

Estrous Cycle Characteristics And Blood Progesterone Levels In Holstein Heifers Under Altitude And Tropical Conditions In Colombia.

J.A. Cardozo*, A. Hernández** & F. Díaz**

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Summary

Ten cycling heifers were studied during 11 months (mo) to determine the possible influence of some environmental parameters of a high altitude and tropical zone, on estrous cycle and estrus duration, hour of estrus presentation and blood progesterone levels.

The climatic variables studied were rainfall, humidity, temperature, and sunshine duration.

Estrous cycle duration varied between 17 and 27 days (d) with a mean value of 21.1 d. Estrus duration varied between 9 and 16 h, with a mean value of 10.64 h. The percent distribution of estrus appearance at different times of a day, was as follows: 25% occurred between 1800 and 0600; 37.5% between 0630 and 1000; 29.4% between 1030 and 1600; and 8.1% between 1630 and 1730. Progesterone levels in days 0 (estrus), 5, 10, 15 and 20 of the estrous cycle had mean values of 0.0, 1.27, 3.77, 4.80 and 0.32 ng/ml, respectively.

Statistical analysis showed no effect of environmental parameters on the physiological variables and on the levels of the hormones analysed throughout the period studied. It seems that Holstein cattle adapt well to the climatic conditions of Bogotá.

Resumen

Con el objeto de estudiar la posible influencia de algunos parámetros medioambientales del trópico y la altura, sobre la duración del estro y del ciclo estral, la hora de presentación del estro y los niveles de progesterona, se utilizaron 10 novillas Holstein ciclantes.

Se analizaron la precipitación, humedad, temperatura y duración del brillo solar.

La duración del ciclo estral, varió entre 17 y 27 d con promedio de 21.1 d. La del estro, entre 9 y 16 h, con promedio de 10.64 h. La distribución porcentual de aparición del estro durante un día, fue de 25% entre las 1800 y las 0600 horas; 37.5% entre las 0630 y las 1000; 29.4% entre las 1030 y las 1600 y 8.1% entre las 1630 y las 1730. Los niveles séricos de progesterona en los días 0 (estro), 5, 10, 15 y 20 del ciclo estral, fueron de 0.3, 3.7, 11.8, 15.1 y 4.1 nmol/L, respectivamente.

El análisis estadístico mostró que no existía efecto de las variables medioambientales en los parámetros fisiológicos estudiados, incluidos los niveles séricos de progesterona.

Aparentemente, el ganado Holstein se adapta bien a las condiciones climáticas de la Sabana de Bogotá.

1. Introduction

Climatic conditions influence the reproductive performance in cattle. Variations in LH secretion during the year were reported in the northern hemisphere (24). Also, more ovarian activity was observed during summer than winter in New Zealand (17). In the tropics and subtropics, duration of estrus was reported to be shorter than values given for temperate climates (3,16,21).

The Bogotá plain, is located at 2638 m above sea level, 4°35'56"30 latitude (north), 74°04'51"30 longitude (east). The average value for rainfall in a month is 1.76 mm, with peaks in October (3.15 mm) and April (2.73 mm). It is an important resource for dairy cattle production, covering an extension of 722 square Km and representing geographic zones devoted to milk production in the tropics. Its environment is characterized by the absence of seasons, the relatively constant photoperiod and the amplitude of temperature variation within a day, among other variables. Also, there is

a hypoxic environment, due to altitude.

There are no reports on the physiology of reproduction of different breeds under the ecological conditions of the Bogotá plain, although European breeds seem to adapt well.

The present study was intended to analyse possible variation in some aspects of the estrous cycle in heifers, due to environmental conditions.

2. Material and Methods

Ten Holstein postpubertal heifers, born in Colombia, that were initiating cyclicity at the beginning of the experiment, between 11 and 15 (mean 13) months of age, weighing from 248 to 306 (mean 274.6) kg were kept outdoors during 11 months (October 1991 to August 1992), to determine the following characteristics of their reproductive physiology: duration of the estrous cycle, time of presentation of estrus,

* Corpoica, Tibaitatá, Bogotá, Colombia.

** Universidad Nacional de Colombia, Facultad de Medicina Veterinaria y de Zootecnia, Apartado aéreo 58442, Bogotá, Colombia.

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estrus and estrous cycle duration and blood progesterone profile.

The animals were healthy and fed with silage of oats and/or corn and 1 kg/day of concentrate (16% protein, 3 Mcal/kg). Their body weight was recorded every 2 wk.

