# Plasma Prolactin, Blood Metabolites and Yield and Composition of Milk during Early Lactation in Goats Following Administration of Bromocryptine

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**ABSTRACT :** Six crossbred goats in their 2nd or 3rd lactation, were administered bromocryptine at 5 mg/day during early lactation of 15-20 days (period I) and thereafter again at an interval of 13 days, bromocryptine was given for 5 days (period II). Blood samples were collected before (-5, -4, -3, -2, -1) during (1, 2, 3, 4, 5) and after (+1, +2, +3, +4, +5) administration of bromocryptine in both the periods of study. In period I, administration of bromocryptine resulted in a decrease in milk yield to the extent of 16..8% in comparison to before treatment, and 28.5% after the cessation of treatment. The glucose content of blood increased ($p<0.01$) as the milk yield decreased without any change in NEFA concentration. During period II of bromocryptine treatment the milk yields did not change in spite of a decline in prolactin level, perhaps the effect of previous treatment was prolonged. A decline in protein and lactose content of milk after bromocryptine treatment in both the periods of study, when prolactin level also declined suggests a role of prolactin in protein synthesis and also a depressing effect on lactose synthesis. (*Asian-Aus. J. Anim. Sci. 1999. Vol. 12, No. 4 : 585-589*)

**Key Words :** Prolactin, Blood Metabolites, Milk Yield and Composition, Bromocryptine, Early Lactation, Goats

## INTRODUCTION

Administration of bromocryptine around parturition decreases prolactin level and delays lactogenesis in cattle, sheep and goats (Schams et al., 1972; Hart, 1973; Davis et al., 1983; Johke, 1986; Gobai et al., 1992; Buys et al., 1985; Knight et al., 1995). In cattle, administration of bromocryptine during mid-lactation suppresses plasma prolactin level with a simultaneous non-significant decline in milk yield (Karg et al., 1972). In sheep also, bromocryptine treatment reduces milk production but has no additional effects during drying off (Buys et al., 1995). Similar reports for goats relate only mid-and late-lactation (Gabai et al., 1992; Forsyth and Lee, 1993). The present study was therefore undertaken to determine the influence of bromocryptine administration on the circulatory level of prolactin and its subsequent effect on quality and quantity of milk, if any, in early lactation. Since blood glucose and non esterified fatty acids (NEFA) are important energy yielding substrates where availability is closely linked to milk production, their levels were also studied.

## MATERIALS AND METHODS

### Selection and management of animals

Six crossbred goats in their 2nd or 3rd lactation immediately after parturition were selected from the Institute's goat herd and were fed on a ration containing green fodder and concentrate mixture. The green fodder consisted of a mixture of mustard (*Brassica compestris*) and barseem (*Trifolium alexandrinum*) which was fed *ad lib* whereas the amount of concentrate mixture having 20% CP and 70% TDN was based on milk production (at 400 g per kg milk) as practiced in the Institute's goat herd. All the goats were hand milked twice daily during morning and evening and the quantity of milk from individual goats was recorded.

### Bromocryptine treatment and collection of samples

2-bromo-alpha-ergocryptine, a dopamine D2 receptor agonist (M/S Sigma Chemical Co., USA) was dissolved in alcohol and saline solution (40:60). Each goat was injected 1 ml (5 mg) of this solution intramuscularly in the gluteal region at 8:00 AM for 5 consecutive days between 15 and 20 days of lactation (period I). Thirteen days later, bromocryptine was again administered for 5 days (period II).

### Sampling of blood and milk

At 8:00 A.M. jugular blood samples were collected in heparinized vacutainer tubes daily for 5 consecutive days before (-5, -4, -3, -2, -1) during (1, 2, 3, 4, 5) and after (+1, +2, +3, +4, +5) bromocryptine treatment in both the periods of study. Blood samples were centrifuged to separate out plasma and stored frozen till analysis. For glucose estimation blood samples were collected in separate tubes containing sodium fluoride. Morning and evening milk samples from individual goats were pooled in proportion to yields.

