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ESTRUS SYNCHONIZATION IN FRIESIAN X BUNAJI AND BUNAJI COWS TREATED WITH CONTROLLED INTERNAL DRUG RELEASE (CIDR-B)

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ABSTRACT

The study was designed to evaluate the efficacy of Controlled Internal Drug Release (CIDR-B), CIDR + Prostaglandin $F_{2\alpha}$ and Prostaglandin $F_{2\alpha}$ alone in synchronizing estrus, determining time of day cows exhibited standing estrus, pregnancy and conception rates in Bunaji and Friesian x Bunaji cows. The study was conducted between July and October using forty seven cows consisting of twenty four Bunaji and twenty three Friesian x Bunaji cows in a 2x3 factorial arrangement with eight cows each except for treatment III which had seven Friesian x Bunaji cows. Cows used for this study aged between $2^1/_2 - 5$ years with body condition score of 2.5 and above were rectally palpated for cyclicity. CIDR coated with 1.39g of progesterone was inserted through the vagina with the aid of an applicator, on day six 2ml of $PGF_{2\alpha}$ (Estrumate) was administered intramuscularly before CIDR removal on day seven and behavioural signs of estrus were observed after insert removal. Retention rates were 100 % for all the treatments. Estrus response rates were 62, 56 and 26 % for CIDR and CIDR + $PGF_{2\alpha}$ respectively. Interval to onset of estrus in Bunaji and Friesian x Bunaji cows was 3 hours and 1.75 hours respectively for CIDR + $PGF_{2\alpha}$ and 5.0 hours for CIDR in both breeds. Estrus duration was longer in Friesian x Bunaji cows; CDIR (12 hours), CIDR + $PGF_{2\alpha}$ (13.5 hours) than Bunaji cows; (CIDR) 7.00 hours, (CIDR + $PGF_{2\alpha}$) 11.0 hours. Number of mounts were more in Friesian x Bunaji cows; 9.00 CIDR, 11.25 CIDR + $PGF_{2\alpha}$ than in Bunaji cows: 8.66 hours CIDR, 4.33 CIDR + $PGF_{2\alpha}$. Fourteen cows came into estrus between 6 am and 12 noon as to nine cows between 12 noon to 6 pm. Pregnancy and conception rates were higher in Friesian x Bunaji treated with CIDR and $PGF_{2\alpha}$ while Bunaji had higher values when treated with CIDR + $PGF_{2\alpha}$. It can be concluded from the study that, one shot of Prostaglandin was effective only in Friesian x Bunaji cows. Bunaji cows treated with CIDR + $PGF_{2\alpha}$ did better in terms of estrus response, pregnancy and conception rates. CIDR and CIDR + $PGF_{2\alpha}$ protocols are capable of synchronizing estrus in Bunaji and Friesian x Bunaji cows with good pregnancy and conception rates.

Key words: Controlled Internal Drug Release, Friesian x Bunaji, Bunaji, Estrus, Synchronization

INTRODUCTION

Synchronization of estrus (heat) involves manipulating the estrous cycle of female animals so they can be bred at approximately the same time. Estrus synchronization and artificial insemination (AI) are reproductive management tools that have been available to producers for over 30 years. These tools remain the most important and widely applicable reproductive biotechnologies available for cattle operations (Seidel, 1995). One measure of the reproductive efficiency of any cow-calf operation is the percent annual calf crop output. Reproductive inefficiency in cow-calf operation has been reported to reduce milk yield, number of replacement heifers and increase involuntary culling due to death, infertility and disease (Grohn

and Rajala-Schultz, 2000). De Rensis (2000) reported an estimated loss of $300 million per year to the United States Dairy industry due to poor detection of estrus.

During the last three decades, various estrus synchronization programmes have been adopted to control onset of estrus and artificial insemination in dairy cattle (Stevenson, 1997; Voh, *et al*., 2004). These are dependent entirely on manipulation of the corpus luteum by prolonging the luteal phase with progestagins or inducing premature luteolysis by prostaglandins. It has been reported that manipulation of ovarian follicular development by Gonadotropin Releasing Hormone (GnRH), human Chorionic Gonadotropin (hCG) or Pregnant Mare Serum Gonadotropin (PMSG) may be necessary adjunct for synchronization of ovulation and improving fertility (De Rensis, 2000). There are several protocols available for synchronizing estrus in female animals. Traditional protocols are designed to mimic or control the corpus luteum of the ovary.

