ESTIMATION OF THE COMMERCIAL VALUE OF PIG CARCASSES BY USING VIDEO IMAGE ANALYSIS

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Background

The gap between the payment of farmers according to the lean meat percentage of the pig carcasses and the pork trade according to the commercial value of the cuts has been an unsolved problem in Germany until the authorisation of the fully automatic grading system Autofom. The Autofom system determines both the lean meat percentage of the carcasses and the weight of the valuable cuts (Branscheid and Höreth, 2000). The competitive Video Image Analysis (VIA) would be an affordable system for the assessment of the carcass market value for small and medium-sized enterprises. Beyond it, the belly quality is an important factor for the commercial value of the carcasses. Due to the high variation, it is difficult to assess the lean meat percentage of this cut. That is why at present no technical solution exists for the estimation of the belly quality in the slaughter line (Tholen *et al.*, 2001).

Objectives

In a previous investigation (Branscheid *et al.*, 1999) the suitability of the Video Image Analysis for the evaluation of the market value of pig carcasses has been proved. The trial was carried out under experimental conditions. In the current study, the capability of the VIA-system has been investigated in the slaughter line. A further objective was to prove the suitability of the VIA to assess the lean meat percentage of the belly.

Methods

The study has been carried out in the abattoir Südost-Fleisch GmbH in Altenburg, Thuringia. A sample of 150 carcasses has been selected directly from the slaughter line. The sample grid was stratified according to the slaughter weight and fat depth. The fat depth was measured with the German reference device for grading of pig carcasses (Ultrasonic Scanner Aloka SSD 256) 7 cm lateral of the split line between the second and third last rib. The sexes were represented equally in the sample. Though genotypes were not defined, the variation of the relevant parameters was sufficient.

The VIA system VCS 2000 (company e + v, Oranienburg) was installed into the slaughter line directly after the grading site. Positioning and fixing of the carcasses halves was carried out fully automatically. Three video images were taken from every carcass (s. Fig. 1):

- a black and white image of the ham, in dorsoventral direction
- two colour images of the split section, cranial and caudal part of the carcass half.

The chilled carcasses were dissected according to the DLG cutting method and subsequently by a commercial cutting method to obtain the reference values for the weights of the primal cuts (Scheper and Scholz, 1985; Höreth, 1997). In addition, the belly was fully dissected into its tissues. Due to technical reasons, the video images were taken on the right half of the carcasses while the left halves were dissected.

The analysis of the images by means of high quality image processing techniques delivers a multitude of carcass dimensions (square and linear dimensions, widths, angles), which can be used as predictors for the calculation of estimation formulae for the joint weights. The estimation formulae were calculated by the multiple linear regression. The number of used variables was limited to those variables, which were highly significant (according to their Student-test) for the estimation of the respective trait. Apart from the variables obtained from the Video Imaging, the slaughter weight was used in the estimation formulae too. The single variables were used directly or as derivations (e.g. quotients, products etc.).

The accuracy of estimation was evaluated by using the correlation (R), the residual standard deviation (RSD, $s_{y.x}$) and the relative standard deviation (rel. RSD, $s_{y.x}$ related to the mean of respective trait in %). The last parameter is a reliable measure for the practical applicability of the estimation and shouldn't exceed a value of 5 % (cp. Dobrowolski and Branscheid, 1997).

Results and Discussion

The estimation of the weight of the primal cuts by the VIA was very accurate (s. Tab. 1). The correlations were high or very high (R = 0,90 to 0,97) and estimation errors (RSD) ranged between 0,18 and 0,29. Relative RSD were not above the target value of 5 %. As expected, the estimation accuracy was somewhat lower in case of the retail cuts but the estimation accuracy was still sufficient or high. Only for the prediction of the boneless loin the relative RSD was with 7,3 % clearly above 5 %. But this is lacking of any practical significance.

The estimation accuracy of the VCS 2000 is maintained under practical slaughterhouse conditions. Even with fully automatically positioning of the carcasses and in spite of the fact that the right halves of the carcasses were measured while the left halves were dissected, estimation errors were barely higher than in previous investigations (Branscheid *et al.*, 1999). The estimation accuracy for the primal cuts could even be improved what is due to technical improvements on the VIA-system.

A further improvement can be achieved when the VIA is used in combination with a device that measures internal fat and muscle depths at the same measuring site (2. /3. last rib, 7 cm lateral of the split line) like conventional grading instruments (Tab. 2). In this combination, the correlations ranged between 0,92 and 0,98 for all retail cuts. The relative RSD declined to the range of 2,4 % to 3,6 % for the primal cuts and below 5,0 % for the retail cuts as well as for the belly. As expected, at this measuring site the VIA/Ultrasonic-combination is particularly effective for the loin and the boneless loin.