### Analytical methods

In milk samples, fat was determined volumetrically by Gerber's method (I.S.I., 1958), protein by the formaldehyde titration (Singhal and Des Raj, 1989) and lactose by the picric acid method (Perry and Doon, 1950). Blood glucose was estimated by the method of Nelson and Somogyi as described by Oser (1965), and NEFA in plasma by the extraction STET (Chloroform: haptane:methanol, 49:49:2) of Shipe et al. (1980).

### Hormone assay

Plasma prolactin was estimated by a modified RIA method of Malven et al. (1987) using ovine prolactin. The iodination of prolactin was done with carrier free iodine Na125 supplied by BRIT, Mumbai (India) and the elution's were collected after passing through

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Received April 21, 1998; Accepted October 21, 1998

sephadex G-75. The first peak of labeled hormone was used for RIA of prolactin. All the reagents were added to RIA tubes at a single sitting in sequence of (a) buffer (b) standards (0.10 to 50 ng/ml) or unknown samples (c) radio-iodinated prolactin tracer (15,000 cpm) and (d) antiserum 1:600,000). The tubes were vortexed and incubated at room temperature for 24 h followed by addition of second antibody GAARG (1:200) and normal rabbit serum. The contents were vortexed and the reaction was stopped using 6% polyethylene glycol. The radioactivity was measured in dried tubes in a cobra II gamma counter. The inter-assay and intra-assay coefficients of variation were 8.7 and 5.5% respectively. The sensitivity of the assay was 10 pg/tube.

**Statistical analysis**

Two way analysis of variance of data was done according to Snedecor and Cochran (1980). For significant differences, averages were compared by Duncan's Multiple Range Test.

## RESULTS

The patterns of change in milk yield and plasma prolactin in individual goats are presented in figures 1 and 2 to show the day to day variations in prolactin levels and subsequent effects on milk production in individual goats.