The CIDR is a T-shaped rubber device that contains progesterone. Longer treatment periods (14-21 days) resulted in a high degree of estrus synchrony but reduced fertility (Macmillan and Peterson, 1990). It has been suggested that hormonal injections can be administered along with the CIDR treatment to increase efficiency (Medina-Britos *et al*., 2001). The objective of the study was therefore to evaluate the efficacy of controlled internal drug release (CIDR) in synchronizing estrus in Bunaji and Friesian x Bunaji cows.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Dairy Research Programme farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, Nigeria. Zaria is located within the Northern guinea savannah zone of Nigeria, latitude 11^0 12' N and longitude 7^0 33' E, at an altitude of 610 m above sea level (Wikipedia, 2013).

Management of Animals and Experimental Design

The cows were grazed on free range pasture and supplemented a concentrate diet consisting of 48% cotton seed cake, 13.7% wheat bran, 35.3% maize, 2% bone meal and 1% common salt, 88% dry matter, 15% crude protein and 55% total digestible nutrients after grazing. Water and mineral licks were provided *ad-libitum*. All cows were ear-tagged to enable identification of the cows during estrus detection. The cows were dipped twice a week for effective control of ectoparasites.

The cows were divided into three groups (Group I, II and III). Group I and II consisted of 16 cows each (8 Friesian x Bunaji and 8 Bunaji cows) and group III had 7 Friesian x Bunaji and 8 Bunaji cows.

Group I, CIDR alone was inserted into the vagina of the cows using an applicator. The vulva of all cows was cleaned to avoid introducing contaminants into the vagina. The CIDR was left in place for seven days before removal, and then heat signs were observed in order to artificially inseminate the animals.

Group II, CIDR was inserted into the vagina of the cows using a special applicator. The vulva of the cows was cleaned to avoid introducing manure into the vagina. The CIDR were left in

place for seven days. On day 6 the cows were administered 2mls $PGF_2\alpha$ (Estrumate®) intramuscularly before removal of the device on day 7 then heat signs was observed for artificial insemination.
Group III, 2 mls of $PGF_2\alpha$ (Estrumate®) was administered intramuscularly on day 0 (first single shot) then heat signs were observed for artificial insemination.

Estrous synchronization and Detection

A total of forty seven cycling animals aged between $2^1/_2$ to 5 years were used for the study consisting of twenty three Friesian x Bunaji cows and twenty four Bunaji in a 2 x 3 factorial arrangement.

Cows were body-condition scored using a score scale of 0–5, from the most emaciated to the fattest (Pullan, 1978). Only cows with body condition scores of 2.5 and above were used.

Estrus Detection

Cows were monitored for mounting activities. Visual detection of estrus was done in the morning (07:00 – 09:00 hours) and evening (17:00 hours – 18:00 hours) and by the grazers during grazing.

Insemination and Pregnancy Diagnosis

Cows with standing estrus (standing to be mounted) were inseminated 12 hours after the onset of estrus using Frozen Friesian semen by an inseminator using the recto-cervical method. Animals were rectally palpated by according to the procedures of Zemjanis (1970) for pregnancy diagnosis.

Parameters Measured

The following parameters were measured and/or calculated: Interval to onset of estrus, Retention rate, swollen vulva rate, Estrus response rate, Estrus duration, number of mounts and time of day cows exhibited standing estrus.

Statistical Analysis

Data on estrus response rate and swollen vulva were expressed as percentages. Interval to onset of estrus, number of mounts and estrus duration were analyzed using the GLM procedure of SAS (SAS, 2002). Significant means were separated using Duncan Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

After the seven days insertion of Controlled Internal Drug Release (CIDR) the retention rates of inserts were 100% for Friesian x Bunaji and Bunaji cows in groups I and II. Retention rate for all the treatments in the study were 100% this could be attributed to the T-shape nature of the intravaginal device which got attached to the vaginal wall of the cow when inserted. The 100% retention rate observed in this study agrees with the reports of McLean (2003) for two different lengths of CIDR insert and Dare *et al*. (2010) for Progesterone Releasing Intra-vaginal Device (PRID) and PRID + Pregnant Mare Serum Gonadotropin (PMSG) during the dry season. Ryan *et al*. (1995) reported lost of over 5% of 1, 559. Lucy *et al*. (2001) reported losing 1 to 5% of inserts per treatment group while Dare *et al*. (2010) reported 90 % and 85% for PRID and PRID + PMSG during rainy season.