Duration of estrus and time of occurrence were assessed daily by direct and permanent observation, between 06.00 until 18.00. A heifer was determined to be in estrus when mounting by other animals was allowed for the first time, and the end of estrus, was marked by the last mounting situation. To establish duration of estrus, 74 cycles were observed, distributed as follows: for animals one through ten, 6, 8, 8, 6, 9, 11, 8, 8, 8 and 7 cycles were observed, respectively. Progesterone levels in serum were determined using a commercial kit (Diagnostic Products, Los Angeles, CA) for RIA. Counts were made with a gamma counter (Beckman Instruments, Fullerton, CA). The program used for this purpose was Riapc (D. Rieger – CRRRA, University of Montreal, 1986), validated for bovine samples.

The animals were maintained in an experimental farm, at the National Institute for Agricultural Research. The climatic conditions were recorded in a daily basis at a meteorological station located in the experimental farm. The following factors were recorded: temperatures (maximal and minimal), relative humidity, rainfall, and duration of sunshine per day.

The statistical procedures included the stepwise test, to choose through regression analysis the more relevant climatic parameters. Also, the effect of these parameters upon estrous duration, was analysed applying the non-parametric test of Kruskal-Wallis. Comparisons of means in the different months for climatic parameters were calculated by the Student-Newman-Keuls test. For these statistical analysis, SAS program was used (20). To analyse the time of estrus occurrence, the chi-square test was applied (22).

3. Results

The results for climatic factors are in Table 1. Temperature ranged between 4 and 21.4°C. Daily mean values were 19.7, 6.1 and 13.19°C for maximal, minimal, and average temperatures respectively, during the study.

Rainfall varied between 6.9 and 71.1 mm/mo, with a mean value of 27 mm/mo. Relative humidity ranged from 75.53 to 85.46% and had a mean value of 80.35%. Sunshine varied from 3.2 to 5.75 h/d, with a mean value of 4.48.

Although the variation in duration of light in a day was not determined for the present work, it has been clearly established that, in Colombia, such variation is approximately 35 min comparing the shorter with the longest day in a year (10).

The number of estrous cycles observed for each animal, are recorded in Table 2. Estrous cycle duration varied between 17 and 27 d with a mean value of 21.1 d. Estrous duration varied between 9 and 16 h, with a mean value of 10.64 h (Table 2). The percentage of distribution of estrus appearance at different times of a day, was as follows: 25% occurred, between 18.00 and 06.00 (those animals which were in heat when observed at 06.00, but had not been seen in heat the previous day at 18.00); 37.5% between 06.30 and 10.00; 29.4% between 10.00 and 16.00 and 8.1% between 16.30 and 17.30.

TABLE 2
Number of estrous cycles and estrus studied and their duration
Estrous cycle duration (days)

Animal Number	Number estrous cycles	Range	Mean	Standard Deviation	Number of estrus	Estrous duration (Hours)
1	11	18-21	20	1.18	12	11
2	9	21-22	21	0.48	10	10
3	12	18-22	20	1.26	13	10
4	12	21-27	23	2.21	13	9
5	11	18-22	20	1.33	12	12
6	13	20-26	22	1.67	14	10
7	10	21-26	24	2.0	11	13
8	7	20-23	21	0.9	9	11
9	14	17-21	20	1.11	15	13
10	13	20-22	20	0.89	14	16
Total	112				123	
Mean		19-23	21.1			10.64

Progesterone levels in day 0 (estrus) 5, 10, 15 and 20 had mean values of 0.0, 1.27, 3.77, 4.8, 0.32, 3.0 and 4.1 ng/ml, respectively. (Figure 3)

TABLE 1
Mean values of environmental parameters. Recorded during 11 months.
October 1991 to August 1992.

MONTHS	1	2	3	4	5	6	7	8	9	10	11	X*
T*Max °C	19.4 cd	19 d	19.8 c	20.1 bc	20 bc	21.4 a	20.7 b	20.1 bc	19.4 cd	17.7 e	18.9 d	19.7
T Min °C	4.9 bc	7.4 a	6.2 ab	4 c	6 ab	5.7 abc	7.6 a	6.7 ab	6.4 ab	6.1 ab	6.6 ab	6.18
Mean T °C	12.6 gf	12.9 de	13.1 d	12.7 e	13.4 c	13.8 ab	14.1 a	13.7 b	13.7 b	12.2 g	12.9 de	13.19
T Variation °C	14.5 ab	11.4 c	13.5 abc	15.8 a	14 abc	15.7 a	13 bc	13.3 abc	13 bc	11.6 c	12.3 bc	13.46
Rain mm	.35 a	2.3 a	1.4 a	.75 a	.91 a	.5 a	1.4 a	.4 a	.2 a	.7 a	1.6 a	.9
Relative Humidity %	79.9 bc	85.4 a	83.4 ab	80.7 bc	79.7 bc	78.6 c	81 bc	81.3 bc	75.5 d	79.8 bc	78.1 c	80.35
Sunshine dayhours	5.2 a	3.2 c	4.9 abc	5.7 a	5.1 ab	5.4 a	4.1 abc	3.3 bc	4.5 abc	3.2 c	4.4 abc	4.48

*T = temperature; X = mean

Values marked with different letter are statistically different ($P < 0.01$).

