

Effect of Cloprostenol, CIDR and Their Combination on Estrus Synchronization in Red Sokoto Doe.

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Abstract: The efficiency of CIDR[®], Cloprostenol and their combinations in estrus synchronization was investigated in Red Sokoto Doe. Fifteen healthy Does weighing 14-25 kg were divided into 3 groups of 5. Group 1 received 2 injections of 125µg Cloprostenol 11 days apart, group 2 received CIDR[®] for 14 days while group 3 received CIDR[®] for 14 days with single injection of 125 µg Cloprostenol 24h prior to CIDR[®] removal. Estrus response was 80%, 100% and 100% for groups 1, 2 and 3 respectively. The onset of estrus for group 1, 2 and 3 was 39.0 ± 9.76h, 49.0 ± 0.83h and 44.8 ± 2.45h respectively. The duration of estrus was 40.6 ± 10.33h, 72.0 ± 0.89h and 73.6 ± 0.81h for groups 1, 2 and 3 respectively. The CIDR[®] retention, vaginal discharge and draw string breakage rates in group 2 were 100%, 80% and 0% while group 3 were 100%, 60% and 0% respectively. The duration of estrus was statistically significant ($p < 0.05$) between group 1 and 2 and between group 1 and 3. Vaginal discharge rate was 80% and 60% in group 2 and 3. These result showed that CIDR[®] protocols are more efficient in synchronizing estrus in Red Sokoto Does owing to more compact synchrony. Therefore the use of this protocol is recommended in controlled breeding programmes.

Keywords: CIDR, Cloprostenol, Doe, Estrus, Synchronization

I. Introduction

Goat production in Nigeria makes a major contribution to the agrarian economy [1]. They are valued mainly for their meat and milk; the skin, wool and hair also strengthen its economic basis in many parts of the world [2]. Goats are of great economic value in the tropics and about 80% of world's goat population is present in this region. In Nigeria, the goat population is about 23.2 million heads and remains the most abundant among the ruminants [3].

Difficulties on reproductive management, that is, estrous detection, and unknown time of ovulation, causes low reproduction performance of goats. Estrous synchronization is a key element of all the assisted reproductive technologies (ARTs) protocols in livestock animals and has a major influence to increase the overall efficiencies of reproduction [4].

Heat detection is the key in the success of any breeding programme this was achieved by closed observation, timed AI and sound record keeping [5]. The purpose of estrous synchronization is to bring a group of animals into estrus so that they can be naturally or artificially inseminated at the same time. In goats, a classical scheme for estrous synchronization involves long-term progesterone treatment, long enough for corpus luteum to undergo regression in all the animals irrespective of the cycle status of each animal at the beginning of the treatment [6]. Oestrussynchronisation is a management practice that manipulates the luteal or follicular phase of the oestrouscycle [7,8], thus controlling oestrus and ovulation in cycling females to enable breeding to be conducted within a short period of time [9]. This practice is applied to farm animals such as cattle [10, 8,9], deer, sheep and goats [7].

High reproductive performance is an essential requirement to ensure maximum livestock production and satisfactory economic return [11]. In goats, the control of estrous and ovulation is a valuable tool to improve and maintain the production of milk and meat throughout the year [12]. Therefore, estrous synchronization together with super ovulation is extensively applied in the reproductive management of goat [12].

Progesterone or a progestagen analogue is generally used to synchronize estrous in does during the breeding and non-breeding seasons [13]. Worldwide, the most common route of progestagen application in goats is via the intravaginal sponge [14]. The most widely used procedures for synchronization and/or the induction of estrous are 12–21 days of fluorogestosterone acetate (FGA) or Medroxy progesterone acetate (MAP) impregnated intra vaginal sponge treatment [15], and an intramuscular injection of pregnant mare serum gonadotrophin (PMSG) at progestagen withdrawal [13,16], or 11 days treatment with FGA impregnated intravaginal sponges and an intramuscular injection of (PMSG) and a synthetic prostaglandin F_{2α} (PGF_{2α}) analogue 48 h before or at sponge withdrawal [17]. Even though some studies have found these two progestagens to be equally effective in the induction of estrus, ovulation and fertility [18].