Estrus response rate for treatment I were 37% and 87% for Bunaji and Friesian x Bunaji cows respectively. Treatment II recorded an estrus response rate of 62% and 50% for Bunaji and Friesian x Bunaji cows respectively, treatment III records were 0% and 57% for Bunaji and Friesian x Bunaji cows respectively. This study revealed a lower estrus response rate in Bunaji (37%) than Friesian x Bunaji (87%) cows treated with CIDR alone. This could be attributed to the poor reproductive performance (genetics) of Bunaji cows which is an indigenous breed.

Treatment II (CIDR + $PGF_{2\alpha}$) estrus response rate showed high differences between Bunaji cows (62%) and Friesian x Bunaji (50%). The combination of progestagen (extending the life span of the CL) and prostaglandin (shortening the life span of the CL, inducing luteolysis) in synchronizing estrus seems more effective in the local breed. The decreased estrus response rate may be due to inhibition of estrus expression caused by incomplete regression of the CL and therefore elevated progesterone concentration (Pinheiro *et al*., 1998; Rekwot *et al*., 1999) and means of estrus detection.

Interval to onset of estrus (mean ± SEM) with CIDR treatment was 5.00 ±1.0 hours and 5.00 ±1.2 hours for Bunaji and Friesian x Bunaji cows respectively. Bunaji and Friesian x Bunaji cows treated with CIDR + $PGF_{2\alpha}$ had 3.00 ± 0.4 hours and 1.75 ± 0.3 hours respectively. The interval to onset of estrus was not significant for Bunaji and Friesian x Bunaji cows treated with CIDR and CIDR + $PGF_{2\alpha}$. Bunaji and Friesian x Bunaji cows treated with CIDR took longer time to come into estrus 5±1.0 and 5±1.2 hours respectively than Bunaji (3±0.45) and Friesian x Bunaji (1.7±0.25) cows treated with CIDR + $PGF_{2\alpha}$. This could the attributed to the breed, environment and efficacy of CIDR + PGF2α protocol to synchronize estrus. Romano (1998), Greyling and Van der Nest (2000) reported interval to onset of estrus to occur within 6-120 hours which is longer than the findings of this study and this could be attributed to the efficacy of CIDR in estrus synchronization.

Estrus duration (mean ± SEM) was 7.00±2.9 hours and 12.00±2.8 hours for Bunaji and Friesian x Bunaji cows treated with CIDR alone, while Bunaji and Friesian x Bunaji cows treated with CIDR + $PGF_{2\alpha}$ recorded 11.00±4.2 and 13.5±.1.2 respectively. The results from this study revealed that there was no significant difference ($p>0.05$) for both treatments. It could be observed that Friesian x Bunaji cows in both treatments recorded longer duration of estrus than Bunaji, this could be attributed to many factors, including breed (Rae *et al*., 1999), environment (Landaeta-Hernandez *et al*., 2002), number of animals in estrus at a time (Landaeta-Hernandez *et al*., 2002), and estrous detection method (Rae *et al*., 1999) influence the duration of estrus; however, multiple studies indicated that *Bos indicus* heifers (Plasse *et al*., 1970) and cows (Pinheiro *et al*., 1998) have a shorter duration of estrus compared to *Bos taurus* heifers (Richardson *et al*., 2002) and cows (Schams *et al*., 1977). The 7±2.9 hours estrus duration for Bunaji treated with CIDR in this study agrees with the report of Rae *et al*. (1999) who reported 6.7 hours for Angus (*Bos taurus*).

