



Effects of Gonadotropin Releasing Hormone and Prostaglandin F2 Alpha (α) on Postpartum Reproductive Fertility in Black Bengal Goat (*Capra hircus*)

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Abstract | A total of 45 postpartum goats were included and allocated into three experimental groups, 15 goats each. Group I was treated with single dose of GnRH (100 μ g/goat) at 10-14 days postpartum and PGF2 α (125 μ g/goat) at 20-24 days postpartum. Group II was treated with only PGF2 α (125 μ g/goat) at 20-24 days postpartum. Group III was kept as a control group. Serum samples were collected from each group to determine the progesterone concentration. Experimental goats were observed for estrus detection regularly. Shorter uterine involution and kidding interval, minimum service per conception, and highest conception rate was significantly ($p \leq 0.05$) found in group I compared with group II and group III. Progesterone level was significantly ($p \leq 0.05$) increased in group I in contrast with group II and group III. Current findings revealed that combined use of GnRH and PGF2 α made an effective combination for the reduction of postpartum intervals and furthermore, to improve postpartum fertility.

Keywords | GnRH, PGF2 α , ELISA, Progesterone, Black Bengal Goat

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INTRODUCTION

Black Bengal goat (*Capra hircus*) is considered a native goat breed available in Bangladesh and northeastern India (Chowdhury et al., 2019). It contributes to the second position in terms of meat, milk, and skin production from livestock (Chowdhury, 2015; Siddiki et al., 2019).

Reproduction plays a vital role in the efficiency of economic purposes in goat farming. Several genetic, environmental and physiological factors are related to the reproductive soundness of goats. Normal postpartum period (PP) (69 \pm 7 days) is consists of both anatomic and physiologic

re-adjustments of the uterus and endocrine system that is considered as a crucial factor for the recrudescence of reproductive capacity and regular cycling of a breeding goat (Greyling, 2000; Moni and Samad, 2019). Complete re-adjustments of the postpartum uterus and resumption of sexual activity following parturition in ruminants normally depends on several factors, such as nutrition, nursing of offspring, and season of parturition (Zongo et al., 2014). Even though, any delay in postpartum uterine and ovarian involution of farm animals exerts a limitation on reproductive performance following parturition (Degefa et al., 2006). Consequently, early occurrence of heat in post-partum animals following uterine and ovarian involution is mandatory

to maximize reproductive performance as well as production (Ibrahim, 2000). Numerous research has been directed to study the interval between parturition and the first postpartum estrous in goats (Greyling, 2000). The longer postpartum interval can be reduced by some hormonal treatment in ruminants (El Tahawy and Sharkawy, 2014). Goat's become responsive to exogenous GnRH as early as the first week postpartum (Elsheikh et al., 2013). Gonadotropin releasing hormone treatment after parturition can reduce the duration of the postpartum anestrus period in cows (El Tahawy and Sharkawy, 2014). The prolonged postpartum period due to failure of resumption of ovarian activity can be corrected with the use of GnRH in the goat. Injection of GnRH during the first week postpartum in Nubian goats induces first postpartum estrus and increase conception rate by enhancing early uterine involution (Elsheikh et al., 2013). Another hormone called PGF2 α is also used to reduce the postpartum period in cows through luteolytic effects (Elsheikh and Elzubeir, 2004). Hence, estimation of progesterone levels during different physiological stages of animals is an important tool to determine their fertility status (Khanum et al., 2008). As far we know that no report on the uses of PGF2 α for the reduction of the PP period in Black Bengal goats in Bangladesh. Therefore, the study on hormonal treatment protocol in postpartum goat is badly needed in postpartum period. Findings from this study would be beneficial for the farmers as they will get more benefits by follow studied treatment. Moreover, the study was designed with aimed to find out the efficacy of GnRH and PGF2 α on early postpartum uterine involution along with their effects on progesterone level in postpartum goats.

MATERIALS AND METHODS

ANIMALS

45 post-partum Black Bengal goats (within 24 days of kidding) were selected for this study. The study was conducted in the Chittagong Metropolitan area of Chittagong district. Hormonal tests were performed in the Laboratory of Andrology, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University (CVASU).

DATA COLLECTION

Age, parity, body condition score (BCS), feeding regimens, deworming and, vaccination history and last delivery information was recorded by questionnaire through face to face interview with owners. Reproductive parameters like postpartum period, days to first mating, service per conception, conception rate and kidding interval, etc. were also recorded.

