Estrus Behavior and Superovulatory Response in Black Bengal Goats (*Capra hircus*) Following Administration of Prostaglandin and Gonadotropins

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ABSTRACT : The present study was conducted to explore the possibilities of estrus induction and superovulation in a native Indian breed of goats called "Black Bengal". Forty-two adult non-pregnant females were divided in two groups, of which 18 goats were subjected to a superovulatory treatment comprising of equine chorionic gonadotropin (eCG), Prostaglandin (PGF2α) and human chorionic gonadotropin (hCG) to induce superovulation. The remaining 24 goats received no treatment and served as controls for the parameter under study as well as recipients for embryo transfer studies. The average duration of estrus was found to be significantly increased in treated goats (34.2±3.4 h) compared to controls (23.0±2.4 h). The average duration between PGF administration and occurrence of estrus was 52.0±5.2 h. After mid ventral laparotomy, superovulatory responses indicated a significant increase in the number of follicles, which was 8.27±0.37 in the treatment group compared to 4.16±0.17 in the control group. The number of corpora lutea was also significantly increased in treated animals compared to control (2.90±0.86 vs. 0.74±0.04) respectively per ovary per goat.
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Key Words : Superovulation, Goat, eCG, hCG, Embryo Transfer

INTRODUCTION

Embryo transfer technology is a scientific tool developed by the scientists for maximum exploitation of superior genetic material from the females of livestock. In developing countries, like India, goats occupy an important place for meeting the demands for meat production. Black Bengal goat is the most important breed of goat for meat production in India. In India, we have large population of about 123 million goats and their contribution to meat production is about 37% (Chandra, 2002). Goat meat is preferred in comparison to other meats due to its lower fat deposit, and due to social custom and religious preference prevailing in many parts of India. Keeping all these aspects in view, the present investigation was designed to synchronize the estrous cycle and cause superovulation in Black Bengal goats in order to see the possibilities of artificial superovulation and embryo transfer for maximum exploitation of females in this breed. Ovarian response in terms of follicular growth and superovulation from each ovary was examined in this paper.

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MATERIALS AND METHODS

Forty-two adult females (between the age of 1.5 to 3.5 years and body weight 15 to 20 kg) Black Bengal goats were utilized for this study. They were maintained on a normal balanced ration. They were allowed to graze 3-4 hours daily and green fodder was made available *ad libitum* during the investigation. All the animals were kept under observation for one month prior to experimentation and were dewormed and given prophylactic treatment. Before the animals were allotted to different groups, they were subjected to morning and evening heat detection by a teaser buck. On the basis of estrus activity, they were observed for regular cyclicity. The allotment of animals into two groups (control and treatment) was done on the basis of random allocation, keeping age, body weight and reproductive status uniform in these two groups. There were 24 animals in the control group. Animals in this group were used as recipients for embryo transfer, at the same time they served as a control for the parameters in this study. There were 18 animals in the treatment group. The animals in the treatment group were subjected to the superovulatory treatment and were used as donors, for embryo collection.

Treatment schedule

No treatments were given to the animals of the control group. However, superovulatory treatment was given to the animals of the treatment group (Mishra et al., 2003). Details of the treatment are shown in Table 1.

Estrus activities

The estrus activity of each animal was observed through

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Table 1. Treatment schedule

Treatment	Equine chorionic gonadotropin hormone (eCG)	Prostaglandin ($PGF_{2\alpha}$)	Human chorionic gonadotropin (hCG)
Trade name	Folligon	Dinifertin	Chorulon
Source, presentation and preparation	Intervet pharmaceutical (Holland). This hormone was marked by Intercare Limtied Calcutta. It was supplied in a glss vial Each vial contained 1,000 IU eCG. The hormone was dissolved in the solvent supplied.	Alved pharmaceutical, Madras (India). The chemical was supplied in 5 ml vial. Each ml contained 5 mg $PGF_{2\alpha}$ dinoprost salt.	Intervet pharmaceutical (Holland). This hormone was marketed by Intercare limited Calcutta. It was supplied in a glass vial. Each vial contained 1,500 IU hCG. The hormone was dissolved in the solvent supplied.
Dose of aiministration	750 IU per goar	5 mg per goat	500 IU per goat
Route of administration	Intramuscular	Intramuscular	Intramuscular
Day of administration in respect to 0 day (i.e. day of standing heat)	10^{th} day	11^{th} day	

Table 2. Showing estrus behavior in goats due to the superovulatory treatment

Groups	Average interval between $PGF_{2\alpha}$ administration and occurrence of heat (h)	Average duration of estrus (h)
Control	-	52.0±5.7 (n=18)
Treatment	23.0±2.4 (n=24)	34.2±3.40 (n=18)

Table 3. Mean values showing the effect of treatment on number of follicles

Groups	Left ovary	Right ovary	Over all
Control	3.90±0.22 (24)	4.37±0.27 (24)	4.16 ± 0.17^{a} (48)
Treatment	7.72±0.46 (18)	8.33±0.53 (18)	8.27 ± 0.37^{b} (36)

Figures in parenthesis indicate number of observations. Means with different superscripts differ significantly ($p<0.01$).

