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**THE EFFECT
OF SOME ENVIRONMENTAL FACTORS
ON BODY WEIGHT
AND RELATIVE GROWTH RATE
IN FRIESIAN CALVES OF TAHREER PROVINCE**

BY

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SUMMARY

This work was carried out to study the effect of sex, system of rearing and month of birth on body weight and growth rate of Friesian calves at the Tahreer Province, Egypt, U.A.R. The data used comprised 218 males and 217 females born from newly imported heifers and cows in their first and second calving, during the period from July 1955 to June 1958. Three systems of pail feeding were used for calf rearing. In the first, the calf consumed 468 pounds of whole milk, 1302 pounds of skim milk and 104 $\frac{1}{8}$ pounds of crushed maize during the suckling period which lasted 20 weeks. In the second and third systems whole milk and calf meal were used. The quantity of milk consumed by every calf was 1162 pounds in the second system and 1008 pounds in the third one; the quantity of calf meal being 187 $\frac{3}{8}$ and 109 $\frac{3}{8}$ pounds in the second and third systems respectively. The period of suckling lasted 16 weeks in the second system and 13 weeks in the third.

Males were significantly heavier in body weight than females in all ages studied. The rate of growth in the first four months of life exceeded that of the following eight months in both males and females, although females had a higher percentage of increase, yet differences were not statistically significant.

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The best results for absolute body weight and growth rate were those obtained through the application of the third system of rearing. The second system also gave better results than the first. Differences between groups of calves representing the three systems of rearing used were significant.

Month of birth affected significantly the absolute body weight and growth rate of the calves studied. The results obtained suggest that calves born from September to December were of higher rate of growth.

INTRODUCTION

Inter-se selection in both buffaloes and native cattle of Egypt is too slow in securing appreciable results that can meet necessities of the country especially in milk production (Asker *et al.*, 1955). Therefore, the introduction and establishment of pure-bred cattle was sought, and the Friesian was the breed that proved itself the most successful of all imported foreign breeds under the local conditions (Sidky, 1950).

In the year 1955-1956, the Tahreer Province imported big numbers of Friesians from Holland, which were the main source of the data used in this study. The study aimed at finding out the effect of sex, system of rearing and month of birth on body weight and its relative growth rate from birth till 12 months of age, being the most important non-genetical factors affecting both birth weight and rate of growth.

The results of such study may indicate the appropriate type of husbandry which ensures the utmost weight and growth rate reached under the local conditions, especially those related to Tahreer Province.

MATERIALS AND METHODS

A number of 218 males and 217 females belonging to the Friesian herds of the Tahreer Province were chosen as the material of this study. Those were calves born from the newly imported Friesian heifers and a limited number of cows at their first and second calving were used for this study.

All calves were pail fed according to the three following different systems. The first system (Table A) was used in feeding the calves born during the period from July 1955 to June 1956. The second and

third systems (Tables B and C) were used in feeding calves born during the periods from July 1956 to June 1957 and from July 1957 to June 1958. Calf meal, hay, water and mineral mixtures were provided when calves were 4 weeks old.

TABLE A

The first system of suckling.

Age of calf	Quantity of milk consumed daily		Crushed maize (pounds)	Hay
	Whole milk (pounds)	Skim milk (pounds)		
1- 3 days	With dam	—	—	—
4- 5 »	8.0	—	—	—
6- 7 »	8.5	—	—	—
8- 9 »	9.0	—	—	—
10-11 »	10.0	—	—	—
12-14 »	11.0	—	—	—
3 weeks	12.0	—	—	—
4 »	14.0	—	—	Ad-lib.
5 »	9.0	5.0	0.125	»
6 »	7.0	7.0	0.25	»
7- 8 »	5.0	9.0	0.5	»
9-10 »	—	14.0	0.75	»
11-12 »	—	14.0	1.0	»
13-14 »	—	14.0	2.0	»
15-16 »	—	14.0	3.0	»
17-18 »	—	12.0	4.0	»
19-20 »	—	10.0	4.0	»
Total ...	468.0	1302.0	104.125	—

From weaning till 6 months of age, calves were given clover or alfalfa and hay ad-lib., and when the pasture was poor each calf was given five pounds daily of a mixture of 1 part linseed cakes, 1 part wheat bran, 1 part crushed barley, 2 % lime and 1 % salt. During the next 6 months, the calf was given 6-7 pounds daily from a mixture consisting of 1 part cottonseed cakes, 1 part wheat bran, 1 part crushed barley, 2 % lime and 1 % salt, with access quantities of straw and good hay.

