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Prediction of Body Weights from Body Measurements in Brown Swiss Cattle

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Abstract : Possibilities of the prediction of body weights from various body measurement taken at birth, 2, 6, 12 months, 2 and 3 years^{+} of age were studied in Brown Swiss cattle. Among the body measurements, heart girth yielded highest correlation coefficients with body weights, determined at different ages. Depending on this relationship, the heart girth measurement alone may be used to predict body weight in Brown Swiss cattle. Tables were developed and presented in order to predict body weights for female and male Brown Swiss cattle at different ages.

Key Words: Brown Swiss, Body Measurements, Body Weights.

Esmer Sığırlarda Vücut Ölçülerinden Canlı Ağırlıkların Tahmini

Özet: Bu çalışmada, esmer sığırların doğum, 2 ay, 6 ay, 12 ay, 2 ve 3 yaş canlı ağırlıklarının çeşitli vücut ölçülerinden tahminlenmesi imkanları araştırıldı. Hesaplanan korelasyon katsayıları, farklı yaşlarda tesbit edilen göğüs çevresi ile vücut ağırlıkları arasında çok kuvvetli bir ilişkin mevcut olduğunu göstermiştir. Ayrıca, esmer sığırlardan tek bir vücut ölçüsü alınması durumunda, yalnız başına göğüs çevresinin vücut ağırlıklarının tahmin edilmesinde kullanılabileceği anlaşılmıştır. Değişik yaşlardaki erkek ve dişi Esmer sığırların canlı ağırlıklarının tahmini olarak belirlenmesi amacıyla tablolar geliştirilmiş ve sunulmuştur.

Anahtar Kelimeler: Esmer Sığırlar, Vücut Ölçüleri, Vücut Ağırlıkları.

Introduction

Determination of the body weights of cattle at certain ages is one of the duties must be done by most dairy farmers. Body weights can be accurately obtained by using platform scales (weigh-bridges), but these facilities are not commonly found on the farms located in Eastern Turkey. Hence, the body weights of cattle at different ages have to be predicted by using body measurements.

The prediction of body weight by using body measurements was first investigated in Great Britain (1). The relationship between body measurements and body weights depends upon breed, age, and fattening level of the animals. Hence, the regression equations have to be determined separately for all cattle bereeds reared in different countries and locations (2).

In a study conducted on Brown Swiss calves raised in the east region of Turkey, only the possibility of prediction of body weights at birth, at weaning age and 6 months of age was investigated (3). However, the prediction of weights of Brown Swiss cattle at different age periods is frequently required in areas where weighing facilities are not available.

The present study was undertaken to develop regression equations for the prediction of body weights based upon the relationship with body measurements at various ages.

Material and Method

The data regarding body weights and measurements were obtained from a Brown Swiss (BS) herd reared at the Research Farm of Atatürk University, Erzurum.

Body weights and measurements were taken within 24 hours after calves were born and at 2, 6, and 12 months of ages. The rest of the measurements and weights were obtained at different time periods and the animals were grouped as 2 years and 3 years^{+} olds. Two years, and 3 years^{+} groups were composed of BS cattle whose ages ranged from 365 to 730 days and >730 days, respectively. The data were also

standardized for 2-or 3-years olds. The distribution of animals into the age groups is presented in Table 1.

Body measurements such as body length (from point of the shoulder to the point of tuber ischii), height at withers (from base hoof to the highest point of the wither), and chest depth (from sternum area immediately caudal to the fore limbs to top of thoracic vertebra area) were measured by using large calipers. Heart girth (circumference of the thoracic cavity immediately behind the fore limbs) was determined by using a tape measure.

Simple correlation coefficients were calculated to ascertain interrelationships among body measurements and weights at various ages. Additionally, the stepwise regression method was used to determine the best fitted regression equation (4). Coefficient of determination values (R^2) were also calculated for each body measurement for explaining variaton in the body weight. Statistical analyses were performed by using SAS statistics program (5). Predicted body weights were calculated by using the spreadsheet program called D-BASE.

