*VETERINARSKI ARHIV 77* (6), 543-550, 2007

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

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**KAWU, M., L. EDUVIE, C. LAKPINI, J. AYO: Peripheral serum progesterone profile in multiparous Nigerian Red Sokoto goats between day one and 30 postpartum. Vet. arhiv 77, 543-550, 2007.**

**ABSTRACT**

Peripheral serum progesterone ($P_4$) 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 $P_4$ was determined on day 1, 5, 9, 13, 17, 21, 25 and 30 pp, that is, on every 4$^{th}$ day after the preceeding sampling and on the 5$^{th}$ day after day 25 sampling. A total of 115 serum samples were analysed by radioimmunoassay. The mean $P_4$ 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 $P_4$ 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 $P_4$ 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). Thereafter, $P_4$ concentrations rose to the highest level by day 17 pp (0.26 ± 0.07 ng/mL). From a 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 (<0.1 ng/mL). On day 30 pp, when the experiment was terminated, $P_4$ concentration rose again to 0.12 ± 0.03 ng/mL. The mean $P_4$ 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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ISSN 0372-5480
Printed in Croatia

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 $P_4$ in goats (GORDON, 1997), serum $P_4$ 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 $P_4$ is associated with puberty, oestrus and the early pp period (BONO et al., 1983; AKUSU et al., 1994), while high peripheral $P_4$ 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 $P_4$ levels in the cycling Red Sokoto does. MALAU-ADULI et al. (2004) reported that feed supplementation had no effect on $P_4$ 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 $P_4$ 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 5$^{th}$ 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 $P_4$. The 'Coat-A-Count' progesterone kit (Diagnostic Products Corporation, Los Angeles, U.S.A)® Supplied by FAO/IAEA was used to assay for serum $P_4$. It is a no-extraction solid phase $^{125}$I-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 0.1ng/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 progestronic 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

| Postpartum sampling day | N | Progesterone concentration (ng/mL) |
|---|---|---|
| 1 | 15 | 0.18 ± 0.04 |
| 5 | 15 | 0.25 ± 0.07* |
| 9 | 15 | 0.23 ± 0.06 |
| 13 | 15 | 0.21 ± 0.05 |
| 17 | 15 | 0.26 ± 0.07** |
| 21 | 15 | 0.17 ± 0.06 |
| 25 | 13 | 0.06 ± 0.01 |
| 30 | 12 | 0.12 ± 0.03 |

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

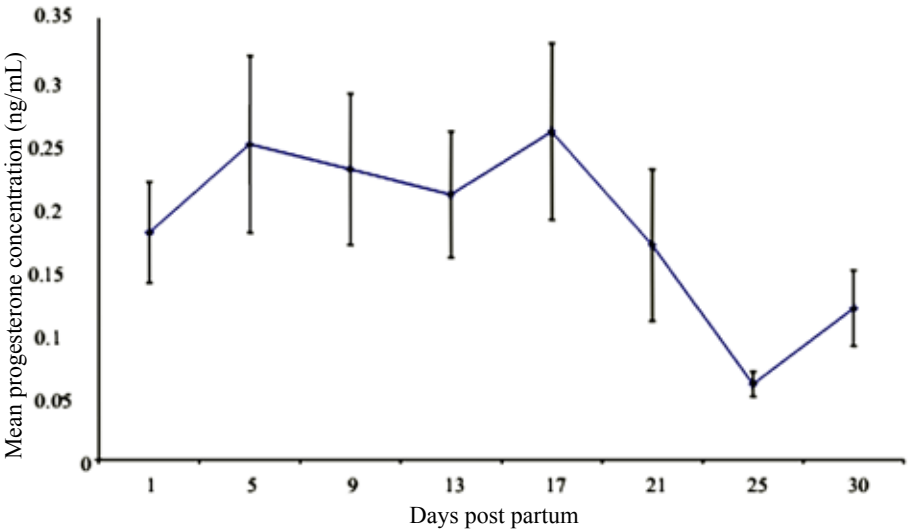


Fig. 1. Peripheral serum progesterone profile in multiparous red Sokoto goats between day one and 30 postpartum (mean ± SEM)

**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 progestronic 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 $P_4$ 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 $P_4$ concentrations may also be due to the short life span and low level functionality of the early pp corpora lutea. The lowest $P_4$ 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 $P_4$ around the period of oestrus in the West African Dwarf goat.