TABLE B
The second system of suckling.

Age of calf	Quantity of milk consumed daily Whole milk (pounds)	Calf meal (pounds)	Hay
1-3 days	With dam	—	—
4-7 »	8.0	—	—
2 weeks	8.5	—	—
3 »	9.0	—	—
4 »	9.5	0.125	Ad-lib.
5 »	10.0	0.25	»
6 »	10.5	0.5	»
7 »	11.0	0.75	»
8 »	11.5	1.0	»
9 »	12.0	1.5	»
10 »	14.0	2.0	»
11 »	14.0	2.5	»
12 »	12.0	3.0	»
13 »	9.0	3.5	»
14 »	7.0	4.0	»
15 »	6.0	4.0	»
16 »	4.0	4.0	»
Total ...	1162.0	187.375	—

During the suckling period, calves were kept in groups of 3 to 4 calves which were similar as possible in age, condition and quantity of milk consumed. Calves of the second and third groups were kept separated in wooden boxes after they were taken from their dams until they were 21 days old.

After weaning, calves were kept in loose barns adequately bedded with rice straw in groups of about 20 calves. When they were 8 months old, males were separated from females. Numbers of calves given in the tables were for the actually weighed calves. In some cases animals would miss weighing at a certain age and weighed afterwards; therefore the numbers may be less or lower in one group to the other accordingly.

TABLE C

The third system of suckling.

Age of calf (week)	Quantity of milk consumed daily Whole milk (pounds)	Calf meal (pounds) ⁽¹⁾	Hay
1	With dam	—	—
2	10	—	—
3	12	—	—
4	14	0.125	Ad-lib.
5	15	0.25	»
6	15	0.5	»
7	15	0.75	»
8	15	1.0	»
9	14	1.5	»
10	12	2.0	»
11	10	2.5	»
12	8	3.0	»
13	4	4.0	»
Total ...	1008	109.375	—

Weights were recorded in kilograms to the nearest kilogram at birth, 4 and 12 months of age. Birth weight was taken within 24 hours after birth; one single reading was taken for the next weights at 3 p.m. before either suckling or feeding. Relative growth rate was estimated for these stages of life according to the formula $\frac{W_2 - W_1}{\frac{1}{2}(W_2 + W_1)} \times 100$ (Brody, 1945). Analysis of variance was followed according to Snedecor (1959).

⁽¹⁾ Contents of calf meal :

- 2 parts wheat bran.
- 2 parts crushed barley.
- 1 part linseed cake.
- 2 % lime.
- 1 % salt.

RESULTS AND DISCUSSION

1.—*Effect of sex on body weight and relative growth rate :*

Table 1 shows the mean body weight at birth, 4 and 12 months of age for males and females. It was noticed that males were superior to females at the different ages studied. Differences due to sex were significant (Table 2). This result agrees with Schutte (1935) and Koger and Knox (1945) who stated that there was a definite effect of sex on weight.

It was also observed that the mean body weights obtained in this work were less than those reported in foreign studies for the same breed. Stallcup (1949) found that the mean birth weight in heifer calves was 35.33 kgs., the mean birth weight at 4 months was 105.37 kgs., and at 12 months was 283.55 kgs. Davis and Hathaway (1956) found that the mean body weight of the yearling females was 704 lbs. (312.8 kgs.).

It was observed from Table 3 that the rate of growth in the first 4 months of life exceeded that of the following 8 months in both males and females. Sex had no significant effect on the relative rate of growth in the two periods of growth studied (Table 4); yet it was observed from Table 3 that the mean relative growth rate was higher in females than in males. This result was contradicting to those obtained by Carneiro (1936) and Tantawy (1948).