Mounts per estrus period (mean ± s.e.m) was 8.66±2.4 and 9.00±1.4 in Bunaji and Friesian x Bunaji cows treated with CIDR alone and 4.33±0.6, 11.25±1.5 in Bunaji and Friesian x Bunaji cows treated with CIDR + $PGF_{2\alpha}$. The primary and most reliable indicator of estrus is for a cow to allow herself to be mounted by another cow (Glencross *et al*., 1981). There was no significant difference in the number of mounts per period for Bunaji and Friesian x Bunaji cows treated with CIDR but there was high difference between Bunaji (4.33±0.61) and Friesian x Bunaji (11.25±1.15) cows treated with CIDR + $PGF_{2\alpha}$. This could be due to the breed effect,

synchronized estrus and environment. Cows that are consuming feed in a crowded pen or aisle, or housed on poor footing will demonstrate less mounting activity (Britt *et al*., 1986).

The results for swollen vulva from the study were 50% and 100% for Bunaji and Friesian x Bunaji cow in treatment I. treatment II recorded 75% and 62% for Bunaji and Friesian x Bunaji cows while treatment III had 50% and 85% for Bunaji and Friesian x Bunaji cows respectively. The result of swollen vulva in this study revealed the efficacy of CIDR, CIDR + $PGF_{2\alpha}$ and $PGF_{2\alpha}$ in synchronizing oestrus in both Bunaji and Friesian x Bunaji cows. Bunaji with low reproductive performance recorded 50% above while Friesian x Bunaji with improved genetic makeup had better results. Secondary signs of estrus include mounting other cows, clear mucous discharge from the vulva, swelling of the vulva, restlessness, following other cows, chin resting, and lip curling. These signs can occur before, during, or after estrus and do not relate to the time of ovulation, but should instead be used as clues that a cow should be observed more closely (Nebel, 2003).

Table 1: ***Estrus activity of Friesian x Bunaji and Bunaji cows treated with different synchronization protocols***

Parameters	Trearment Groups					
	CIDR		**CIDR+$PGF_{2\alpha}$**		**$PGF_{2\alpha}$**	
	BJ	**FRxBJ**	**BJ**	**FR x BJ**	**BJ**	**FR x BJ**
N	8	8	8	8	8	7
Retention (%)	100	100	100	100		
Esrus response (%)	37	87	62	50	0	57
Interval to onset of estrus (h)	5.00±1.0	5.00±1.2	3.00±0.4	1.75±0.3		
Estrus Duration (h)	7.00±2.9	12.00±2.8	11.00±4.2	13.50±1.2		
No of mounts	8.66±2.4	9.00±1.4	4.33 ± 0.6^{b}	11.25 ± 1.5^{a}		
Swollen vulva (%)	50	100	75	62	50	85

Mean values with the different superscript within a row are significantly different ($p<0.05$)
CIDR=controlled Internal Drug Release, $PGF_{2\alpha}$=prostaglandin, Fr x BJ= Friesian x Bunaji cross, BJ= Bunaji.

From the findings of this study (Table 2), number ofcows exhibited standing estrus between 6am and 12noon s of the day for Bunaji and Friesian x Bunaji cows in as follows; 1, 5 in treatment I, 4, 1 in treatment II and 0, and 3 in treatment II respectively. While between 12noon and 6pm were 2, 2, for Bunaji and Friesian x Bunaji cows in treatment I, 1 and 3 in treatment II and 0 and 1 in treatment III respectively. The results revealed higher values between 6 am - 12 noon than 12 noon – 6 pm for all the treatments respectively. The time of the day cows display estrus can also be influenced by breed. It has been indicated that the onset of estrus occurs more frequently during the night time hours than daytime hours in both *Bos taurus* (Stevenson *et al*., 1996) and *Bos indicus* (Pinheiro *et al*., 1998) cows.

Table 2: ***Number of cows that exhibited standing estrus at different times of the day***

Time of day	Treatments								
	CIDR			CIDR + $PGF_{2\alpha}$			$PGF_{2\alpha}$		
	BJ	FR x BJ	Total	BJ	FR x BJ	Total	BJ	FR x BJ	Total
6am-12noon	1	5	6	4	1	5	0	3	3
12noon-6pm	2	2	4	1	3	4	0	1	1

CIDR=controlled Internal Drug Release, $PGF_{2\alpha}$=prostaglandin, Fr x BJ= Friesian x Bunaji cross.