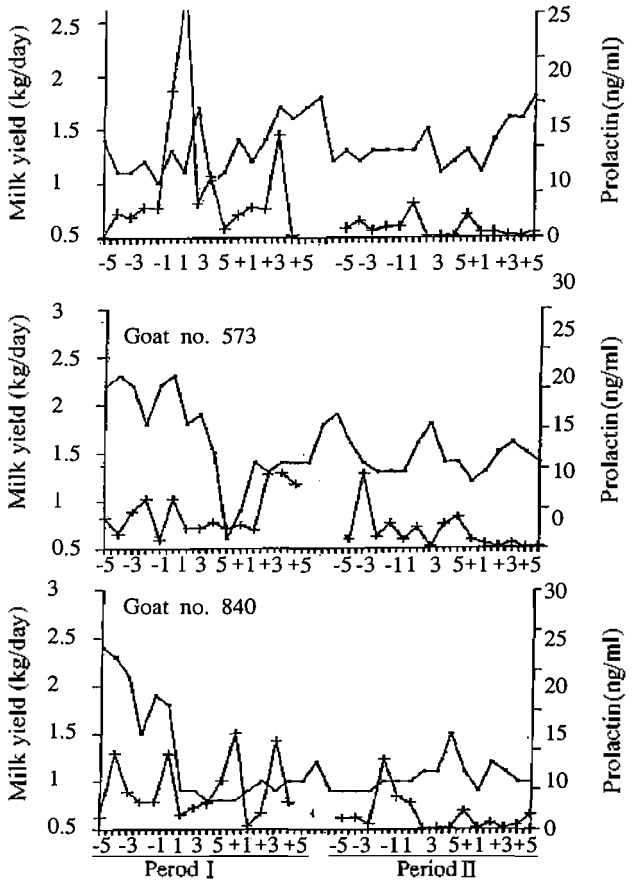


**Figure 1.** Milk yield ( • ——— • ) and prolactin (+———+) concentration during early lactation

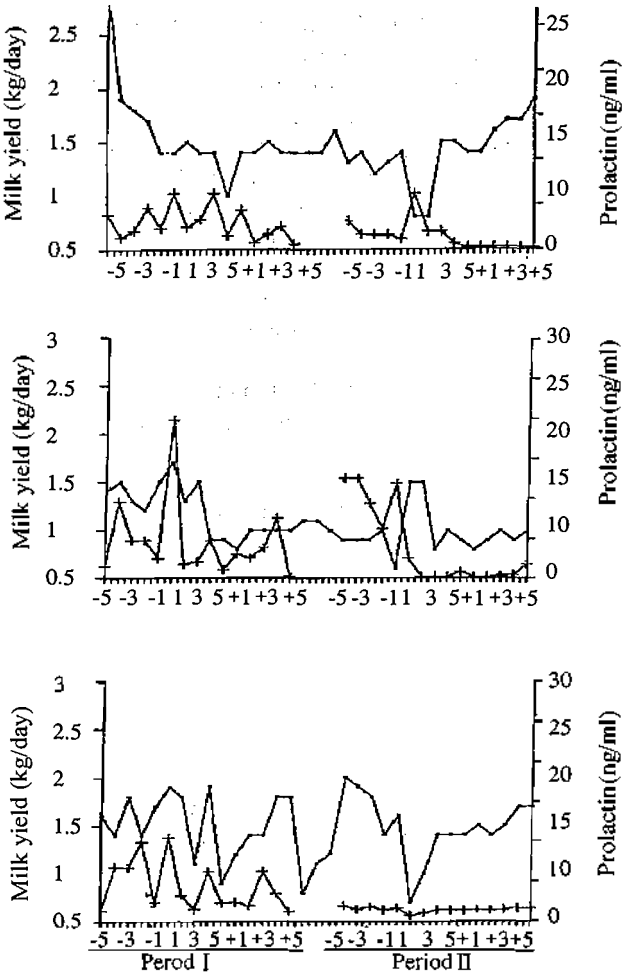


**Figure 2.** Milk yield ( • ——— • ) and prolactin (+———+) concentration during early lactation

The average values for plasma prolactin, milk yield, milk composition, blood glucose and NEFA are presented in tables 1 and 2 respectively. In period I, the effect of bromocryptine treatment on plasma prolactin varied which reflected to wide variation in day to day values. The bromocryptine administration decreased plasma prolactin from day 3 of treatment during both periods of study, but in period II, the effect of bromocryptine administration on plasma prolactin continued even after the cessation of treatment. Since the milking stimulus effect on prolactin release could not be controlled in these studies, the levels of prolactin could not reach a minimum value, and day to day and between animals differences existed. As a result of bromocryptine treatment during period I, milk yield started declining at a slow rate during the treatment period after day 1 onwards. The effect of bromocryptine treatment continued even after the cessation of treatment. As compared to pre-treatment values (1.70 kg), milk yield during (1.49 kg) and after (1.28 kg) bromocryptine administration decreased significantly ($p<0.01$) by 16.8 and 28.5%, respectively. During period II, milk yields

continued to be low before the start of treatment, perhaps because the effect of first bromocryptine treatment was prolonged. The values before administration were already low and were not further affected as a result of bromocryptine treatment in period II. Though the response of all the goats was not similar, in the majority of them a depression in milk yield during bromocryptine treatment can be seen. Due to great variation in fat content of milk on different days of sampling, no effect of bromocryptine treatment on milk fat content was evident. However, protein percent in milk decreased, the values being 3.18 (before), 2.85 (during) and 2.62% (after) during period I. These declines during and after bromocryptine treatment were 10.4 and 17.6%. The pattern of decrease in protein content was similar to the decline in milk yield. During period II also, bromocryptine treatment decreased protein content significantly ($p<0.01$) from 2.98 to 2.83 and 2.85% during and after bromocryptine administration. These declines on a percent basis were 5.0 and 4.4. The lactose content of milk in period I decreased by 10.7% during and 14.9% after bromocryptine treatment, but during period II, these declines were 2.5 and 5.4% only. Glucose content of blood increased ($p<0.01$) as the milk yields decreased during period I. But in period II, the glucose level did not increase significantly. NEFA concentrations did not exhibit any distinct trend in relation to bromocryptine treatment.

