

CIRCADIAN RHYTHM OF PLASMA CORTISOL AND BLOOD GLUCOSE IN GOATS

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Introduction

Although plasma concentration of glucocorticoids have a distinct circadian rhythm in most mammals, reports on ruminants are conflicting (Basset, 1974; Fulkerson and Tang, 1979; Murayama et al., 1986). Accordingly, we monitored changes in plasma cortisol and blood glucose levels in goats during twenty-four hours.

Materials and Methods

Eight non-lactating unoestrous female goats weighing around 40 kg were housed individually in metabolism cages with the lights turned on between 7.30 and 17.30. Daily feeding included hay at 7.30 and 14.30, and grain mixture at 10.30 with water given *ad libitum*.

Each goat was tested twice at a one week interval and the results were averaged. Blood samples were taken from a jugular vein through an indwelling catheter into prechilled EDTA-tubes. Sampling intervals were 30 min during the day and 2 hours at night. The goats were well adapted to the experimental conditions and seemed undisturbed by blood sampling. Plasma cortisol was analyzed using protein-binding radioassay (Novacenko et al., 1980) and blood glucose enzymatically (Werner et al., 1970). All data are given as mean \pm SEM with differences between various time periods analyzed using paired t-tests.

Results

Plasma cortisol concentrations during the twenty-four hours period varied between 5 ± 1 and 31 ± 9 ng/ml (figure 1). Mean values did not differ significantly between light and dark periods, but fluctuated much more during the daytime. Feeding hay either in the morning or afternoon increased plasma cortisol significantly within 60 min. On the other hand, changes after feeding grain mixture were not statistically significant.

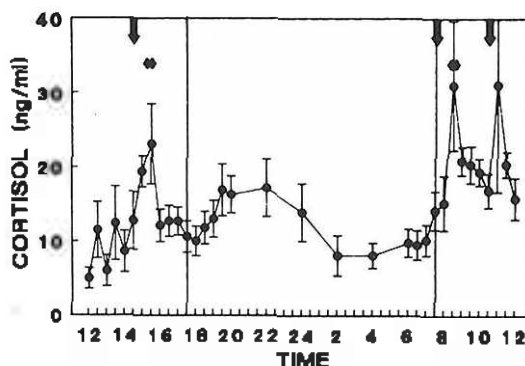


Figure 1. Plasma cortisol concentration of 8 goats during 24 hours. Data is given as mean \pm SEM. Arrows show feeding times and vertical lines the beginning and the end of dark period.

* $p < .05$ when compared to prefeeding level.

Although blood glucose concentration was stable most of the time (2.5 mmol/l), it was decreased by morning feeding of hay to 2.0 ± 0.1 mmol/l after which prefeeding levels were restored within 2½ hours.

Discussion

Glucocorticoids are secreted in abrupt bursts causing wide fluctuations in plasma levels. And since, many external factors stimulate secretion, it is not surprising that results of studies on circadian rhythms have been inconsistent. In sheep, cortisol has been reported to have no circadian rhythm (Basset, 1974), increased at night (Fulkerson and Tang, 1979), and influenced by feeding (e.g. Murayama et al., 1986). But experimental conditions (e.g. feeding pattern, sampling technique, lighting conditions, etc) in these studies have been highly variable. Like Murayama and coworkers (1986) we found plasma cortisol changes associated with feeding, but in goats plasma cortisol

peaked both after morning and afternoon feeding, while in sheep Murayama and coworkers (1986) observed the highest values just before morning feeding. They considered the rise to be an anticipatory response. However, feeding times were different: their feeding was at 10.00 o'clock, whereas our goats were fed at 7.30. Thus, after the light period started their sheep had to wait, while our goats were fed immediately, which could in part explain the different results.

An overall stability of blood glucose in non-lactating goats was expected, because blood glucose in ruminants instead of being directly absorbed from the gut is mainly derived by gluconeogenesis. Only morning feeding caused a sharp drop in glucose level. Basset (1974) has observed in sheep a slow cycle between feedings. After a slight initial decrease, blood glucose slowly rose and then returned to prefeeding levels.

Our results suggest that feeding is the most important factor influencing cortisol circadian rhythms in goats.

(Key Words: Cortisol, Glucose, Circadian Rhythm)

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