RESEARCH ARTICLE

Influence of Synchronization Protocols on Estrus Expression and its Intensity in Surti Goats

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Abstract

The present work was conducted to study the influence of different synchronization protocols on estrus expression and its intensity in Surti goats. Thirty goats were selected and divided into five equal groups (n=6 each). The goats of groups G1, G2 and G3 were implanted with intra-vaginal progestagen sponges (IVPS) for 11 days, without and with exposure to buck in G1 and G2, and with injection of 125 µg cloprostenol at the time of sponge removal in G3 group. Animals of group G4 were exposed to buck only for 11 days, while group G5 acted as control without any treatment or buck exposure. Estrus detection was performed by apronized bucks. Estrus intensity was determined based on behavioural and physiological signs associated with estrus. The mean scores, scales and ranks for estrus intensity did not differ significantly ($p>0.05$) between the groups. However, group G3 had highest mean score, scale and rank for estrus intensity, while overall the maximum frequency of behavioral signs was wagging of tail (100.00%), standing to be mounted (96.67%) and clustering around buck (93.33%). It was thus concluded that expression of induced estrus was similar to natural estrus and none of the synchronization protocols significantly influenced the pattern of estrus expression and its intensity in Surti goats.

Key words: Estrus expression, Estrus intensity, Intra-vaginal progestagen sponges, Surti goats, Synchronization protocols.

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Introduction

Among the domesticated farm animals, goats are seasonal breeders, but tropical breeds may exhibit estrus throughout the year. Economic feasibility of goat rearing and its profitability depends on efficient exploitation of reproductive potential that can be achieved through assisted reproductive technology and estrus synchronization by conventional methods like altering the period of light exposure, buck exposure and use of suitable hormonal treatments. Hormonal treatments comprise one of the common assisted reproductive technologies in goat industry. Synchronization of estrus reduces the time required for estrus detection as well as large numbers of goats can be bred over a short period (Amle *et al.,* 2017). It also helps in optimizing time and labour management due to customization of kidding schedule and provision of efficient and effective care to kids as well as does.

Estrous cycle in non-primate mammals consists of three phases: pro-estrus, estrus and post-estrus (metestrus and diestrus combined) (Rajanarayanan and Archunan, 2011). Behavioral changes during different phases of reproductive cycle are also observed in higher mammals, among which estrus-specific behaviors particularly sexual desire during estrus indicate associated physiological status of the animal (Mondal *et al*., 2006; Archunan *et al*., 2014). Beyond behavioral expression of estrus, the intensity of its expression is also critical for successful mating. Homosexual behaviour (mounting on female by other females) is commonly observed in estrus goats and cows (Hafez and Hafez, 2008).

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Male goats also exhibit some characteristic behaviour prominently towards the female goats (Sankar and Archunan, 2004; Devaraj *et al*., 2014). The estrus behaviour is associated with sensible animal farming and nowadays for estrus synchronization various natural and artificial techniques are being used that may lead to change in the frequency of estrus behaviour in does (Islam *et al*., 2012). Hence, the present experiment was conducted to study the influence

of different synchronization protocols on estrus expression and its intensity in Surti goats.

Materials and Methods

Animals and Management

The study was conducted during June-2018 to May-2019 at University Livestock Research Station (AICRP, Surti Goat), Navsari Agricultural University, Gujarat, India. A total of 30 healthy Surti goats, irrespective of their parity, were selected at random from the University farm flock. Selected goats were isolated from male until the experiment was initiated and they were maintained under standard housing and management practices followed at the farm. Feeding comprised of daily ration of 250 gm concentrate mixture per animal with free access to green fodder and drinking water in the shed having both covered area and open paddock. Animals were exposed to natural lighting conditions at latitudes between 20°15'N and 21°23'N, where average ambient temperatures and relative humidity of zone ranged from 25.14°C to 32.50°C and 35% to 85%, respectively.

