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LIVEWEIGHT CHANGE DURING THE FIRST 90 DAYS OF LACTATION AND ITS EFFECT ON REPRODUCTION

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Least squares analysis of 425 reproductive records from the Institute's Holstein herd in Maracay, were used to study the effects of origin (imported or born in Maracay), year of calving (70-75), month of calving (1-12), problems at calving (normal and abnormal), on interval between parturition and first oestrus, and calving and conception. Covariates were: calving weight and cow's age; change of weight at 90 d of lactation and milk production at 150 d of lactation. Means for age and weight at calving and for change of weight and milk production at 150 d were 45.7 months, 543 kg, - 77 kg and 2321kg, respectively. Adjusted means for intervals to first oestrus and to conception were 63.7 and 155 d. Analysis of variance showed a highly significant linear effect of year of calving and weight at calving on both variables. A highly significant linear and quadratic effect of weight change was also found on these two variables whereas a linear effect of age at calving affected only the variable interval from parturition to first oestrus.

Key words: Holstein, reproductive efficiency, calving weight and live weight

Climatic stress and low quality of forages are the two major factors that effect the performance of high yielding cows in the tropics. Limitation of heat dissipation, especially during the first phase of lactation, causes a reduction of feed intake followed by mobilization of the cow's fat depots and weight loss. When these stresses coincide with the breeding period, there may be an increase in the interval from parturition to conception and physiological disturbances could occur, especially when restricted energy intake is imposed (Donaldson et al 1970; Gombe and Hansel 1973; Spitzer et al 1978).

The objective of this experiment was to determine the effect of weight at calving and liveweight changes during the initial stages of lactation on first post partum oestrus and interval between calving and conception, in a Holstein herd located in Maracay, Venezuela.

Materials and Methods

A total of 425 recordings from the Holstein cows of the Institute's herd, that had calved down during the period 1970 to 1975,were used in this study. Maracay is located at 452 m above sea level and has a rainy season from May to October. Maximum, minimum and mean temperatures are 31.8, 17.9 and 24.8°C respectively; mean rainfall is 813 mm precipitation with considerable monthly fluctuations (Martínez et al 1982). Relative humidity varies from 65 to 80%.

Management, nutritional and reproductive characteristics of the herd were descibed by Martinez et al (1982). Reproductive parameters under study were: interval between calving and first oestrus ; and interval between calving and conception. Independent variables were: origin (imported or born in Maracay), year of calving (1970 to 1975), month of calving (1 to 12), difficulties at calving (0 = normal; 1 = with problems). Covariables were age and weight at calving, liveweight change during the first 90 d of lactation and milk yield at 150 d. Data were analysed by least squares. The statistical model was:

$$Y_{ijklm} = \alpha + O_i + a_j + m_k + P_l + b_1 E_{ijklm} + b_2 Z_{ijklm} + b_3 D_{ijklm} + b_4 D^2_{ijklm} + b_5 L_{ijklm} + e_{ijklm}$$

Where:

Y_{ijklm} = Interval between calving and first oestrus or conception for cow "m", origin O_i; year of calving "a_j" and month of calving "m_k"; problem at calving "p_l"; age "E" (in months at calving); "Z" kg of weight at calving; "D" kg of liveweight change during the first 90 days of lactation and "L" kg of milk at 150 d of lactation.

α = overall theoretical population mean (when E = Z = D = L = zero)

O_1 = effect of i^{th} origin of cow i = 1 and 2

a_j = effect of j^{th} year of calving j = 1, ... , 6

m_k = effect of k^{th} month of calving k = 1, ..., 12

p_l = effect of "l" problem at calving l = 1,2

b_1 = linear regression of Y_{ijklm} on E_{ijklm}

E_{ijklm} = calving age of cow "m"

b_2 = linear regression of Y_{ijklm} on Z_{ijklm}

Z_{ijklm} = weight at calving of cow "m"

b_3 and b_4 = linear and quadratic regression of Y_{ijklm} on D_{ijklm}

D_{ijklm} = liveweight change during the first 90 d of lactation of cow "m"

b_5 = linear regression of Y_{ijklm} on L_{ijklm}

L_{ijklm} = milk yield at 150 d of lactation of cow "m"

e_{ijklm} = residual error

Factors not contributing to the characteristics under study were deleted from this model. The Multiple Range Test was used to compare differences between levels of significant variables.

