The Suitability of Measurement Points and Carcass Traits for Estimating the Main Tissue Composition of Beef Carcasses

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SUMMARY

The aim of this study is to develop methods for estimating the percentage of lean and fat in beef carcasses for industrial classification purposes. To reach this aim many carcass traits have been recorded at 271 carcasses. Furthermore all these carcasses have been dissected into lean, fat and bone. Prediction of tissue proportions by multiple regression equation based on the measured carcass traits has been carried out with the following degree of accuracy and RSD-values: lean percentage with an accuracy of 0,67 and RSD of 1,9%, fat percentage with an accuracy of 0,64 and RSD of 1,98%.

In conclusion, this study gives a view on a possible future objective classification for beef carcasses. Estimating the lean and fat percentage may get an importance in such a classification system.

INTRODUCTION

Classification of beef carcasses in the EEC is based on the visual grading system for fleshiness (E-U-R-O-P) and fatness (1-5). As generally known, especially the fleshiness score gives only little information about the meat and fat content of the carcass. Therefore methods for estimating beef carcass composition have been developed that are in use for industrial carcass classification. Even an instrumental grading device is tested in several studies with fairly good results (KIRTON et al, 1987; SORENSEN et al, 1988; MILES et al, 1990). Additional research has been done in order to predict carcass composition of typical german breeds. Especially the suitability of prediction equations using various combinations of fat depth and shape traits as well as the kidney- and pelvic- fat was tested in this study.

MATERIALS AND METHODS

The investigations were undergone at two abbatoirs in the northern and the southern part of Germany from March up to October 1990. The left sides of 271 beef carcasses of the category "young bull" have been involved. They were selected at random from the slaughterline. The sample consists of the breeds "Fleckvieh" (Simmenthal type) and "Schwarzbunt" (Frisian type). A detailed description of this sample is given in table 1. With respect to the breed types and carcass weights the sample is representative for the german situation.

After slaughtering the intact sides have been scored by an experienced judge for conformation and fatness score according to the visual EEC-classification system. On the other hand a wide range of measurements has been carried out. In these determinations the carcass weight and the weight as well as the percentage of the kidney- and pelvic- fat are implicated.

Furthermore fat depth measurements at several sites in the rump, loin and chest area have been involved. Some traits describing the eye muscle at the level of the 8th rib have been included,too. Additionally a great number of body shape measurements including the width (medio-lateral), depth (dorso-ventral) and length at several sites of the carcass have been recorded. All these measurements were carried out by the same team.

In order to get an exact information about the main tissues of the carcasses the rump and the shoulder have been fully dissected into muscle, fat and bone according to the method decribed by SACK and SCHOLZ (1987).

All calculations were carried out using the Statistical Analysis System (SAS). Means, standard deviations, correlation (r) as well as determination coefficients (r^2) and residual standard deviations (RSD) were calculated.

RESULTS AND DISCUSSION

The simple correlations between the carcass traits and the meat, fat and bone content make clear that -as it is to expect- a single measurement is not suitable for predicting the lean and fat content of beef carcasses. (table 2).

But some fat depth measurements and specially the percentage of kidney- and pelvic- fat show a relative close correlation to the meat and fat content. Single shape traits are of limited value for estimating the lean and fat content. These traits show a stronger correlation to the bone content.

A combination of several carcass traits is necessary for predicting the lean and fat content of beef carcasses. Combinations of shape traits alone, as well as the combinations of some fat depth measurements were not sufficient for those purposes. Therefore, a combination of both, shape traits and fat depth measurements, is necessary.

The "best" equation found -also in the practical point of view- (table 3) includes two fat depths, two shape traits and the percentage of kidney- and pelvic- fat. Generally a degree of accuracy of 0,67 together with a RSD of 1,9% can be achieved by this equation. The inclusion of kidney- and pelvic- fat leads to a significant increase in the degree of accuracy. Similar results have been found by TEMISAN (1987).

