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PREDICTION OF LIVE-WEIGHT FROM CHEST GIRTH IN FRIESIAN BEEF CATTLE*

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Holştayn Sığırlarında Göğüs Çevre Ölçüsünden Canlı Ağırlığın Tahmini

Özet: Göğüs çevre ölçüsünden canlı ağırlı tahmin edebilme imkânını araştırmak için 27 adet Holştayn sığırı bu araştırmada materyal olarak kullanılmıştır. Analizler beş canlı ağırlık periyodunde; 90-173, 173-257, 257-318, 318-379 ve 379-440 kg yapılmıştır. Göğüs çevre ölçüsü ile canlı ağırlık arasında yüksek bir korelasyon bulunmuştur. Canlı ağırlığı tahmin etmek için, birinci canlı ağırlık periyodunda (90-173 kg) erkek, kastre edilmiş erkek ve dişi sığırlar için müşterek bir regresyon eşitliği, 173-440 kg arasındaki canlı ağırlık periyodlarında ise farklı cinsiyetler için değişik regresyon eşitlikleri kullanmanın uygun olacağı hesap edilmiştir.

Summary: Twenty-seven Friesian cattle, including three sexes, were used to investigate possibility of estimating live-weights from chest girth measurement. The relationship between live-weight and chest girth measurement was investigated in each of the five-weight periods (90-173, 173-257, 257-318, 318-379 and 379-440 kg). Chest girth measurement was highly correlated with live-weight. For the period 90-173 kg a pooled regression equation (all sexes) satisfactorily represented in the relationship between chest girth and live-weight. For the periods 173-440 kg it was necessary to use separate regression equations to descriribe the relationship between chest girth and live-weight.

Introduction

The objective of this investigation was to devise regression equations to enable live-weight to be predicted from chest girth measurement. This information is already in existence for adult cattle, from the pioneering work of Brody (5), but there is less information availab-

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le, perticularly for rapidly growing cattle of different sexes. The usefullness of such regression equations is not stressed in view of the high cost of purchasing weighbridges. Such information would be useful when the weighing facilities of cattle are not available.

Studies into the relationship between live-weight and chest girth are summarised in table 1.

Table 1. Relationship Between Live-weight (kg) and Chest Girth (cm) in Cattle.

Breed	Sex and Age	No. of Animals	Mean Live Weight	r	b
Local breeds[1]	Fermale				
	1–12 weeks	36	35	0.90	–
	13–24 weeks	36	71	0.91	–
Hungarian Brown[2]	Cows 4/½ years	451	–	0.70	–
Dairy Shorthorn[3]	Male and female calves, 24 hours after birth	74	37	0.83	–
Friesian[6]	Bulls, cows and heifers	474	495	0.95	7.58
Hariana[7]	Mixed, —	153	–	0.95	10.4
Jersey[8]	Cows: pregnant	36	–	–	6.7
	old	117	–	–	5.5
	young	61	–	–	4.4
Norvegian Red Poll[9]	Bulls,	282	633	0.92	8.83
Aberdeen Angus[10]	Castrates,	32	482	0.32	–
	1 year	39	430	0.60	–
		29	346	0.87	–
Hereford[11]	Castrates,	14	488	0.56	–
	1 year	13	451	0.57	–
		18	361	0.70	–

The experiments cited show a wide range of breed, age and live-weight. Most investigators quated correlation coefficients only. The b value of the regression equation was given in only 4 of the 9 references and none of these gave standart errors of the estimation.

Correlation coefficients were high in calves (1, 3) (90–91 and 0.83). Correlation coefficients were also high in adult cattle (2, 6, 9) (0.70, 0.95 and 0.92). In the another data correlation coefficients ranged from 0.32 to 0.87. According to these results, lighter animals appeared to give a higher correlation than heavier types (11).

The pioneering work on estimating live-weight from body measurements in cattle was done by Brody and his associates (4). Their investigation involved four breeds: Holstein, Jersey, Guernsey and Ayrshire, and data was obtained from 15, 610 animals of widely different live-weights and ages. Chest girth was found to be the measurement most closely related to live-weight.

The extent to which the relationship between live-weight and chest girth measurement is changed by weight ad age of animals is not documented, as mentioned earlier. The effect of sex during growth upon relationship at different live-weights appears to be unknown as judged by the lack of published information. The investigation to be described in this paper was conducted to yield information on these points.

Material and Method

Twenty-seven Friesian cattle, including three sexes, were used in this study. The plan of the experiment from which data for the present study was collected is shown in table 2.