**Table 1.** Average plasma prolactin, daily yield, fat, protein and lactose content of milk in periods I and II of early lactation before, during and after bromocryptine administration

| Period | Before | | | | | Average |
|---|---|---|---|---|---|---|
| | -5 | -4 | -3 | -2 | -1 | |
| | | | Milk Yield (kg) | | | |
| Pd. I | 1.92±0.21 | 1.88±0.23 | 1.80±0.20 | 1.53±0.15 | 1.82±0.23 | 1.79[a] |
| Pd. II | 1.33±0.17 | 1.28±0.15 | 1.23±0.14 | 1.22±0.07 | 1.20±0.14 | 1.25 |
| | | | Fat (%) | | | |
| Pd. I | 5.13±0.16 | 5.35±0.37 | 4.05±0.31 | 3.87±0.11 | 5.16±0.28 | 4.71[a] |
| Pd. II | 4.60±0.10 | 4.57±0.28 | 4.13±0.11 | 4.52±0.13 | 4.38±0.24 | 4.44[a] |
| | | | Protein (%) | | | |
| Pd. I | 3.32±0.22 | 3.04±0.12 | 3.11±0.15 | 3.25±0.15 | 3.20±0.15 | 3.18[a] |
| Pd. II | 2.81±0.07 | 3.06±0.11 | 3.06±0.09 | 3.29±0.06 | 2.66±0.10 | 2.98[a] |
| | | | Lactose (%) | | | |
| Pd. I | 5.67±0.21 | 5.70±0.15 | 5.70±0.25 | 5.78±0.08 | 5.65±0.25 | 5.70[a] |
| Pd. II | 5.15±0.07 | 4.58±0.27 | 4.60±0.20 | 4.52±0.20 | 4.43±0.08 | 4.66[a] |
| Period | During | | | | | Average |
| | 1 | 2 | 3 | 4 | 5 | |
| | | | Milk Yield (kg) | | | |
| Pd. I | 1.87±0.15 | 1.62±0.28 | 1.50±0.17 | 1.32±0.20 | 1.13±0.12 | 1.49[b] |
| Pd. II | 1.15±0.15 | 1.28±0.15 | 1.22±0.11 | 1.33±0.08 | 1.22±0.08 | 1.24 |
| | | | Fat (%) | | | |
| Pd. I | 3.92±0.30 | 4.25±0.21 | 4.50±0.26 | 4.33±0.17 | 4.17±0.05 | 4.23[b] |
| Pd. II | 4.53±0.16 | 4.92±0.18 | 4.58±0.22 | 4.75±0.20 | 4.72±0.26 | 4.70[b] |
| | | | Protein (%) | | | |
| Pd. I | 3.31±0.15 | 2.71±0.21 | 2.83±0.14 | 2.86±0.19 | 2.57±0.19 | 2.85[b] |
| Pd. II | 2.87±0.10 | 2.82±0.09 | 2.96±0.06 | 2.79±0.10 | 2.69±0.08 | 2.83[b] |
| | | | Lactose (%) | | | |
| Pd. I | 5.45±0.25 | 5.15±0.20 | 5.07±0.33 | 5.37±0.23 | 4.40±0.13 | 5.09[b] |
| Pd. II | 4.65±0.14 | 4.44±0.11 | 4.58±0.09 | 4.57±0.06 | 4.39±0.06 | 4.53[ab] |
| Period | After | | | | | Average |
| | +1 | +2 | +3 | +4 | +5 | |
| | | | Milk Yield (kg) | | | |
| Pd. I | 1.17±0.11 | 1.22±0.09 | 1.27±0.09 | 1.37±0.15 | 1.37±0.13 | 1.28[c] |
| Pd. II | 1.17±0.11 | 1.33±0.10 | 1.42±0.12 | 1.40±0.15 | 1.47±0.16 | 1.36 |
| | | | Fat (%) | | | |
| Pd. I | 5.02±0.14 | 5.35±0.21 | 4.75±0.20 | 5.08±0.22 | 4.78±0.27 | 5.00[c] |
| Pd. II | 4.83±0.25 | 4.67±0.22 | 4.85±0.22 | 4.30±0.09 | 4.05±0.19 | 4.54[ab] |
| | | | Protein (%) | | | |
| Pd. I | 2.32±0.11 | 2.72±0.02 | 2.83±0.09 | 2.55±0.12 | 2.68±0.16 | 2.62[c] |
| Pd. II | 2.82±0.11 | 2.78±0.07 | 2.80±0.12 | 3.01±0.08 | 2.86±0.08 | 2.85[b] |
| | | | Lactose (%) | | | |
| Pd. I | 4.48±0.18 | 4.52±0.19 | 4.92±0.23 | 5.18±0.20 | 5.18±0.19 | 4.85[c] |
| Pd. II | 4.39±0.04 | 4.28±0.11 | 4.17±0.16 | 4.60±0.07 | 4.63±0.12 | 4.41[b] |