TABLE 1
Effect of sex on absolute body weight.

Sex	Age in months					
	Birth		4		12	
	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)
Males	189	32.50 ± 0.36	117	98.64 ± 1.02	65	176.88 ± 3.93
Females	185	30.44 ± 0.36	111	95.91 ± 0.87	70	170.58 ± 3.56

TABLE 2

Summary of the effect of sex, system of rearing
and month of birth on body weight.

Factors	Age in months		
	Birth	4	12
	M. S.	M. S.	M. S.
Sex	16.4167 ^{XX}	4.1456 ^X	6.9479 ^{XX}
System of rearing	7.8418 ^{N.S.}	28.4412 ^X	207.7312 ^{XX}
Month of birth	5.2194 ^X	6.9534 ^X	15.6970 ^{XX}

TABLE 3

Effect of sex on relative rate of growth in body weight.

Sex	Age in months			
	0-4		4-12	
	No.	Percentage	No.	Percentage
Males	105	101.7 ± 0.1	35	59.0 ± 2.4
Females	105	102.4 ± 0.1	41	60.0 ± 2.6

TABLE 4

Summary of the effect of sex, system of rearing and month of birth
on relative rate of growth in body weight.

Factors	Age in months	
	0-4	4-12
	M. S.	M. S.
Sex	2.00 ^{N.S.}	8.33 ^{N.S.}
System of rearing	34.00 ^{XX}	39.50 ^{XX}
Month of birth	9.00 ^{XX}	5.19 ^{XX}

A fair comparison could be made between these estimates and the results obtained in this work without bearing in mind that our estimates represented the calf crop of the first imported herd which consisted of heifers and young cows still far from full body maturity and not yet adapted to the new environment.

Through time, it will be evident whether the future Friesian breed of this country can keep its original size or better be smaller, since animals of small size are more tolerable to heat. The reflection of size on the other productive characteristics along with the interaction between the elements of the new environment and the inherent characters of this breed will define the final picture of the Friesian in its new habitat.

II.—*Effect of system of rearing on body weight and relative growth rate :*

There were no significant differences between the mean birth weights of the three calf groups representing the three systems of rearing used. At the age of 4 months, the best results obtained were those of the third system of rearing (Table 5). It enabled the calves to reach nearly the same weaning weight at the age of 3 months, which was reached at 4 months of age following other systems. This result pointed to the fact that more quantities of milk must be fed at early stages of life (Table C) to obtain better growth and weight. Differences between groups in body weight were statistically significant (Table 2).

TABLE 5
Effect of system of rearing on absolute body weight.

System	Age in months					
	Birth		4		12	
	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)
1	129	32.60 ± 0.41	58	90.43 ± 1.17	78	153.27 ± 2.26
2	72	31.21 ± 0.49	73	96.92 ± 1.10	57	201.46 ± 2.44
3	173	30.77 ± 0.41	97	101.78 ± 0.92	—	—

Unfortunately, data were not collected for the third group of calves at the age of 12 months. However, the estimates obtained for the first and second group at this age showed that the mean body weight of the second group exceeded that of the first by 48.19 kgs., which represented 31.44 % of body weight. This difference was highly significant (Table 2). It could be reported that differences in body weight between groups, in favour of the second and third systems, were mainly due to the higher standard of nutrition used in these systems, represented in the amounts of whole milk and calf meal consumed (Tables A, B and C). Also, the improvement of management, housing and treatment of calves had contributed to the differences obtained in these results.

The results obtained for the relative growth rate body weight ensured those of the absolute body weight obtained through the application of the three systems of rearing used. The group of calves representing the third system of rearing gave the highest percentage of increase in body weight as compared with the other groups during the first a months of age (Table 6).

TABLE 6

Effect of system of rearing on relative growth rate in body weight.

System	Age in months			
	0-4		4-12	
	No.	Percentage	No.	Percentage
1	54	92 ± 0.4	36	50 ± 0.2
2	59	104 ± 0.1	40	67 ± 0.4
3	97	107 ± 0.4	—	—

The calves of the second group scored a higher rate of growth than those of the first one during the following 8 months of age. Differences between groups were highly significant (Table 4). No data were available for the third group concerning this stage of life.