Experimental Design

Thirty goats were randomly divided into five equal groups (G1, G2, G3 and G4 as treatment and G5 as control) comprising of six animals in each group. Goats in G1 group were synchronized for estrus using intra-vaginal sponges impregnated with 60 mg medroxy-progesterone acetate (MAP) that were left *in-situ* for 11 days. Animals in G2 and G3 group were subjected to same intra-vaginal placement of progesterone sponge along with an exposure of sexually active apronized buck for 11 days in G2, and intramuscular administration of 125 µg cloprostenol at the time of sponge removal in G3 group. In group G4, a sexually active apronized buck was kept along with the goats for 11 days as a teaser, and goats of group G5 (control) were maintained as such for 11 days without any treatment or buck exposure.

The goats in each group were exposed to apronized bucks for detection of estrus twice a day during morning and evening hours. Observations were recorded for pattern of estrus expression (behavioural and physiological signs) and its intensity during induced and natural estrus in each goat in the treatment and control groups. The opening of cervical-os was assessed by ease of its penetration by AI sheath through lubricated vaginal speculum after adequately dilating the reproductive passage (Ramya, 2010; Panicker *et al.*, 2015). Intensity of estrus was measured with the help of scores (numerical value) assigned to each behavioral and physiological sign associated with estrus as explained by Panicker (2011) (Table 1). Further, the type of estrus intensity (*i.e.,* poor, fair, good and very good) and its scale (*i.e.,* 1, 2, 3 and 4) was determined according to Ramya (2010) based on total score achieved by each goat during estrus (Table 2).

Table 1: Intensity score of estrus signs (Panicker, 2011)

Type of signs	Estrus signs	Intensity score (20)
Behavioural	Restlessness	1
	Frequent micturition	1
	Frequent bleating	1
	Clustering around buck	1
	Mounting on other animals	1
	Wagging of tail	2
	Standing to be mounted	3
Physiological	Vulvar hyperemia	2
	Vulvar edema	2
	Opening of cervical-os	3
	Cervico-vaginal mucus discharge	3

Statistical Analysis

Data was analyzed using one way ANOVA and mean differences were compared using Duncan's new multiple range test. Frequency (%) of different behavioral and physiological signs of estrus in each group was calculated. Fisher's exact test was used for comparison between the groups. The scores and scales of intensity of estrus, were analyzed by using Kruskal-Wallis Sum Rank Test.

Results and Discussion

The results obtained for frequency percentage of different behavioral and physiological signs of estrus are presented in Table 3 and those of estrus intensity in Table 4.

Behavioral and Physiological Signs of Estrus

In the present study, there was no significant difference between groups for exhibition of different estrus signs. Overall, the maximum frequency of behavioral signs was for wagging of tail (100.00%), standing to be mounted (96.67%) and clustering around buck (93.33%), while the least

Table 2: Estrus intensity scale and type based on intensity score range (Ramya, 2010)

Intensity score range	Intensity scale	Type of intensity	Estrus intensity and its description
1-5	1	Poor	No overt estrus sign but exhibited some of the behavioural signs
6-10	2	Fair	Most of the behavioural signs including standing to be mounted
11-15	3	Good	Most of the behavioural and some of the physiological signs
16-20	4	Very good	Exhibited most of the behavioural as well as physiological signs

frequency for behavioural signs was restlessness (30.00%) and frequent micturition (33.33%) in the experimental goats (Table 3). Likewise, the maximum frequency of physiological signs was vulvar hyperemia (73.33%) and opened cervical-os (70.00%), while least frequency was for vulvar edema (36.67%). The other signs were of intermediate frequency. Greater numbers of animals in groups G2, G3 and G4 exhibited various estrus signs compared to groups 1 and 5.

In the current study, comparison of different behavioural signs revealed that wagging of tail, standing to be mounted and clustering around bucks were the most common behavioural signs that were exhibited by more than 90% goats. The CV values for these signs were also well below 0.10 that indicated the consistency, reliability and accuracy for their use to detect estrus in Surti goats. Among the physiological signs, more than 70% goats exhibited vulvar hyperemia and open cervical-os with CV values well below commonly acceptable limit of 0.20. Wagging of tail and buck clustering were also reported to be most intense signs of estrus behaviour in non-descript does by Singh *et al*. (2018). Islam *et al*. (2012) reported tail wagging as most abundant sign during estrus in indigenous goats, with overall frequency of 87.50%, but clustering around bucks and standing to be mounted were found to be least intense signs in their study.