The low levels of circulating $P_4$ 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 $P_4$ 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 $P_4$ output in early lactation (MALAU-ADULI et al., 2004), rebreeding may be delayed in this breed until after day 30 pp. The peak $P_4$ 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 oetrus in dry non-pregnant does (PATHIRAJA et al., 1991; FASANYA et al., 1992a). However much higher $P_4$ 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.

**Acknowledgements**

The assistance of the Director, National Animal Production Research Institute, Ahmadu Bello University, Shika, Zaria, Nigeria, in authorizing the use of the Institute's animals and providing the radioimmunoassay facilities is appreciated.

## References

AKUSU, M. O., E. NDUKA, B. A. SOYEBO (1994): Peripheral plasma levels of progesterone and oestradiol-17β in West African Dwarf (WAD) goats during oetrus cycles following oetrus synchronization. Trop. Vet. 12, 27-36.

ANONYMOUS (1992): Nigerian livestock resources. Four Volume report to the Federal Government of Nigeria by Resource Inventory and Management Limited: Vol. 1 Executive Summary and Atlas. Nigeria Livestock Resources Survey. pp. 1-30.

BONO, G., F. CAIROLI, C. RAMANINI, L. ABRATE (1983): Progesterone, oestrogen, LH, FSH, and prolactin concentrations in plasma during the oestrus cycle in goat. Reprod. Nutri. Dev. 23, 217-222

DAWE, S. T., FLETCHER (1976): The effect of post lambing interval on fertilization in lactating ewes treated with progestagen impregnated sponges and gonadotropin. Proceedings of the Australian Society for Animal Production 11, 137 - 140.

DONALDSON, E. L., J. M. BASSET, G. D. THORBURN (1970): Peripheral plasma progesterone concentrations of cows during puberty, oestrous cycles, pregnancy and lactation and the effect of undernutrition or exogenous oxytocin on progesterone concentration. J. Endocrinol. 48 599-614.

EPSTEIN, H., I. L. MASON (1971): The Savanna goats of Africa. In: The Origin of Domestic Animals of Africa. Revised Edition, Vol. II Africana Publishing Corporation. New York. London. Munich. pp. 236-293.

FASANYA, O. O. A., E. C. I. MOLOKWU, D. S. ADEGBOYE, N. I. DIM (1987): Gross and histological changes of the postpartum gentalia of Savanna Brown goat. Anim. Reprod. Sci. 14, 65-74.

FASANYA, O. O. A., E. C. I. MOLOKWU, L. O. EDUVIE, N. I. DIM (1992a): Dietary supplementation in the Savanna Brown goat. I: Effect on attainment of puberty in the doe. Anim. Reprod. Sci. 29, 157-166.

FASANYA, O. O. A., E. C. I. MOLOKWU, L. O. EDUVIE, N. I. DIM (1992b): Dietary supplementation in the Savanna Brown goat. II: Gestation and postpartum activity in primiparous does. Anim. Reprod. Sci. 29, 167-174.

GEREŠ, D., D. ŽUBČIĆ, D. SABO. A. PLELI, P. DŽAJA, D. MIHELIĆ, G. MULLER (2000): Changes of progesterone concentrations in blood plasma of sows during periparturient period. Vet. arhiv. 70, 47-57.

GORDON, I. (1997): Controlled Reproduction in Sheep and Goats: Controlled Reproduction in Farm Animals Series, Vol. 2, 1st ed., CAB International. United Kingdom, pp. 398-415.

