Hormonal Profiles during Periparturient Period in Single and Twin Fetus Bearing Goats

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ABSTRACT : The effect of fetal number (single or twin) on plasma concentrations of progesterone, estradiol 17β, cortisol, prolactin, growth hormone, triiodothyronine, thyroxine and insulin around parturition (periparturient period) were studied on ten Alpine × Beetle crossbred goats in their first to third lactation. The hormone profiles were studied on days -20, -15, -10, -5, -4, -3, -2, -1 prior to kidding and on day 0 and +1, +2, +3, +4, +5, +10, +15, +20 days postkidding. Plasma progesterone levels were significantly ($p<0.01$) higher in twin bearing goats comparison to single bearing goats during all the days of sampling. The decline in progesterone concentration from day 20 to day 1 before kidding was 56% in twin and 42% in single bearing goats. In single bearing goats plasma estradiol 17β was significantly ($p<0.01$) higher during prekidding days compared to twin bearing goats. The level of estradiol 17β was highest on the day of kidding in both the groups. The plasma prolactin level in twin bearing goats from day 10 to day 1 prepartum was higher as compared to single fetus bearing goats. However there was abrupt increase in prolactin level on the day of kidding in both the groups. The plasma growth hormone levels were significantly ($p<0.01$) higher in twin compared to single bearing goats. On the day of kidding growth hormone levels were significantly ($p<0.01$) higher in twin as compared to single bearing goats (1.40 vs. 0.95 ng/ml). In twin bearing goats plasma cortisol values from day 5 till the day of kidding remained elevated and the levels on the day of kidding was significantly highest in both the groups. The levels of triiodothyronine (T_3) were significantly higher ($p<0.01$) during all the periods of sampling in single compared to twin bearing goats. Plasma thyroxine (T_4) was significantly ($p<0.01$) lower in twin compared to single bearing goats. In single bearing goats plasma insulin levels were significantly ($p<0.01$) higher than twin bearing goats during prepartum period however during post partum period the levels in both the groups remained similar. It can be concluded that number of fetuses is having significant influence on the hormone profile during periparturient period. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 3 : 346-351)***

Key Words : Hormones, Periparturient Period, Goats

INTRODUCTION

The metabolic and functional changes between conceptions to termination of pregnancy is brought about by the interaction of various hormones. A major amount of mammary development is associated with hormonal stimuli of pregnancy. During prepartum period there is massive development of the mammary gland for lactogenesis and expulsion of fetus at parturition involved a control interaction of different hormones and absence of these stimuli reduces the amount of mammary tissue (Cowie, 1971). The administration of hormones like growth hormone, estrogen, progesterone and prolactin stimulate the growth and development of mammary gland. (Harness and Anderson, 1977a,b). The corpus luteum is the only source of progesterone for the maintenance of pregnancy in goats. Ovariectomy and hypophysectomy at any stage of pregnancy causes abortion (Meites et al., 1951). The presence of more placental tissue in goats due to twinning was related to more placental lactogen secretion to stimulate mammary gland growth (Anderson et al., 1981). An increase number of corpora lutea may contribute more estrogen and progesterone secretion, which leads to stimulation of mammary gland development in goats or sheep bearing twin fetuses. The increased plasma progesterone during pregnancy is due to increase litter size in sheep (Butler et al., 1981). Serum estrone sulfate was found to be positively correlated with number of fetuses in does (Thimonier et al., 1977; Tamanini et al., 1986; Refsal et al., 1991). Maternal serum progesterone concentrations are positively correlated with the number of Copora lutea (Quirke et al., 1979). During the placental phase of pregnancy in goats and sheep progesterone and estradiol (Manalu et al., 1996).

The determination of simultaneous changes in maternal peripheral plasma levels in twin and single fetus bearing goats has not been previously reported for Alpine × Beetal genotype. Consequently, the objective of the study was to determine the influence of number of kids on progesterone, estradiol 17β, cortisol, prolactin, growth hormone, T_3, T_4 and insulin concentrations during the last three weeks of gestation through the first three weeks of lactations.

MATERIALS AND METHODS

Selection and management of animals

Ten cycling, Alpine × Beetal crossbred goats in their first to third lactation with body weight ranging from

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48-61 kg were selected from National Dairy Research Institute goat herd. They were mated and at the end of the gestation period, the does gave birth to normal kids (four single and six twins). The experimental dose were classified in Group-1 (Does carrying single fetus) Group-2 (Does carrying twin fetus).