EXPERIMENTAL LAYOUT

45 goats were divided into three subgroups as Group-I

Group-II and Group-III. Each group contains 15 goats. Group-I was an experiment with GnRH (Fertilon[®] synthetic Gonadorelin, Techno Ltd. BD) of a dose of 100 μ g/goat at 10-14 days of PP and PGF2 α (Prostamol[®], Cloprostenol Sodium, Techno Ltd. BD) of a dose of 125 μ g/goat at 20-24 days of PP. Group II (n=15) was an experiment with only PGF2 α (Prostamol[®], Cloprostenol Sodium, Techno Ltd. BD) of a dose of 125 μ g/goat at 20-24 days PP. Group-III was used as a control group to rear natural habitation.

ESTRUS DETECTION

Clinical estrous signs such as tail wagging, bleating, frequent urination, mock fighting, licking and rubbing each other, increased vocal activity, hyperemia and edema of the vulva, and vaginal mucus discharge were observed by owners in experimental goats twice daily at 6.00 a.m. and 4.00 p.m. (Fakruzzaman et al., 2012). After 10 days postpartum, active and sound bucks were mixing with the female goats (Fakruzzaman et al., 2012). During estrous, the female goat allow mounting by Bucks (Elsheikh et al., 2013).

COLLECTION OF BLOOD SAMPLES

3ml blood was collected from the jugular vein of every single experimental goat after 3 days of each treatment. Each blood sample was allowed to clot for 1 hour at room temperature (Perry et al., 2019; Tuck et al., 2009). The serum was separated by centrifugation at 1000g for 10 minutes, transferred to 1.5 ml micro-centrifuge tubes, and stored at -20°C until used for hormone analysis.

PROGESTERONE ASSAY

The concentration of progesterone was measured by progesterone ELISA kit (JAJ International, Inc, medical diagnostic manufacturer, USA) using procedures recommended by the manufacturer (Auffrère and Benson, 1976). Absorbance was measured at 450 nm with a micro titter well reader within 15 minutes.

STATISTICAL ANALYSIS

The data were analyzed using the statistical software program SPSS 22.0 for Windows 10. The normality test of data was done by the Kolmogorov-Smirnov test (Steinskog et al., 2007). One way ANOVA test was performed among three treatment groups (Zimmerman and Zumbo, 1993). Chi-Square test with Fisher's exact test was done to calculate the reproductive parameters (Hopkins, 1978). Significant was considered at $p \leq 0.05$ (Rice, 1989).

RESULTS AND DISCUSSION

Hormonal treatment at the postpartum period in Black Bengal goat influenced the reproductive performances with increasing progesterone concentration in blood. The

study was conducted to observe the effects of GnRH with PGF2 α , and single PGF2 α at two different times at postpartum in goats. Uterine involution, service per conception, and kidding intervals were significantly ($p \leq 0.05$) shorter in Group I compared with Group II and Group III (Table 1). The conception rate was higher in Group I in comparison to Group II and Group III that was statistically significant ($p \leq 0.05$) (Table 1).

Table 1: Effects of hormones (GnRH and PGF2 α ; and PGF2 α) in post-partum reproductive parameter among three experimental group.

Parameters	Group of animals		
	Group - I	Group-II	Group - III (control)
Uterine involution (days)	56.05 \pm 17.63 ^a	68.53 \pm 15.4 ^{bc}	73.53 \pm 11.58 ^c
Service per conception	1.40 \pm 2.07 ^a	1.73 \pm 1.73 ^{ab}	2.07 \pm 0.80 ^b
Conception rate	93.4 ^a	80 ^{bc}	73.4 ^c
Kidding interval (days)	218.47 \pm 23.42 ^a	239.53 \pm 29.78 ^{bc}	254.33 \pm 23.42 ^c

Superscript letter a, b, c indicate significant difference with group at $p \leq 0.05$.

GnRH with PGF2 α was used to increase reproductive performance in animals including goats (Elsheikh et al., 2013). Group I treatment the GnRH with PGF2 α initiates in a regular estrous cycle with subsequently positive effects in uterine involution, service per conception, kidding intervals, and conception rate respectively. The results were agreed with Panicker et al. (2015) and Holtz et al. (2008). Uterine involution and estrus cycle is associated with the GnRH concentrations after postpartum and the first ovulation followed by a normal luteal phase (Elsheikh et al., 2013). PGF2 α enhances uterine involution rate by direct ecobolic effect on the uterus that increases the tone of the uterine muscle. It also stimulates uterine smooth muscle in absence of a luteal structure that aggravates uterine involution and postpartum estrus (Elsheikh et al., 2013). The mean postpartum intervals (68.53 \pm 15.40 days) of does in our study was very close to the Nubian Goats treated with PGF2 α immediately after kidding (first week) were reported as (61 \pm 0.71) days (Elsheikh et al., 2013). However, the

author used the drugs at the first week of calving, while, in the present study it was used at 20-24 days (3rd week) postpartum (Elsheikh et al., 2013).