The Controlled Internal Drug Release (CIDR) is an alternative device to progestogen sponges for estrus synchronisation in ruminants [19]. The usage of CIDR provides advantages compared with the sponges such as elimination of foul-smelling mucus discharged upon removal of sponges, lower loss rates, higher percentage of animals coming into estrus, earlier exhibited estrus and more compact estrus [20]. The effectiveness of CIDR in estrus synchronisation can be increased by co- treatment with hormones [21]. Estrus synchronisation protocols using CIDR vary from insertion of the CIDR for five to 16 days with hormone co-treatment using 100 to 500 IU of equine chorionic gonadotrophin (eCG) or pregnant mare serum gonadotrophin (PMSG) and/or 0.05mg of prostaglandin F_{2α} (PG) [22, 23,24].

The need for increased animal protein production in developing countries like Nigeria cannot be over emphasized. This is because the population of Nigeria is constantly on the increase; with over 140 million population size [25]. Many Nigerians consume less than 10 g of animal protein daily, against the minimum of 28 g/caput/day for a balanced diet [26]. Because of the high cost, furthermore, our livestock industries have not been fully developed to meet the ever increasing demand for animal protein. To achieve success succeed in increasing available animal protein in Nigeria [26].

There is paucity of information on the use of Control internal drug release (CIDR) and its combination with cloprostenol as synchronizing agents in this part of the country. The aim of the study was to modify estrus synchronization using cloprostenol and CIDR in Red Sokoto Doe.

II. Materials and Methods

Study Location

The research was carried out in the small ruminant experimental unit of Veterinary Teaching Hospital UsmanuDanfodiyo University Sokoto. Sokoto is located in North Western Nigeria and lies between longitude 5° 14' East and latitude 13° 04' North at an elevation of 263m above sea level [27].

Experimental Animals

Sixteen Red Sokoto goat (15 does and 1 buck) weighing between 14-25kg, aged between 12-36 months and body condition score 3-4 on a scale of 1-5 (BCS) were purchased from Achida market for the study. The animals were conditioned for 21days during which they were physically examined and laboratory investigations conducted on the fecal sample for helminthes eggs and blood for hemoparasite and full blood count. The animals were prophylactically treated with antibiotics (Oxytetracycline 20% w/v Vetindia Pharmaceuticals Limited) and dewormed with (2.5% Albendazole). They were fed with wheat bran, bean husk and hay. Water was provided *ad libitum*. The does were then randomly divided into 3 groups of 5 does each. The groups were designated as group 1, group 2 and group 3

Experimental Procedure

Estrus Synchronization

Estrus was synchronized in group 1 as described by [28] with slight modification. Two injections of 125µg Cloprostenol (EstrumateShering-Plough (PTY) isando R.S.A) were administered intramuscularly 11 days apart

Group 2 were treated with Controlled internal drug release (CIDR) (Eazi Breed, Newzeland) containing 0.3g progesterone for 14 days as described by [29]. The CIDR applicator was loaded with the device, disinfected with chlorhexidine and lubricated with glycerol, the tail of doe was raised, the perineum was cleaned and disinfected, the loaded applicator was slowly inserted in to the vagina through the vulval opening, the applicator plunger was pressed to release the device leaving the cord protruding from the vulva, the device was then left in the vagina for 14 days after which the device was removed by pulling the draw string.

Group 3 were synchronized as describe by [29] with slight modification. Control Internal Drug Release (CIDR) was inserted for 14 days and 125µg cloprostenol was injected intramuscularly 24 hours prior to CIDR removal.

Estrus Detection

Does in group 1 were observed for the signs of estrus 24hours after the second injection, while group 2 and 3 were observed 24hours after the removal of CIDR device for two hours three times a day (0800-1000, 1400-1600 and 1800-2000) for 5 days (120hours). Standing to be mounted was the only cardinal sign used to determine estrus response.

