

Pakistan Vet. J., 2008, 28(1): 1-4.

PROGESTERONE AND ESTRADIOL PROFILES DURING ESTROUS CYCLE AND GESTATION IN DWARF GOATS (*CAPRA HIRCUS*)

S. A. KHANUM, M. HUSSAIN AND R. KAUSAR

Nuclear Institute for Agriculture and Biology (NIAB), P.O. Box 128, Jhang Road, Faisalabad, Pakistan

ABSTRACT

Serum progesterone and estradiol profiles during estrous cycle, gestation and parturition in four Dwarf goat females (*Capra hircus*) were monitored. Blood sampling was carried out daily during estrous cycle and on alternate days during gestation till parturition. Observations regarding length of estrous cycle, gestation length, litter size and birth weight of kids were recorded. With the initiation of cyclicity, estradiol attained higher levels (7.7 ± 1.7 pg/ml) at estrus phase and dropped down to the lower levels within 3 to 4 days post-estrus. Concomitantly, progesterone started to increase from the mean basal value of 0.1 ± 0.03 ng/ml on day-0 to 3.0 ± 0.9 ng/ml on day-6 of estrous cycle and reached the peak value of 7.7 ± 0.6 ng/ml on day-12. From day-15, a decline was observed in progesterone values till the end of the cycle. A second estradiol rise of 14.0 ± 1.2 pg/ml was observed on day-18 of the cycle. The mean estrous cycle length was 18.2 ± 2.1 days. During gestation, higher progesterone levels were maintained in the range of 4.3–11.0 ng/ml. Estradiol remained at lower concentrations for 30–50 days of gestation, then gradually increased and reached 270 ± 13.0 pg/ml a few days before parturition. It dropped again to basal values within 1–2 days postpartum. The mean gestation length in Dwarf goats was 144.8 ± 3.9 days and the litter size was 1.8 ± 0.5 . It was concluded that Dwarf goat is a prolific breed, having a short gestation length with multiple births being common.

Key words: Estrous cycle, Dwarf goat, progesterone, estradiol.

INTRODUCTION

At present, there are 34 recognized breeds of goat in Pakistan (Devendra *et al.*, 2000). Their population during 2006 was estimated as 54 million heads (Livestock Census, 2006). In Pakistan, goat meat is preferred due to cultural adaptation and taste development (Jindal, 1984). The Dwarf is one of the popular breeds of goat reared in Pakistan. It is a Bengal breed flourished excellently in this region (Devendra and Burns, 1983). Farmers prefer it over other breeds because it is a nonseasonal, early maturing breed and has high prolificacy with 3 kidding in 2 years (Khanum *et al.*, 2000). Due to these characteristics, this breed is playing an important role in the economy, particularly in the present scenario of bird flu disease of poultry.

Reproduction is a major factor contributing to the efficiency of meat and milk production. Many genetic, environmental and physiological factors affect the reproductive efficiency of the female goat. Assessment of progesterone levels during different physiological stages in animals is considered one of the most important parameters to determine their fertility status (Zarkawi and Soukouti, 2001). Estradiol is another hormone playing a major role in the reproductive physiology of a female. Little information is available regarding changes in progesterone and estradiol levels

during different reproductive stages in Dwarf goats, compared to that in other farm animals (Bauernfeind and Holtz, 1991; Riesenberg *et al.*, 2001).

The main objective of this experiment was to determine the progesterone and estradiol profiles during different phases of estrous cycle, gestation and parturition in Dwarf goats.

MATERIALS AND METHODS

Four adult female Dwarf goats of almost similar age (1.5 ± 0.2 years), weighing 22–24 kg, were selected from the lot maintained at the Nuclear Institute for Agriculture and Biology, Faisalabad, Pakistan. Different fodders such as *Sorghum vulgare*, *Medicago sativa* and *Sesbania aculeata* etc, were available at the farm in different seasons for free grazing. Water was provided *ad libitum*. Based on the behavioral signs of estrus, blood sampling was started. It was carried out daily during the estrous cycle and twice a week during gestation period. Goats with non return to estrus were considered pregnant. Serum was separated by centrifugation and frozen in plastic capped tubes at -20°C until analysis.

