

Relationship of visual muscular and skeletal scores and scanned muscle measurements with carcass grades, composition and value of steers

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Introduction

Visual muscular and skeletal scoring in addition to ultrasonically scanned muscle and fat measurements recorded on the live animal are used in breed improvement programmes. These scores and measurements may be recorded on pedigree animals retained for breeding or on progeny to allow evaluation at an early stage in the animals life. However, such procedures are only useful if they show good relationships with economically important traits such as meat yield and distribution. The objectives of this study were to examine the relationships of live animal muscular and skeletal scores and scanned muscle and fat measurements with carcass meat, fat and bone proportions, proportion of high priced meat cuts in the carcass, meat in each cut expressed as a proportion of total meat and carcass value.

Materials and Methods

The results presented involved 134 steers which are a subset of a more comprehensive study involving up to 500 animals. The steers were slaughtered at approximately two years of age in three separate batches of 44, 47 and 43 animals. Prior to slaughter visual scores were assigned to each animal using both the Irish Cattle Breeding Federation (ICBF) and Signet scoring procedures. The ICBF system involved assigning muscular scores (scale 1 to 15) at six locations (width at withers, width behind withers, loin development, development of hindquarters, width of hindquarters and development of the inner thigh), and skeletal scores (scale 1 to 10) at three locations (length of back, pelvic length and height at withers. One scorer (A) scored all three batches while a second (B) scored one batch and a third (C) scored the remaining two batches. The data from scorers B and C were combined (B/C). In the Signet procedure, muscular scores (scale 1 to 15) were assigned at 3 locations (roundness of hindquarters, width of rump and width and thickness of the loin) averaged to give one score for each animal. Two scorers (X and Y) separately scored all the animals. In addition, steers were ultrasonically scanned by one operator for eye muscle depth at the 3rd lumbar vertebra and fat depth at both the 3rd lumbar vertebra (3 sites) and the 13th rib (4 sites) using a Dynamic imaging scanner.

Hot carcass weight was recorded at slaughter and cold weight was taken as 0.98 hot carcass weight. Carcasses were visually and mechanically graded according to the EU Beef Carcasses Classification Scheme. Carcass meat, fat and bone proportions were obtained following dissection of the right side of each carcass. The right side was split into an 8 rib pistola hindquarter and the remaining forequarter. The pistola was dissected into 12 cuts (silverside, topside, knuckle, rump, tail of rump, fillet, striploin, cube roll, cap of ribs, leg, heel and salmon). The bones were removed and scraped clean. All dissectable fat was removed from each cut. The weight of each cut and total weight of fat trim, lean trim and bone were then recorded for the pistola. The forequarter was dissected into 11 cuts (front shin, brisket, chuck, neck, flat ribs (1 to 5), plate, leg of mutton cut, bladesteak, braising muscle, chuck tender and clod) and a similar procedure was undertaken as outlined for the pistola. For both quarters, lean trim was added to the fat trimmed boneless cuts to give meat yield. Total carcass yields of meat, fat and bone were the combined values for the pistola and forequarter. Carcass value was taken as twice the sum of the commercial values of the boneless, fat trimmed cuts from the half carcass with a deduction for bone. Thus, when estimating carcass value the weight of carcass fat was not taken into consideration.

Results and Discussion

Details of the animals are presented in Table 1. The correlations between the visual scores using the ICBF scoring procedure pre-slaughter with carcass meat, fat and bone proportions, the proportion of high value cuts and carcass value was similar for scores A and B/C and thus only the results for scorer A are shown (Table 2). These showed high positive correlations ($P < 0.001$) between the individual and