The gestation length ranged from 145-157 days in different goats. Gestation length was more in goats, which gave birth to single kids (152-157 days) compared to twin births (145-151 days). The birth weight of single kids varied from 3.5 to 5.0 kg and twin kids varied from 2.8-4.0 kg. The experimental goats were kept in goat pen with brick flooring. The experiment was conducted during the spring season (March and April). Fresh green fodder consisted of berseem (Trifolium Alexandrium) and mustard (Brassica campestris) was fed *ad libitum*. The requisite amount of concentrate mixture was fed in the morning and evening which contain 19.5% CP and 72.00% TDN. The animals were provided drinking water *ad libitum*.

Blood sampling and processing

The blood samples were drawn in heparinized vacutainer tubes from jugular vein in the morning time between 08:00 to 09:00 h prior to feeding. The samples were collected on day -20, -15, -10, -5, -4, -3, -2, -1 prior to the day of expected kidding and also on day 0 (day of kidding). After kidding samples were collected on day +1, +2, +3, +4, +5, +10, +15, +20. The samples were immediately centrifuged. Blood plasma was separated and then kept frozen at -20°C for further hormone analysis.

Hormone assays

Plasma progesterone concentration in duplicate was determined by RIA method as per procedure of Kamboj and Prakash (1993). Progesterone antiserum was obtained from the dairy cattle Physiology Division National Dairy Research Institute, Karnal, India. The Inter and intra assay coefficients of variation was 10.5% and 6.5% respectively. The sensitivity of the assay was 4 pg/tube. The plasma estradiol 17β concentration was determined in duplicate by the method of Sigma chemical Co. USA with the antiserum (lot no. 97F 4821) after solvent extraction as per Khan (1998). The sensitivity of the assay was 3 pg/ml. The interassay and intrassaey coefficient of variation were 13.8 and 7.66%, respectively. The plasma cortisol concentration in duplicate were estimated by radioimmuno assay procedure as per Singh and Ludri (1999) using highly specific antiserum for cortisol (lot no. 89 F 4801) from M/s Sigma Chemicals Co. USA. The sensitivity of assay was 5 pg/tube within and between assay variation were 11 and 8.99%. The triiodothyronine (T_3), thyroxine (T_4) and insulin were determined in duplicate by RIA kits. Supplied by Board of Radiation and Isotope Technology (BRIT) Mumbai, India as per Khan (1998). The interassay coefficient of variation for T_3, T_4 and insulin were 8.3, 7.55, 11.11% and intra-assay coefficient of variation were 10.3, 2.5 and 7.35%, respectively. Double antibody radio-immunoassay procedure was used to quantify prolactin and growth hormone concentration in duplicate. For prolactin the method of Malven et al. (1987) was modified and ovine prolactin (OPRL-AFP 10789B) was used for iodination and standard preparation. Labelled Sodium iodine was used for iodination, which was supplied by BRIT Mumbai India. The sensitivity of the assay was 15 pg/tube within assay and between assay variation were 8.33 and 9.37% (n=5) respectively. Growth hormone assay was as described by Singh and Ludri (1994). The antiserum AFPC 0123080 was diluted (1:20,000) in a Phosphate buffer (0.01 MPO_4, PH. 7.00). The ovine growth hormone (OGH- AFP 12855) were obtained from National Hormone and Pituitary program, Bethesda MD USA. The sensitivity of the assay was 12 pg/tube and the between assay and within assay variation were 11.0 and 8.99%, respectively.

Statistical analysis

The statistical analysis of the data was done according to Snedecor and Cochran 1980. The least square analysis using two way ANOVA was carried out for both the groups. The randomised block design was used to find out the significant difference during periparturient period. The means were compared using t-test.

RESULTS

The mean circulatory levels of progesterone, estradiol 17β, prolactin, GH, cortisol, T_3, T_4 and insulin during periparturient period from 20 days prepartum to 20 days post partum in goats bearing twin and single fetuses have been presented in figure 1 to 8 with SD. In twin bearing goats plasma progesterone level was significantly ($p<0.01$) higher in comparison to single bearing goats during all days of sampling. During prepartum period in twin bearing goats the levels declined from 2.82 ng/ml on day 20 to 1.24 ng/ml on day 1 prepartum whereas in single fetus bearing goats the value declined from 2.08 ng/ml on day 20 to 1.16 ng/ml on day 1 prepartum on the day of kidding the values in both the groups were similar (0.62 vs 0.62 ng/ml). However during postpartum period there was no significant difference in the levels of both the groups. In single bearing goats plasma estradiol 17β was significantly ($p<0.01$) higher during prepartum days compared to twin bearing goats. In twin bearing goats the levels of estradiol 17β slowly decline from day 20 prepartum (16.65 pg/ml) to 13.15 pg/ml on day 3 prepartum. Thereafter, the levels increased to 24.86 pg/ml on day 1 prepartum followed by an abrupt increase on the day of kidding (39.10 pg/ml) after

