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INTER-RELATIONS BETWEEN BODY-WEIGHT,
BODY MEASUREMENT AND RELATIVE GROWTH
RATE IN A GROUP OF FRIESIAN CALVES

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I.—Interrelationship between body weight & relative rate of growth :

A rather low but significant correlation was observed between body weight at birth (W_1) and at 4 months (W_2), as it was 0.1917. Correlation was also strong between body weight at 4 months and at the age of 12 months (W_3). The correlation coefficient was 0.348. On the other hand, the relation between w_1 and w_3 was negative but too low to be significant.

A strong correlation was also observed between the relative rate of growth during the first months of life (R_1) on one hand and w_1 and w_2 on the other, and between the relative rate of growth during the next 8 months (R_1) and W_3 . Correlation Coefficients were 0.3796, 0.4965, 0.7678 respectively for $w_1 R_2$ & $w_3 R_2$ and $w_3 R_2$ while there was a weak correlation between w_2 and R_2 , and between R_1 and R_2 .

II.—Interrelationship between body measurements and relative rate of growth :

The relationship between the estimates of absolute body length at different ages was too weak to be significant. The correlation between the estimates of height at withers (H_1), heart girth (G_1) and abdomen girth (A_1) at birth on the one hand and respectively at 4 months H_2 , G_2 and A_2 on the other hand, were highly significant.

Relationship between H_1 and H_3 was negative and not significant. It was also negative but significant between G_1 and G_3 . The correlation between A_1 and A_3 was positive and highly significant. The correlation coefficients between the absolute body measurements at four months and at 12 months of age were not significant in all cases except in height at withers as it was highly significant.

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A strong correlation was found between the absolute body measurements and the contiguous relative rate of growth in all stages studied. The correlation coefficients showed similar trend in all cases. They were negative between the initial measurements and the following percentage of increase, while they were positive between the final measurements and the previous relative rate of growth.

Correlation coefficient between R_1 and R_2 were too low to be significant in all cases.

III.—*Relationship between body weight & certain measurements :*

The relationship between weight on the one hand and between height at withers and heart girth on the other was investigated at all ages studied. The correlation coefficients between body weight and height at withers were 0.6144 at birth, 0.4037 at 4 months and 0.7466 at the age of 12 months, while the correlation coefficient between body weight and heart girth were 0.7576, 0.7880 and 0.9142 respectively for the previously mentioned age groups.

INTRODUCTION

Body weight and growth rate are two physiological features of body development. The relation between the two aspects are still questionable and if it is proved to exist and on genetical basis, selection for fast growing and heavy animals could be more constructive.

Therefore the relationship between body weights and body measurements as well as growth rate were studied.

Material and methods :

Material previously described by the authors (1961) was used. Body measurements were taken. Relative rate of growth was estimated for 2 periods : from birth to 4 months, and from 4 months to 12 months of age. The formula used was that mentioned by Brody (1945). The inter-relationship between body weights, body measurements and relative rate of growth at different ages in study was estimated by using simple correlation coefficients calculated according to Snedecor (1959).

The following symbols were used in the text :—

LIST OF SYMBOLS

Item	Symbol		
	At birth	At 4 months	At 12 months
Body weight	W_1	W_2	W_3
Body length	L_1	L_2	L_3
Height at withers	H_1	H_2	H_3
Heart girth	G_1	G_2	G_3
Abdomen girth	A_1	A_2	A_3
Relative rate of growth	R_1		R_2

RESULTS AND DISCUSSION :

I.—*Relationship between body weights at different ages :*

The correlation coefficient between birth weight (W_1) and the weight at 4 months of age (W_2), and between (W_2) and the weight at 12 months of age (W_3), were significant (Table 1).

The relation between W_1 and W_3 was negative, but lacking significance. These results indicated that the preceding body weight influenced the following weight in different extents depending on the stage of life. This agrees with the findings of Ver (1950) and Mayer (1958), who reported that there was no constant relationship between birth weight and weight at maturity, and indicated

that birth weight is not important in selecting calves for breeding. On the other hand, Tantawy and Ahmed (1955) found a close correlation between birth weight and body weight up to 2 years in Egyptian cattle. Willard (1948) also reported that the final weight was directly proportioned to birth weight.

II.—*Relationship between body measurements at different ages:*

The correlation between the first two age groups was highly significant in all the measurements studied, except in the case of body length, following the same trend arrived at for body weight. (Table 1). No significant correlation was found between body length and height at withers at birth on the one hand, and at 12 months of age of the other, while there were significant correlation coefficients in the case of heart girth and abdomen girth in the previously mentioned age groups. The correlation coefficients between the direct body measurements at the age of 4 months and their corresponding ones at 12 months of age were not significant in all cases except in the case of height at withers.