Values with different superscripts in a line differ significantly ($p<0.01$).

**Table 2.** Average daily blood glucose and plasma NEFA concentration in periods I and II of early lactation before, during and after bromocryptine administration

| Period | Before | | | | | Average |
|---|---|---|---|---|---|---|
| | -5 | -4 | -3 | -2 | -1 | |
| | Blood Glucose (mg %) | | | | | |
| Pd. I | 54.21±2.20 | 53.57±2.19 | 59.02±2.48 | 52.12±3.63 | 55.18±2.97 | 54.82[a] |
| Pd. II | 44.11±2.77 | 48.30±0.99 | 51.49±2.03 | 48.89±2.08 | 51.24±1.28 | 48.80[a] |
| | NEFA (mM/L) | | | | | |
| Pd. I | 0.48±0.10 | 0.34±0.08 | 0.44±0.11 | 0.40±0.11 | 0.84±0.21 | 0.51[a] |
| Pd. II | 0.72±0.11 | 0.44±0.13 | 0.27±0.06 | 0.43±0.11 | 0.22±0.04 | 0.42[a] |
| Period | During | | | | | Average |
| | 1 | 2 | 3 | 4 | 5 | |
| | Blood Glucose (mg %) | | | | | |
| Pd. I | 55.37±2.42 | 56.36±0.82 | 55.22±3.56 | 59.45±2.00 | 54.60±1.60 | 56.20[a] |
| Pd. II | 44.28±3.04 | 31.54±0.95 | 49.67±2.28 | 55.61±1.59 | 51.54±0.81 | 46.53[b] |
| | NEFA (mM/L) | | | | | |
| Pd. I | 0.72±0.25 | 1.23±0.20 | 1.09±0.32 | 1.37±0.26 | 0.76±0.19 | 1.04[b] |
| Pd. II | 0.39±0.06 | 0.09±0.02 | 0.17±0.04 | 0.08±0.02 | 0.15±0.04 | 0.18[b] |
| Period | After | | | | | Average |
| | +1 | +2 | +3 | +4 | +5 | |
| | Blood Glucose (mg %) | | | | | |
| Pd. I | 67.50±0.85 | 62.72±2.08 | 59.73±0.83 | 56.79±0.74 | 57.00±2.00 | 60.75[b] |
| Pd. II | 59.28±1.73 | 56.63±1.02 | 55.23±2.05 | 51.86±2.19 | 52.85±1.98 | 55.17[c] |
| | NEFA (mM/L) | | | | | |
| Pd. I | 0.66±0.29 | 0.66±0.19 | 0.49±0.12 | 0.93±0.13 | 0.35±0.08 | 0.62[c] |
| Pd. II | 0.20±0.05 | 0.17±0.05 | 0.13±0.04 | 0.26±0.08 | 0.22±0.05 | 0.19[b] |

Values with different superscripts in a line differ significantly ($p<0.01$).