Statistical analysis showed no effect of environmental factors on estrus, estrous cycle duration, and progesterone levels, throughout the studied period of time.

4. Discussion

The effect of high ambient temperature on reproduction is well documented (5,13,19,26), but not the influence of temperature variation (i.e., 16°C variation from 05.00 to 11.30 as seen in the present work), as it occurs in the present study. However, it seems that Holstein heifers do have an adequate degree of adaptation to these conditions. In this context, it has been reported that the bovine has a comfort "zone" which goes from 0 to 16°C (7). Furthermore, it has been proposed that most domestic species do adapt well to temperatures between 4 and 24°C (14). The conditions of the present study do coincide with this temperature range, and only goes 3 to 4°C above 16°C for approximately 5 h during the warmest days (from 11.00 to 16.00).

According to the findings of this work, it seems that there are no differences in the physiology of the estrous cycle during the year. This might imply similar reproductive potential, when the animals are in good health and nutritional conditions.

Estrous duration seems to be shorter in the present study, than the values reported for tropical (lowlands) and temperature climates in Holstein heifers. In Holstein cattle under tropical conditions, values of 14.1 ± 1.0 , $16.4 \pm .69$, $15.8 \pm .55$ and 14.9 ± 1.21 h have been reported (12,16,21). However, extreme values of 4 and 20 h are reported for Friesian x Bunaji (Nigeria) and Jersey (India) cattle, respectively (6,15). In temperate climates, duration of estrus in three different reports has been estimated to be 15.3, 16 and 18 h (1,2,11). It is expected to obtain shorter values in heifers than in cows (8).

The duration of the estrous cycle is similar to the reports given for both, temperate and tropical conditions (1,8,11,25). For heifers, duration of estrous cycle was found to be between 18 and 25 d, with a mean of 20 d. For cows the values were 18 to 24, and 21 d, respectively (1). In other reports, values of 21 d are given as normal (2,11).

As can be seen in Table 3, there is a clear tendency for some heifers to have either low or high blood progesterone levels at day 10 and 15 of the cycle. For instance, cows 1 and 10

TABLE 3
Progesterone levels (ng/ml) at days 5, 10, 15 and 20 of the estrous cycle in heifers

Animal No.	Day 5	Day 10	Day 15	Day 20
1	1.69	4.76	6.48	0.08
2	1.35	3.47	4.88	0.06
3	1.72	4.58	5.37	0.28
4	1.49	3.41	5.45	3.04*
5	1.13	3.24	4.55	0.22
6	1.10	3.37	3.40	0.75
7	1.25	4.49	4.96	4.08*
8	1.02	3.88	5.76	1.06
9	0.68	3.59	4.24	0.01
10	1.31	2.95	2.94	0.08
Mean	1.27	3.77	4.80	0.32
Standard deviation	0.30	0.59	1.02	0.36

* Not taken into account for calculation of general mean.

for high and low levels, respectively. This might be important to be considered, because higher blood progesterone levels have been associated with better levels of fertility (4,18).

In general, the blood progesterone levels recorded in the present study, are in agreement with the ones found for cattle in different parts of the world (9,23,25).

Although the altitude and tropical conditions of the Bogotá plain, do not appear to modify the physiology of the estrous cycle, in relation to the observations made in other climates of the world (non tropical and seasonal), it is suggested that duration of estrus and time of presentation of estrus should be taken into account in the management of reproductive efficiency in Holstein cattle.

The present results imply that Holstein cattle are well adapted to the climatic conditions of the Bogotá plain. Also that under appropriate sanitary and nutritional conditions reproductive performance (and perhaps efficiency) should be the same throughout the year.

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J.A. Cardozo, DVM, M. Sc., Director Physiology Programme, Corporación de Investigación Agropecuaria.

A. Hernández, DVM, M. Sc., Ph.D. Professor Universidad Nacional de Colombia.

F.H. Díaz, DVM, M. Sc., Dr Associate Professor.

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For more information, contact:

Sandra Bukkens
Organizing Secretariat
Istituto Nazionale della Nutrizione
Via Ardeatina, 546 - 00178 Rome, Italy
Fax: 39-6-51 95 70 31
Phone: 39-6-50 32 421
e-mail: Giampietro @ IN8800.INGRM.IT