LLEWELYN, C. A., J. S. OGAA, M. J. OBWOLO (1993): Plasma progesterone profiles and variation in cyclic ovarian activity throughout the year in indigenous goats in Zimbabwe. Anim. Reprod. Sci. 30, 301-311.

MALAU-ADULI, B. S., L. EDUVIE, C. LAKPINI, A. E. O. MALAU-ADULI (2004): Crop-residue supplementation of pregnant does influences birth weight and weight gain of kids, daily milk yield but not the progesterone profile of Red Sokoto goats. Reprod. Nutri. Dev. 44, 111-121.

MOLOKWU, E. C. I., M. O. IGONO (1978): Reproductive performance and pattern in the Brown goat of Nigerian Savanna zone. Proceedings of the 4th World Conference on Animal Production, Argentina, pp. 578-590.

MOLOKWU, E. C. I., M. O. IGONO (1982): Reproductive cycle of the Nigerian Savanna Brown Goat. Proceedings of the III International Conference on Production and Diseases. Tucson, Arizona, United State of America. January, 1982, p. 312.

MUKASA-MUGERWA, E., P. VIVIANI (1992): Progesterone concentrations in peripheral plasma of Menz sheep during gestation and parturition. Small Rumin. Res. 8, 47-53.

PATHIRAJA, N., E. O. OYEDIPE, E. O. GYANG, A. OBASI (1991): Plasma progesterone levels during oestrus cycle and their relation ship with the ovulation rate in Red Sokoto (Mara di) goats. Br. Vet. J. 147, 57-62.

PELLETIER, J., J. THIMONIER (1973): Comparison of the induced preovulatory LH discharge in lactating and dry sheep during seasonal anoestrus. J. Reprod. Fert. 33, 310-313.

ROSENBERG, M., HERZ, M. DAVIDSON, V. FOLMAN (1977): Seasonal variations in postpartum plasma progesterone and conception in primiparous and multiparous dairy cows. J. Reprod. Fert. 51, 363-367.

SNEDECOR, G. W., W. G. COCHRAN (1980). Statistical Methods. 7th ed., Iowa University Press. Ames, 1A. pp 507.

SUSMEL, P., E. PIASENTIER (1992): Assessment of pregnancy in Bergamasca ewes by analysis of plasma progesterone. Small Rumin. Res. 8, 325-332.

TROXEL, T. R., D. J. KESLER (1984): Effect of progestin and GnRH treatments on ovarian and reproductive hormone secretions of anoestrus postpartum beef cows. Theriogenology 21, 699-711.

TROXEL, T. R., M. J. OPSOMER, D. J. KESLER (1984): The effect of days postpartum, indomethacin and oxytocin on prostaglandin metabolite concentration in postpartum suckled beef cows. Theriogenology 22, 187-196.

Received: 26 January 2005
Accepted: 2 November 2007

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**KAWU, M., L. EDUVIE, C. LAKPINI, J. AYO: Koncentracija serumskoga progesterona u multiparih crvenih Sokoto koza od prvoga do 30. dana nakon jarenja. Vet. arhiv 77, 543-550, 2007.**

**SAŽETAK**

Istraživana je koncentracija perifernoga serumskoga progesterona ($P_4$) kao pokazatelja ponovne aktivnosti jajnika u 15 multiparih crvenih Sokoto koza od prvoga do 30. dana nakon jarenja. Koncentracija serumskoga $P_4$ 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 predposljednjega uzimanja uzoraka. Ukupno je radioimunim testom bilo pretraženo 115 uzoraka seruma. Srednja koncentracija $P_4$ u razdoblju istraživanja bila je 0,19 ± 0,02 ng/mL. Povećane koncentracije ustanovljene su petoga i 17. dana nakon jarenja. Najveća koncentracija $P_4$ 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 petoga dana, a i dalje se spuštala do devetoga (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