Results

Analysis of variance for first post partum oestrus and interval between calving and conception are given in Tables 1 and 2. Although the variables were affected by year of calving, cows with different origins had similar behaviour. The interval between calving and conception was longer for calving in the first months of the year. Cows with problems at calving, such as placenta retention, infections etc, showed positive constants.

Table 1 [1]

Analysis of Variance for interval between calving and first oestrus[1,5]

Source of Variance	Cows	1st Calving	Cows with 2 or more calvings		All cows	
	df	mean square	df	mean square	df	Mean square
Origin	-	-	1	1.106	1	1.776
Year of calving	5	3.403**	5	3.084	5	6.484**
Month of calving	11	1.974**	11	1.758	11	2.116
Problems at calving	1	746	1	2.850*	1	2.893
Age at calving (linear)	1	452	1	273	1	11.807**
Age at calving (quadratic)	-	-	-	-	1	10.333**
Weight at calving (linear)	1	6.555**	1	9.353*	1	11.136*
Weight change (linear)	1	607	1	2.128*	1	4.052*
Weight change (quadratic)	-	-	1	4.706*	1	6.494*
Milk production at 150 d of lactation (linear)	1	1.225		5	-	-
Residual	141	859	239	1.525	402	1.324
T o t a l :	162		262		425	

* P < .05 ** P < .01

The covariate, age at calving, affected only the first post partum oestrus, whereas weight of cow at calving and liveweight change during the first 90 days of lactation affected both variables. Milk yield at 150 d of lactation had no effect.

Adjusted means and standard errors of first post partum oestrus and interval between calving and conception are shown in Table 3 while Table 4 shows those for the covariates. Individual regressions and their respective mathematical equations are given in Figures 1 and 2. After deletion of the covariates which did not contribute significantly to the statistical model, the regression equations to estimate both first post partum oestrus and days open, were as follows:

$$\hat{Y}_1 = 65.29 - 0.106X_a + 0.274X_b - 0.001X_b^2 - 1.483X_c - 0.011X_c^2$$

$$\hat{Y}_2 = 383.74 - 1.497X_a - 0.174X_b + 0.003X_b^2$$

where:

$\hat{Y}_1$ = Interval between calving and first oestrus (d)

$\hat{Y}_2$ = Interval between calving and conception (d)

X_a = Weight at calving (kg)

X_b = Liveweight change (kg) at 90 d of lactation plus a constant (200)

X_c = Calving age (months)

The coefficients of determination for both equations were 0.49 and 0.53 respectively.

Table 2:
Analysis of Variance for interval between calving and conception

Source of Variance	Cows 1st calving		Cows with 2 or more calvings		All cows	
	df	mean square	df	mean square	df	mean square
Origin	-	-	-	-	1	5.591
Year of calving	5	28.989**	5	24.121**	5	36.537**
Month of calving	11	10.715**	11	4.435	11	12.856**
Problems al calving	-	-	1	21.501*	1	11.447
Age at calving (linear)	1	9.944	1	12.475	1	3.197
Weight at calving (linear)	1	60.902**	1	5.924	1	29.413**
Weight change (linear)	1	60.948**	1	194.399**	1	120.762**
Weight change (quadratic)	1	8.982	-	-	1	26.659**
Milk production at 150 d of lactation (linear)	1	1.932	1	12.949	1	12.438
Residual	141	3.740	242	4.116	402	4.218
T o t a l :	162		263		425	

* P < .05 ** P < .01

Table 3:
Adjusted means and standard errors of variables for first Post-partum oestrus and internal between claving and conception

	First Post-partum oestrus (d)	Interval between calving and conception (d)
First calving cows	57 ± 2.9	158 ± 5.2
Cows with more than one calving	67 ± 3.3	156 ± 4.4
All cows	64 ± 2.9	155 ± 5.2

Table 4.
Adjusted means and standard errors for covariables included in the models.