Table 4 Average number of follicles in different groups

Group	Small (<3 mm)	Medium (3 to 5 mm)	Large (>5 mm)
Control	2.02 ± 0.10 (48)^{a}	1.56 ± 0.15 (48)^{ab}	0.79 ± 0.00 (48)^{b}
Treatment	2.22 ± 0.15 (36)^{x}	2.11 ± 0.15 (36)^{x}	3.69 ± 0.28 (36)^{y}

Figures in parenthesis indicate number of observations. Means with different superscripts differ significantly in a row ($p<0.01$).

Table 5. Average number of corpora lutea per ovary in different groups

Group	Left ovary	Right ovary	Over all
Control	0.66±0.11 (24)	0.83±0.11 (24)	0.74±0.04 (48)
Treatment	2.70±0.22 (18)	3.16±0.26 (18)	2.9±0.86 (36)

Figures in parenthesis indicate number of observations. Mean with different superscript differs significantly ($p<0.01$).

the use of a teaser buck and complete information regarding duration of estrus and the interval between Prostaglandin ($PGF_{2\alpha}$) administration and occurrence of heat was recorded. The superovulated animals of the treatment group were mated twice with a fertile buck at intervals of 12 h during estrus.. Laparotomy was performed in the animals of both groups on 3^{rd} day following the appearance of the estrus as described by Dzuik (1971). The reproductive organs and ovaries were exteriorized after a mid ventral incision anterior to the udder and responses on the surface of the ovaries were recorded. Comparison was made between the ovaries of control and treatment groups.

RESULTS

Duration of estrus was studied in superovulatory as well as control groups. *T*-test of significance (*t* value: 2.78) indicated significantly longer duration of estrus in the treatment group than in the control group. The average interval between $PGF_{2\alpha}$ administration and occurrence of heat in the treatment group was 52.0±5.71 h (Table 2).

During the process of embryo collection in the goats of treatment group (donors) and control group (recipients), superovulatory and ovulatory responses were recorded. Analysis of variance shows significant effects of treatment (F value: -110.70) but non-significant effects due to the position of ovary (i.e. left and right ovary, F value -1.89) on average number of follicles (Table 3).

One-way analysis of variance was also done to see whether there were significant differences in the number of follicles of different sizes, which were divided into small, medium and large. (<3, 3-5 and >0.5 mm in diameter respectively). In the control group, significant difference was observed between the number of small and large size follicles. However, no significant difference was seen between small and medium or medium and large size follicles (CD=0.86). In the treatment group, significant difference was found only between small and large as well as medium and large size follicles (CD=0.57). Difference was not significant between medium and small sized follicles (Table 4). Analysis of variance indicated significant effects of treatment (($p<0.01$; F value: 80.66) but no significant effect of position of ovary (F value: -1.14; i.e. left and right ovary) on number of corpora lutea. Average values presented in Table 5 showed significantly higher

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number of corpora lutea in the treatment group than in the control group.

DISCUSSION

Duration of estrus was longer in the treatment group than in the control group in the present study. Our observation was in agreement with the findings of Greyling and Nickerk (1986). However, Wani et al. (1985) did not find any difference between the prostaglandin and the progesterone treated groups of goats for synchronization of estrus. Olveria et al. (2001) compared different protocols for induction or synchronization of estrus. They reported 100 to 75% induction of estrus with equine chorionic gonadotropin (eCG.) treatment. It appears that administration of eCG+ hCG caused superovulatory responses, resulting from increased follicular activity which could be the reason for higher estrogen from the growing follicle might be a contributory factor for the elevated level of estrogens over an extended period of time. Armstrong et al. (1983) reported higher levels of plasma 17β estradiol, which persisted considerable longer in eCG treated than in FSH treated goats. It is known that biological half-life of eCG is considerably longer, i.e. approximately 20 h, compared to FSH, which is 2 h or less (Akber et al., 1974; McIntosh et al., 1975). It is a well known fact that estrogens are mainly responsible for behavioral estrus in females and increased duration of estrus in the treatment groups might be attributed to the higher levels of estrogen in blood compared to the controls. The time interval between administration of $PGF_{2\alpha}$ and occurrence of heat was on average 52.0±45.7 hours in this study, which is in agreement with the findings of Otta et al. (1979), and Vander (1979). But our reported duration was greater than those reported by Parera et al. (1978), Taylor (1978) and Debendetti et al. (1982). Comparison was made between the ovulatory responses in the treated and control groups of goats. The results indicated a significant increase in the number of follicles in the superovulatory group. The study further revealed that the position of ovaries did not have any significant effect on the follicle number. This indicated that both the ovaries were equally functional when subjected to superovulatory treatment. Along with follicles, the number of corpora lutea was also counted in both the groups. Results indicated significant increase in their number in the treated group. There was also a 4- fold increase in the number of corpora lutea in the treatment group when compared to the control group. As seen earlier for the follicle, the number of corpora lutea did not differ in the left and right ovary. The treatment regime induced a consistent and efficient superovulation rate from donors, with an ovulation rate of 3.16±0.26. However, Leea et al. (2000) was able to get an ovulation rate of 12.1±0.5 when superovulation was tried with a combination of FSH and hCG. But our superovulatory response along with ovulation rate was in agreement with the finding of Pandiya and Rathore (1986), Cox et al. (1987), Nuti et al. (1987), and Rajkhowa et al. (1992).

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