combined muscular scores with carcass meat proportion ($r = 0.59$ to 0.72), proportion of high value cuts in the carcass ($r = 0.50$ to 0.61), carcass value ($r = 0.59$ to 0.71) and carcass conformation score ($r = 0.78$ to 0.87). High negative correlations ($P < 0.001$) were obtained between the muscle scores with carcass bone proportion ($r = -0.74$ to -0.83), while those with carcass fat proportion were low and negative ($r = -0.26$ to -0.42). Similar results to the above were recorded by two scorers (X and Y) using the Signet scoring system (Table 2). Correlations between each of the ICBF skeletal scores with meat proportion, proportion of high value cuts in the carcass, carcass value and carcass conformation were low and negative ($r = -0.26$ to -0.51). Correlations between the skeletal scores and carcass bone, although significant were low ($r = 0.36$ to 0.45), while those with carcass fat proportion and carcass fat score were positive and low (0.11 to 0.29). High correlations ($P < 0.001$) were obtained between scanned muscle depth and carcass meat proportion ($r = 0.66$), proportion of high value cuts (0.63), carcass value ($r = 0.69$) and carcass conformation score ($r = 0.79$), while a highly significant negative correlation ($r = -0.79$) was obtained with carcass bone proportion. When scanned muscle depth was expressed as a proportion of carcass weight the correlations with the above parameters were substantially reduced. Correlations between the above parameters and carcass weight were moderate. Moderate to low correlations ($P < 0.001$) were obtained between scanned fat depth with carcass fat proportion ($r = 0.30$) and carcass fat score ($r = 0.54$).

Regression equations were also used to quantify the relationship between scanned muscle and fat measurements and muscular scores (using the ICBF procedure) with carcass meat, fat and bone proportion, meat distribution and carcass value (Table 3). The combined muscular scores and scanned muscle and fat depth measurements were good predictors of proportions of meat and high value cuts in the carcass and carcass value ($R^2 = 0.48$ to 0.62). The corresponding R^2 values with carcass bone and fat proportions were 0.76 and 0.36 respectively (Table 3). Using the combined scanned measurements and muscular scores resulted in higher R^2 than those obtained with either alone.

Conclusion

- ❖ High relationships were obtained between live animal muscular scores and scanned muscle depth at the 3rd lumbar with carcass meat proportion, the proportion of high value cuts in the carcass and carcass value.
- ❖ Correlations using muscular scoring at 2 (or 3) locations were similar to those using 6 locations.
- ❖ A low negative relationship was obtained between live animal skeletal scores with the above parameters.
- ❖ Regression analyses showed that live animal muscular scores and scanned muscle and fat measurement were good predictors of the proportion of carcass meat, bone and high value cuts and carcass value but were poor predictors for carcass fat proportions.

Table 1: Details of the animals used in the study

	<u>Mean</u>	<u>Standard deviation</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Coefficient of variations</u>
Scanned muscle depth (mm)	63	8.7	45	89	
Scanned fat depth (mm)	1.3	0.813	0.33	4.4	
Muscular score A	6.8	2.11	1.8	10.7	
Muscular score B/C	6.5	2.44	2.3	13.2	
Muscular score X	4.6	2.20	1.0	10.3	
Muscular score Y	4.7	2.76	1.0	11.0	
Slaughter wt. (kg)	619	62.1	495	784	10.0
Cold carcass weight (kg)	319	36.3	257	450	11.3
³ Conformation score - mechanical	5.7	2.17	2.0	11.0	38.1
- visual	6.0	2.47	2.0	11.0	41.1
⁴ Fat score - mechanical	8.7	1.81	4.0	14.0	20.8
- visual	9.2	1.62	5.0	14.0	17.4
Meat (g/kg)	672	38.2	593	771	5.7
Fat (g/kg)	120	27.7	55	211	23.0
Bone (g/kg)	208	20.6	160	260	9.9
⁵ High priced cuts (g/kg)	70	5.7	56	87	81
Value (C)	247	17	210	292	681

¹Scorers A and B/C using the ICBF procedure; ²Scorers X and Y using the Signet muscular scoring procedure;

³Scale 1 to 15 (best conformation); ⁴Scale 1 to 15 (fattest); ⁵Meat in fillet, striploin and cube roll.