Estrus Response (%)

This was calculated by dividing the number of does that shows standing estrus and subsequently mated with the total number of does synchronized in each group using the formula SE/DS x100 where SE = Does showing standing estrus and DS = Synchronized does.

Time to Onset of Estrus

This was measured by recording the time (h) interval from when the second injection was administered for group 1. In group 2 and 3 it was measured from when the CIDR device was removed to the time when the does first express standing estrus.

Occurrence of Estrus during the Time of the Day

This was determined by dividing the number of does that came on estrus in either morning, afternoon or evening with the total number of animal in each group.

Duration Of Estrus

This was determined by measuring the time (h) between the first standing estrus and the last time the doe allows mounting in each group.

CIDR Retention Rate (%)

This was measured by dividing the number of does that retained the CIDR device with the total number of the does in group 2 and 3.

Vaginal Discharge Rate (%)

This was measured by dividing the number of does that showed vaginal discharges on removal of the CIDR device with the total number of the does in group 2 and 3.

Draw String Breakage Rate (%)

This was measured by dividing the number of device that firmly adhered to the vaginal mucosa resulting in breakage of the cord to the number of the does in group 2 and 3.

III. Statistical Analysis

Estrus response rate, time of the day at which estrus was observed, CIDR device retention rate, vaginal discharge rate and draw string breakage rate were expressed in percentages. Data on time to onset of estrus and duration of estrus were expressed as mean \pm SEM and analyzed by post-hoc using the turkey test (Graphadinstat version 3.0). ANOVA was used to compare means between treatment groups. Value of $p \leq 0.05$ was considered significant.

IV. Result

Estrus Response Of RSD Synchronized Using Cloprostenol, CIDR And CIDR + Cloprostenol.

The result showed that high percentage synchrony was recorded in all treatment groups. Group 1 which was treated with 125 μ g cloprostenol showed 80% synchrony while group 2 treated with 0.3g CIDR and group 3 treated with CIDR + 125 μ g cloprostenol showed 100% synchrony each (Table 1).

Onset And Duration Of Estrus In RSD Synchronized With Cloprostenol, CIDR And CIDR + Cloprostenol.

The onset of estrus was shorter in cloprostenol treated group 39 \pm 9.76h when compared with CIDR + cloprostenol treated group whose onset of estrus was 44.8 \pm 2.45h (Table 2). Group 2 treated with CIDR had the longest onset of estrus 49.0 \pm 0.83h (Table 2). However, the differences were not statistically significant between the groups ($p > 0.05$)

The duration of estrus was found to be longer in Group 3 (CIDR + cloprostenol) compared to CIDR and cloprostenol treated groups. The mean duration of estrus for groups 1, 2 and 3 were 40.6 \pm 10.33h, 72.0 \pm 0.89h and 73.6 \pm 0.81h respectively (Table 2). Group 1 had significantly lower duration of estrus when compared with groups 2 and 3 ($p < 0.01$) but the difference was not statistically significant when estrus duration of group 2 was compared with group 3 ($p > 0.05$; Table 2).

CIDR Device Retention Rate, Vaginal Discharge Rate And Draw String Breakage Rate.

Both groups 2 and 3 had a CIDR device retention rate of 100% (Table 3). While 80% of the experimental animals in group 2 had vaginal discharges, vaginal discharge rate in group 3 was 60% (Table 3). Draw string breakage rate was 0% in both groups 2 and 3 (Table 3).

Day Time Of Estrus Onset In RSD Synchronized With Cloprostenol, CIDR And CIDR + Cloprostenol.

The day time of estrus onset for group 1 was 100% in the morning while groups 2 and 3 had 80% in the morning, 0% in the afternoon and 20% in the evening (Table 4).

Table 1: Estrus response of RSD synchronized with cloprostenol, CIDR and CIDR + cloprostenol.

