

Effect of Milking and Ambient Temperature on Thyrotropin Concentration in Serum of Cattle¹ (40484)

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Thyrotropin releasing hormone (TRH) causes release of prolactin (PRL) as well as thyrotropin (TSH) in cattle (1, 2), and therefore may participate in the control of secretion of both hormones. Stimuli which increase PRL concentrations in serum of cattle include milking (3) and increased ambient temperature (4). If these stimuli cause release of PRL through increased release of TRH, then TSH should also increase.

TSH and PRL are increased in serum of rats during suckling (5, 6), but only PRL increases in serum of women during nursing (7, 8). In rats, exposure to cold causes an initial increase in serum PRL and TSH (9) followed within 1-2 hr by a decrease in PRL concentrations to values less than those observed pretreatment (10). The initial acute increase in PRL (9) may have been due to stress of handling. Cold increased TSH concentration in serum of humans (11).

Objectives of these experiments were to determine the effects of milking and change in ambient temperature on serum TSH concentrations in cattle and to determine if changes of serum TSH and PRL concentrations occur concurrently.

Methods and materials. To test effects of milking on TSH release, five Holstein cows, lactating 1-13 days postpartum, were used. These cows were milked with a milking machine for 6-8 min between 1600 and 1700 hr; ambient temperature was 28°. The milking machine motor was turned on 3 hr before milking to let the cows adapt to the sound. Udders were washed for 15 sec beginning 30 sec before milking. Blood was collected via cannulae from a jugular vein of each cow at -30, -15, 0, 2, 4, 6, 8, 10, 15, 20, 25, 30, 45,

60 and 90 min relative to the start of milking.

As part of another experiment (4), blood was collected twice weekly via venipuncture from a jugular vein of ten Holstein heifers (3.0-6.5 months of age at the start of experiment) at 1300 hr from November 11, 1977 to March 9, 1978. From among these samples we selected those collected on 8 days. Days selected represent the extremes of successive temperature fluctuations greater than 10°. Heifers were housed in an unheated barn with cool-white fluorescent lighting between 0600 and 2200 hr (16L:8D). Artificial lighting was used to minimize seasonal photoperiod effects. Ambient temperature within the barn was measured immediately after blood was collected.

TSH and PRL were quantified in serum with specific radioimmunoassays (2, 12) and thyroxine was assayed by sponge resin procedures² described previously (13). Analyses of variance were as described by Gill and Hafs (14) for repeat measures on individual animals. In addition, simple within animal correlations were computed in the second study to determine whether change in serum concentrations of TSH and PRL occur concurrently in individual animals.

Results. Milking increased ($P < 0.001$) PRL concentration in serum 10-fold within 6 min after onset (Fig. 1). In contrast, milking did not change TSH, which averaged 7.1 ng/ml throughout (Fig. 1).

Changes in TSH, PRL and thyroxine concentrations in serum of these cows with change in ambient temperature are depicted in Fig. 2. PRL data are a portion of those which have been reported previously (4) and are included here for comparison purposes. Serum PRL concentration for the 8 days selected were positively correlated ($r = 0.36$;

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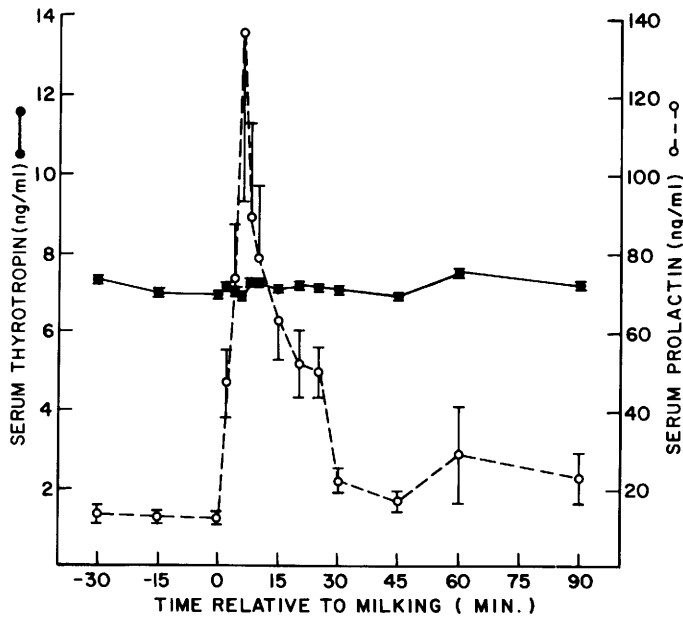


FIG. 1. Serum thyrotropin and prolactin concentrations after milking of five lactating cows. Cows were milked for 6-8 min. Values represent means \pm SE.