III.—*Relationship between body weight and body measurements :*

Height at withers and heart girth were taken as criteria for the relation between body conformation and weight. This relation is important from the partial point of view since body weight and chest girth are highly correlated that a fairly accurate estimate of weight may be attained by measuring chest girth. The accuracy can be measured by the measurement of height at withers (Davis et al., 1937).

Correlation coefficients between body weight on the one hand, and height at wither and heart girth on the

other, were highly significant in all the age groups studied, heart girth was more strongly correlated to body weight (Table 2.).

Similar results were obtained in many studies, as Veiga (1939), Branton and Salisbury (1946) and Buiatti (1954), reported strong correlation coefficients between body weight and height at withers, and between body weight and heart girth.

IV.—*Relationship between body weight and relative rate of growth :*

Table (1) shows the relationship between W_1 and R_1 , W_2 and R_1 and between W_3 and R_2 . All coefficients were positive and highly significant, while there was a weak correlation between W_2 and R_2 .

Willard (1948) reported that the daily gain up to 180 days in the Holstien calves was influenced by birth weight which agreed with the results obtained in this study. Further study was made by Ruby et al (1948) reported also that there was close correlation between contiguous weights and gains, while Warwick (1955) found that there was no important effect of the initial weight on the subsequent gain.

V.—*Relationship between body measurements and relative rate of growth :*

Strong relationships between the absolute body measurements and the preceeding and following rates of growth in all cases were observed (Table 1). The relation between body measurements and their relative rate of growth showed a similar trend. The correlation coefficients between the initial body measurements and the following rates of growth,

were negative while they were positive when worked out between each of the body measurements and its previous rate of growth. The correlation between body length at birth (L_1) and the following rate of growth (from birth to 4 months of age) was negative, while it was positive between the same rate of growth and the body length at 4 months of age (L_2). These results show that the relative rate of growth influences the following absolute body measurement to a greater extent than the effect of the initial measurement.

VI.—*Relationship between relative rate of growth in body weight and measurements in the different periods of growth :*

Correlation coefficients were estimated for the relationship between the relative rate of growth in body weight and measurements in the two periods of growth studied (from birth to 4 months R_1 , and from 4 to 12 months of ages R_2). All the correlation coefficients were not significant and found to be positive in all cases except in the case of the abdomen girth (Table 2).

The weak correlation obtained R_1 and R_2 indicated that the relative rate of growth in the first 4 months of life was absolutely independent from that of the next 8 months.

General Discussion :

The relationship between body weight at birth and that at 4 months of age, and between weight at 4 months and at 12 months of age, were highly significant, while the correlation coefficient was too low to be significant in the case of the relationship between body weights at birth

dan at 12 months of age. Concerning body measurements, the correlation between the first two age groups was highly significant in all measurements studied except body length. No significant correlation was found in the case of body length and height at withers at birth on the one hand, and at 12 months of age of the other hand, while there was significant correlation in the case of heart girth and abdomen girth in the previously mentioned age groups.

The correlation between body measurements at the age of 4 months and then at 12 months of age were not significant in all cases except in the case of height at withers.

Correlation between body weight at different ages on the one hand and the relative rates of growth on the other, were all positive and highly significant, except in the case of the relation between body weight at 4 months of age and the following rate of growth. Correlation between body measurements and their relative rate of growth in the two periods studied showed a similar trend in all cases. For instance, the correlation between body length at 4 months of age and the previous relative rate of growth (from birth to 4 months) was positive, while it was negative between body length at this age and the relative rate of growth from 4 months to 12 months of age, i.e. the correlation was found to be negative between the initial body measurements and the following relative rate of growth, while it was positive between the final body measurements and the previous rate of growth.

These results show that the relative rate of growth influence the following absolute body weight and measurements to a greater extent than the effect of the initial weights and measurements.

No significant correlation was found between the relative rates of growth in the two periods studied in body weight and measurements.

Studying the relationship between body weight and measurements, a strong correlation was found between body weight on the one hand and height at withers and heart girth on the other. This relation is important from the practical point of view since it is an exponential relation. The body weight and chest girth are so correlated that quite an accurate estimate of weight may be obtained by measuring chest girth. The accuracy can be measured by the measurement of height at withers (Davis et al., 1937).

Repeatability of body weight in Friesian calves was 0.205, while it was 0.054, 0.319, 0.235 and 0.647 respectively for body length, height at withers, heart girth and abdomen girth.

It was found that abdomen girth had the highest repeatability. The heritability of birth weight on this study was very close to that obtained by Asker and Ragab (1952), Abdel Salam (1960) working on Egyptian cattle, and Knapp and Nordskog (1946) on beef cattle in U.S.A. Heritability estimates of body weight at 4 and 12 months of age do not agree with those reported by other workers. However, it could be mentioned that only dependable heritability estimate was that of the body weight at birth. The limited number of sires as well as the small number of calves in some cases, may be responsible for the odd results obtained.