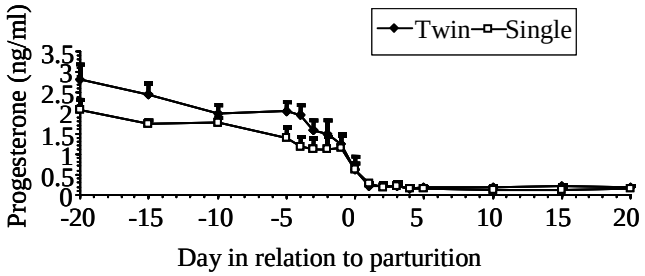

Figure 1. Plasma Progesterone concentration during periparturient period in goats

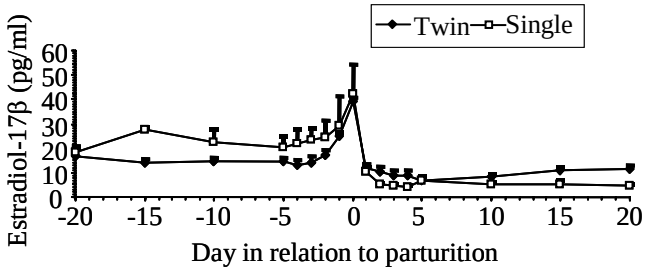

Figure 2. Plasma Estradiol-17β concentration during periparturient period in goats

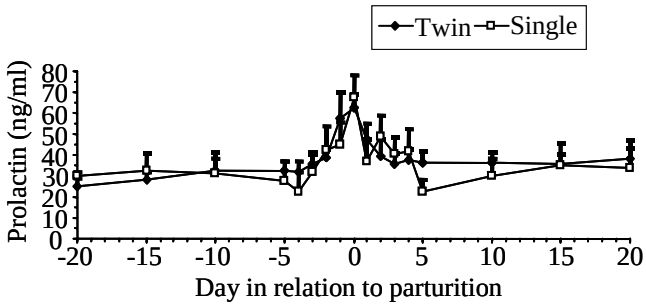

Figure 3. Plasma Prolactin concentration during periparturient period in goats

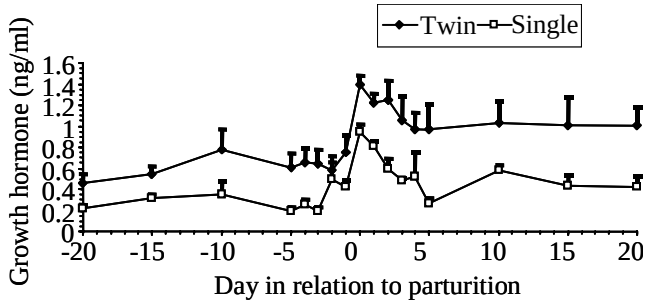

Figure 4. Plasma Growth hormone concentration during periparturient period in goats

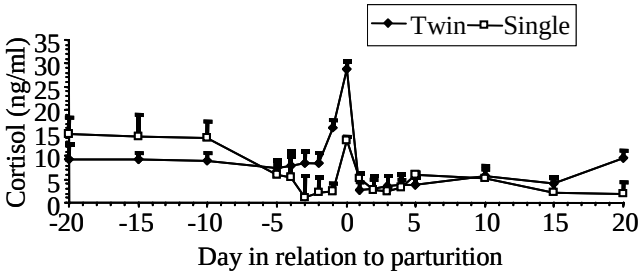

Figure 5. Plasma Cortisol concentration during periparturient period in goats

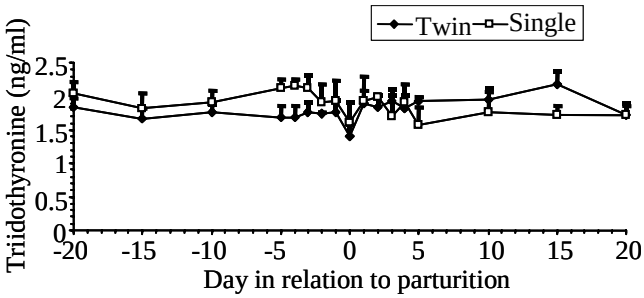

Figure 6. Plasma Triiodothyronine concentration during periparturient period in goats