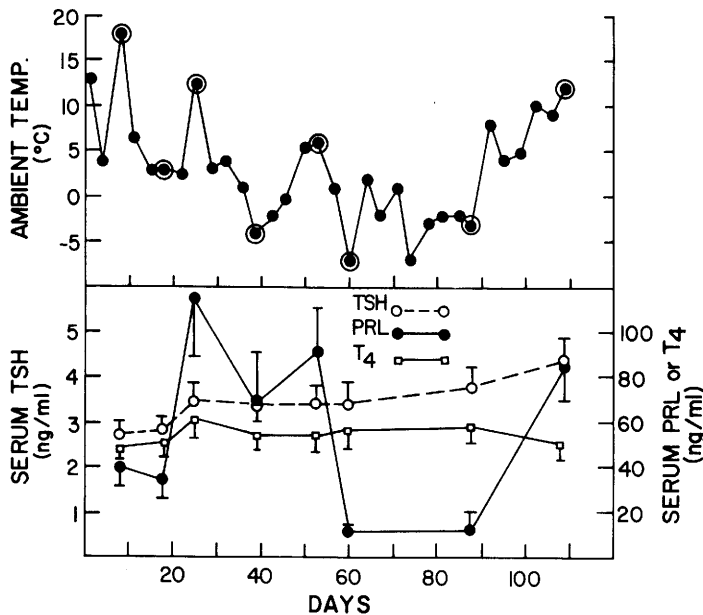


FIG. 2. Serum TSH, PRL and thyroxine (T_4) concentrations in ten heifers from November 11 to February 28. Ambient temperatures at 1300 hr are also presented; those circled correspond to days selected for serum hormone analyses. Hormone values represent means \pm SE.

$P < 0.005$) with temperature, whereas TSH ($r = 0.04$; $P > 0.5$) and thyroxine ($r = 0.12$; $P > 0.2$) were not, despite a 25° range in ambient temperature. On the other hand,

serum concentrations of TSH and PRL were correlated ($r = 0.28$; $P < 0.05$), whereas serum concentrations of TSH and thyroxine were not ($r = 0.02$; $P > 0.05$).

Discussion. TRH may regulate PRL as well as TSH release. Supporting evidence includes equipotency of TRH to cause both TSH and PRL release from bovine pituitary cells in culture (15) and a concurrent increase in TSH and PRL concentrations in serum after suckling (5, 6) or a decrease in temperature (9) in rats. Unfortunately, in the latter study (9) it is not obvious whether cold or stress of handling caused the increased PRL release.

In the present studies, milking or changing temperature altered serum PRL concentrations in cattle without a concurrent change in TSH. Similarly, nursing caused PRL, but not TSH, release in women (7, 8). Whereas serum TSH concentrations were not significantly correlated with ambient temperatures, they were correlated with serum PRL concentrations. Although this within animal correlation between serum TSH and PRL concentrations was small, it may suggest a common control for these two hormones. One interpretation of these results is that TRH participates in regulation of basal TSH and PRL secretion, but does not cause acute changes in PRL caused by stimuli such as milking or temperature changes. This hypothesis is supported by studies in which TRH antiserum reduced basal PRL concentrations in serum of rats (16) but did not reduce the initial increase in PRL that occurs shortly after rats are placed in a cold environment (17).

Our results indicate that neither TSH nor thyroxine concentrations in serum of cattle were altered by temperature changes. Others (18) have also observed no significant correlation between temperature and thyroxine concentration in cattle. Our inability to detect a significant correlation between TSH and temperature may indicate that: (a) temperature change may affect the hypothalamo-hypophyseal-thyroid axis less in cattle than in other species; (b) TSH concentrations may change only briefly after a temperature change or; (c) TSH release may be episodic (19) and temperature induced changes in frequency or amplitude may not have been detected by our limited sampling.

Thyroid hormones are galactopoietic in cattle (20, 21). However, it is unlikely that their action is dependent on the milking stimulus since TSH did not increase after milking.

Summary. Neither milking nor changes in ambient temperature affected TSH concentrations in serum of cattle. On the other hand, serum PRL concentration increased 10-fold after milking and was positively correlated with ambient temperature. These results do not support the premise that endogenous TRH releases both TSH and PRL in cattle.

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