Table 2. Live-weight Periods, Number of Animals and Observations Per Period.

Live-weight periods analysed	MALE		CASTRATE		FEMALE	
	n	Number of observs.	n	Number of observs.	n	Number of observs.
I. 90–173 kg	10	63	8	57	9	66
II. 173–257 kg	10	59	8	54	9	62
III. 257–318 kg	10	48	8	47	7	43
IV. 318–379 kg	8	36	5	28	4	25
V. 379–440 kg	5	31	4	24	3	17

The weighing of animals was carried out every two weeks at 08. 00 h. or as near as possible to that time. Using a halter, each animal was taken to the weighbridge (Avery platform scale, weighing to nearest 1/2 kg). Animals were identified by metal ear tags.

Chest girth measurements (the circumference immediately behind the shoulder blades in a plane perpendicular to the body axis - the smallest circumference) were taken at fortnightly intervals starting at the beginning of 90 kg live-weight. Chest girth measurements were taken with a tape measure graduated in mm. In the case of measurements a pocket spring balance was attached on the end of the tape,

tightened to tensions 1 kg, 1.5 kg. and 2 kg. The measurements using three different tensions, were repeated four times and observations were recorded to the nearest 1 mm. The mean of these observations at a given tension was taken as the measurement for that occasion.

The animals were measured on level concrete ground, care being taken to get them standing squarely on all four feet, in a natural position. Measurements were always taken on the right hand side of the animal. During measuring, animals were tightened to a gate. As described earlier, weighing was carried out at 08.00 h. and measuring proceeded during the rest of that day.

All animals were fed with a High Plane diet and given on *Ad. libitum* basis. This diet was an all concentrate "barley beef" system (Intensive Cereal Beef, as defined by U. K. Meat and Live-stock Commission).

Results

The relationship between live-weight and chest girth measurement was investigated in each of the five live-weight periods (c. f. table 2) in an attempt to establish the usefulness of the measurements as methods of predicting live-weight. In the regression equation computed, live-weight was taken as the dependent variable and chest girth measurement as independent variable.

Girth of chest was measured using different tensions of measuring, but the regression equation presented for this measurement involve only 1 kg of tension of tape. Because, this tension yielded equations with the lowest standard error of the regression coefficient (b).

Correlation and regression coefficients are presented in table 3.

Table 3. Correlation (r) and Regression (b) Coefficients at Five Live-weight Periods.

Live-weight periods	Males		Castrates		Females	
	r	b∓SE	r	b∓SE	r	b∓SE
I. 90.173 kg	0.98	3.1 ∓ .08	0.98	3.1 ∓ .07	0.97	3.1 ∓ .08
II 173–257 kg	0.97	4.2 ∓ .13	0.96	3.9 ∓ .13	0.96	3.9 ∓ .14
III. 257–318 kg	0.91	4.3 ∓ .27	0.91	3.8 ∓ .24	0.90	3.8 ∓ .28
IV. 318–379 kg	0.90	4.2 ∓ .33	0.89	3.8 ∓ .38	0.84	3.5 ∓ .47
V. 379–440 kg	0.91	4.9 ∓ .41	0.84	4.2 ∓ .58	0.93	4.9 ∓ .49

All coefficients were significant at $P < 0.001$ level.

In colsulting table 3 it is notable that live-weight was significantly related to chest girth measurements throughout the experimental period (90–440 kg). Casual observation of the regression coefficients indicates a similarity for the different sexes within a given live-weight period. Therefore, the possibility of pooling the regression equation was examined. The validity of using one pooled equation for each period was established by comparing the residual sum of squares for the pooled data with the sum of the residuals for sexes, using the method of Snedecor (10). The failure of the F value to be significant indicates that for the live-weight period 90–173 kg one regression equation would satisfactorily represent the relationship between live-weight and chest girth, thus eliminating the need to consider the relationship for the sexes separately.

This exercise was repated for the relationship between live-weight and chest girth in each of the live-weight periods 2–5, but in each case the F ratio was highly significant, indicating that a pooled regression equation was unsatisfactory.

Table 4, therefore, shows a pooled regression equation for period one; but for periods 2–5 equations for the individual sexes are presented.

Table 4. Regression Equations For Estimating Live-weights (y, kg) from Chest Girth Measured at 1 kg Tension of Tape (x, cm) in Different Periods.