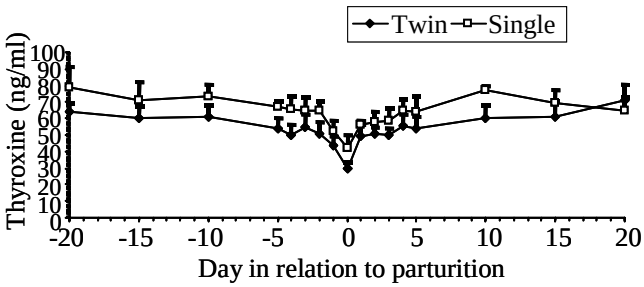

Figure 7. Plasma Thyroxine concentration during periparturient period in goats

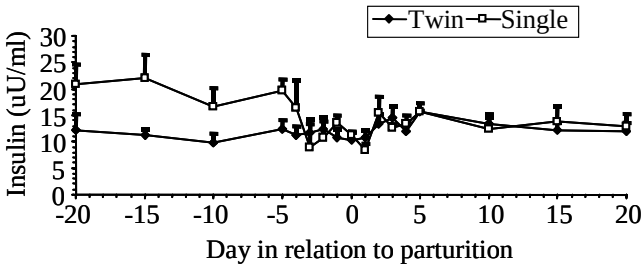

Figure 8. Plasma Insulin concentration during periparturient period in goats

kidding the levels declined to low values of 6.79 to 11.81 pg/ml up to 20 days postpartum. In single bearing goats the increase in estradiol 17β occurred from day 4 (21.79 pg/ml) to day 1 (29.33 pg/ml) prepartum and the peak levels of 42.47 pg/ml on day of kidding, thereafter

declined abruptly on day 1 and 2 postpartum and the remained lower than the prepartum levels.

The plasma prolactin levels in twin bearing goats from day 10 to day 1 prepartum was higher as compared to single fetus bearing goats. However there was abrupt increase in prolactin level on day of kidding in both the groups. Thereafter it declined on day 1 postpartum and remained similar during postpartum period. In twin bearing goats plasma growth hormone levels were significantly ($p<0.01$) higher compared to single bearing goats during all the days of sampling in both pre and post partum period. In twin bearing goats plasma GH levels increased continuously from 0.46 ng/ml on day 20 to 0.75 ng/ml on day 1 prepartum whereas in single bearing goats the levels increased from 0.22 ng/ml to 0.43 ng/ml for the same period. On the day of kidding GH levels were significantly ($p<0.01$) higher in twin as compared to single bearing goats (1.40 vs 0.95 ng/ml). After kidding the levels in both the group declined. In twin bearing goats the levels from day 20 to day 2 prepartum did not decline at a rate observed in single bearing goats. The levels were higher in twin bearing goats compared to single bearing goats during prepartum period. However during postpartum period there was no difference between the two groups. In twin bearing goats plasma cortisol levels from day 20 to day 2 prepartum did not decline at a rate observed for single bearing goats. The difference between days during prepartum and postpartum period was highly significant ($p<0.01$). The values were significantly higher ($p<0.01$) in twin bearing goats compared to single fetus bearing goat. The peak value was observed in both the groups on the day of kidding (28.34 vs 13.48 ng/ml) in twin and single fetus bearing goats). The levels of T_3 were significantly higher ($p<0.01$) during all the periods of sampling in single bearing goats compared to the twin. After kidding the levels in both the groups were almost similar. The plasma T_4 levels were significantly ($p<0.01$) lower in twin bearing goats as compared to single bearing ones. This difference was maintained even in postpartum period up to day 15. In single fetus bearing goats the plasma insulin levels were significantly ($p<0.01$) higher than in twin fetus bearing goats during prepartum period. In postpartum period, however, the levels in the two groups remained similar.

DISCUSSION

The decline in progesterone concentration from day 20 to day 1 before kidding was 56% in twins and 42% in single bearing goats. The progesterone concentration was significantly ($p<0.01$) greater in twin bearing goats than single bearing goats which is in agreement with Irving et al. (1972) and Manalu (1996). This difference was probably due to the number of corpora lutea present as it is the source of progesterone in goats (Meites et al., 1951; Jarell and Dziuk, 1991). Manalu et al. (1996) reported almost twice higher maternal serum progesterone concentration during last two months of gestation period for twins was almost twice as compared to single bearing goats. Progesterone and estradiol are hormones that play critical roles in mammary gland development during pregnancy (Anderson, 1986; Knight and Peaker 1982; Tucker, 1986,1987). The increase fetal number would increase hormonal stimulation for growth and development of mammary gland for preparation of more milk synthesis for the newborn kids. However, Butler et al. (1981), Agarwal et al. (1988), Kaushik et al. (1992) did not find any significant effect of number of fetuses on maternal estradiol and progesterone concentration in sheep and goats.