Results

Interrelationships among body measurements and weights for female and male calves at birth and at 2 months of age were calculated by means of a simple correlation coefficient, and the results are presented in Table 2.

The correlation coefficients between various body measuremnets and weights for females and males taken at 6 and 12 months of age are tabulated and presented in Table 3.

In order to reveal interrelations among body weights and measurements, the correlation coefficients between body weights and measurements obtained at 2 and 3 years$^+$ of age are given in Table 4.

Best fitted regression equations for each age and sex group were determined by using determination coefficients (R^2). According to the results obtained from the stepwise regression analysis, the highest R^2 values were obtained when the heart girth alone was included into the regression models. Additional use of other body measurements did not make a significant contribution to the increase of R^2 values. Thus, regarding the major contribution of heart girth to the increase in R^2, the weights may be predicted with confidence. The R^2, F, a and b values of the regression equations using heart girth alone as the independent variable are given in Table 5.

The body weights of male female Brown Swiss cattle were predicted by using the regression equation where heart girth was used as an independent variable and the estimates are tabulated in Table 6 and 7.

Table 1. Number of Brown Swiss cattle in different age groups.

Ages	Sex	
	Female	Male
Brith	73	64
2 Months	91	72
6 Months	86	72
12 Months	76	44
2 Years	49	-
3 Years$^+$	76	-

Table 2. The correlation coefficients between body measurements and weights for females and males at birth and 2 months of age.

Body Measurements	Birth		2 Months	
	Female n=73	Male n=64	Female n=91	Male n=72
height at withers	0.571**	0.472**	0.691**	0.726**
body length	0.407**	0.508**	0.706**	0.762**
heart girth	0.844**	0.837**	0.792**	0.855**
chest depth	0.783**	0.809**	0.826**	0.583**

** : P < 0.01

Table 3. The correlation coefficients between the body measurements and weights determined at 6 Months and 12 Months of age.

Body Measurements	6 Months		12 Months	
	Female n=86	Male n=78	Female n=76	Male n=44
height at withers	0.829**	0.771**	0.676**	0.610**
body length	0.695**	0.395**	0.640**	0.809**
heart girth	0.838**	0.848**	0.769**	0.858**
chest depth	0.783**	0.809**	0.826**	0.583**

** : P < 0.01

Table 4. The correlation coefficients between the body measurements and weights for females at 2 and 3 years$^+$ of age.

Body Measurements	2 Years Female n=49	3 Years$^+$ Female n=76
height at withers	0.570**	0.704**
body length	0.039	0.431**
heart girth	0.868**	0.883**
chest depth	0.558**	0.725**

** : P < 0.01

Discussion

In regards to the interrelationship between body measurements and weights, as can be seen in Tables 2, 3, and 4, the highest relationship was determined

Table 5. Regression equations for body weights at birth, 2 months, 6 months, 12 months, 2 and 3 years+ of Age.

	Female	Calves			Male	Calves		
Age	a@	b+	R^2(%)	F	a	b	R^2(%)	F
Birth	-51.20	1.206	71.3	176.3**	-62.57	1.366	70.2	143.7**
2 Months	-59.78	1.354	62.8	150.5**	-71.14	1.521	73.2	191.4**
6 Months	-147.32	2.401	70	198.8**	-143.83	2.406	72.0	195.7**
12 Months	-180.98	2.924	73.6	117.1**	-211.27	3.106	68.7	158.5**
2 Years	-512.69	5.119	75.3	140.4**	-	-	-	-
3 Years+	-693.48	6.259	78.0	263.2**	-	-	-	-