Comparable results can be observed when estimating the fat content of the carcasses (table 4). A good alternative for predicting the fat content is the combination already being used for estimating the lean content. This observation is important for the practical application.

The inclusion of the percentage of kidney- and pelvic- fat has got a special role in this study. It leads to a considerable increase in accuracy of predction of lean and fat using multiple regression equations. Furthermore, in this case a particular consideration of the breed is not necessary.

The special importance of the percentage of kidney- and pelvic- fat is not observed in recent works. KIRTON et al. (1987) suggest combinations of fat depth measurements taken by a Hennessy grading probe. MILES et al. (1990) have got good predicting results by using combinations of carcass traits taken by Ultrasound. SORENSEN et al. (1988) used VIA measurements of the body shape combined with fat or lean depth measurements taken by a FOM probe. Precise results also have been obtained by WASSENBERT et al. (1986) by using the VIA technique for taking measurements on the ribbing surface of the 12th rib.

CONCLUSIONS

Based our investigations the conclusion can be drawn that it will be possible to predict the lean and fat percentage with a high degree of accuracy by using a combination of carcass traits. These are fat depths, shape traits and the percentage of kidney- and pelvic- fat. Considering the bride scale of classification instruments available there even exists a possibility for practical application.

In the future, it is highly desireable to use such automatical devices for grading beef carcasses instead of the visual EEC-system. In such a system the percentage of lean may get an important factor. Additionally the percentage of fat should be involved in the classification system. The fat content gives an indirect information about meat quality (AUGUSTINI and TEMISAN, 1986). The importance of the conformation score in classification systems of the future is not obvious. Recently OVENSEN (1990) suggests a special muscle index for getting an idea of the industrial fabrication of beef carcasses.

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Table 1: Structure of the sample

Trait	Fleckvieh	Schwarzbunt	total
number (n)	170	101	271
carcass weight (kg) - mean (x)	363	321	347
coefficient of variance (CV%)	9,5	12,0	11,9
range	265-476	233-413	233-476

Table 2: Simple correlation (r) between carcass traits and the percentage of lean, fat and bone

trait	lean%	fat%	bone%
carcass weight	0,09	0,23	-0,53
kidn.+pelv. fat%	-0,68	0,57	0,02
mean fat thickness	-0,61	0,64	-0,27
fat thickness at loin	-0,56	0,53	-0,14
fat thickness at chest	-0,49	0,34	0,14
wide of the round	0,47	-0,23	-0,26
length of round	-0,17	-0,08	0,44
depth of the chest	-0,34	0,14	0,26
weight/length	0,17	0,21	-0,62

Table 3: Comparison of different trait combinations for estimating the lean content of beef carcasses

traits	breed	r^2	$s_{y.x}$
15 fat depth and	Flv	0,60	1,89
shape traits	Sbt	0,81	1,39
kid.+pelv.fat%	total	0,75	1,61
2 fat depths,	Flv	0,55	2,10
2 shape traits	Sbt	0,76	1,58
kid.+pelv.fat%	total	0,67	1,90
3 fat depths,	Flv	0,39	2,25
3 shape traits	Sbt	0,71	1,79
	total	0,61	2,12
2 fat depths,	Flv	0,40	2,24
4 shape traits	Sbt	0,68	1,87
	total	0,58	2,19

Table 4: Comparison of different traits combinations for estimating the fat content of beef carcasses

traits	breed	r^2	$s_{y.x}$
12 fat depth and	Flv	0,71	1,75
shape traits	Sbt	0,87	1,23
kid.+pelv.fat	total	0,73	1,65
2 fat depths,	Flv	0,54	2,14
2 shape traits	Sbt	0,85	1,43
kid.+pelv.fat%	total	0,64	1,98
3 fat depths,	Flv	0,47	2,34
4 shape traits	Sbt	0,74	1,87
	total	0,55	2,17
2 fat depths,	Flv	0,51	2,25
5 shape traits	Sbt	0,69	2,04
	total	0,53	2,27