PREDICTION OF CARCASS COMPOSITION FROM CARCASS CUTS COMPOSITION

S. Žgur, M. Čepon

University of Ljubljana, Biotechnical faculty, Zootechnical department, Groblje 3, 1230 Domžale, Slovenia

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Background

Carcass composition is one of the most important factors that define the market value of the carcass. Accurate estimation of carcass composition is required by the breeders and beef industry as well. For the breeders, it is not important only because of payment, but also because of possibilities to use these data for selection purposes. The most accurate method of determining carcass composition is total tissue dissection. Unfortunately, dissecting each tissue from the carcass is highly labour intensive and as such very expensive.

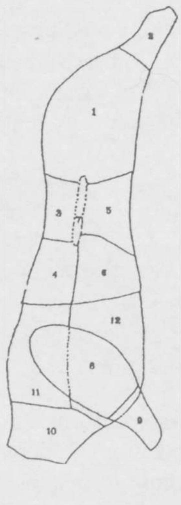
Objective

The purpose of this work was to estimate the possibilities for predicting lean meat, fat and bone proportion in the carcass from carcass weight and tissues weight and proportion of tissues in several carcass cuts.

Material in methods

The data for this study were collected from 251 Brown bulls fattened from 1992 to 1996 at progeny testing station in Logatec. Bulls were fed with mixture of maize and grass silage ad libidum and with concentrate. They were slaughtered in three commercial slaughterhouses. After slaughter carcasses were weighted. Carcass halves were cut into quarters between the 7th and 8th rib. Carcass halves were dissected first to different cuts (chuck, shoulder, front shank, rib roast, back, loin, tenderloin, brisket, rib, flank, leg and hind shank -figure 1). After that the cuts were further dissected into lean meat, fat, tendon and bone and percentage of tissues in the cuts were calculated. Proportion of lean meat, fat and bone in the carcass were estimated on the basis of carcass weight, weight and proportion of the specific cut in the carcass, lean, fat, tendon and bone weight in the specific cut and lean, fat, tendon and bone proportion in the specific cut. Linear and quadratic terms of all independent variables were included in the model. The stepwise regression procedure (SAS, 1998) was used. Means and standard deviation for carcass cuts percentage and carcass cuts tissue composition are presented in Table 1.

Figure 1: Dissection of right carcass side: leg (1), hind shank (2) loin (3), back (4), flank (5), rib (6), tenderloin (7), shoulder (8), front shank (9), chuck (10), rib roast (11) and brisket (12).



MODEL:

$$\hat{Y}_{ij} = b_0 + b_1 * X_1 + b_2 * X_2 + ... + b_i * X_i + e_{ij}$$

$\hat{Y}_{ij}$ = dependent variable, % of tissue in the carcass
b_0 = constant
$b_1...b_i$ = partial regression coefficients
$X_1...X_i$ = independent variables
e_{ij} = estimation error

The greatest variability in proportion of the cuts in the carcass was found for rib, followed by flank, rib roast and tenderloin, where coefficient of variability was greater than 10 %, and the lowest for hind leg and shoulder. Also lean proportion in the flank, tenderloin, rib, loin, back and brisket showed the greatest variability. As expected, fat proportion in the cuts showed the greatest variability, which was from 2 to 7 fold greater than lean proportion. Large coefficient of variability for fat proportion in front and hind shank were also the consequence of difficult separation of fat and tendon in those two cuts. Variability of bone proportion in the cuts was between variation of lean and fat. The greatest variability was in those cuts, which adjacent to splitting line of the carcass (chuck, rib roast, back and loin).

Table 1: Means and standard deviations for the dependent and independent variables in equations for predicting tissue proportion in the carcass (Average carcass weight was 321.85 kg, SD = 24.42 kg; N=251)

