POLISH INDUSTRIAL VIA BEEF CARCASSES CLASSIFICATION SYSTEM

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Background

Subjective bovine carcass classification based on visual assesment of both conformation and fatness according to the EC-system (Council Regulation 1208/81) and Polish Standard, obligatory in Poland since 1997, is characterized by relatively small accuracy. Furthermore it gives no sufficient information about the carcass composition needed for prediction of later yield and destination of raw material. For that reason the methods of objective grading and valuation with proper apparatus (like in pig carcasses) are looked for. Starting with research and development works in this matter became feasibile in the mid-eighties because of fast development in digital-circuit and computer engineering using digital video cameras connected with powerful computers. As result of it in mid-nineties in few countries the different systems called Video Image Analysis (VIA) Systems or Computer Vision Systems (CVS) were designed. One can to mention here e.g. systems like BCC-2 in Denmark, VBS2000 in German and VIAscan in Australia. In Denmark 5 industrial BCC-2 systems are working in slaughter-houses (SFK Information, 1998) and other like VBS2000 were tested in particular countries (Sönnichsen et al., 1998). The comparison test of above mentioned 3 systems in one slaughter-house in Ireland was carried out as well (Allen, 1999). In relation to carcass classification in 5-points and 15-points scale of conformation and fatness these tests are completed with positive results giving information about better accuracy of objective versus subjective carcass grading and regarding prediction of carcass composition.

In Poland Meat and Fat Research Institute has initiated the research works on objective beef carcass grading including prediction of carcass composition over 10 years ago, at the beginning in cooperation with Technical University in Poznań and later with „Computer Scaning Systems" company in Warsaw (Polish patent, 1997, Wichłacz et al. 1998, Wichłacz, 1999). Investigations were guided by dr H. Wichłacz. In the first two parts of work the experimental VIA systems temporarily installed in meat plants in Poznań and Szczecin were used. The results of these experiments were used for designing of industrial prototype VIA grading system which was installed and set working in June 2000 in slaughter-house in Leszno having the slaughter-line with capacity of about 30 heads per hour. As apposed to other systems this one is not fully automatized and adapted only to maximal capacity of beef slaughter-lines existing in Poland (up to 45 carcasses per hour). Presently the system is normally used, but some improvments in designing and computer software were implemented. The further investigations are carried out as well.

Objective

The objective of this study was estimation of Polish VIA beef grading system in all R and D work stages since experimental installation up to industrial prototype.

Methods

In the first two phases of investigations using experimental installations respectively 60 and 220 bovine carcasses of carcasses of different categories (young bulls, cows and heifers) are used.

For establishing of the regression equations needed for tissue components and meatness index assesment the analysis of usefulnes of paricular methods and carcass traits were carried out. The parameters like geometrical dimensions of half-carcasses (including external muscle and fat cover surface) captured with video camera and thickness of muscle and fat layear measured with optical probe as well as carcass kidney fat weight were taken into account. It was stated that general fat content in carcass is relatively strong correlated with suet weight. This observation was employed as one of parameters in carcass fatness assesment.The meat weight: bone weight ratio was than used for estimation of carcass conformation in 5-points scale. In investigation on prediction of carcass composition as reference the yields obtained in partial half-carcass dissection were applied. The results of experiments were adapted in the 3rd phase of R and D works for designing of industrial prototype VIA system. In multiple regression equations involved in specjal computer programm called „Multi-Scan-Meat-Fat" 8 traits of carcass were used including 6 parameters captured „one-line" by video camera and 2 weights (carcass weight before and after kidney fat removing). For simplification of the system the application of needle optical probe was given up. Now the Polish VIA beef classification system contains: black-white high sensivity and resolution digital video camera with double colour filter, powerful PC computer with monitor and printer, stable lighting system providing outer half-carcass surface uniform lighting with illumination of 1000-1200 1x from distance of 1,5 m (5 fluorescent lamps each 133 W and 1,6 m long), black background screen 2,44 x 3,66 m of plastic plates, two electronic overhead scales mounted in space of 3 m connected to the computer, two loudspeaker for sound signalling. In distance of 25 cm before background screen the guide-bar for half-carcasses positioning after hand pushing is mounted. The system is operated by one person. Twice carcass weighting (before and after removing of kidnay fat) enables to calculate the suet weight, which is introduced into computer analysis. On the base of two-dimensional picture captured by didgital video camera the needed geometrical carcass parameters like lenght, maximal and minimal width, span as well as the surface of muscles and fat cover (by calibrated brightness manifold) are calculated. Time of picture analysis of one half-carcass is 25 s. After completing of slaughter the classification report is pronted out. It contains the following data: data and time of recording, carcass slaughter number, bovine category, ear tag number, weight 1 and weight 2, conformation class and fatness class in 5-points scale, meat content, fat content (for fatness grading), suet content, retail cuts content

(rump muscles without bones and sinews, LD muscle and tenderloin), meat: bones ratio (for conformation grading), maximal and minimal half-carcass width (for calibration of the system). The columns „bovine category" and „tag number" are destinated for introducing of this data by hand with keyboard. „Multi-Scan-Meat-Fat" software is very flexible and enables easy inroducing of different changes and corrections into the system, e.g, for improving the calibration.

Results and discussion

The performances of the system in 5-points carcass EC-classification and predicting of carcass composition are showed in the table below.

Agreement with subjective classification in 5-points scale		Meat content		Fat content		Meat: bones ratio		Ratail cuts content	
Conformation	Fatness	R^2	RSD	R^2	RSD	R^2	RSD	R^2	RSD
1	2	3	4	5	6	7	8	9	10
80%	70%	0.74	2.75	0.71	3.34	0.66	0.25	0.70	2.0

Data in column 1 and 2 relate to industrial system, n=600 carcasses of bovine 4 categories (young bulls, bulls, cows and heifers), refered to subjective classification made by trained classifiers. Data in column 3-10 relate to experimental systems using 8 carcass traits with video camera without optical probe, n=280 (Wichłacz, 1999).
We can see that the performances of Polish VIA system are similar like performances of other systems tested in Ireland, especially refering to conformation and fatness grading in 5-points scale (Allen, 1999) in spite of using of simpler facilities (without colour vision technique and volumetric measurements by light striping). Observations showed thad objective fatness assesment is more difficult than conformation assesment (Sönnichsen et al., 1998, Allen, 1999). It seems that Polish system gives more information about carcass composition than other systems.

Conclusions

Polish VIA beef classification system can be recognized as having sufficient accuracy for carcass grading according to present EC-requirements (5-points scale of conformation and fatness). Of course in case of introducing 15-points grading scale the proper adaptation of system software will be needed. Moreover the improvments, in particular biger mechanization and further investigations related to testing of carcass composition predicting are needed.

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