According to experience the estimation of the lean meat content of the belly at the carcass halves is a difficult task and remains with R = 0,82 and RSD = 7,3 % dissatisfying with the VIA too (s. Tab. 1). When the VIA/Ultrasonic-combination is used at a half carcass the lean meat of the belly is assessed with R = 0,91 and RSD = 5.3 % (s. Tab. 2). With it, at least a pre-sorting of the carcasses according to the expected lean meat content of the belly will be possible.

Conclusions

In a previous investigation the suitability of the Video Image Analysis for the estimation of the commercial value of pig carcasses had been established (Branscheid *et al.*, 1999). The present work has shown that the performance of the VIA-system is maintained under practical slaughter line conditions. Even the fact, that the right halves of the carcasses were assessed by VIA while the left halves were dissected, did not impair the reliability of the estimations. First analyses of a so far unpublished investigation show, that even at an independent and not representative sample (breeding pigs) correlations range between 0,86 to 0,96 and rel. RSD lay between 3,4 to 6,5 (except Loin = 7,3). That indicates a certain stability of measurements. Insofar the Video Image Analysis represents an alternative method to the Autofom system.

To achieve a higher accuracy of estimation, the VIA-system should be combined with an additional device. It would be sensible to combine the VIA with the conventional grading apparatus because those devices are inevitably integrated into the slaughter line. Since the conventional grading devices are not fully automatic, an operator influence cannot be avoided completely. This disadvantage has to be accepted.

References

Branscheid, W.; Dobrowolski, A. und R. Höreth (1999): Video-Image-Analyse als Methode zur automatischen Handelswertbestimmung von Schweinehälften. Mitteilungsblatt der BAFF 38, Nr. 144, 207-214.

Branscheid, W. und R. Höreth (2000): Bei Autofom zählt mehr als der Rückenspeck. Agrarzeitung Ernährungsdienst, Nr. 8 vom 28.01.2000.

Dobrowolski, A. und W. Branscheid (1997): Zur statistischen Prüfung von Schätzfunktionen der Schlachtkörperzusammensetzung und der Fleischqualität. Fleischwirtschaft 77, 359-362.

Höreth, R. (1997): Veränderung von Anteilen und Zusammensetzung der Teilstücke durch Variation der Schnittführung bei Schweineschlachtkörpern. Mitteilungsblatt der BAFF 36, Nr. 137, 273-285.

Tholen, E.; Baulain, U.; Henning, Martina; Hoppenbrock, K.-H. und F. Adam (2001): Bauchbewertung: Verschiedene Methoden im Vergleich. Schweinezucht und Schweinemast 49 (3), 38-41.

Tab. 1: Estimation of the joint weights in pig carcasses and the lean meat percentage of the belly by the VCS 2000 device (n=150)

Joint	Mean[1] (kg)	R	RSD (kg)	Rel. RSD[2] (%)
Ham	12,0	0,97	0,29	2,43
Loin	5,6	0,90	0,28	5,02
Shoulder	5,5	0,94	0,18	3,29
Belly	4,6	0,92	0,22	4,74
Ham, boneless/defatted	8,7	0,94	0,38	4,36
Shoulder, boneless/defatted	4,0	0,90	0,20	5,01
Loin, boneless	3,4	0,86	0,25	7,27
	Mean (%)	R	RSD (%)	Rel. RSD[2] (%)
Belly, lean mean content	50,6	0,82	3,70	7,32

[1] Mean value related to the joint weights of a half carcass resp.
[2] related to the mean value of the actual trait

Tab. 2: Estimation by a combination of VCS 2000 and the Ultrasonic-Scanner SSD 256 (n=150)

Joint	Mean[1] (kg)	R	RSD (kg)	Rel. RSD[2] (%)
Ham	12,0	0,97	0,29	2,43
Loin	5,6	0,95	0,20	3,58
Shoulder	5,5	0,95	0,17	3,11
Belly	4,6	0,92	0,22	4,74
Ham, boneless/defatted	8,7	0,96	0,31	3,56
Shoulder, boneless/defatted	4,0	0,93	0,17	4,26
Loin, boneless	3,4	0,94	0,16	4,65
	Mean (%)	R	RSD (%)	Rel. RSD[2] (%)
Belly, lean mean content	50,6	0,91	2,70	5,34

[1] Mean value related to the joint weights of half carcass resp.
[2] related to the mean value of the actual trait

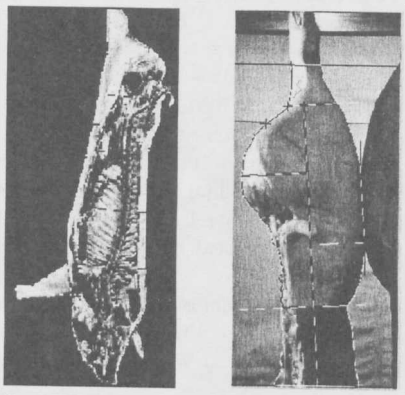

Fig. 1: Video Images taken by the VCS 2000