## DISCUSSION

The results of the present study indicate that in early lactation bromocryptine suppressed milk yield at a slow rate in the begining and the effect continued even after the withdrawal of bromocryptine. Further administration of bromocryptine did not significantly decrease yields. A simultaneous decline in prolactin during bromocryptine treatment, and thereafter also during period I suggest that prolactin plays a role in the maintenance of milk secretion in early lactation. During period II, though the levels of prolactin further declined after bromocryptine administration, the yields remained unchanged. This suggests that prolactin's role in the maintenance of lactation is limited and some other hormones may play the major role for maintaining the yields (Hart, 1973). A number of studies have indicated no role of prolactin during established lactation in ruminants. In cattle, administration of bromocryptine reduces plasma prolactin concentration but milk yields are not significantly affected (Karg et al., 1972; Smith et al., 1974; Beck et al., 1979). In goats, Hart (1973) reported a reduction in plasma prolactin but milk yields were not affected in bromocryptine treated goats. However, Forsyth and Lee (1993) reported that compared with a week before treatment milk yield reduced significantly ($p<0.03$) in the week of bromocryptine treatment and in the following week, and then began to recover. Knight (1993) also found that prolactin depletion does reduce milk yield significantly and consistently by 10-20% as observed in this study. When bromocryptine treated goats were injected simultaneously with sufficient ovine prolactin (12 mg/d) to maintain serum prolactin, milk yields were not affected. Thus prolactin replacement prevented the deleterious effect of bromocryptine, but an identical dose of porlactin in the absence of bromocryptine treatment did not increase milk yield. In the bromocryptine treated goats small amount of prolactin in blood is probably galactopoietic and may play a crucial role in the maintenance of lactation (Hart, 1974). When lactating goats rendered growth hormone deficient by immunization against growth hormone releasing factor and then administered bromocryptine for 2 days to lower plasma prolactin concentration showed depressed milk yield in response to bromocryptine but only by a modest amount; the reduction was no greater in growth hormone deficient goats than in controls (Knight et al., 1995) thereby suggesting that majority of support for milk synthesis comes from a source other than growth hormone or prolactin. It is also possible that there is prolactin variation not yet identified and which is unaffected by bromocryptine treatment, or perhaps the mammary secretory cells may produce their own prolactin to maintain milk secretion (Knight, 1993). Though in the present study the fat content of milk was not affected by bromocryptine, a significant decrease in protein content of milk occurred which clearly indicated effects of prolactin suppression for the synthesis and secretion of protein. A concomitant decline in lactose content occurred even when the glucose level did not change. The depression of prolactin was perhaps responsible for a reduction in alpha-lactalbumin synthesis, which decreased the lactose content of milk. Non-Esterified Fatty Acid as an energy yielding substrate

showed no relation to milk synthesis.

## CONCLUSIONS

In early lactation in the goat bromocryptine treatment decreases the yield and composition of milk significantly. A simultaneous decline in prolactin levels after bromocryptine administration suggests that prolactin is required for lactogenesis in early lactation in goats. Further, a decrease protein and lactose content of milk concomitant with the decline in prolactin indicates a possible role of prolactin in the synthesis of protein and lactose by the mammary gland.

## ACKNOWLEDGEMENTS

The author are grateful to the Director, National Dairy Research Institute, Karnal for providing necessary research facilities to conduct the study. Thanks are also due to Dr. Philip J. Smith, National Hormone and Pituritary program for providing gift of ovine prolactin hormone and its antiserum.

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