Objective Classification of Beef Carcasses and Prediction of Carcass Composition by Video Image Analysis

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BACKGROUND

In Germany bovine carcasses are visually graded according to the EC-system and German regulations in 5 main classes for both conformation and fatness. On account of the wide variation the visual classification is difficult to conduct consistently. Furthermore the EC-classification gives no sufficient information about the carcass composition so that the development of a value-based marketing system is an industrial requirement. Video image analysis (VIA) offers the potential to remove the subjectivity associated with visual classification and to estimate the carcass composition.

OBJECTIVES

The aim of this study was to determine the performance of the VIA-System VBS 2000 (e+v Lehnitzstr. 24 D-16515 Oranienburg) for objective classification of beef carcasses. The system should be able to predict EC-classification on a 15-point scale as well as carcass composition. In that context the influence of different genotypes on the validity of prediction equation had been investigated.

METHODS

Source of carcasses. In a first experiment a total of 301 young bull carcasses were selected from 3 genotypes (German Friesian, Crossbreeds, German Simmental) which represent 75-80 % of German cattle population. Carcasses were classified by one inspector into classes from 1 to 15 for both conformation and fatness and measured with the VBS 2000. Carcasses were cut first in accordance to a defined German standard (DLG-Schnittführung). A further dissection was carried out according to a commercial standard. Additionally, in a second experiment 1365 carcasses consisting of different categories and breeds were classified by two experienced inspectors. The producer has developed on the basis of this data set his own categorie-specific formulae.

VIA-System. The VBS 2000 consists of a handling unit for an exact positioning of the half carcass for two and three dimensional measurements, lighting, and a camera unit that leads the video signals to a separate computer unit in the measurement control room in order to process and evaluate the video images. The images are archived on videotape for documentation purposes simultaneously with the image processing on the PC. The system is based on colour vision technique and volumetric measurement by a light striping system, which is very similar to the system described by Madsen et al. (1996). Pictures are taken at the end of the slaughter line.
Statistical Procedure. Estimation functions were calculated by using the multiple linear regression. The selection of the predictors was made by a forward stepwise regression, using a low threshold value followed by an elimination procedure based on the partial significance of the variables. It was succeeded to keep the number of predictors on a tolerable level with the highest partial significance ($p<0.001$). The statistical evaluation of the predictions occurred with the values of R^2 and RSD. The success of the grading into conformation and fat classes was characterised by the percentages of the direct hits and the single and double class deviations respectively.

RESULTS AND DISCUSSIONS

The performance of VBS 200 for EC-classification on a 15-point scale is shown in Table 1. Although only one classifier was employed the prediction of conformation was very accurate. Conformation was assessed with R^2=0.90 and SEP=0.93. The prediction of fatness was less accurate than that of the conformation. This is thought to be due to the fact that the fat cover in bull carcasses is often very thin and that within the dehiding process parts of the fat cover can be removed. Moreover, the camera scans the fat cover only on the meat-side of the carcass. The R^2 amounted to 0.75 and SEP to 1.20. Accordingly, the deviations reached higher values than by prediction of the conformation.

The prediction of carcass composition was very accurate too (Tables 2 and 3). Weights of main cuts were predicted with R^2=0.96-0.98. There was almost no effect of genotype on the prediction of carcass composition. Biases ranged from -0.13 to 0.17 kg. Due to the fact that the range of the values is generally lower for percentages than for absolute values, prediction of the tissue proportions was less accurate than that of the weights. The R^2 ranged from 0.76-0.85.

In the second experiment when two experienced classifiers were employed, all of the 1365 carcasses slaughtered within a week were classified. In spite of the combination of breeds and categories the Standard Error of Prediction was lower than in the first experiment (Table 4). The conformation was assessed with R^2=0,91 and SEP=0,81. The fatness was estimated with R^2=0,83 and SEP=0,91. Madsen et al (1996) reported R^2=0.93 and SEP=0.57 for prediction of conformation and R^2=0.75 and SEP=0.97 for prediction of fatness.

The deviations between the visual and the VIA-grading were in 97,9 % and in 89,3 % in the range of 0-1 classes for the conformation and the fatness respectively. There was no deviation over 3 classes (Table 1). These results are very good as compared with the visual classification according to the EC-system on a 5 point scale where the agreement between Classifier and Inspector was found with 79.5 % for conformation and 81.0 % for fatness in a former investigation (Bach (1987)).

CONCLUSIONS

Considering its good performance the VBS 2000 seems to be an appropriate instrument for beef classification and prediction of carcass composition. It meets the EC requirements, which are generally accepted for the assessment of pig carcasses. It seems not to be necessary to develop special predicting equations for different genotypes. Further investigations have to be done for other categories especially for carcasses from cows and heifers for predicting carcass composition.

LITERATURE

Bach, H. (1987): Klassifizierung und Vermarktung von Rindfleisch. In: Kulmbacher Reihe, Bd. 7, 55-86.

Madsen, N.T., Thodberg, H.H., Fiig, Th. and Ovesen, E. (1996): BCC-2 for Objective Beef Carcass Classification and Prediction of Carcass Composition. Proc. 42nd ICoMST, 244-245

TABLES

Tab. 1: Deviations of prediction of EC-classification by VIA-System at different breeds (n=301)

Grading scale	Breeds	Deviation class, %			
		0 - 1	2	3	
Conformation 15-scale	GSi	89.9	10.1	-	
	GFr	88.9	11.1		
	CB	89.2	9.8	1.0	
	total	89.3	10.3	0.4	R^2 =0.90 SEP=0.93
Fatness 15-scale	GSi	78.8	15.3	5.9	
	GFr	85.2	12.3	2.5	
	CB	81.4	13.7	4.9	
	total	81.4	13.9	4.7	R^2 =0.75 SEP=1.20

GSi=German Simmental, GFr=German Friesian, CB=Crossbreeds;

Tab 2: Prediction of carcass composition - weights of main cuts (n=301)

	Mean (kg)	S.dev. (kg)	R^2	SEP (kg)	bias		
					GSi	GFr	CB
Forequarter	81.4	15.3	0.98	1.7	0	-0.13	0.11
Pistol	65.2	10.7	0.98	1.7	-0.03	0.06	0.09
Round	45.2	7.7	0.98	1.3	0.17	-0.13	-0.10
Roast beef	21.8	4.2	0.96	0.9	0.09	0.09	-0.17

GSi=German Simmental, GFr=German Friesian, CB=Crossbreeds

Tab. 3: Prediction of carcass composition - percentages of saleable meat, bones and fat trims (n=301)

	Mean (%)	S.dev. (%)	R^2	SEP (%)	bias		
					GSi	GFr	CB
saleable meat	69.5	3.5	0.76	1.8	0.35	0.11	-0.49
bones	16.8	2.1	0.85	0.8	-0.01	-0.02	0.03
fat trims	13.5	3.6	0.77	1.8	0.00	-0.24	0.18

GSi=German Simmental, GFr=German Friesian, CB=Crossbreeds

Tab. 4: Prediction of EC-classification by VIA-System VBS 2000 (n=1365)

Grading scale	Deviation class, %			
	0 - 1	2	3	
Conformation 15-scale	97.9	2.1	0.1	R^2 = 0.91 SEP = 0.81
Fatness 15-scale	89.3	9.2	1.5	R^2 = 0.83 SEP = 0.91

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