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Effect of Season and Progesterone-Releasing Intravaginal Device Alone or with Pregnant Mare Serum Gonadotropin on Fertility Rates of Bunaji Cows

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Abstract: The effect of season and Progesterone-Releasing Intravaginal Device (PRID) alone or with Pregnant Mare Serum Gonadotropin (PMSG) on ovarian function of 106 Bunaji cows was investigated in two seasons. In the dry season trial, 46 cows were randomly distributed into the following treatment groups: PRID alone (n = 16), PRID+PMSG (n = 15) and control (15). In the rainy season trial, 60 cows were randomly distributed into the following treatment groups: PRID alone (n = 20); PRID+PMSG (n = 20) and control (20). During the dry season, Bunaji cows treated with PRID alone had a significantly ($p<0.05$) lower estrus response than the cows administered with PRID+PMSG (37.5 vs 66.7%, respectively). During the rainy season, 65.0% of Bunaji cows treated with PRID+PMSG were found to be in estrus; this was not significantly higher than the value of 60.0% estrus rate recorded in Bunaji cows treated with PRID only. In PRID treated Bunaji cows, pregnancy rates of 25.0 and 45.0% was recorded during the dry and rainy season, respectively. Pregnancy rates in PRID+PMSG treated cows were 46.7 and 50.0%, respectively. Pregnancy rate was generally lower in the dry season than in the rainy season in both PRID only, PRID+PMSG and control groups. However, the highest pregnancy rate of 50.0% was obtained in PRID+PMSG treated Bunaji cows during the rainy season. Conception rate in Bunaji cows treated with PRID only (66.7%) was lower than cows treated with PRID+PMSG (70%) during the dry season, although not significantly. Similarly during the rainy season, Bunaji cows treated with PRID+PMSG had a higher conception rate than cows treated with PRID only (76.9 vs 75.0%, respectively). In conclusion, this study suggests that the rainy season enhances greater ovarian function in dairy cows in the Northern Guinea Savannah zone of Nigeria and that administration of PMSG may potentiate fertility rates.

Key words: PRID, PMSG, cows, dry season, rainy season, reproduction effciency, Nigeria

INTRODUCTION

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 decrease milk yield, reduce number of replacement heifers and increase involuntary culling due to death, infertility and disease (Grohn and Rajala-Schultz, 2000). According to Buvanendran (1979), several interrelated factors, such as genetic, physiologic, management and environmental factors are responsible for poor performance of dairy cows in Nigeria. Inaccurate heat detection, poor signs of estrus and irregularity of the estrus cycle affect fertility in zebu cattle (Laudivar *et al*., 1985). De Rensis (2000) has also reported an estimated loss of $300 million per year to the United States Dairy Industry due to poor detection of estrus.

Extreme environmental conditions such as temperature and humidity have been reported to decrease reproductive efficiency. According to Walker *et al*. (1994) changes in the pregnant cow's body temperature of ±1.5-2°C can result in embryonic mortality and abortion. Extreme cold results in increased caloric maintenance requirement, such that for each 1°C drop below the critical ambient temperature of 25°C for beef cow, a corresponding 1% increase in energy requirement has been reported (Walker *et al*., 1994).

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*., 2004a, b). These are dependent entirely on manipulation of the corpus luteum by prolonging the luteal phase with progestins or inducing premature luteolysis by prostaglandins.

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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).

Although, there are many published reports on the use of progestins for estrus control in temperate breeds of cattle (Bos taurus), there is a dearth of information on the use of progestins and PMSG in indigenous breeds of cattle (Bos indicus) in Nigeria. Therefore, the aims of the present study were to determine the effectiveness of PRID and PMSG in synchronizing estrus in Bunaji cows during the dry and rainy seasons.

MATERIALS AND METHODS

Location: This study was carried out at the Dairy Research Programme of the National Animal Production Research Institute (NAPRI), Shika, Zaria (11°N and 12°N, 7°E and 8°E), at an elevation of 650 m above sea level, in the northern Guinea Savannah zone of Nigeria. An average annual maximum and minimum temperature of 31.8+3.2 and 18.0+3.7°C, respectively characterize the climate of the area. The monthly average rainfall during the rainy season (May to October) is 148.1+68.4 mm (69.2-231.9 mm) while mean monthly relative humidity is 71.1+9.7%.

