Peripheral serum progesterone profile in multiparous Nigerian Red Sokoto goats between day one and 30 postpartum

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ABSTRACT
Peripheral serum progesterone (P₄) profile as an index of postpartum (pp) resumption of ovarian activity was determined in fifteen (15) multiparous Red Sokoto goats between day 1 and 30 pp. Serum P₄ was determined on day 1, 5, 9, 13, 17, 21, 25 and 30 pp, that is, on every 4th day after the preceding sampling and on the 5th day after day 25 sampling. A total of 115 serum samples were analysed by radioimmunoassay. The mean P₄ concentration during the period of study was 0.19 ± 0.02 ng/mL. Two progestronic peaks were observed at day 5 and 17 pp. The highest P₄ concentration occurred on day 17 pp (0.26 ± 0.07 ng/mL) and the lowest level on day 25 pp (<0.1 ng/mL). Progesterone levels rose from day 1 pp (0.18 ± 0.04 ng/mL) to a moderate peak at day 5 pp (0.25 ± 0.07 ng/mL). A sudden fall in P₄ level occurred after day 5 pp and continued through days 9 and 13 pp (0.23 ± 0.06 and 0.21 ± 0.05 ng/mL, respectively). Thereafter, P₄ concentrations rose to the highest level by day 17 pp (0.26 ± 0.07 ng/mL). From a second peak on day 17 pp, P₄ levels fell progressively through day 21 pp (0.17 ± 0.06 ng/mL) to basal concentrations on day 25 pp (<0.1 ng/mL). On day 30 pp, when the experiment was terminated, P₄ concentration rose again to 0.12 ± 0.03 ng/mL. The mean P₄ concentrations between sampling days were not significantly different (P>0.05). It is concluded that ovarian activity in the early pp period is characterized by fluctuating short-term luteal phases and may resume as early as day 5 pp in multiparous Red Sokoto goat.

Key words: progesterone profile, postpartum, multiparous, Red Sokoto goat

Introduction
The Red Sokoto goat belong to the Savannah goat breed of the Nigerian guinea Savannah zone (EPSTEIN and MASON, 1971). They constitute 60% of the Nigerian goat

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population of about 34.5 million (MOLOKWU and IGONO, 1978; ANONYMOUS, 1992). They are year-round breeders with average oestrous cycle length and oestrus duration of 19 - 21 days and 21 - 26 hours, respectively (MOLOKWU and IGONO, 1982; PATHIRAJA et al., 1991). First pp oestrus and completion of uterine involution in this breed occur at 19 - 30 and 24 - 28 days pp, respectively (FASANYA et al., 1987; FASANYA et al., 1992b). Early resumption of ovarian activity during the pp period is a necessary requirement for successful rebreeding in domestic animals. Since the ovaries are the main source of P₄ in goats (GORDON, 1997), serum P₄ concentration is an important index of ovarian activity and pregnancy diagnosis in goats (BONO et al., 1983; SUSMEL and PIASENTIER, 1992; AKUSU et al., 1994). Ovarian activity is affected by puberty, season, teasing, nutrition, parturition, and lactation (ROSENBERG et al., 1977; LLEWELYN et al., 1993). Low levels of circulating P₄ is associated with puberty, oestrus and the early pp period (BONO et al., 1983; AKUSU et al., 1994), while high peripheral P₄ levels are normally seen at the luteal phase of oestrous cycle and during pregnancy (BONO et al., 1983; SUSMEL and PIASENTIER, 1992; AKUSU et al., 1994). PATHIRAJA et al. (1991) reported a luteal phase duration of about 12 days, but no correlation between ovulation rate and P₄ levels in the cycling Red Sokoto does. MALAU-ADULI et al. (2004) reported that feed supplementation had no effect on P₄ concentrations during gestation and early lactation in Red Sokoto goats. Still, the information on pp progesterone profile as an indicator of resumption of ovarian activity in Red Sokoto goats is scanty. Consequently, the objective of this study was to determine the P₄ profile of the Red Sokoto goat as an index of pp resumption of ovarian activity. This will facilitate the design of an appropriate and controlled rebreeding programme for this goat breed.