Table 3 shows that conception rates of Bunaji and Friesian x Bunaji cows for treatment I were 33% and 42%. In treatment II the conception rates for CIDR + $PGF_{2\alpha}$ were 60% and 50% for Bunaji and Friesian x Bunaji cows while those of treatment III were 0 % and 75% for Bunaji and Friesian x Bunaji cows respectively.

Table 3: Conception and pregnancy rates of Bunaji and Friesian x Bunaji cows treated with CIDR, CIDR + PGF2α and $PGF_{2\alpha}$.

	Treatments					
	CIDR		CIDR+ $PGF_{2\alpha}$		$PGF_{2\alpha}$	
	BJ	FR X BJ	FR X BJ	BJ	FR X BJ	BJ
Conception Rates (%)	33	42	60	50	0	75
Pregnancy Rates (%)	12	37	37	28	0	42

CIDR=controlled Internal Drug Release, $PGF_{2\alpha}$=prostaglandin, Fr x BJ= Friesian x Bunaji cross, BJ= Bunaji.

This study revealed that conception rate of Bunaji treated with CIDR alone had the lowest and Friesian x Bunaji treated $PGF_{2\alpha}$ alone had the highest. The low conception rate in treatment I may be attributed to the low progesterone levels which is important in pregnancy. Cows treated with CIDR + $PGF_{2\alpha}$ did better which could be due to increased levels of progesterone because of its importance in maintaining pregnancy. Conception rate of cows treated with CIDR + $PGF_{2\alpha}$ for Bunaji (60%) and Friesian x Bunaji (50%) in this study were lower than the 75% for Friesian x Bunaji treated with $PGF_{2\alpha}$ this agrees with the report of Dare *et al*. (2010) who reported 70.0% (dry season) and 76.9% (rainy season) treated with PRID + PMSG. The 60% for Bunaji cows treated with CIDR + $PGF_{2\alpha}$ in this study also agrees with reports of (Stevenson *et al*., 2000) and (Lucy *et al*., 2001) treated with 2 shots of $PGF_{2\alpha}$ and CIDR + $PGF_{2\alpha}$.

Pregnancy rates of Bunaji and Friesian x Bunaji cows were 12% and 37% for treatment I. treatment II had pregnancy rates of 37% and 28.5% for Bunaji and Friesian x Bunaji cows while those of treatment III were 0% and 42% for Bunaji and Friesian x Bunaji cows respectively.

Pregnancy rates for all the treatments in this study were low. Buanji cows treated with CIDR and Friesian x Bunaji cows treated with $PGF_{2\alpha}$ recorded the lowest and highest respectively. This could be attributed to the effect on breed and/or amount of progesterone as it is a major hormone in maintaining pregnancy. Rekwot *et al*. (1999) reported pregnancy rate of 45.7% for Zebu cattle treated with $PGF_{2\alpha}$ which is higher than the findings of this study 42 % for Firesian x Bunaji cows treated with $PGF_{2\alpha}$. All the findings of this study were lower than those reported by (Dejarnette *et al*., 2001) who reported 52% and 60% for select synch and select synch + MGA in suckled beef cows. The pregnancy rate of 28% for Friesian x Bunaji cows treated with

CIDR + $PGF_{2\alpha}$ in this study agrees with the findings of (Lucy *et al*., 2001) who reported 26% for suckled beef cows treated with CIDR + $PGF_{2\alpha}$.

CONCLUSION

Based on the findings of this study, it can be concluded that CIDR, CIDR + $PG_{2\alpha}$ and $PG_{2\alpha}$ are capable of inducing good estrus response, conception and pregnancy rates in Bunaji and Friesian x Bunaji cows except in Bunaji cows treated with one shot of $PGF_{2\alpha}$ alone. One shot of $PGF_{2\alpha}$ was more effective in Friesian x Bunaji cows in terms of conception and pregnancy rates with no effect in Bunaji. The combination of CIDR + $PGF_{2\alpha}$ seems more effective in synchronizing estrus, shorter time to onset of estrus, longer estrus duration and conception and pregnancy rates in Bunaji and Friesian x Bunaji cows.

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