The plasma estradiol 17β levels were significantly higher in the single bearing than in twin bearing goats. The increase in concentration from day 20 to day 1 prepartum were 49 and 59% in twin and single fetus bearing goats. However, Manalu et al. (1996) reported twice in twin as compare to single bearing goats Dhindra et al. (1981) reported significantly higher estradiol 17β, estradiol 17α and estrone in pregnant goats with multiple fetus compared to single fetus suggested a fetoplacenta is the source of estrogen. The prepartum increase and an abrupt spurt in the level of estradiol 17β on day of parturition is in general agreement with similar observation in goats (Jain et al., 1982; Emanuel et al., 1986; Patel et al., 1992a; Salah, 1994). The increase level on day 1 prepartum is required for uterine contractivity for giving favourable stimulus for oxytocin and triggering prostaglandin release for myometrial contraction Patel et al. (1992b). The estradiol concentration increased with advance of pregnancy approaching parturition (Umo et al., 1976; Rice et al., 1984). The significance of increase estradiol 17β concentration prepartum is probably associated with the preparation of mammary gland to initiate milk secretion by stimulating prolactin secretion (Umo et al., 1976). In the present study also there is increase in prolactin concentration during prepartum period. The prolactin levels around parturition is similar to that already reported in sheep (McNeilly, 1971), cows (Schams and Karg, 1969), goat (Buttle and Forsyth, 1971). The prolactin level in twin were higher compared to single bearing goats. However, the difference was not significant. The growth hormone concentration was higher in twin fetus bearing compared to single fetus bearing goats Forsyth et al. (1985) found low GH concentration during 8-20 weeks pregnancy and more during last week of pregnancy and highest level on the day of parturition, Kornalijnstijper et al. (1997) reported a significant elevation in GH levels. The higher levels in twin fetus bearing goats may be due to lipolytic action of GH enable depot fat to be mobilized for energy for the parturition and initiation of

lactation by increasing the availability of milk precursor to meet increased demand of energy for the initiation of milk secretion.

In twin bearing goats plasma cortisol values from day 5 till the day of kidding remained elevated and the levels on the day of kidding were significantly highest in both the groups. The high levels of cortisol in twin bearing goats during 5 day prepartum are indicative of stress of twin pregnancy on the maternal side but this fact can be confirmed only after cortisol secretion rate in twin and single fetus bearing goats are studied. During the last stage of parturition, there is an increase secretion of ACTH from the fetal pituitary, which stimulates rapid growth of fetal adrenals to rise the levels of cortisol. These elevated levels enter the maternal blood and induce parturition by activating PGF2α and coordinating the endocrine profile of the animal (Adams and Wagner, 1970; Arthur, 1989). After kidding the levels abruptly declined and remained similar in twin and single bearing goats.

The T_3 levels were significantly ($p<0.05$) higher in single fetus bearing goats compared to twine during prepartum period and on the day of kidding. There was decrease in the level on the day of kidding and there after an elevation is indicative of enhanced utilization as a result of increase in metabolism due to stress of parturition as the levels of cortisol in this period increased and not due to its utilization by the mammary tissue alone. The lower concentration of T_4 in twin bearing goats compared to single may be due to decrease secretion rate and not due to transplacental transfer as per Mc Donald et al. (1988). The decrease in T_4 may favour the mammary gland in partitioning of nutrients between mammary and non mammary tissue Madsen (1985). This decrease secretion of T_4 thus decreases the adverse effect of nutrients deficiency in body tissue at the onset of lactation. Single bearing goats had higher levels of insulin presumably because in these goats the partitioning of nutrients towards body weight gain was more compared to twin bearing goats as in these animal the gain in weight was significant. Around kidding the decline in level is an effort to mobilize nutrients from depot fat for milk synthesis which is an essential process for initiation of lactation. Since there is no data available in literature on the levels of T_3, T_4 and insulin in twin and single fetus bearing goats hence it was difficult to compare our results. It was concluded that twin fetus bearing goats had higher plasma progesterone, GH, prolactin and cortisol levels compared to single fetus bearing goats. The fluctuation in the levels of these hormones (Progesterone cortisol, prolactin, growth hormone) during periparturient period may have influence on hormonal stimulation for mammary gland growth, development and the act of kidding with the increase number of fetuses in preparation of more milk synthesis and secretion. The number of fetuses is having significant influence on the hormonal profiles during periparturient period.

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