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FACTORS INFLUENCING THE WEIGHT OF CALF AND PLACENTA AT CALVING IN FRIESIAN COWS

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ABSTRACT

Data on 259 pure bred Friesian cows, collected from consecutive seasons, were used to examine the effects of season of calving, parity, weight of cow and sex on calf birth-weight and calf weight. The adjusted correlation coefficients between calf weight at birth and placental weight with weight of cow were detected.

No consistent pattern of parity effects on calf birth-weight was observed. Placental weight increased in a linear fashion ($P<0.01$) from the 1st to the 4th parity and decreased thereafter. Birth weight and placental weight were heavier for male calves than for female calves; sex differences were found to be neither considerable nor significant. Calf birth-weight and placental weight increased significantly ($P<0.01$) in a curvilinear fashion of year of calving during winter season. The heaviest weight of calf and placenta were obtained during spring and winter calvings while summer and autumn calvings were the lowest. Calf weight and placental weight increased linearly ($P<0.01$) with the increase of weight of cow. The overall means of calf weight and placental weight (adjusted for other effects in model of analysis) were observed to increase, respectively by 0.029 and 0.003 kg for each kg increase in weight of cow at calving. Calf weight at birth was significantly positively correlated with placental weight.

INTRODUCTION

Birth weight is an economically important trait in dairy cattle. Birth weight of the calf has been shown to be the most important factor affecting calving difficulty (Bellows *et al.*, 1971). Weight of calf at

calving is, however, positively associated with placenta weight (Gianola and Tyler, 1974).

Accordingly, the factors affecting birth weight of calf are mostly the same factors influencing placental weight at calving. However, calf birth weight and/or placental weight in a herd of a dairy cattle appear to be affected by maternal factors (Donald *et al.*, 1962; Ellis *et al.*, 1965 and Touchberry and Bercskin, 1966), direct genetic effects (Tyler *et al.*, 1947; Gianola and Tyler, 1974), sex (Boyd and Hafs, 1965 and Afifi and Soliman, 1971) and physiological stage of the dam as indicated by age, parity or weight (Foote *et al.*, 1959; Donald *et al.*, 1962; Afifi and Soliman, 1971; Bellows *et al.*, 1971 and Gianola and Tyler, 1974).

The objectives of this study were to evaluate the nongenetic maternal and some environmental influences on calf and placental weight at calving and to clarify the relationship between placental weight and the weight of calf produced at calving.

MATERIAL AND METHODS

Data on 259 pure-bred Friesian cows were collected for this study from Sakha Experimental Station, Kafer El-Sheikh governorate, Animal Production Research Institute, Ministry of Agriculture, Egypt in the period from 20th of February 1981 to 17th of March, 1982.

Cows were artificially inseminated by frozen semen collected from 22 bulls. Rectal palpation was done at 21 days prior to the expected parturition day. All cows were delivered normally. Weight of calf at birth and cow weight at calving were recorded after the expultion of placenta (6-8 hours after parturition). Weight of placenta was recorded to the nearest 10 grams.

A green fodder (alfalfa) and rice straw were provided to cows from December to May. A dry concentrated ration (co-op concentrate mixture), rice straw and berseem hay were offered from the beginning of June till the end of November in quantities scheduled by the recommendation of the Ministry of Agriculture (1968). Fresh and clean water was available to cows all day.

Data of weight of calf and placenta at calving were analysed by the Least-Squares and Maximum Likelihood Program of Harvey (1977). A linear model including the fixed effects of parity, sex and season of calving was considered in the analysis. Weight of cow at calving was used as a covariant in the model of analysis. Data of weight of calf at birth was analysed once more for the same effects used in the previous linear model in addition to the effect of placental weight at calving as a covariant.

