maurya, et al., 1998). The results of this study indicate that the pattern of sexual behaviour of ewes treated for superovulation is highly affected due to thermal stress. Further, there is need to ascertain whether the sexual behaviour in ewes coincides with any physiological condition which corresponds to the optimum time for mating or insemination for achieving maximum fertility.

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