Materials and methods

Fifteen postpartum multiparous (2-4 parity) Red Sokoto goats weighing 10-30 kg and aged between 2-4 years were used for this study. They were sourced from the Small Ruminant Programme of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika, Zaria, latitude 11° 12’ N, longitude 7° 33’ E, and altitude 610 m. The experiment was carried out in the rainy hot sub-humid months of July-September. The animals were grazed for 6-8 hours on improved pasture and provided with a supplementary concentrate ration of approximately 15% crude protein at 300g/head/day. The animals were bled via jugular venipuncture beginning from day 1 pp and subsequently at 4 days interval, until day 25 pp, and on the 5th day after the day 25 sampling (i.e., day 30 pp). At each sampling, 10 mL of whole blood was collected and immediately refrigerated and later centrifuged at 3,000 g. The serum was then decanted and stored at 20 °C until assayed for P₄. The ‘Coat-A-Count’ progesterone kit (Diagnostic Products Corporation, Los Angeles, U.S.A)® Supplied by FAO/IAEA was used to assay for serum P₄. It is a no-extraction solid phase ¹²⁵I-progesterone radioimmunoassay (RIA)
technique. The sensitivity of the assay, defined as twice the standard deviation from the zero standard, was 0.14 ng/mL. The intra-and-interassay coefficients of variation were 6.7% and 7.1%, respectively. Progesterone concentration equal to or greater than 0.1 ng/mL was used as evidence of luteal activity (FASANYA et al., 1992a). Progesterone concentrations were expressed as mean and standard error of the mean (± SEM). Student’s t-test and One-way ANOVA was used to determine the significant difference in mean $P_4$ concentrations between sampling days, and values of $P<0.05$ were considered significant (SNEDECOR and COCHRAN, 1980).

**Results**

Mean $P_4$ concentration during the period of study was $0.19 ± 0.02$ ng/mL. Two progestrionic peaks were observed at days 5 and 17 pp. The highest $P_4$ concentration occurred on day 17 pp ($0.26 ± 0.07$ ng/mL) and the lowest on day 25 pp (<0.1 ng/mL). Progesterone levels rose from day 1 pp ($0.18 ± 0.04$ ng/mL) to a moderate peak on day 5 pp ($0.25 ± 0.07$ ng/mL). A sudden fall in $P_4$ level occurred after day 5 pp and continued through days 9 and 13 pp ($0.23 ± 0.06$ and $0.21 ± 0.05$ ng/mL, respectively). Subsequently, $P_4$ concentration rose again to the highest level on day 17 pp ($0.26 ± 0.07$ ng/mL). From the second peak on day 17 pp, $P_4$ levels fell progressively through day 21 pp ($0.17 ± 0.06$ ng/mL) to basal concentrations on day 25 pp (<0.1ng/mL). At the termination of the experiment on day 30 pp, $P_4$ concentration had risen from a basal level to $0.12 ± 0.03$ ng/mL. Mean $P_4$ concentrations between sampling days were not significantly different ($P>0.05$).

Table 1. Mean (± SEM) serum progesterone concentrations in Red Sokoto goats between day one and 30 postpartum

<table>
<thead>
<tr>
<th>Postpartum sampling day</th>
<th>N</th>
<th>Progesterone concentration (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>$0.18 ± 0.04$</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>$0.25 ± 0.07*$</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>$0.23 ± 0.06$</td>
</tr>
<tr>
<td>13</td>
<td>15</td>
<td>$0.21 ± 0.05$</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>$0.26 ± 0.07**$</td>
</tr>
<tr>
<td>21</td>
<td>15</td>
<td>$0.17 ± 0.06$</td>
</tr>
<tr>
<td>25</td>
<td>13</td>
<td>$0.06 ± 0.01$</td>
</tr>
<tr>
<td>30</td>
<td>12</td>
<td>$0.12 ± 0.03$</td>
</tr>
</tbody>
</table>

*First Progesterone peak; **Second progesterone peak; N = Number of animals/serum samples analysed per postpartum sampling day

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**Discussion**

The increase in P$_4$ level recorded between day 1 and 5 pp (0.18 ± 0.04; 0.25 ± 0.07 ng/mL) suggests that prepartum P$_4$ level declined prior to parturition and that first pp ovulation and the corpus luteum activity may have resumed as early as day 5 pp. Since circulating P$_4$ in goats is almost completely sourced from an active corpus luteum (GORDON, 1997), the relative increase in P$_4$ level on day 5 pp could be attributable mainly to the presence of an active corpus luteum at that period. The sudden decrease in P$_4$ concentrations following peak levels on day 5 and 17 pp is suggestive of the occurrence of fluctuating short-term luteal phases and thus short oestrous cycles. Also, with an average oestrous cycle length of 19 - 21 days and a normal luteal phase of about 12 days (MOLOKWU and IGONO, 1982; PATHIRAJA et al., 1991), the 12-day interval between the 2 progestrionic peaks on days 5 and 17 pp indicates shortened oestrous cycle length in the early pp period of this breed. The occurrence of short-term luteal phases in the early pp period has been attributed to the short life span of the corpora lutea formed at that period (DONALDSON et al., 1970; TROXEL et al., 1984). Premature luteolysis caused by uterine prostaglandin F$_{2a}$, short-term Gonadotropin-releasing hormone (GnRH)-induced Luteinizing hormone (LH)
surge, low number of LH receptors and granulosa cells in the early pp ovary, are thought to be responsible for the short life span of the early pp corpora lutea (TROXEL et al., 1984; TROXEL and KESLER, 1984).