RESULTS AND DISCUSSION

Means and Variation of Uncorrected Records

The means, standard deviations and coefficients of variation (CV) of calf birth weight and placental weight at calving is given in Table (1). For both traits studied, CV are nearly similar in magnitude (17.1% vs 18.0% for calf weight and placental weight, respectively). These higher coefficients of variation are more likely to be due to higher maternal effects on growth of calf during the prenatal period.

Table (1) : Means, standard deviations (S.D.), and coefficients of variation (CV%) of unadjusted records and calf birth weight and placental weight at calving.

Trait	Mean ± SD	CV%
Calf birth weight (kg)	29.700 ± 5.700	17.1
Placental weight at calving (kg)	2.925 ± 0.788	18.0

The average weight of calf and placenta at calving in Friesian cows of the present study (29.7, 3.925 kg, respectively) is relatively low compared to other estimates for the same breed cited in the literature. In this respect, higher average birth weight for the same or different breed of dairy cows have been reported by other Egyptian investigators (Ahmed and Tantawy, 1954; Afifi and Soliman, 1971; Afifi *et al.*, 1975; Helali *et al.*, 1979 and Omar, 1984) while the contrary was observed by others (Alim and Taher, 1979). The evidence from the differences between the estimates of cow traits studied and those reported by other Egyptian workers for the same and/or different breeds of dairy cows could possibly be attributed to one or more of the following reasons: (1) The herds were raised under different climatic, nutritional and managerial conditions, (2) Different herds could possibly be genetically different from each other and/or (3) Differences in the models of the statistical analysis of data.

Parity

Calves of the 1st parity were the lightest in weight as compared with the calves of the other parities (Table 2). Similar results were observed by other investigators (Afifi and Soliman, 1971; Gianola and Tyler, 1974; Helali *et al.*, 1979; Taneja *et al.*, 1981 and Lazarevic, 1982). However, the effect of parity could result as a combination of increased

nutritional supply to the embryo, increased placental size, physical effects, etc. Therefore, findings of the present and reviewed studies can be expected because cows in their 1st parity have just reached sexual maturity and consequently their efficiency in providing their foetus with nourishment and intra uterine environment during the prenatal development are at their lowest level. Moreover, prenatal mothering ability increases with the advancement of parity until a certain age, then remains constant for a period and decreases thereafter due to aging (Afifi and Soliman, 1971).

Table (2) : Least squares-means ($\bar{X}$) of factors affecting calf birth weight and placental weight of calving.

Independent Variable	N	Calf birth weight (kg) $\bar{X} \pm$ S.E.	Placental weight (kg) $\bar{X} \pm$ S.E.
Parity			
1st	60	28.2 ± 0.7	3.656 ± 0.098
2nd	51	30.7 ± 0.7	3.719 ± 0.102
3rd	51	29.7 ± 0.7	3.872 ± 0.103
4th	41	29.7 ± 0.8	3.999 ± 0.117
5th	20	31.0 ± 1.1	3.881 ± 0.159
> 6th	36	28.9 ± 0.9	4.422 ± 0.125
Season of calving			
Spring	78	32.1 ± 0.6	4.065 ± 0.085
Summer	29	28.4 ± 1.0	3.710 ± 0.133
Autumn	85	27.8 ± 0.6	3.902 ± 0.079
Winter	67	30.5 ± 0.6	4.023 ± 0.088
Sex			
Males	128	30.4 ± 0.5	3.963 ± 0.066
Females	131	29.0 ± 0.5	3.887 ± 0.068
Regression on cow weight at calving			
Linear		0.029 ± 0.006	2.85 ± 0.80

Placental weight at calving increased linearly ($P<0.01$) as parity advanced (Tables 2 and 3). During the 1st pregnancy, the cows are still growing (i.e., there is a competition between the cow and its foetus concerning the use of nutrition) and consequently their body size (relevant to placental weight) are increased with advancement of parity.

Table (3) : Analysis of variance and coefficients of determination (R^2) of factors affecting calf birth weight and placental weight of calving.