These results indicated that the system of rearing and the quantity of milk consumed not only affect the absolute body weight, but also

influences its growth rate. This agrees with Knapp and Black (1941) and Willard (1948). However, further detailed work for more than one season on calves born from heifers and cows of different ages should be carried out to find out the methodical systems of rearing, feeding and grazing of animals under the local conditions.

III.—*Effect of month of birth on body weight and relative growth rate :*

The mean birth weight fluctuated from 26.64 ± 1.55 kgs. for calves born in August to 32.89 ± 0.58 kgs. for those born in January (Table 7). Slight increase was generally observed in the mean birth weight of the calves born from August to January; only small variation was found between the calves born from January to May. No calves were born in June. The variation of birth weight due to month of calving was highly significant (Table 2). It was clearly noticed that seasonal variation in atmospheric temperature, level of nutrition and adequacy of green fodder affect the newly born calf through the effect of its dam during the months of pregnancy. This result was contradictory to that reported by Asker and Ragab (1952) when studying the factors affecting birth weight in Egyptian cattle and buffaloes. This may be due to the fact that native animals are more adaptive to the local environment than the Friesian cattle.

The effect of month of birth on body weight was less remarkable at the age of 4 months (Table 7). This may be due to the fact that calves were put under similar conditions during their first 4 months of age, and received adequate quantities of milk, hay and concentrates. The maximum weight was 104.66 ± 1.74 kgs. for calves born in September, while the minimum weight was 85.5 ± 4.21 kgs. for those born in July. The mean body weight tended to increase from July to September, when it reached its maximum. Irregular decrease was noticed from September to August. No data were available for the months of April, May and June. Differences between month groups were statistically significant (Table 2). This is contradictory to what Ahmed (1953) has found in both Egyptian cattle and buffaloes where no effect for the month of birth was observed.

TABLE 7

Effect of month of birth on absolute body weight

Month of birth	Age in months					
	Birth		4		12	
	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)	No.	Mean Wt. (kgs.)
July	5	30.40 ± 4.40	4	85.50 ± 4.21	—	—
Aug.	14	26.64 ± 1.55	9	91.00 ± 3.14	6	216.33 ± 8.77
Sept.	12	28.00 ± 1.05	6	104.66 ± 1.74	4	220.75 ± 3.57
Oct.	38	29.29 ± 0.86	33	98.79 ± 1.94	7	212.14 ± 6.36
Nov.	49	30.41 ± 0.66	43	101.77 ± 0.53	10	203.10 ± 7.71
Dec.	40	30.62 ± 0.71	25	98.16 ± 1.93	14	185.50 ± 4.02
Jan.	53	32.89 ± 0.58	43	99.63 ± 1.46	18	174.22 ± 6.19
Feb.	65	32.54 ± 0.60	43	92.81 ± 1.30	32	163.53 ± 4.83
Mar.	60	32.82 ± 0.62	18	89.87 ± 2.05	32	157.03 ± 4.05
Apr.	24	32.08 ± 0.76	—	—	9	145.67 ± 3.63
May.	7	32.43 ± 2.06	—	—	—	—

The effect of month of birth on body weight was highly significant in the yearling calves (Table 2). The maximum body weight was 220.75 ± 3.57 kgs. for calves born in September, while those born in April had the minimum body weight (145.67 ± 0.63 kgs.). This may be due to the fact that the former group had a better chance for clover during mild weather after weaning. Peacock (1956) agreed with these results, indicating that the effect of month of birth on body weight is significant.

The mean percentage of increase in body weight during the first 4 months of life tended to be higher in calves born from August to December, as the calves born in October and November scored the maximum percentage of increase in body weight (Table 8). Lower rates of growth were found in calves born December to February. In March, the mean relative growth rate in body weight was rather high as happened in the mean birth weight. No data were available for April, May and June. Differences between months of birth, concerning rate of growth, were highly significant (Table 4).