	First calving cows	Cows with more than one calving	All cows
Age at calving (months)	28 ± 4	56 ± 18	- 46 ± 19
Weight at calving (kg)	488 ± 54	576 ± 76	- 543 ± 80
Liveweight change at 90 d of lactation (kg)	-66 ± 23	-82 ± 22	-77 ± 23
Milk production at 150 d of lactation (kg)	2,100 ± 440	2,460 ± 560	-2,320 ± 547

Figure 1:
Effect of weight, and age at calving and liveweight change during the first 90 d of lactation on the first post-partum oestrus.

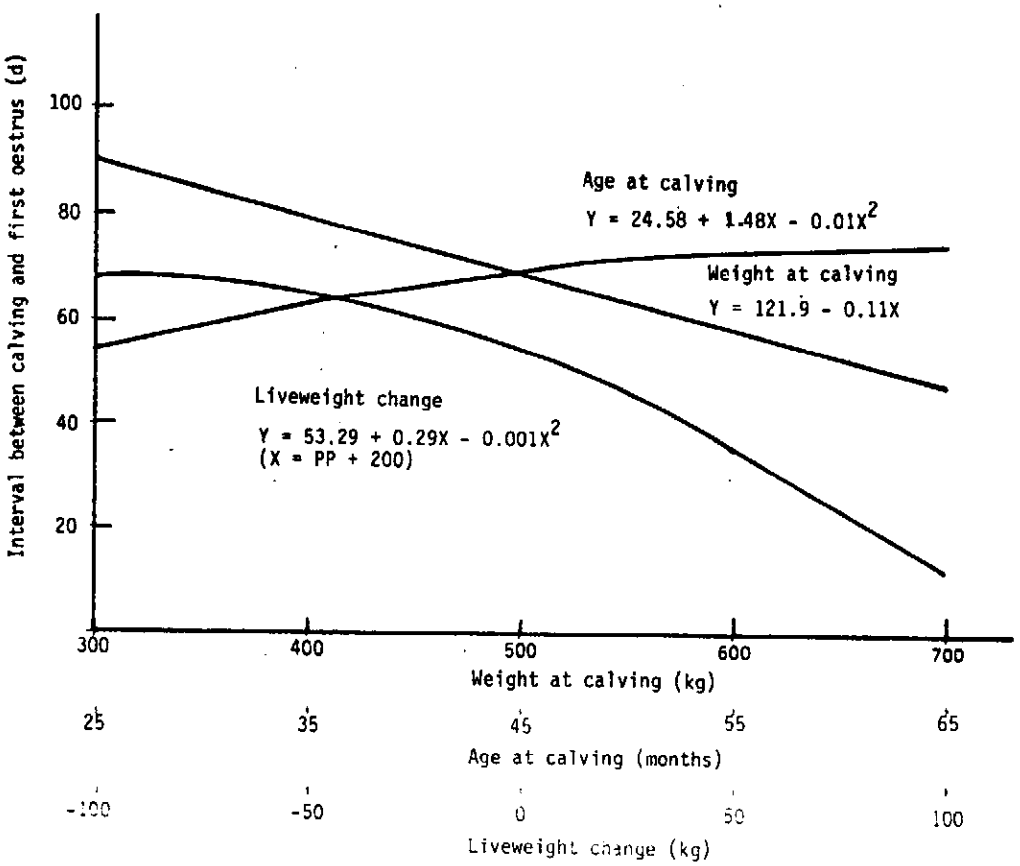
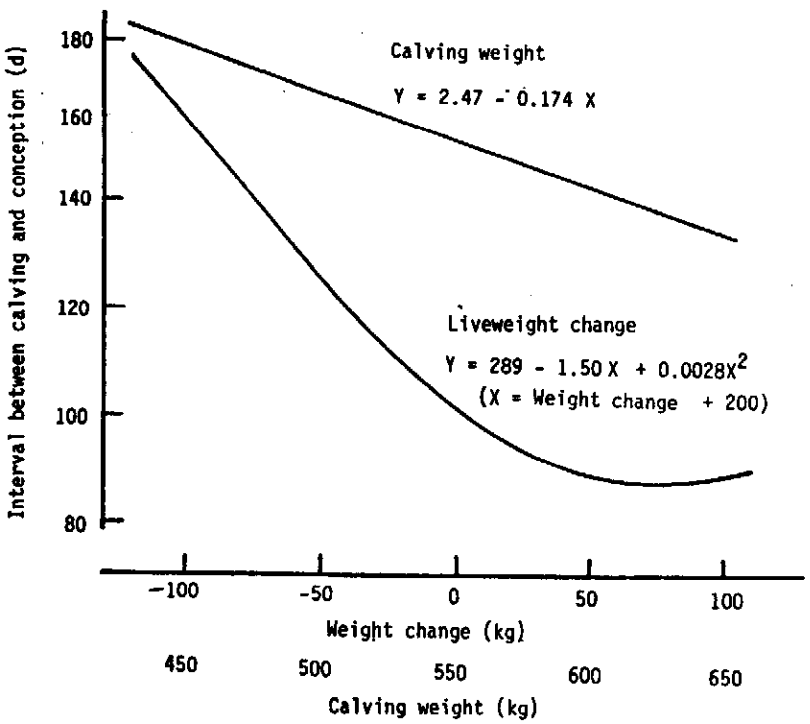