Our findings revealed that exogenous GnRH and PGF2 α administered in goat (Group I) during the early postpartum period significantly ($p \leq 0.05$) decreased kidding intervals followed by Group II and Group III. It possesses similarity with Wright et al. (1981) who reported that kidding interval was lowest in does treat with GnRH with PGF2 α . These findings were also agreed with the previous results reported by Ibrahim, (2000). Administration of GnRH in animals is reported to induce postpartum ovarian cyclicity and having indirect and/or direct activity on the ovarian functions (Elsheikh et al., 2013). Consequently, service per conception in group III was statistically higher than group I and group II ($p \leq 0.05$). This result indicated that GnRH treated goats performed less number of services to ensure their ultimate conception. This finding was in agreement with Takayama et al. (2010). In conception rate, the highest rate was found in Group I compared with Group II and Group III. Our reports supported by Zonturlu et al. (2018). This result revealed that GnRH hormone also prevent embryonic and foetal loss or to increase reproductive performance in goat and sheep (Zonturlu et al., 2018). The variations of the study might be due to differences in breed, management, treatment method used, or epidemiological factors.

After the treatment of GnRH and PGF2 α in experimental goats, progesterone level was significantly ($p \leq 0.05$) increased in Group I compared to Group II and Group III (Table 2).

The P₄ profile is an indicator for the recurrence of postpartum estrus in goats (Elsheikh et al., 2013). The concentration of progesterone in the blood is a crucial key to study luteal functions during the postpartum period. The P₄ concentration in the peripheral circulation does not exceed 0.6 ng/ml until the time of ovulation (El-Naiem 2003). The concentration of serum P₄ in group I was higher (0.48 \pm 0.12 ng/ml) in comparison with the control group, Group III (0.35 \pm 0.09 ng/ml). Subsequently, days 20-24 PP after PGF2 α administration in group I the P₄ concentration was higher (0.6 \pm 0.11 ng/ml) compared with control does

Table 2: Effects of hormones (GnRH and PGF2 α ; and PGF2 α) in progesterone level (P₄) during postpartum period among three experimental group.

Treatment groups (n)	Treatment time (10-14 d of PP)	P ₄ level (10-14 days) ng/ml	Treatment time (20-24d of PP)	P ₄ level (20-24 days) ng/ml
Group I	GnRH	0.48 \pm 0.12 ^a	PGF2 α	0.6 \pm 0.11 ^a
Group II	-	0.41 \pm 0.13 ^{ab}	PGF2 α	0.53 \pm 0.17 ^a
Group III	-	0.35 \pm 0.09 ^b	-	0.44 \pm 0.09 ^b

PP= Postpartum period, P₄ = Progesterone level, Superscript letter a, b indicate significant difference with group at $p \leq 0.05$.

(0.44 ± 0.09 ng/ml). These results were in agreement with the findings of El-Naiem (2003). The P_4 level increased slowly from day 7 (0.54 ± 0.2 ng/ml) and reached a peak level on day 27 of pp (0.87 ± 0.4 ng/ml) and then declined rapidly to the minimum level on day 31 postpartum (Khanum et al., 2007). These results were also slightly higher than the present findings. El-Naiem (2003) reported the basal level of serum P_4 after treatment with PGF 2α at third week postpartum was 0.49 ng/ml in a study.

CONCLUSIONS

Administration of GnRH between 10-14 days followed by PGF 2α between 20-24 days of postpartum influenced early postpartum cyclicity in goats. This treatment also influenced the blood progesterone in postpartum goats that accelerated early postpartum estrus. We can conclude that combined use of GnRH and PGF 2α triggers a fundamental paddle for the reduction of postpartum intervals and subsequent, to improve the reproduction of goats.

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AUTHOR CONTRIBUTIONS

TH and A conceived and designed the experiment, TH and MMBR conducted collection and analyzed the samples, AHMMU and TH conducted data management, all authors contributed to write and review of the final manuscript.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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