The relatively low P₄ concentrations (<1.0 ng/mL) recorded in this study agrees with similar observations in parturient ewes and sows (MUKASA-MUGERWA and VIVIANI, 1992; GEREŠ et al., 2000). These low P₄ concentrations may also be due to the short life span and low level functionality of the early pp corpora lutea. The lowest P₄ concentration obtained on day 25 pp (<0.1 ng/mL) may correspond to a period of behavioral oestrus. AKUSU et al. (1994) reported the lowest P₄ around the period of oestrus in the West African Dwarf goat.

The low levels of circulating P₄ observed in this study could also mean poor fertility, following rebreeding during the first 30 days pp in Red Sokoto goat. This is because inadequate P₄ support during the early pp period has been associated with embryonic mortality and low pp fertility (PELLETIER and THIMONIER, 1973; DAWE and FLETCHER, 1976). Since even feed supplementation in pregnant Red Sokoto goats did not alter their P₄ output in early lactation (MALAU-ADULI et al., 2004), rebreeding may be delayed in this breed until after day 30 pp. The peak P₄ concentrations of 0.25 ± 0.07 ng/mL and 0.27 ± 0.07 ng/mL, occurring on day 5 and 17 pp, respectively, are similar to values obtained in the same breed at puberty and just prior to standing oestrus in dry non-pregnant does (PATHIRAJA et al., 1991; FASANYA et al., 1992a). However much higher P₄ concentrations ranging from 2.2 - 5.2 ng/mL have been reported mid-cycle in Nigerian goats (PATHIRAHA et al., 1991; AKUSU et al., 1994).

**Conclusion**

Based on the findings of this study, it is concluded that ovarian activity in the early pp period is characterized by fluctuating short-term luteal phases and may resume as early as day 5 pp in multiparous Red Sokoto goats.

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SAŽETAK
Istraživana je koncentracija perifernoga serumskoga progesterona (P₄) kao pokazatelja ponovne aktivnosti jajnika u 15 multiparh crvenih Sokoto koza od prvoga do 30. dana nakon jarenja. Koncentracija serumskoga P₄ bila je određena 1., 5., 9., 13., 17., 21., 25. i 30. dana nakon jarenja, tj. svakoga četvrtoga dana nakon prethodnoga uzorkovanja odnosno petoga dana nakon predposljednja uzimanja uzoraka. Ukupno je radioimmunnim testom bilo pretraženo 115 uzoraka seruma. Srednja koncentracija P₄ u razdoblju istraživanja bila je 0,19 ± 0,02 ng/mL. Povećane koncentracije ustanovljene su petoga i 17. dana nakon jarenja. Najveća koncentracija P₄ ustanovljena je 17. (0,26 ± 0,07 ng/mL), a najmanja 25. dana nakon jarenja (<0,1 ng/mL). Razine progesterona umjereno su se povećavale od prvoga dana (0,18 ± 0,04 ng/mL) do petoga dana nakon jarenja (0,25 ± 0,07 ng/mL).
Razina $P_4$ naglo se smanjila nakon petog dana, a i dalje se spuštala do devetog (0,23 ± 0,06) i 13. dana nakon jarenja (0,21 ± 0,05 ng/mL). Poslije toga koncentracija $P_4$ povećala se do najveće vrijednosti 17. dana (0,26 ± 0,07 ng/mL). Od drugoga vrhunca koncentracije 17. dana, razine $P_4$ naglo su se smanjile 21. dana nakon jarenja (0,17 ± 0,06 ng/mL) sve do bazalne koncentracije 25. dana (<0,1 ng/mL). Na dan završetka pokusa, 30. dana, koncentracije $P_4$ ponovo su rasle do 0,12 ± 0,03 ng/mL. Srednje vrijednosti koncentracije $P_4$ na dane uzimanja uzoraka nisu se međusobno značajno razlikovale ($P>$0,05). Zaključeno je da se aktivnost jajnika u ranom postpartalnom razdoblju očituje kratkotrajnim fluktuirajućim lutealnim fazama i može se u multiparih crvenih Sokoto koza ponovo vratiti na istu koncentraciju 5. dana nakon jarenja.

Ključne riječi: progesteron, postpartum, crvena Sokoto koza