Figure 2:

Effect of calving weight and liveweight change during first 90 d of lactation on days open



Discussion

Means for first post-partum oestrus (64 ± 3.3 d) and days open (155 ± 5.2 d) did not differ between the imported cows amd those born in Maracay. Similar results were reported by Román García et al (1979) and Martínez et al (1977).

The year of calving significantly affected both variables. After 1973, although there was a delay in the first post-partum oestrus, days open were reduced, maybe due to a higher conception rate during this period . This higher reproductive rate in 1974 was previously reported by Fenton et al (1976), who considered it to be normal,and acceptable for Holsteins in the tropics, and similar to many herds in the temperate zone.

Month of calving affected days open. Cows that calved during the first months of the year were inseminated within the rainy season and needed more services per conception. This was previously reported by Fenton et al (1972) who suggested that it was not the absolute level of temperature, but rather that the variation between the maximum and min - imum temperature was less at this time and the relative humidity was higher, both factors affecting reproduction by altering the dissipation

heat flow of the cow. In this respect, Ingraham et al (1976) demonstrated a negative correlation between conception rate and the temperature - humidity index.

A delay in the interval between calving and first oestrus, as well as a longer time to conception, were noticed in those cows with problems at parturition. This was often seen in multiparous cows. This agrees with the reports of Fenton et al (1976) and Serrano et al (1977).

Means and standard errors, of covariates included in the model shown in Table 4, were similar to those reported by Bodisco et al (1976). Cows in this study had a 77 kg weight loss during the first 90 d of lactation. This could be attributed to the high nutritional requirement of the cow, at this stage of lactation, which cannot be met by feed intake, thus causing a mobilization of fat depots to fulfill their energy requirements. This was also reported by Broster (1973) and Vasilatos and Wangsness (1981).