The serum progesterone and estradiol-17 β concentrations were measured by the solid-phase radioimmunoassay using kits (coat-A-count

progesterone and estradiol; Diagnostic Products Corporation, 5700 West 96th Street, Los Angeles, CA 90045). For progesterone assay, the minimal detectable concentration was 0.015 ng/ml. Intra- and inter-assay co-efficients of variation were 4.5 and 10.8%, respectively. The sensitivity of estradiol assay was 5.00 pg/ml with intra and inter-assay coefficients of variation of 5.7 and 8.1%, respectively.

Observations regarding length of estrous cycle, gestation, parturition and general observations were recorded. Data were analyzed in terms of standard deviation to the group mean.

RESULTS

Estrous cycle

Two of the four animals exhibited one normal estrous cycle and conceived during the second cycle, while the other two showed two normal consecutive estrous cycles and conceived during the third cycle. With the initiation of cyclicity on day-0, first estradiol rise of 7.7 ± 1.7 pg/ml was observed which dropped to the lower levels within 3-4 days in post-estrus phase. When the estradiol levels declined, the progesterone levels started to increase (Fig. 1a).

The serum progesterone concentration increased gradually from the mean basal value of 0.1 ± 0.03 ng/ml on day-0 to 3.0 ± 0.9 ng/ml on day-6 and reached the peak value of 7.7 ± 0.6 ng/ml on day-12. These levels were maintained up to day-15 and then a decline was observed till the end of the cycle before next estrus. The mean estradiol levels remained below 3 pg/ml with no significant variation in the luteal phase. A second estradiol rise was observed on day-18 of the cycle with a value of 14.0 ± 1.2 pg/ml (Fig. 1a). The mean cycle length was found to be 18.2 ± 2.1 days.

Gestation period

After conception, higher progesterone levels (4.3–11.0 ng/ml) were maintained throughout the gestation period, and declined rapidly during 19 days pre-partum, reaching 0.8-1.0 ng/ml on the day of parturition (Fig 1b). The mean maximum progesterone level during gestation was 10.9 ± 1.3 ng/ml. The mean gestation length was 144.8 ± 3.9 days.

Regarding estradiol profile, after conception, it remained at lower concentrations of 0.8 ± 0.1 to 2.7 ± 0.02 pg/ml for 30 days and then gradually increased up to 38.2 ± 1.23 pg/ml on day-50. Then it kept increasing and attained maximum levels (270.0 ± 13.0 pg/ml) at day-141 and dropped again to basal values within 1-2 days postpartum. All the parturitions were normal. The litter size was recorded as 1.8 ± 0.5 with 3 goats gave

birth to twins, while a single kid was born to one doe. The average birth weight of kids was 1.6 ± 0.2 kg.

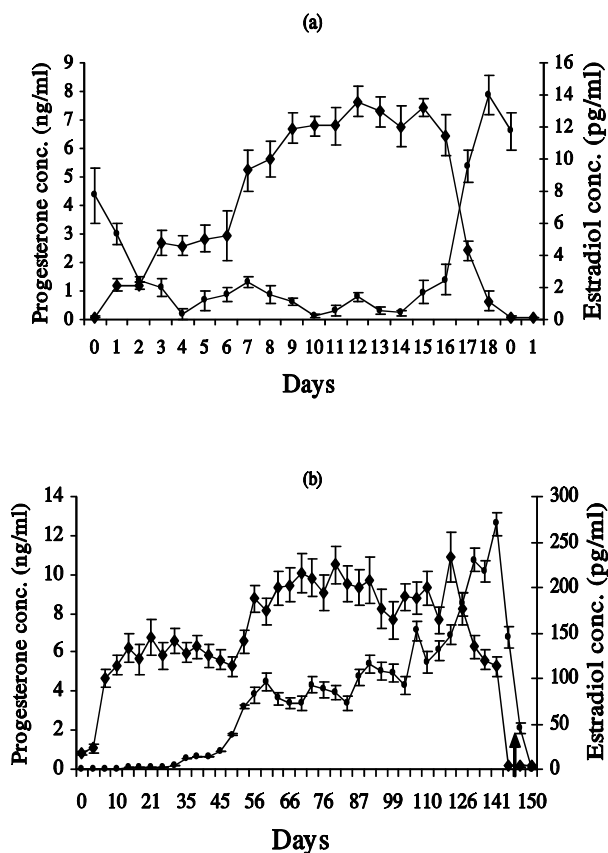


Fig. 1: Serum progesterone (♦) and estradiol (●) levels in Dwarf goat (*Capra hircus*) during estrous cycle (a) and gestation (b). Arrow shows the day of parturition.