There was no significant difference between the groups for exhibition of studied signs of estrus behaviour, except for bleating that was lowest in G1 and highest in G5 goats. Variation in the frequency of other behavioural as well as physiological signs of estrus found in different studies might be attributed to selection and physiological status of females, parity, season of experiment and synchronization protocols.

Estrus Intensity

Analysis of data on estrus intensity using Kruskal-Wallis sum rank test revealed that, the mean rank for estrus intensity was found higher in G3 group, *i.e.* 18.75 followed by G4 (18.25), G2 (16.33), G5 (13.42), and the lowest in G1 (10.75) group (Table 4). However, these did not differ significantly ($p>0.05$) between groups.

None of the animals under study showed poor estrus intensity. Relative proportions of goats exhibiting fair, good and very good types of estrus intensity varied in different groups (Table 4). More number of goats in G1 and G2 expressed good intensity of estrus, whereas goats in G3 and G4 mainly expressed very good intensity of estrus. Profile for intensity of estrus expression as intensity score ranged from 6 to 19 with the lowest and highest mean intensity scores as 11.50±1.38 in G1 and 14.67±1.84 in G3, and mean intensity scale as 2.83±0.31 in G1 and 3.50±0.34 in G5, respectively (Table 4).

Table 3: Frequency (%) of behavioural and physiological signs of estrus in different groups of Surti goats

Estrus signs	Groups of goats						CV	Fisher's test (P value)
	G1 (n=6)	G2 (n=6)	G3 (n=6)	G4 (n=6)	G5 (n=6)	Overall (n=30)		
Restlessness	1 (16.67)	1 (16.67)	3 (50.00)	2 (33.33)	2 (33.33)	9 (30.00)	0.465	0.894
Frequent micturition	0 (0.00)	2 (33.33)	1 (16.67)	3 (50.00)	4 (66.67)	10 (33.33)	0.791	0.169
Frequent bleating	0 (0.00)	2 (33.33)	3 (50.00)	5 (83.33)	6 (100.00)	16 (53.33)	0.746	0.002
Clustering around buck	5 (83.33)	6 (100.00)	6 (100.00)	6 (100.00)	5 (83.33)	28 (93.33)	0.098	1.000
Mounting on others	2 (33.33)	4 (66.67)	3 (50.00)	5 (83.33)	5 (83.33)	19 (63.33)	0.343	0.447
Wagging of tail	6 (100.00)	6 (100.00)	6 (100.00)	6 (100.00)	6 (100.00)	30 (100.00)	0.000	-
Standing to be mounted	6 (100.00)	6 (100.00)	6 (100.00)	6 (100.00)	5 (83.33)	29 (96.67)	0.077	1.000
Vulvar hyperemia	4 (66.67)	5 (83.33)	5 (83.33)	4 (66.67)	4 (66.67)	22 (73.33)	0.124	1.000
Vulvar edema	4 (66.67)	2 (33.33)	2 (33.33)	2 (33.33)	1 (16.67)	11 (36.67)	0.498	0.611
Opened cervical-os	4 (66.67)	5 (83.33)	5 (83.33)	4 (66.67)	3 (50.00)	21 (70.00)	0.199	0.894
Cervico-vaginal mucus discharge	1 (16.67)	4 (66.67)	4 (66.67)	4 (66.67)	2 (33.33)	15 (50.00)	0.471	0.343

G1 = Intra-vaginal sponge, G2 = Intra-vaginal sponge + Buck effect, G3 = Intra-vaginal sponge + $PGF_2\alpha$, G4 = Buck effect, G5 = Control, Figures in the parenthesis indicate percentage

Table 4: Number and percentage of Surti goats with intensity of estrus in different groups