Group	Treatment	Estrus response (%)
1 (n=5)	Cloprostenol (125µg)	80
2 (n=5)	CIDR (0.3g)	100
3 (n=5)	CIDR + Cloprostenol	100

n = Number of animals

Table 2: Mean ± SEM onset and duration of estrus in RSD Synchronized with 3 different protocols.

	Group 1 Cloprostenol (n=5)	Group 2 CIDR (n=5)	Group 3 CIDR + Cloprostenol(n=5)
Onset of estrus (hours)	39.0 ± 9.76	49.0 ± 0.83	44.8 ± 2.45
Duration of estrus (hours)	40.6 ^a ± 10.33	72.0 ^b ± 0.89	73.6 ^b ± 0.81

n=numbers of animal in each group

^{ab}Means within the same row with different superscript alphabet differ significantly.

Table 3: Device retention, vaginal discharge and draw string breakage of does treated with CIDR and CIDR + cloprostenol.

	Group 2 CIDR(n=5)	Group 3 CIDR + Cloprostenol (n=5)
Device retention rate (%)	100	100
Vaginal discharge rate (%)	80	60
Draw string breakage (%)	0	0

n= Number of animals in each group

Table 4: Occurrence of onset of estrus during the day Time in RSD treated with cloprostenol, CIDR and CIDR + cloprostenol

Group	Time of estrus onset		
	Morning (%)	Afternoon (%)	Evening (%)
1 (n=4)	100	0	0
2 (n=5)	80	0	20
3 (n=5)	80	0	20

n= Number of animals

V. Discussion

The three estrus synchronization protocols used in this study effectively synchronized estrus in red Sokoto does.

Eighty percent (80%) of the does in group 1 responded to treatment with cloprostenol, the doe that fails to show any sign of estrus may have exhibited silent estrus in which animals with this condition are cycling but they will not show any sign of estrus. The estrus response in group 1 is slightly lower compared to the 100% reported in Sudanese nubian goat in which 125µg cloprostenol was used [30].100% estrus response was reported using 100µg cloprostenol in Red Sokoto Doe [28]. The variation on response observed in this study may be due to silent estrus and low level ovarian activity. In group 2 and 3 100% of the does treated exhibited standing estrus within 2-3 days post CIDR removal. The high degree of estrus synchrony achieved in these groups indicated that the CIDR effectively prolong the luteal phase of the cycle, and prostaglandin was given when the corpus luteum was responsive. The finding of this study is higher than the report of 20% estrus response with FGA and 55.6% estrus response using CIDR [31]. However it is in agreement with the report of 100% estrus response recorded in ewes treated with CIDR [32]. The finding of our research is also in agreement with the report of 98% in three groups of Greek goat treated with FGA PGF_{2α} and FGA + PGF_{2α}[33]. It is also consistent with the report of 95.5% estrus response using MAP/ECG in boar and nguni goats [34]. The slight differences between the result obtained in this study and those of the proceeds researchers may be due to differences in breed of goat, agents of synchronization and climatic condition in which the studies were executed.

The variations observed in the onset of estrus at the termination of treatment where group 1 had a relatively shorter onset than group 2 and 3 could be attributed to certain properties of the different synchronization agents used, and or their routes of administration. There was shorter interval to onset of estrus post treatment by the does treated with cloprostenol (group 1) 39 ± 9.76h. This could be as a result of high affinity of PGF_{2α} to the corpus luteum which in turn leads to the rapid luteolysis, falling of the progesterone in circulation and initiation of the new cycle. The finding in this study is shorter compared to the 50.04 ± 4.8h observed in sheep treated with the same estrus synchronization protocol [32]. These differences could be as a result of specie differences. The finding of this study was also shorter than the values of 62.3 ± 43h recorded as the time interval between second injection and onset of estrus [28]. This may be as a result of dose differences in which the previous researcher used 100µg while this study used 125µg cloprostenol. The finding of our study is in agreement with the report of 41.67 ± 2.22h onset of estrus in does using prostaglandin F_{2α} [35]. In group 2 the mean interval between the CIDR device removal and onset of estrus was 49.0 ± 0.83h this was longer than the