DISCUSSION

In the Dwarf goat, the pattern and levels of increase in progesterone concentration and then its decline after the luteal phase is similar to that found in other goat breeds. The progesterone concentrations remained at basal levels throughout the estrus, as observed by others (Zarkawi and Soukouti, 2001; Khadiga *et al.*, 2005). Musaddin *et al.* (1996) reported mean progesterone concentration during the follicular phase of estrous cycle as 0.19 and 0.26 ng/ml in Dorset Horn-Malin (DHM) and Malin ewes, respectively. During the luteal phase, the concentrations were 2.33 and 2.94 ng/ml, respectively. In Damascus goats, the progesterone level during luteal phase ranged from 2.6 to 5.4 ng/ml (Khadiga *et al.*, 2005), which is comparable to the levels in Dwarf goats. Blaszczyk *et*

al. (2004) reported the estradiol levels in Anglo-Nubian does at the time of estrus as 15.3 ± 5.0 and 12.2 ± 3.8 pg/ml in and outside the breeding season, respectively. The length of estrous cycle is almost the same as reported by other workers in goats. Akusu and Ajala (2000) reported the mean cycle length of 18.3 ± 1.6 days in West African Dwarf goats. In Damascus goats, the length of estrous cycle was reported as 21.2 ± 1.5 days (Zarkawi and Soukouti, 2001).

In Dwarf goats, during gestation higher levels of progesterone were maintained with wide variations. In indigenous Small East African goats, the mean plasma progesterone concentration ranged from 2.6 to 10.8 ng/ml from conception to the mid-gestation (Kanuya *et al.*, 2000). The overall increase in progesterone levels during gestation and a decline towards the parturition and parturition, observed in the Dwarf goats, also resembled with other breeds (Kadzere *et al.*, 1997; Ozpinar and Firat, 2003). The parturition decline in the progesterone levels was correlated with the onset of parturition (Laura *et al.*, 2004).

Ford *et al.* (1998) reported that in Angora does, estradiol and estrone sulphate concentrations correlated negatively with progesterone ($r = -0.902$; $p < 0.01$) during the last 9 days of gestation. In case of Dwarf goats used in the present study, progesterone showed a declining trend from day-126 of gestation, while estradiol levels increased gradually and attained highest peak on day-132 of gestation. It was not possible to determine with certainty whether the increase in the estrogens preceded the decrease in progesterone concentrations.

Length of gestation period (144.8 days) observed in Dwarf goats is comparatively shorter than some other breeds of goat such as 152.1 days in Toggenburg, 151.1 days in Nubian and 150.5 days in Saanen breed (Amoah *et al.*, 1996). This short gestation length of Pakistani Dwarf goat is also the characteristic of some other small breeds, viz. Black Bengal goat (143 days), South African Dwarf goat (146 days) and West African Dwarf goat (144.9 days) (Peaker, 1978; Akusu and Ajala, 2000). In the present study, the short gestation length of Pakistani Dwarf goat may be related to the bigger litter size (1.8 and previously reported as 1.9 by Khan *et al.*, 1982). The decrease in gestation length as the litter size increases further suggests that optimal uterine stretch may play a role in the initiation of parturition (Oyeyemi *et al.*, 1997).

It was concluded that Dwarf goat exhibits progesterone and estradiol profiles comparable to other breeds and has short gestation length along with multiple births being common. Management of the reproductive process, by the use of modern

reproductive tools and improved nutritional strategies could further enhance its reproductive efficiency.

Acknowledgements

Authors acknowledge International Atomic Energy Agency (IAEA) for supplying RIA kits for hormonal analysis.