Estrus intensity	Groups of goats					F value	P value
	G1 (n=6)	G2 (n=6)	G3 (n=6)	G4 (n=6)	G5 (n=6)		
Fair	2 (33.33)	1 (16.67)	1 (16.67)	2 (33.33)	3 (50.00)	--	--
Good	3 (50.00)	3 (50.00)	1 (16.67)	1 (16.67)	1 (16.67)	--	--
Very good	1 (16.67)	2 (33.33)	4 (66.67)	3 (50.00)	2 (33.33)	--	--
Intensity score Mean ± SE (range)	11.50±1.38[a] (6-16)	14.33±0.92[a] (10-16)	14.67±1.84[a] (6-18)	14.50±1.84[a] (8-19)	12.33±2.03[a] (6-19)	0.77	0.55
Intensity scale Mean ± SE	2.83±0.31[a]	3.17±0.31[a]	3.50±0.34[a]	3.17±0.40[a]	2.83±0.40[a]	0.62	0.65
Mean Rank (K-W Test)	10.75[a]	16.33[a]	18.75[a]	18.25[a]	13.42[a]	--	--
Chi-square value			3.579				
P value			0.47				

G1 = Intra-vaginal sponge, G2 = Intra-vaginal sponge + Buck effect, G3 = Intra-vaginal sponge + $PGF_2\alpha$, G4 = Buck effect, G5 = Control, Figures in the parenthesis indicate percentages. Means bearing common superscript within a row (between the groups) did not differ significantly.

As compared to G1 group, slightly better results were observed by Selvaraju *et al*. (2003) for types of estrus intensity in Malabari goats synchronized by using 60 mg MAP intra-vaginal sponges for 18 days in Tamil Nadu (India). However, slightly inferior results were reported by Naveen Kumar (2017), who observed excellent, good, fair and poor types of estrus intensity as 0.00%, 33.33%, 16.67% and 0.00%, respectively, in Sirohi goats synchronized by using 100 mg MAP sponges for 10 days in Jabalpur (India). Relevant literature for estrus intensity by using MAP sponges along with buck effect was not available for comparing present findings of G2 group.

The results of intensity of estrus in goats of G3 group were better than those reported in Sirohi goats by Naveen Kumar (2017). Mean estrus intensity score in G3 group was more or less similar to score of 14.37±1.46 (range 6 to 20) reported by Panicker *et al*. (2015) in Malabari crossbred goats synchronized by using intra-vaginal placement of progesterone device containing 160 mg of natural progesterone (P_4) for 7 days along with i/m injection of 12.5 mg prostaglandin (Dinoprost) at the time of device withdrawal. The mean estrus intensity scale in G3 group was similar to scale 3.47±0.16 reported by Dash *et al*. (2017) in Black Bengal does by using intra-vaginal sponges impregnated with 300 mg natural P_4 for 15 days along with i/m injection of 125 µg cloprostenol on the day of sponge withdrawal. Compared to the present findings in group G4, higher estrus intensity scale (4.40) was observed by Mondal *et al*. (2009) in local indigenous does teased by sexually experienced apronized males.

The observations on intensity of estrus in control group G5 were somewhat similar to those reported by Selvaraju *et al*. (2003) in Malabari goats. Further comparing G5 results with other studies revealed that lower (1.50) and slightly higher (3.21) estrus intensity scale was reported by Mondal *et al*. (2009) and Dash *et al*. (2017), respectively. Moreover, Ramya (2010) recorded fair (25.00%), good (59.09%) and very good (15.91%) types of natural estrus intensity in Malabari crossbred goats presented for AI in Kerala (India) and recorded better conception in goats with good to very good estrus intensity.

Intra-vaginal progestagen sponge used in the present study increased the circulatory progesterone level. The increased circulatory concentration of progesterone sensitizes the hypothalamus-pituitary-ovarian axial system and blocks the estrogen induced LH surge. Therefore, sudden removal of progesterone induces increase in hypothalamus sensitivity followed by release of follicle stimulating hormone-releasing hormone (FSHRH) that subsequently leads to FSH release from anterior pituitary gland and development of several ovarian follicles. Increased circulatory estrogen associated with higher numbers of developing follicles subsequently increases the intensity of behavioral and physiological signs of estrus.

Conclusions

The present study revealed that wagging of tail, standing to be mounted and clustering around buck were exhibited by most of the goats, and expression of induced estrus was similar to natural estrus. Thus, it was concluded that none of the synchronization methods influenced the pattern of estrus expression and its intensity in Surti goats. However slightly higher frequency of signs such as wagging of tail, standing to be mounted and clustering around buck as well as higher intensity of estrus expression in group treated with IVPS for 11 days followed by $PGF_2\alpha$ at sponge removal needs further exploration with more number of goats.

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