values obtained in group 1 even though the differences was not statistically significant ($p>0.05$). The differences could be as a result of the synchronizing agents used. Cloprostenol seems to be very effective for rapid luteolysis of the caprine corpora lutea and subsequent falling of progesterone levels when the does are cycling [29]. The finding of group 2 was also longer than that of group 3 ($44.8 \pm 2.45h$) the differences could be as a result of the co-treatment with cloprostenol which is effective in rapid lysis of corpus luteum and subsequent initiation of new cycle. The finding of group 2 is in agreement with the report of $46.1 \pm 37.2h$ in ewe synchronized with CIDR [32]. The finding of group 3 (CIDR + cloprostenol) is consistency with the work of [36] who recorded $42.00 \pm 4.0h$ and $42.25 \pm 4.80h$ from the end of treatment with lutalyse and sil-oestrus (subcutaneous implant containing 375mg progesterone) respectively.

Group 1 had a shorter duration of estrus ($40.6 \pm 10.33h$) compared to group 2 ($72.0 \pm 0.89h$) and group 3 ($73.6 \pm 0.81h$) the differences may be due to the agents of synchronization used which act on the ovary differently. These differences showed that CIDR produces more compact estrus synchrony than cloprostenol. The finding of group 2 and 3 of this research is not in agreement with the previous report of $44.7 \pm 2.4h$, $44.5 \pm 1.8h$, $39.31 \pm 5.3h$ and $29.28 \pm 2.6h$ duration of estrus using FGA, CIDR + $PGF_{2\alpha}$ and $PGF_{2\alpha}$ in ewes respectively [32]. However, the finding of [32] is consistent with that of group 1 in which $39.40 \pm 10.33h$ estrus duration was recorded.

The duration of estrus in group 2 and 3 are longer compared to the report of [31] in which $39.99 \pm 6.05h$ was reported in does treated with CIDR. The differences may be as a result of environmental condition. The findings of our research are in agreement with the earlier report that the duration of estrus were between 18-72hrs [24]. A shorter duration of estrus $31.11 \pm 2.74h$ was also reported in West African dwarf goat [36]. The differences may be as a result of agents used breeds and environmental condition.

The CIDR device retention rate in group 2 and 3 were 100%, this may be due to the correct insertion of the CIDR the result of this study is consistent with the previous report of 100% retention rate using FGA sponges and CIDR [37]. The findings of our research are slightly higher than 88.9% retention rate in does [31]. The vaginal discharge rate recorded in this study was 80% and 60% in groups 2 and 3 respectively the volume of discharge was very small ($< 1ml$) and the discharge was not foul smelly. This finding indicated that CIDR is very good in synchronizing does compared to sponges in which foul smelly discharge was reported [31]. This finding also confirms earlier report of 77.8% vaginal discharge rate [31]. Majority of ewes that received CIDR (17/19) and Sponges (14/14) had vaginal discharge at the time of device removal [38]. The above result is slightly similar to the finding of our research. Draw string breakage was absent in both groups 2 and 3 this made removal of the device easier because there were no adhesion of CIDR to the vaginal mucosa. 0% draw string breakage was also reported using CIDR in does [31].

VI. Conclusion

In this study, we observed that cloprostenol and progestagens are suitable for synchronizing estrus in the Red Sokoto Doe.

The fact that more compact synchrony was observed using CIDR + cloprostenol and CIDR suggest that both protocols are good in estrus synchronization in red Sokoto doe.

Control internal drug release (CIDR), CIDR+Cloprostenol and Cloprostenol are recommended for estrus synchronization in red Sokoto doe. Therefore the choice of any of the three protocols depends on the access to the drugs as well as economic consideration. The fact that CIDR + Cloprostenol produces better or compact synchrony it is use in synchronization in red Sokoto doe is recommended.

Based on the data produced by this research on the time of the day on which the onset of estrus was observed it is recommended that more attention should be given in the morning while observing animals' estrus. There is the need for further studies on the hormonal concentration following treatment with these synchronization hormones.

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