REFERENCES

- Akusu, M. O. and O. O. Ajala, 2000. Reproductive performance of West African dwarf goats in humid tropical environment of Ibadan. *Israel Vet. Anim. Prod.*, 50: 215–227.
- Amoah, E. A., S. Gelaye, P. Guthrie and C. E. Rexroad, 1996. Breeding season and aspects of reproduction of female goats. *J. Anim. Sci.*, 74: 723–728.
- Bauernfeind, M. and W. Holtz, 1991. Progesterone and estrogen levels in serum of cycling goats measured by enzyme immunoassay. *Small Rumin. Res.*, 6: 95–102.
- Blaszczyk, B., J. Udala and D. Gaczarzewicz, 2004. Changes in estradiol, progesterone, melatonin, prolactin and thyroxin concentrations in blood plasma of goats following induced estrus in and outside the natural breeding season. *Small Rumin. Res.*, 51: 209–219.
- Devendra, C. and M. Burns, 1983. *Goat production in the Tropics*. Commonwealth Agricultural Bureaux, UK.
- Devendra, C., D. Thomas, M. A. Jabbar and E. Zerbini, 2000. *Improvement of Livestock Production in Crop–Animal Systems in Agro-Ecological Zones of South Asia*. International Livestock Research Institute (ILRI), Nairobi, Kenya.
- Ford, M. M., I. R. Young, D. J. Caddy and G. D. Thorburn, 1998. Fetal and maternal endocrine changes approaching parturition in the goat: lack of evidence for prostaglandin E_2 and $F_2\alpha$ as signals for luteolysis. *Biol. Reprod.*, 58: 1065–1070.
- Jindal, S. K., 1984. *Goat Production*. Cosmo Publications, New Delhi, India.
- Kadzere, C. T., C. A. Llewelyn and E. Chivandi, 1997. Plasma progesterone, calcium, magnesium and zinc concentrations from estrous synchronization to weaning in indigenous goats in Zimbabwe. *Small Rumin. Res.*, 24: 21–26.
- Kanuya, N. L., B. M. Kessy, R. Nkya and P. F. Mujuni, 2000. Plasma progesterone concentrations and fertility of indigenous small East African goats bred after treatment with cloprostenol. *Small Rumin. Res.*, 35: 157–161.

- Khadiga, M. G., K. G. Mohamed and F. T. Doaa, 2005. The hormonal profile during the estrous cycle and gestation in Damascus goats. *Small Rumin. Res.*, 57: 85-93.
- Khan, B. B., M. Younas and S. H. Hanjra, 1982. Breeds and types of livestock in Pakistan. Department of Livestock Management, Univ. Agri. Faisalabad, Pakistan.
- Khanum, S. A., M. Hussain, M. Ali, R. Kausar and A. M. Cheema, 2000. Age at puberty in female Dwarf goat kids and estrous cycle length on the basis of hormones. *Pakistan Vet. J.*, 20: 71-76.
- Laura, A. S., M. S. Kumar, G. William and L. A. Sandra, 2004. Predicting the onset of parturition in the goat by determining progesterone levels by enzyme immunoassay. *Small Rumin. Res.*, 52: 203-209.
- Livestock Census, 2006; Ministry of Food, Agriculture and Livestock, Govt. of Pakistan. Islamabad.
- Musaddin, K., H. S. Tan, M. Y. M. Khushry and I. Jasm, 1996. Resumption of postpartum ovarian activity in Malin, Dorset Horn Malin and Long Tail ewes. *Mardi Res. J.*, 24: 31-37.
- Oyeyemi, M. O., O. O. Ajala, O. I. Edike and A. O. Ayorinde, 1997. Effect of cross-breeding on the reproductive performance of West African Dwarf Goat. In: Proc. 34th Annual National Congress, Osogbo, Nigeria, pp: 94-98.
- Ozpinar, A. and A. Firat, 2003. Metabolic profile of pre-pregnancy, pregnancy and early lactation in multiple lambing Sakiz ewes. *Ann. Nutr. Metab.*, 47: 139-143.
- Peaker, M., 1978. Gestation period and litter size in the goat. *British Vet. J.*, 134(4): 379-383.
- Riesenberg, S., S. Meinecke-Tillmann and B. Meinecke, 2001. Estradiol 17- β and progesterone in the peripheral blood plasma of goats following superovulation with a single dose of pFSH, hMG or eCG. *Small Rumin. Res.*, 40: 73-82.
- Zarkawi, M. and A. Soukouti, 2001. Serum progesterone levels using radioimmunoassay during oestrous cycle of indiginous Damascus does. *New Zealand J. Agri. Res.*, 44: 165-169.