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THE RECTAL TEMPERATURE AND SERUM LUTEINIZING HORMONE CONCENTRATION OF HEIFERS DURING ESTRUS[1]

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ABSTRACT

Kwok-Yuen F. Pau and W. Chia-Mo Wan (1975). *The Rectal Temperature and Serum Luteinizing Hormone Concentration of Heifers During Estrus.* Bull. Inst. Zool., Academia Sinica 14(2): 55-59. Holstein heifers were examined for rectal temperatures (RT) to correlate with serum luteinizing hormone (LH) during estrus.

In ten selected heifers, three demonstrated four successive estrous cycles. The rise in RT corresponded to the LH peak in the blood. Not like in human, the RT dropped to the original level one day after estrus. The RT was not influenced by either the ambient temperature or the relative humidity.

It is known that an elevation of basal body temperature indicates the possibility of ovulation in human, and it has been reported that the LH surge in blood can be found on the day of basal body temperature elevation[6]. The present study intends to apply similar techniques to domestic animals by correlating the rectal temperatures with serum LH variations in heifers in order to find a guideline for more successful artifical insemination in cattle production.

MATERIALS AND METHODS

Ten Holstein heifers selected from the imported herd were utilized for the present investigation. The heifers were transported from Iowa, US, and kept in Young-Mei Branch Station, Taiwan Provincial Livestock Research Institute (YM-PLRI) since February 1973. The investigation started in December 1973 for 3 months. During that time the animals were under careful management and observation in the stalls. The feedings given included roughage *ad lib.*, and PLRI formulated maintenance ration[12] twice daily (at 8.00 to 10.00 and 16.00 to 18.00 hours) with a total of 3 kg/head/day.

Ambient temperature (AT), relative humidity (RH) of YM-PLRI and rectal temperature (RT)

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of the animals were recorded by thermometer, wet-dry bulb humidity recorder and rectal thermometer respectively. The RT for the heifers were taken every morning before feeding.

The serum samples were obtained from blood of the jugular vein and stored in the deep freezer (−20°C) till the time for bovine LH radioimmunoassay (RIA). Blood samples were taken twice a day during the estrus with RT as a reference. On other occasions, the blood samples were obtained in a 3-4 day intervals.

The RIA on serum samples was carried out by a modification of double antibody method[5]. NIH-LH-B_7 served as a reference material. The rabbit anti-bovine LH antiserum was prepared in this laboratory by using the same material as reported previously[13]. The goat antirabbit gamma globulin was purchased from Calbiochem AG (Lucerne, Switzerland). Radioiodination was performed by a modification of the method described by the Michigan group (personal communication with Dr. A. R. Midgley Jr.).

RESULTS

As shown in Table 1, simple and partial correlation analysis on AT, RH and RT recorded within the investigation period indicated that there was no correlation in any combination of AT, RH and RT for all of the ten hiefers.

Among the ten animals, the regular cyclic changes were observed only in three heifers (No. 9, 58 and 71). In four apparent estrus, the RT increment and serum LH elevation were observed. One of these observations was shown in Fig. 1A. Fig. 1B shown the daily changes of AT and RH recorded in YM-PLRI. A pooled serum LH data compared with the deviations of RT from the average indicated that an elevation of RT was corresponded with the increment of serum LH with no exception (Fig. 2). However, the maximum of the serum LH varied widely (heifer no. 9 at first estrus, serum LH was 72 ng/ml, at second estrus, 40; no. 58, 54; and no. 71, 20). The correlation between serum LH and deviation from RT average was significant ($P<0.01$, $a=7.348$, $b=31.645$, $r=0.772$, $n=11$) within the range of 7 days prior to and 5 days after the estrus. The observed positive deviation of RT at estrus ranged from +0.3 to +0.87°C. One to two days previous to estrus, a negative deviation was observed (−0.3 to −0.5°C).

DISCUSSIONS

There are controversies on the influence of AT and RH on body temperature variations. In pigs, it was reported that the body temperature

TABLE 1

Simple and partial correlation analysis of rectal temperature of heifers (x), relative humidity (y), and ambient temperature (z).

Heifer No.		42	9	61	17	11	36	71	56	53	58
Sample size (n)		26	35	26	26	26	26	33	26	35	26
Simple correlation	xy	−0.079	0.082	0.114	0.046	0.128	−0.230	−0.104	0.097	0.095	−0.079
	xz	−0.214	−0.141	−0.009	−0.200	−0.169	−0.300	0.171	−0.163	0.071	−0.041
	yz	0.524	0.492	0.524	0.524	0.524	0.524	0.489	0.524	0.492	0.524
Partial correlation	$xy \cdot z$	0.040	0.175	0.139	0.181	0.258	0.090	−0.218	0.217	0.069	−0.068
	$xz \cdot y$	−0.204	−0.209	−0.082	−0.263	−0.280	−0.217	0.256	−0.252	0.028	−0.001

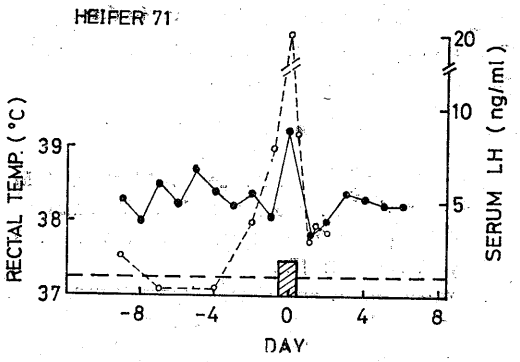

Fig. 1A The variation of serum LH and rectal temperature of heifer 71. The dots and solid line indicate the daily morning rectal temperature recording, the circles and dashed line indicate the measurements of serum LH. On day 0, two blood samples were taken, one in the morning and the other in the afternoon. Shaded area indicates the period when the heifer permitted to be mounted. The sensitivity of the present assay system is 1 ng/ml.