Experimental cows and herd management: A total of 106 Bunaji cows aged between 5-7 years were involved in an estrus synchronization trial using PRID and PMSG. The study was carried out during two seasons: dry season (November to April) and rainy season (May to October) to determine the influence of season on the conception rate of Bunaji cows. The cows weighed between 250-400 kg with body condition score of 2.5 and above; using a scale of 0-5 from the most emaciated to the fattest of 5.0 (Pullan, 1978). All cows were rectally palpated for ovarian cyclicity before being included in the experiment. In the dry season trial, 46 cows were randomly distributed into the following treatment groups viz: PRID alone (n = 16), PRID+PMSG (n = 15) and control (n = 15). In the rainy season trial, 60 cows were randomly distributed Into the following treatment groups viz: PRID alone (n = 20), PRID+PMSG (n = 20) and control (20).

The cows were grazed free-range on improved legume and grass pastures and supplementary feed mixture of cotton seed/cake, maize and bone meal at 1-3 kg/cow/day was provided. Water and mineral salt lick were provided *ad libitum*. All cows were tagged with bold-numbered plastic ear tags for easy identification; the animals were routinely dipped once in a week in coumaphos (Asuntol®, Bayer), according to the manufacturer's recommendation for the control of ectoparasites. Cows were screened for blood and helminth parasites before the commencement of the study and appropriate prophylactic veterinary measures against contagious bovine pleuropneumonia, blackleg and haemorrhagic septicemia were conducted.

Insertion and removal of Progesterone Releasing Intravaginal Device (PRID): In the PRID and PRID+PMSG groups, PRID was inserted into the vagina of each cow with the aid of a speculum maintained for 12 days. PRID (Sanofi Animal Health Limited, Watford, WDI 8YJ) is a strip of coiled stainless steel that is coated with silastic rubber. The stainless steel strip, coiled by hand to a final diameter of about 5.5 cm has a piece of nylon cord attached to one end of the coil. Each device contains 1.55 g progesterone and a 10.0 mg capsule of oestradiol benzoate. The speculum was disinfected with chlorhexidine and then rinsed in clean water. The tip of the speculum was lubricated inside-out with a cetrimide cream and the PRID was inserted into the reproductive tract of the cows.

The device was allowed in place for 12 days after which they were removed by pulling the exposed string. Cows in PRID+PMSG group received deep intramuscular injection of 400 IU of PMSG on the day of PRID removal. Retention rate was measured by the number of cows that retained the device for the period of the experiment without voiding it.

Blood sampling and Radioimmunoassay (RIA): Before inserting PRID, blood samples were collected from the jugular vein of each cow. Similarly, blood samples were collected from all synchronized cows on the day of insemination and on days 20 and 45 post-insemination. Blood samples were collected with vacutainers without anticoagulant but placed immediately on ice. Serum samples were separated by centrifugation at 2500 g for 15 min and stored at -20°C until analysis using Radioimmunoassay (RIA) for progesterone. To minimize inter-assay variation, all samples from the same cow were run in the same assay and their progesterone concentrations determined spectrophotometrically using average absorbance of 450 nm. A serum progesterone concentration of 1ng mL^{-1} was taken to indicate the presence of functional luteal tissue (Oyedipe *et al*., 1986; 1988).

Heat detection and insemination: Heat detection was carried out by visual observation of cows for 20-30 min

twice daily. Standing to be mounted by other cows (homosexual mounting) was taken as the sole determinant of estrus. Other secondary sign of estrus, such as clear mucus discharge, trailing and mounting other cows, reddening and swelling of the vulva, frequent adoption of urination posture and isolation from herd mates were noted (Zakari *et al*., 1981). All inseminations were done with frozen semen from pure Friesian bulls (Worldwide sires, California, USA) within 10-14 h after the beginning of estrus using the recto-cervical vaginal method. Inseminated cows were further monitored for evidence of estrus every evening and morning for a period of 8 weeks. Non-pregnant cows were rebred whenever natural estrus recurred. Pregnancy was diagnosed by rectal palpation 60 days after artificial insemination (Sorensen and Bevely, 1984).

Statistical analysis: Data was collated and analyzed by ANOVA according to the method of Steel and Torrie (1960). Percentage pregnancy rate was calculated as number of cows pregnant over total number of cows synchronized. Percentage conception rate was determined as number of cows pregnant over total number of cows on estrus (heat). Probability values <0.05 were considered significant.

RESULTS

The results of retention rates, estrus responses, pregnancy rates and conception rates of Bunaji cows are shown in Table 1. There were no significant ($p>0.05$) differences in retention rates either for the drug treatment or season. In the PRID group, cows in the dry season had a significantly lower ($p<0.05$) estrus response rate than the cows in the rainy season. During the rainy season, there was no significant difference in estrus response of Bunaji cows treated with PRID+PMSG or PRID alone ($p>0.05$).

However, in the dry season, 66.7% of the PRID+PMSG treated cows came into estrus and this was significantly h >37.5% of PRID alone treated cows ($p<0.05$). In the control group, 25% of the cows were in estrus in the rainy season, significantly higher than the 13% of cows in estrus in the dry season. Irrespective of the treatments, 50% of the cows came into heat in the rainy season against 39.1% of estrus in the dry season.