Source of Variation	D.F.	Calf birth weight (kg) Mean Squares	Placental weight (kg) Mean Squares
Parity	5	*(R^2 = 0.03)*	*(R^2 = 0.08)*
Linear	1	7.9	10349230**
Quadratic	1	96.3	606094
Cubic	1	14.1	383605
Residual	2	103.7	1251816
Season of calving	3	*(R^2 = 0.09)*	*(R^2 = 0.02)*
Linear	1	177.5**	63291
Quadratic	1	610.8**	2239019*
Cubic	1	0.1	832762
Sex	1	107.5*	265305
Regression on cow weight at calving		*(R^2 = 0.08)*	*(R^2 = 0.04)*
Linear	1	652.7**	6308062**
Remainder	248	25.9	496917

* P < 0.05 and ** P < 0.01

Season of Calving

Least-Squares means given in Table (2) revealed that there was a general tendency for calf birth weight and placental weight at calving to be low when calving took place in summer and autumn seasons and to increase with calving during winter and spring. This trend has been observed by other Egyptian investigators, e.g., Beckhit and Hathout (1966); Afifi and Soliman (1971); Fahmy *et al.* (1975) and Omar (1984). These results could be attributed to the fact that, during summer and autumn seasons, green fodder for the pregnant cows is not available in sufficient quantity and lower in the nutritive value as well as the weather is not favourable but during winter and spring, fodder becomes more abundant and of high nutritive value and the weather becomes milder. Afifi and Soliman (1971) reported that the seasonal fluctuation in calf birth weight is probably due to the difference in condition of the cows during gestation period and their ability to provide the vital requirements to the foetus. They also reported that the differences in system of feeding and management which are practised at different seasons of the year can explain the variation.

In conclusion the results of the analysis of variance in Table (3) showed that a curvilinear relationship ($P<0.01$) existed between calf birth weight and month of calving, while a non-orthogonal quadratic relationship ($P<0.05$) was observed between placental weight at calving and month of calving. Accordingly, a curvilinear and quadratic curves could be fitted on the data of calf birth weight and placental weight, respectively.

Sex

Male calves were heavier in birth weight and placental weight than female calves (Table 2). In this repect, the results of many investigators working on different breeds of dairy cattle showed that male calves and their placenta were heavier in weight at calving than female calves (Ahmed and Tantawy, 1971; Foote *et al.*, 1959; Plum *et al.*, 1965, Afifi and Soliman, 1971; Gianola and Tyler, 1974; Afifi *et al.*, 1975; El-Barbary and Ahmed, 1980 and Alaku, 1982). These are expected results because weight of calf at birth was significant and positively correlated with placental weight at calving (the adjusted correlation coefficients between the two variables was 0.31). The trends in sex differences in birth weight of calves were statistically significant ($P<0.05$) while they were nonsignificant for placental weight (Table 3). In Egypt similar results in the Egyptian studies were reported by Afifi and Soliman (1971).

Cow Weight at Calving

The analysis of variance revealed an indication that calf birth weight and placental weight increased linearly ($P<0.01$) with the increase of weight of cow (Table 2 and 3). Meanwhile, the relative sizes of the F-values for the fixed effects included in the model of analysis (Table 3) indicate also that weight of cow effects contribute significantly ($P<0.01$) to the variance of both calf and placental weights at calving. In this respect, Foote *et al.*, 1959 concluded that heavier cows may produce heavier calves by virtue of having greater facilities for fetal growth or because of a genetic association between adult weight and birth weight in Friesian cattle.

Estimates of linear regression (Table 2) reveal that the increase in cow weight was associated with an increase in weights of calf and placenta. Accordingly, each kg increase in cow weight was associated with an increase of 0.029 and 0.003 kg in the weight of calf and placenta, respectively.