@ : Intercept

+ : Regression coefficient of the heart girth

** : P<0.01

Table 6. Predicted birth, 2 months, and 6 months weights of Brown Swiss catle

Heart Girth (cm)	Brith Weight (kg) Male	Female	Heart Girth (cm)	2 Months Weight (kg) Male	Female	Heart Girth (cm)	6 Months Weight (kg) Male	Female
63	-	25	73	-	39	90	-	69
64	-	26	74	41	41	91	75	71
65	26	27	75	43	42	92	77	74
66	27	28	76	44	43	93	79	76
67	29	30	77	46	45	94	82	78
68	30	31	78	48	46	95	84	81
69	32	32	79	49	47	96	87	83
70	33	33	80	51	49	97	89	86
71	34	34	81	52	50	98	92	88
72	36	36	82	54	52	99	94	90
73	37	37	83	55	53	100	97	93
74	39	38	84	57	54	101	99	95
75	40	39	85	58	56	102	102	98
76	41	40	86	60	57	103	104	100
77	43	42	87	61	58	104	106	102
78	44	43	88	63	60	105	109	105
79	44	43	88	64	60	105	109	105
80	47	-	90	66	62	107	114	110
81	48	-	91	67	64	108	116	112
82	49	-	92	69	65	109	118	114
83	51	-	93	70	66	110	121	117
			94	72	68	111	123	119
			95	73	69	112	126	122
			96	75	71	113	126	122
			97	76	72	114	130	126
			98	78	73	115	133	129
			99	79	75	116	135	131
			100	81	76	117	138	134
			100	82	77	118	140	136
			101	84	79	119	142	138
			102	-	80	120	145	141
			103	-	81	121	147	143
			104	-	83	122	150	146
			105	-	84	123	152	148
			106	-	85	124	155	150
			107	-	87	125	157	153
			108	-		126	159	155
						127	162	158
						128	164	-
						129	167	-
						130	169	-
						131	171	-
						132	174	-

between heart girth and weights for both sex groups at various age periods. The results are supported by several studies conducted on various cattle breeds (3, 6-8). Tüzemen et al. (3) reported that the correlation coefficients between heart girth and weights in Brown Swiss calves taken at birth, 4 and 6 months of age were 0.815, 0.939, 0.921 for male calves and 0.839, 0.852, 0.765 for female calves, respectively. Soysal and Konak (10) also calculated a high correlation value (r=0.972) between heart girth and body weights in Brown Swiss cattle reared at state farms located in Trakya region of Turkey.

In regards to the determination of best fitted regression equations the results of the stepwise regression analysis revelaed that when a single measurements was used, heart girth gave the best estimates among the body measurements studied (Table 5). Similar results were reported by several researchers investigating different cattle breeds throughout the world (3, 6-15).

Table 7. Predicted 12-month, 2-years and 3 years+ weights of Brown Swiss cattle

12-Month Weights (kg)			2years Weights (kg)		3years+ Weights (kg)	
Heart Girth (cm)	Male	Female	Heart Girth (cm)	Female	Heart Girth (cm)	Female
120	-	161	149	250	170	371
121	-	165	150	255	171	377
122	176	168	151	260	172	383
123	179	171	152	265	173	389
124	182	174	153	271	174	396
125	185	177	154	276	175	402
126	187	180	155	281	176	408
127	190	183	156	286	177	414
128	193	186	157	291	178	421
129	196	189	158	296	179	427
130	199	193	159	301	180	433
131	202	196	160	306	181	439
132	205	199	161	311	182	446
133	208	202	162	317	183	452
134	211	205	163	322	184	458
135	214	208	164	327	185	464
136	217	211	165	332	186	471
137	220	214	166	337	187	477
138	223	217	167	342	188	483
139	225	220	168	347	189	489
140	228	224	169	352	190	496
141	231	227	170	358	191	502
142	234	230	171	363	192	508
143	237	233	172	368	193	515
144	240	236	173	373	194	521
145	243	239	174	378	195	527
146	246	242	175	383	196	533
147	249	245	176	388	197	540
148	252	248	177	393	198	546
149	255	252	178	398	199	552
150	258	255	179	404	200	558
151	261	258	180	409	201	565
152	263	261			202	571
153	266	264			230	577
154	269	267				
155	272	270				
156	275	273				
157	278	276				
158	281	279				
159	284	-				
160	287	-				

The results of this study can be summarized such that correlation coefficients among body measurements and weights are statistically significant ($P<0.05$). The highest relationship was found between heart girth and body weight at different age periods. Since heart girth can be measured easily using a tape measure, the prediction of body weihgt can be accomplished with relative accuracy in areas where no weighing facilities are available.

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