In the dry season, 25.0% the PRID treated cows were pregnant, significantly lower ($p<0.05$) than the pregnancy rate of 45.0% of the PRID treated cows in the rainy season. On the contrary, there was no significant difference in pregnancy rates in the PRID+PMSG treated cows in both seasons (46.7 vs. 50.0%). Pregnancy rate was lower in the control group than the PRID and PRID+PMSG treatment groups in both seasons. Irrespective of the treatments, pregnancy rate was 40% in the rainy season, significantly >28.3% in the dry season ($p<0.05$).

During the dry season, conception rate of 66.7% was recorded for PRID treated cows which was not significantly <75.0% conception rate, recorded for PRID treated cows in the rainy season. Overall mean conception rate was 72.7 and 80.0% in dry and rainy season, respectively with no significant differences ($p>0.05$). Mean progesterone concentration of cows before PRID insertion, day of estrus, 20 and 45 days post-insemination are shown in Table 2:

- Estrus Response Rate (ERR) is the number of animals that came into estrus divided by the number of animals that were synchronized and expressed as percentage
- Pregnancy rate is the number of animals that became pregnant by AI divided by the number of animals that were synchronized expressed as percentage
- Conception rate is the number of animals that became pregnant by AI divided by the number of animals that came into estrus expressed as percentage
- Retention rate is the number of animals that retained the device for the period of insertion without voiding it divided by the total number of treated animals expressed ass percentage

Table 1: Fertility indices of Bunaji cows following estrus synchronization with Prid and PMSG

	PRID		PRID+PMSG		CONTROL		TOTAL	
Fertility indices	Dry` season	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
No. of cows	16.0	20.0	15.0	20.0	15.0	20.0	46.0	60.0
PRID retention (%)	100.0	90.0	100.0	85.0	-	-	100.0	87.5
Estrus response rate (%)	37.5	60.0	66.7	65.0	13.3	25.0	39.1	50.0
Pregnancy rate (%)	25.0	45.0	46.7	50.0	13.3	25.0	28.3	40.0
Conception rate (%)	66.7	75.0	70.0	76.9	100.0	100.0	72.7	80.0

Table 2: Confirmation of ovarian cyclicity, estrus and pregnancy of Bunaji cows by serum progesterone profile

Reproductive parameters	n	Dry season P_4 (ng mL^{-1}) Mean+S.D	n	Rainy season P_4 (ng mL^{-1}) Mean+S.D
Functional CL	40	11.85+2.78	55	11.23+1.18
Estrus	16	<1	25	<1
Day 20 post AI	12	12.00+1.23	20	13.60+1.19
Day 45 post AI	11	17.50+2.14	19	18.24+2.22

DISCUSSION

The results of the study clearly demonstrate the effectiveness of the two regimes (PRID alone, PRID+PMSG) in synchronizing estrus in Bunaji cows. These results agree with those reported earlier following the use of $PGF_{2\alpha}$ in Bunaji cows (Voh *et al*., 2004a).

Estrus response rate was highest in the PMSG treated group, followed by PRID alone and the control in both seasons which was in agreement with the findings of Chauhan *et al*. (1984) and Lokhande *et al*. (1984). The improved estrus and fertility rates in the PMSG treated group in this study contradicts the findings of Anchondo and Ramirez-Gondinez *et al*. (2000) who reported that the use of PMSG did not increase the percentage of cows detected in estrus and fertility after implant removal.

The relatively lower estrus response rate recorded in this study may be due to silent estrus and this corroborates the findings of Dawuda *et al*. (1989) who reported high incidence of silent estrus in Bunaji cows under tropical conditions. Fetrow and Blanchard (1987) reported that the estrus detection is one of the most economically important problems affecting dairy herd productivity and performance. Although, season did not seem to have significant effect on mean estrus response rate, pregnancy and conception rates were higher during the rainy season than during the dry season and this finding is in agreement with other reports by Zakari *et al*. (1981) and Rekwot *et al*. (1999).

The results of this study showed that estrus activity was significantly higher in PRID+PMSG administered cows, than PRID only and this result corroborates similar reports by Eduvie and Senguin (1982) and Santos *et al*. (2001), where hCG was used to enhance oestrus and conception rates in Holstein dairy cows.

CONCLUSION

It is observed that this study showed a synergy between PRID+PMSG which enhanced ovarian function in dairy cows; this advantage was better favoured during the rainy season. Since various estrus synchronizing agents have been adopted in synchronization and artificial insemination in the dairy industry, additional use of PMSG in enhancing fertility in dairy cows merits further investigation.

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