These results were confirmed by the positive estimates of correlation coefficients (adjusted for other effects) of 0.35 and 0.36 obtained in this study between weight of cow and weights of calf and placenta at calving, respectively. Similarly, most of the Egyptian studies (Tantawy and Ahmed, 1955; Afifi and Soliman, 1971; Fahmy *et al.*, 1975 and

Omar, 1984) reported that the correlation coefficient between cows weight at calving and the weight of their calves at birth were positive and highly significant.

From the linear regression coefficients given in Table (2), prediction equations for calf birth weight and placental weight at calving (adjusted for other effects in the model of analysis) are calculated as:

$$\hat{Y}1 = 29.71 \pm 0.029 (CW - \bar{X})$$

$$\hat{Y}2 = 3.924 \pm 0.003 (CW - \bar{X})$$

Where Y1 and Y2 are the predicted calf birth weight and placental weight at calving, respectively. CW = observed weight of cow at calving and X = mean of the trait. Therefore, a prediction curve based on the regression of calf birth weight and placenta weight at calving on weight of cow at calving, adjusted for other effects in the model, could be plotted to indicate the changes that would be expected in weights of calf and placenta with increasing weight of cow at calving.

Data of calf birth weight were reanalyzed for the same factors used in the first analysis in addition to the effect of placenta at calvings a covariant. It was observed that calf weight increased significantly ($P<0.01$) with the increase of placenta weight. This may be due to the positive correlation ($r = 0.31$) between the two variables. However, estimate of linear regression revealed that each kg increase in placental weight was associated with an increase of 2 kg in weight of calf at calving.

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العوامل التى تؤثر فى وزن العجول والمشيمة عند الولادة فى ماشية الفريزيان

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٣ كلية الزراعة ـ جامعة عين شمس ـ شبرا الخيمة ـ القاهرة
٤ قسم الانتاج الحيوانى ـ كلية الزراعة ـ جامعة طنطا ـ كفر الشيخ

فى هذا البحث أستخدمت بيانات ٢٥٩ رأسا من ماشية الفريزيان فى أربعة فصول متتالية لدراسة تأثير كل من :ـ

١ ـ فصل السنه ٢ ـ عدد مرات الولادة ٣ ـ وزن الام عند الولادة
٤ ـ جنس المولود ٠ وذلك على وزن العجول ووزن المشيمة عند الولادة ٠

عند حساب معامل الارتباط المعدل بين وزن العجل عند الولادة ووزن المشيمه مع وزن الام لم يكن لعدد مرات الولادة تأثيرا معنويا على وزن العجل بينما زاد وزن المشيمه معنويا (احتمال خطأ أقل من ٠١ر) بزيادة عدد مرات الولادة من الموسم الاول وحتى الرابع ثم أخذ فى الانحدار بعد ذلك ٠ كان وزن العجول عند الميلاد ووزن المشيمه أثقل فى الذكور عنها فى الاناث ـ كانت العلاقة بين وزن العجل عند الميلاد ووزن المشيمه وقت الميلاد علاقه معنوية (احتمال خطأ أقل من ٠١ر) وتأخذ الشكل المنحنى وذلك من بداية الربيع حتى نهاية الشتاء ٠

تميزت العجول الناتجه خلال فصل الربيع والشتاء بثقل وزنها عن مثيلتها الناتجه خلال الصيف والخريف ٠ كانت العلاقة بين وزن العجل عند الولادة ووزن المشيمه عند الولادة تزداد خطيا زيادة معنويه (احتمال خطأ أقل من ٠١ر) وذلك بزيادة وزن الام عند الولاده٠ وقد لوحظ أن المتوسط العام لوزن العجل عندالولاده ووزن المشيمه عند الولاده (بعد تعديل جميع العوامل الاخرى) يزيد بمعدل ٣ر٠٢٩ كجم فى وزن الام عند الولادة ٠ لوحظ أن وزن العجل عند الميلاد له ارتباط معنوى (احتمال خطأ أقل من ٠١ر) موجب مع وزن المشيمه ٠