Table 2: Correlations between live animal visual muscular and skeletal scores and scanned muscle and fat measurements with carcass grades, composition and value

	Meat	Bone	Fat	High Value Cuts	Carcass Value	Machine Conformation	Machine Fat
Muscle scores: ICBF							
Width at withers	0.66***	-0.83***	-0.29***	0.59***	0.67***	0.83***	0.07
Width behind withers	0.67***	-0.83***	-0.30***	0.60***	0.68***	0.85***	0.07
Loin development	0.61***	-0.77***	-0.26**	0.51***	0.59***	0.78***	0.03
Development of hindquarters	0.72***	-0.76***	-0.42***	0.61***	0.71***	0.84***	-0.14
Hindquarter width	0.59***	-0.74***	-0.26**	0.50***	0.59***	0.82***	0.03
Development inner thigh	0.67***	-0.75***	-0.37***	0.59***	0.67***	0.84***	-0.09
Average of 6 locations	0.69***	-0.83***	-0.34***	0.61***	0.69***	0.87***	-0.00
Average of 2 locations	0.69***	-0.78***	-0.37***	0.58***	0.68***	0.86***	-0.07
Skeletal scores: ICBF							
Height at withers	-0.42***	0.38***	0.29***	-0.37***	-0.41***	-0.51***	0.27**
Length of back	-0.34***	0.36***	0.21*	-0.26**	-0.33***	-0.39***	0.11
Length of pelvis	-0.42***	0.45***	0.24**	-0.36***	-0.39***	-0.49***	0.12
Signet: Scorer A	0.69***	-0.83***	-0.34***	0.61***	0.69***	0.87***	-0.00
Signet: Scorer B	0.66***	-0.81***	-0.30***	0.58***	0.69***	0.81***	0.19*
Scanned fat depth	0.03	-0.45***	0.30***	0.07	0.07	0.35***	0.54***
Scanned muscle depth	0.66***	-0.79***	-0.32***	0.63***	0.69***	0.79***	0.13
Carcass conformation	0.78***	-0.82***	-0.46***	0.71***	0.80***	1.0***	-0.06
Carcass fat	-0.32***	-0.17*	0.57***	-0.26**	-0.28**	-0.06	1.0***
Carcass weight	0.39***	-0.61***	-0.09	0.37***	0.44***	0.55***	0.38***
Muscle depth/carcass weight	0.42***	-0.37***	-0.30***	0.41***	0.41***	0.44***	-0.21*

Table 3: Regression equations using live animal muscular scores and ultrasound muscle and fat measurements for predicting the proportions of meat, fat, bone and higher value meat cuts in the carcass and carcass value

	Intercept	Muscular score ²	Muscle depth ³	Fat depth ³	R ²
Meat (g/kg)	586	+12.6 (1.14)***			0.48
	472		+3.5 (0.29)***	-15.3 (3.16)***	0.52
	509	+8.6 (1.47)***	+2.0 (0.37)***	-16.1 (2.83)***	0.61
Fat (g/kg)	151	-4.5 (1.10)***			0.11
	208		-1.80 (0.25)***	+18.7 (2.68)***	0.34
	194	-3.32 (1.37)*	-1.21 (0.34)***	+19.0 (2.64)***	0.36
Bone (g/kg)	263	-8.2 (0.47)***			0.69
	319		-1.72 (0.14)***	-3.36 (1.50)*	0.63
	297	-5.32 (0.629)***	-0.78 (0.158)***	-2.87 (1.211)*	0.76
High value cuts (g/kg)	59	+1.6 (0.19)***			0.36
	42		+0.48 (0.050)***	-1.81 (0.506)***	0.44
	46	+0.88 (0.253)***	+0.33 (0.064)***	-1.88 (0.486)***	0.48
Value (c)	209	+6.0 (1.0)			0.48
	155		+1.59 (0.0012)***	-6.1 (1.4)***	0.55
	169	+3.3 (0.64)***	+1.0 (0.0016)***	-6.0 (1.23)***	0.62

¹ICBF procedure evaluation A; ²Scale 1 to 15; ³cm.