	Carcass cut, %		Lean meat, %		Fat, %		Tendon, %		Bone, %	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Carcass			68.72	2.43	12.92	2.49	1.73	0.30	16.63	1.25
Shoulder	16.09	0.79	72.02	2.62	12.74	2.69	1.29	0.38	13.95	1.00
Front shank	2.68	0.19	41.71	2.45	2.55	1.70	6.58	2.48	49.16	2.36
Hind leg	28.24	0.84	74.09	2.05	10.55	1.88	1.23	0.35	14.13	1.00
Hind shank	3.70	0.22	38.92	2.18	6.45	2.65	7.67	2.54	46.96	2.82
Chuck	10.06	0.92	77.90	3.16	8.36	2.41	1.72	0.48	12.02	2.09
Rib roast	7.39	0.78	71.54	4.28	7.47	2.65	1.94	0.81	19.05	3.81
Back	5.32	0.50	65.29	4.09	12.72	3.57	0.87	0.54	21.12	3.67
Loin	3.85	0.32	66.30	4.51	8.25	2.79	1.63	1.13	23.82	4.18
Brisket	9.51	0.73	58.22	3.64	23.76	4.39			18.02	1.86
Rib	5.56	0.63	63.93	4.35	18.53	5.22			17.54	2.41
Flank	5.40	0.59	67.82	5.92	26.74	6.07	5.44	1.75		
Tenderloin	2.20	0.22	81.52	5.86	18.48	5.86				

Results and discussion

The most precise estimates of lean proportion in the carcass were provided from dissected hind leg (r^2 =0.807, RSD =1.077), followed by shoulder, back, brisket and flank. If we combined data from flank and rib, we got very good estimation of lean proportion in the carcass (r^2=0.7885 RSD=1.135). Fan et al. (1992) studied precision of prediction of lean meat content from carcass weight, proportion of the specific cut in the carcass, and proportion of lean meat in the specific cut. The best results were obtained from chuck (r^2=0.783 RSD=1.50) and hip (r^2=0.686 RSD=1.81). Even higher r^2 and lower RSD were reported by Engelhardt (1991) by predicting lean proportion from hind leg tissue composition (r^2 =0.88, RSD =1.27). The lowest precision of estimate was calculated from shank. Similar precision of estimates as for lean meat, was also found for fat proportion in the carcass. The combination of data from flank and rib gave even higher r^2 and lower RSD than from hind leg. In general, lower r^2 and higher RSD were found for bone proportion in the carcass. This can be explained by lower standard deviation for bone proportion in the carcass in comparison with lean meat and fat.

Table 2: Coefficients of determination (r^2) and residual standard deviations (RSD) for predicting carcass tissue proportion in the carcass from carcass weight and several carcass cuts composition

	Lean, %		Fat, %		Bone, %	
	r^2	RSD	r^2	RSD	r^2	RSD
Shoulder	0.7703	1.178	0.8137	1.083	0.4914	0.901
Front Shank	0.1944	2.202	0.2659	2.167	0.5726	0.829
Hind leg	0.8074	1.077	0.8121	1.087	0.7606	0.620
Hind shank	0.3575	1.983	0.2773	2.137	0.3830	0.988
Chuck	0.5081	1.721	0.5242	1.734	0.4774	0.914
Rib roast	0.5854	1.590	0.6072	1.575	0.6064	0.794
Back	0.7074	1.327	0.7472	1.266	0.6112	0.784
Loin	0.6505	1.466	0.5802	1.635	0.4242	0.958
Brisket	0.7061	1.333	0.7707	1.201	0.5499	0.849
Rib	0.5802	1.596	0.7093	1.352	0.4971	0.897
Flank	0.6809	1.383	0.7853	1.162	0.3408	1.023
Tenderloin	0.4806	1.776	0.4149	1.911	0.2811	1.069
Rib + Flank	0.7885	1.135	0.8952	0.817	0.5773	0.828

Conclusions

The best results in predicting carcass composition were achieved by including the following traits in the model: carcass weight, hind leg weight and proportion in the carcass, and tissue weight and proportion of tissues in the hind leg. The results were for lean meat r^2=0.807, RSD =1.077, fat r^2 =0.812, RSD =1.087 and bone r^2 =0.761, RSD =0.620). Very high precision of regression was also calculated for the combination of data from flank and rib (for lean meat r^2 =0.788, RSD =1.135; fat r^2 =0.895, RSD =0.817 and bone r^2 =0.577, RSD =0.828). Flank and rib appear to be suitable cuts for predicting carcass composition also because of low market value of these two cuts.

References

Engelhardt, G. (1991). Eignung verschiedener Meßstellen, Hilfskriterien und Schätzfunktionen zur Abschätzung der grobgeweblichen Schlachtkörperzusammensetzung beim Rind. Disertation. Göttingen, Georg-August-Universität, 166 s.

Fan L.Q., Wilton J.W., Usborne W.R., McMillan I. (1992). Prediction of lean content in the carcasses of beef cattle. II. From measurements of specific cuts. Can. J. Anim. Sci., 72, p. 517-524

SAS (1989): SAS/ STAT User's, Version 6. Cary, NC, USA, SAS Institute Inc.