Live-weight periods	Sex	Range of chert girth (cm)	Regression equations
I. 90–173 kg	Mixed	95.3–126.3	$y = 3.2\ (\pm .03)x - 224.3$
II. 173–257 kg	Males	120.5–143.0	$y = 4.2\ (\mp .13)x - 337.6$
	Castrates	119.5–145.0	$y = 3.9\ (\mp .13)x - 316.5$
	Females	119.8–145.9	$y = 3.9\ (\mp .14)x - 307.5$
III. 257–318 kg	Males	137.9–155.3	$y = 4.3\ (\mp .27)x - 357.4$
	Castrates	138.4–159.4	$y = 3.8\ (\mp .24)x - 287.8$
	Females	138.8–158.6	$y = 3.8\ (\mp .28)x - 278.5$
IV. 318–379 kg	Males	149.4–166.6	$y = 4.2\ (\mp .33)x - 328.7$
	Castrates	153.0–172.2	$y = 3.8\ (\mp .38)x - 280.8$
	Females	150.0–170.3	$y = 3.5\ (\mp .47)x - 222.6$
V. 379–440 kg	Males	161.6–180.1	$y = 4.9\ (\mp .41)x - 425.3$
	Castrates	165.4–182.2	$y = 4.2\ (\mp .58)x - 327.9$
	Females	163.7–178.8	$y = 4.9\ (\mp .49)x - 442.7$

Discussion

Calculation of correlation and regression coefficients and their standard errors showed that chest girth was the most reliable for use in

predicting live-weights of animals and this is in agreement with the literature findings (1, 2, 3, 6, 7, 8, 9, 11).

The present investigation also showed that the residual variance was lower when using a measuring tape tension of 1 kg rather than 1.5 and 2 kg. There is no published data showing which tension is preferable. Besides giving the highest correlation with live-weight the chest girth is the simplest measurement to record.

The fact that the data for the sexes could not be pooled for animals in excess of 173 kg means that separate equations would need to be used for different sexes after this live-weight.

Assuming that chest girth measurement be used to estimate live-weight, the question that needs to be asked before the practical application is appreciated is with what confidence could one predict live-weight using the regression equations computed?.

Table 5 shows the confidence limits (10) of live-weight predicted in periods one and five from mean chest girth values at the beginning and end of the live-weight periods.

Table 5. The Confidence Limits of Predicted Live-Weight in Periods One and Five.

Periods		X_o (cm)	Y	$\hat{Y}$ (kg)	95 % Confidence limits	
					Lower	Upper
I. 90–173 kg	Males	97.8	90	88.6 ∓ 0.8	87.8	89.4
		121.8	173	165.5 ∓ 3.4	162.1	168.9
	Castrates	98.2	90	89.9 ∓ 1.3	88.6	91.2
		122.8	173	168.6 ± 3.5	165.8	172.1
	Females	97.4	90	87.3 ∓ 0.9	86.4	88.2
		121.6	173	164.8 ∓ 3.4	161.4	168.2
V. 379–440 kg	Males	163.9	379	377.8 ∓ 4.7	373.1	382.5
		174.7	440	430.7 ∓ 4.3	426.4	435.0
	Castrates	168.0	379	377.7 ∓ 5.9	371.8	383.6
		178.1	440	420.1 ∓ 6.0	414.1	426.1
	Females	166.8	379	374.6 ∓ 6.1	368.5	380.7
		177.6	440	427.5 ∓ 5.0	422.5	432.5

X_o = Mean chest girth at beginning or end of given period.
Y = Actual Live-weight.
$\hat{Y}$ = Predicted live-weight.

Table 5 shows that the live-weight in periods one and five would be estimated with accuracy such that 95 % of the predicted weight would be within at least 5 % of the true value.

The same picture is shown in table 6 for the confidence limits for males at six successive live-weights.

Table 6. The Confidence Limits of Predicted Live-weight of Males

Live-weights	X (cm)	$\hat{Y}$ (kg)	95 % Confidence limits	
			Lower	Upper
90 kg	97.8	88.6 ∓ 0.8	87.8	89.4
173 kg	121.8	165.5 ∓ 3.4	162.1	168.9
257 kg	140.5	246.7 ∓ 3.4	243.3	250.1
318 kg	152.2	310.5 ∓ 2.8	307.7	313.3
379 kg	163.9	377.8 ∓ 4.7	373.1	382.5
440 kg	174.7	430.7 ∓ 4.3	426.4	435.0

X_o = Mean chest girht measurement.
$\hat{Y}$ = Predicted live-weight.

There is no data in the literature showing confidence limits of live-weights estimated from chest girth. It is, therefore, impossible to make any comparison between the present results and published literature.

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