TABLE 8
Effect on month of birth on relative growth rate in body weight

Month of birth	Age in months			
	0-4		4-12	
	No.	Percentage	No.	Percentage
July	4	96.0 ± 14.0	—	—
Aug.	6	102.0 ± 6.0	—	—
Sep.	4	105.0 ± 11.0	—	—
Oct.	21	108.0 ± 0.2	—	—
Nov.	43	108.0 ± 0.2	10	68.0 ± 0.2
Dec.	26	104.0 ± 0.2	10	69.0 ± 1.1
Jan.	44	99.0 ± 0.2	15	61.0 ± 3.3
Feb.	42	94.0 ± 0.2	24	55.0 ± 0.3
Mar.	18	99.0 ± 10.0	13	50.0 ± 6.3

In the following 8 months (from 4 to 12 months of age), the maximum mean relative growth rate was that for calves born in December. The percentage of growth in body weight decreased in calves born in January and February till it reached the minimum mean in the March group. No data were available for the months from April to October. Differences between month groups were highly significant (Table 4).

The results obtained in this study suggest that calvings occurring during the months of September to December resulted in greater rate of growth for calves from birth till 12 months of age. These results agree with Philips (1946) who reported that calves born in October to December made greater gains during their first 700 days of life.

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المخلص

تأثير بعض العوامل البيئية على وزن الجسم ومعدل النمو في ماشية الفريزيان بمديرية التمحرير

أجريت هذه الدراسة على قطع الفريزيان بمديرية التمحرير خلال الفترة من يوليو سنة ١٩٥٥ إلى يونيو سنة ١٩٥٨ لدراسة تأثير الجنس وطريقة الرعاية وشهر الميلاد على وزن العجول والعجلات ومعدل نموها خلال السنة الأولى من حياتها . وقد شملت الدراسة ٢١٨ ذكراً و٢١٧ أنثى واستعملت ثلاث طرق للرعاية كما استمرت الولادات طوال السنة . وقد اتبعت التغذية على اللبن الكامل واللبن الفرز في الطريقة الأولى - وقد استهلك كل حيوان ٤٦٨ رطلاً من اللبن الكامل و١٣٠٢ رطلاً من اللبن الفرز و $١٠٤\frac{1}{8}$ رطلاً من الذرة المجروشة - واستمرت فترة الرضاعة ٢٠ أسبوعاً . أما الطريقتين الثانية والثالثة فقد كانت التغذية فيهما على اللبن الكامل وعليقة خاصة للنمو - وقد استهلك في الطريقة الثانية ١١٦٢ رطلاً من اللبن الكامل و $١٨٧\frac{3}{8}$ رطلاً من العليقة لكل حيوان في مدة ١٦ أسبوعاً ، بينما استهلك في الطريقة الثانية ١٠٠٨ رطلاً من اللبن الكامل و $١٠٩\frac{3}{8}$ رطلاً من العليقة لكل حيوان في مدة ١٣ أسبوعاً . وقد اتضح من الاختبارات الإحصائية وجود تأثير معنوي لجميع العوامل التي تناولها البحث على وزن الجسم - فقد تفوقت الذكور على الإناث وحققت الطريقة الثالثة للرعاية أفضل النتائج كما كان لمواليد شهر يناير أكبر متوسط لوزن الميلاد ، بينما كان أكبر متوسط للوزن عند عمر ٤ ، ١٢ شهراً لمواليد شهر سبتمبر .

وبالنسبة لمعدل النمو فقد اتضح أنه يزيد خلال الأربعة أشهر الأولى للنمو عنه خلال الثمانية أشهر التالية في الذكور والإناث ورغم أن الإناث فاقت الذكور في معدل نموها إلا أنه لم يكن هناك فرق معنوي بين معدل النمو . بينما كان لطريقة الرضاعة وشهر الميلاد تأثير معنوي على معدل النمو ، وقد حققت الطريقة الثالثة أيضاً أفضل النتائج بالنسبة لمعدل النمو - كما كانت موالييد أشهر أكتوبر ونوفمبر وديسمبر أسرع نمواً من غيرها .