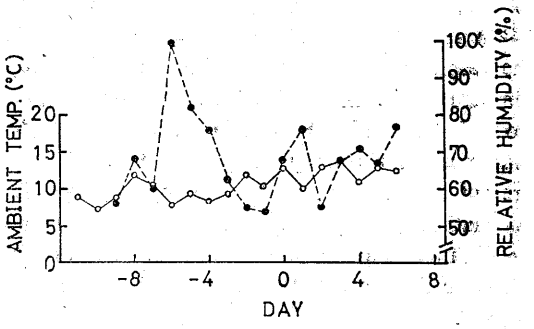

Fig. 1B The variation of relative humidity and ambient temperature recorded through the period corresponding to Fig. 1A. The dots and dashed line indicate the daily morning relative humidity; the circles and solid line indicate the daily morning ambient temperature.

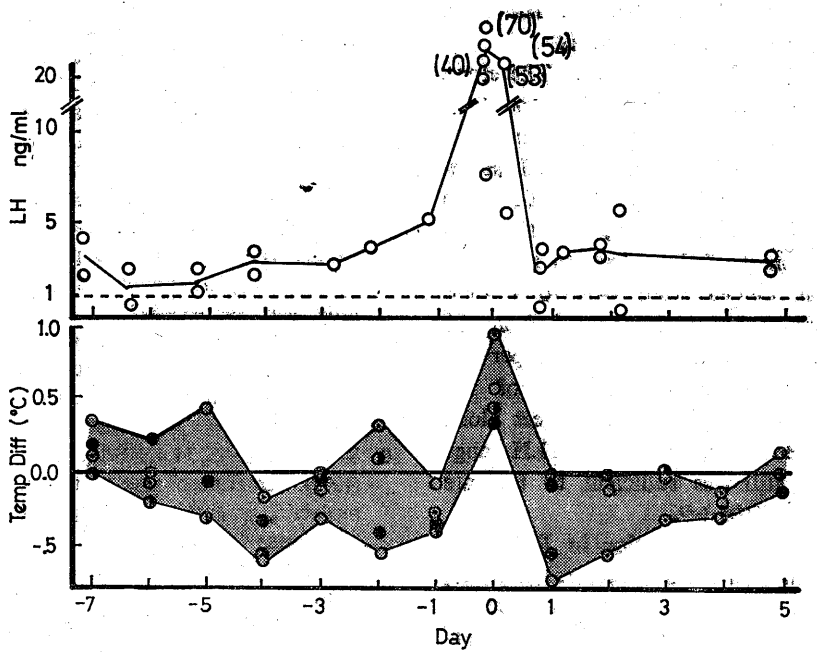

Fig. 2: The pooled data for serum LH and rectal temperatures of 4 estrus including those of 7 days previous to and 5 days after estrus.
Upper: the variation of serum LH.
Lower: rectal temperature difference (Temp. Diff. °C) from the average (0) of the respective heifers.

and respiratory rate increased with the increase of AT, and a rapid increase of RH (from 30 to 94%) at high AT (96°F≅35.6°C) also hastened the respiratory rate and elevation of the body temperature[2]. In cattle, a sudden steep elevation of AT (from 18° to 38°C) resulted in 1.5°C increment of the body temperature[15]. In the present study, after analyses of simple and partial correlations among AT, RH and RT (Table 1), no significant change was demonstrated. This agreed with the findings of Tidwell and Fletcher in the pigs[11]. In addition, no such sudden change of AT was ever recorded in YM-PLRI.

It has been described that, by palpation, in 53 Holstein hiefers 74 per cent demonstrated silent estrus at first ovulation. The incidence of silent estrus gradually decreased to 43 per cent at 2nd and 21 per cent at 3rd ovulation[4]. In the present report, seven out of 10 heifers did not show apparent estrus. Among the seven, one had a significantly high level of LH in the blood obtained on the day of a RT decline. However, no sufficient data can be presented at this moment for the event of this category. Therefore, it is proposed that a further study should be undertaken in order to elucidate this point.

Cummins *et al.*[1] investigated the LH secretion of cows and reported that the length of the estrus varied from 0 to 21 hours, the time interval from the onset of the estrus to the start of the LH peak ranged from −12 to 1 hour, and the duration of LH peak covered from 10 to 13 hours. Sampling the blood twice per day in this experiment, the measurement of LH could not possibly fall upon the highest blood concentration. However, the measured LH range (20 to 72 ng/ml) still was sufficient to indicate its relation with RT[1,5,7,9].

The explanation for elevation in RT prior to or during ovulation is not all clear. However, the complicated hormonal fluctuations before ovulation has been well-documented, the hormones being the estrogens, progesterone[7,8,10,14], prolactin and glucocorticoid[10] besides FSH and LH. It was observed that previous to estrus most animals demonstrated restlessness[8,9]. Thus, it is possible that the restlessness is due to the changes of ovarian hormones in blood and in turn causes the RT elevation.

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處女牛於發情時直腸溫度與血中排卵素濃度之關係[1]

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荷蘭種處女牛在四次發情期間記錄其直腸溫度 (RT) 並抽取血樣，發現 RT 之上升與血液中排卵素之升高相吻合。RT 在發情之次日即恢復原狀。RT 之改變與大氣溫度及濕度在本試驗階段無相關關係。

1. 本實驗之完成全賴臺灣省畜產研究所楊梅分所所長許登造先生及諸同人之協助，並賴美國國家衛生研究所純激素 (NIH-LH-B_7) 之贈與，謹此致謝。