It should be noted that in studying the growth and development of Friesian calves in Egypt, the problem should be tackled from the physiological point of view. Moreover, the heat tolerance as well as the age at sexual

maturity, and breeding efficiency should be studied. It should be taken into consideration that the characteristics of the successful Friesian in Egypt may not be necessarily the same as those of the standard breed in Holland or any other country. The history of this breed itself gives a good example as to how its characteristics differed not only from one country to the other, but also differed from one province to another in the same country.

The characteristics of the Egyptian Friesians would be those of rapid growing animals achieving weight heavier than those of Egyptian cattle at younger ages, and may be less than those of buffaloes, and heifers should be early in sexual maturity. The average age at first service should be 15 months, so that the average age at first calving should be 24 months. Mortality rate should not be exceeding 15% to the age of 3 years. Cows should give an average of 3000 kgs. of milk per lactation, and the fat percentage should not be less than 3.8%.

These characteristics are not supposed to remain static as they may change if either environmental or economic circumstances are changed.

TABLE 2.

Relationship Between Body Weight and Body Measurements (*)

Items	No.	r
$B_1 \times H_1$	187	0.6144 xx
$B_2 \times H_2$	219	0.4037 xx
$B_3 \times H_3$	116	0.7466 xx
$B_1 \times G_1$	187	0.7576 xx
$B_2 \times B_2$	219	0.7680 xx
$B_3 \times G_3$	116	0.9142 xx

(*) The number of calves at the age of 4 months was more than that used at birth, because some of the calves used in the study were not measured at birth for technical difficulties.

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ملخص

العلاقات المتبادلة بين وزن الجسم ومقاييسه وبين معدل النمو
في مجموعة عجول الفريزيان

١ — العلاقات بين أوزان الجسم ومعدل النمو عند مراحل العمر المختلفة :

من دراسة علاقة أوزان الجسم عند المراحل المختلفة من العمر اتضح وجود علاقة قوية بين وزن الميلاذ والوزن عند ٤ شهور وبين الوزن عند ٤ شهور والوزن عند ١٢ شهراً من العمر . أما العلاقة بين وزن الميلاذ والوزن عند ١٢ شهراً فوجدت سالبة إلا أن التلازم لم يكن معنوياً .

وقد وجد أيضاً تلازم قوى بين معدلات النمو من جهة وبين أوزان الجسم من جهة أخرى في مراحل العمر التي تناولتها الدراسة إلا أن العلاقة بين الوزن عند ٤ شهور وبين معدل النمو في الفترة من ٤ شهور إلى ١٢ شهراً من العمر كانت ضعيفة كما كان الارتباط بين معدلات النمو في مرحلتى العمر التي أجريت عليها الدراسة غير معنوياً .

٢ — العلاقات بين مقاييس الجسم ومعدل النمو عند مراحل العمر المختلفة :

بحساب معامل التلازم بين طول الجسم في مراحل العمر المختلفة وجد أن التلازم لم يكن معنوياً بين جميع مراحل العمر التي درست . بينما كانت العلاقة بين باقى المقاييس التي تناولها البحث عند الميلاذ وعند ٤ شهور من العمر معنوية . وقد درست العلاقة بين مقاييس الجسم عند الميلاذ وعند ١٢ شهراً من العمر ووجد أن معامل التلازم في حالة ارتفاع الكتف كانت سالبة غير أنها لم تكن معنوية . كما كانت سالبة ومعنوية في حالة الصدر . أما في حالة محيط البطن فقد كان التلازم قوياً وموجباً . وقد كان التلازم بين المقاييس عند ٤ شهور وعند ١٢ شهراً من العمر ضعيفاً في جميع المقاييس ما عدا في حالة ارتفاع الكتف حيث كان معامل التلازم مرتفعاً .

وقد لوحظ أن العلاقة بين مقاييس الجسم ومعدلات النمو المجاورة لها تعطي اتجاهًا متشابهًا في جميع الحالات . فقد وجد أن العلاقة بين المقاييس الأولية ومعدل النمو التالي لها سالبة بينما كانت موجبة بين المقاييس النهائية ومعدل النمو السابق .

أما العلاقة بين معدلات النمو في مرحلتى النمو (من الميلاد إلى ٤ شهور ومن ٤ شهور إلى ١٢ شهرًا) فقد كانت ضعيفة في جميع المقاييس .

٣ — العلاقة بين وزن الجسم وبعض المقاييس :

درست العلاقة بين وزن الجسم من جهة وارتفاع الكتف ومحيط الصدر من جهة أخرى . وقد كان معامل التلازم معنويًا في كل الحالات وعند مراحل العمر المختلفة ، إلا أنه كان أكثر وضوحًا في حالة التلازم بين وزن الجسم ومحيط الصدر .