The analyses of variance (Table 1) showed significant linear and quadratic effects of calving age, a linear effect of weight at calving and quadratic effects of weight change during the first 90 d of lactation, on first post-partum oestrus (Figure 1). With regard to interval between calving and conception (Table 2) there was a highly significant linear effect of weight at calving and linear and quadratic effects of weight change in the initial stages of lactation. This is in agreement with reports by Bodisco et al (1976) and Payne (1966). The relationship between these two covariates and fertility was studied by Haresign (1979), McClure (1970), Lamond (1970) and King (1968), who reported fertility to be highly affected by amount of weight lost. Boyd (1972) reported a similar result, although the relationship was not as strong.

Conclusions

Under the conditions described in this paper, Holstein cows lose weight during the first weeks of lactation. Their fertility depends to a high degree both on the weight at calving and the extent of liveweight loss during this period.

References

Bodisco V, Valle A, García E & Mendoza S 1976 Cambio de peso en vacas lecheras durante la lactancia y su efecto sobre la reproducción Agronomía Tropical 26:191-204

Boyd H 1972 Weight change and fertility in one herd of dairy cattle Veterinary Record. 91:193.

Broster W H 1973 Live weight change and fertility in the lactating dairy cow, A review Veterinary Record October 13th 417-420

Donaldson L E, Basset J and Thorburn G D 1970 Peripheral plasma progesterone concentration of cows during puberty, oestrous cycles, pregnancy and lactation and the effects of under nutrition or exogenous oxytocins on progesterone concentration Journal of **Endocrinology** 48:599

Fenton F R, Branton C. McDowell R E & Benezra M V 1972 Reproductive efficiency of Holstein herd in tropical environment IV International Congress of Biometeorology **Holland**

Fenton F R, Blanco F B, Ramírez S G de & Verde O 1976 Fertilidad de vacas Holstein en Maracay Venezuela. Agronomía Tropical 26:473-488.

Gombe S & Hansel W 1973 Plasma Luteinizing hormone (LH) and progesterone levels in heifers on restricted energy intake Journal of Animal Science 37:728

Haresign W 1979 Body condition, milk yield and reproduction in cattle. Recent advances in Animal nutrition. Ed W Haresign y D Lewis Butterworths. London 107-122

Ingraham R H, Stanley R W & Waner W C 1976 Relationship of temperature and humidity to conception rate of Holstein cows in Hawaii Journal of Dairy Science 59:2086-2090

King J O L 1968 The relationship between conception rate and change in body weight, yield and SNF Content of milk in dairy cows. Veterinary Record 83:492
Lamond D R 1970 The influence of undernutrition on reproduction in the cow Animal Breeding Abstracts 33:359-372.
Martínez N D, Fenton F R, Verde O & Rojas G 1977 Comportamiento reproductivo de bovinos de lecheros en la zona alta de Venezuela VI Reunión Alpa, La Habana, Cuba. Res. Tomo I. 59.
Martínez N, Galindo de Ramírez S & Combellas J 1982 Reproductive and productive performance of a Holstein herd in Maracay, Venezuela Tropical Animal Production 7:31-39
McClure T J 1970 An experimental study of the causes of a nutritional and lactational stress infertility of pasture fed cows, associated with loss of body weight about the time of mating Review of Veterinary Science 11:247
Payne W J A 1966 Nutrition of ruminants in the tropics Nutr Abstr Rev 36:653-670.
Román-García F, McDowell R E, Centeno H, Rivero Amaya J D & Arrollo-Aguilu J A 1979 Performance of Holstein cows born in Puerto Rico versus cows imported from the United States J of Agriculture of University of Puerto Rico 63:13-21
Serrano de G L, Sosa G S de, Rodríguez J E & Fuentes A 1977 Fertilidad en un rebaño Holstein y Pardo Suizo en Venezuela. Veterinaria Tropical 2:11-26
Spitzer J C, Ninwender G D, Seidel G E, Jr and J Wiltbank 1978 Fertilization and blood levels of progesterone and LH in beef heifers on restricted energy diet J Animal Science 46:1071
Vasilatos R & Wangsness P J 1981 Diurnal variation in plasma insulin and growth hormone associated with two stages of lactation in high producing dairy cows Endocrinology 108: 300-304

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