Attempt to enhance EUROP system for pig carcasses classification with information about the quality of meat

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Abstract. Pig carcass classification in EUROP system based on estimating the whole carcass meatiness using one or more measurements. The aim of the study was to investigate the usefulness of the measurement with the apparatus optical-needle to assess the quality of the meat, ie. intramuscular fat (marbling), chemical composition and its color. On the slaughter line 20 porcine carcasses were examined and the results were statistically processed. It seems that it is possible to estimate some quality traits (protein content, b* and marbling) in m. LD, because correlation coefficients between investigated traits was satisfactory, respectively: r = - 0.58; 0.73 and 0.47. Results of this study are promising, but they need to be supplemented by further investigated characteristics and increase the research material.

Key words – EUROP classification system, optical-needle device, meat quality

I. INTRODUCTION

EU slaughterhouses that fulfil all legal requirements are using the EUROP classification system for estimating the commercial value of pork carcasses. The classification system is based on estimating lean meat content in the carcass using regression equation with one or more measurements, usually the measurement of loin and backfat thickness. Carcass lean meat content estimated that way is a base for establishing the commercial value of the carcass (Borzuta et al., 2010; Engel et al., 2012; Font I Furnols & Gispert, 2009). The most frequently used devices for lean meat estimation in pig carcasses are: optical-needle, ultrasound and visual ones (Fortin, 2004; Lisiak et al., 2012). Some devices used for EUROP carcass classification may deliver significantly more info about carcass composition (Fortin et al., 2004). Many recent scientific research have indicated that they may be used for the identification of meat quality (eg. marbling of meat or PSE meat), which are as well a very important indicator to determine a commercial value (Przybylak et al., 2016). An instrumental method is required for rapid evaluation of marbling in muscles remaining inside the carcass, without the need to have them cut. According to Janiszewski (2014) meatiness of fatteners slaughtered in the leading pig producers in Europe has reached a constant level, which e.g. in Denmark does not change from approx. 20 years, and is 61%. This therefore brings the question about the future of the classification in EUROP system, in this current form, that is, estimating the whole carcass meatiness on the basis of one or more measurements. Such system begins to play in Europe increasingly smaller role but the increase interest in the searching for other

methods to obtain as much information about the quality of the carcass.

The aim of the study was to investigate the usefulness of the measurement apparatus optical-needle to assess the quality of the meat, ie. intramuscular fat (marbling) and its color.

II. MATERIALS AND METHODS

On the slaughter line 20 porcine carcasses were examined using an optical needle device. Measurements were taken on the *longissimus dorsi* muscle between the 3rd and the 4th ribs, 6 cm from the carcass midline. After 24h carcass cooling at the same point meat samples were collected for laboratory analyses. At the cross-section of m. LD marbling was evaluated, using the Canadian standard (Wise 1981) within a scale of 1 to 5 points (1 point - no marbling, 5 points - high marbling). Measurements of the colour of meat were taken using a Minolta Chronometer CR-400, and the values of L* (lightness), a* (redness) and b* (yellowness) were determined. Moreover, in meat samples the water content was measured according to the ISO 1442 (2000), fat content was determined by the Soxhlet method, according to ISO 1444:2000 procedure. The protein content was established according to the Polish norm PN/A-04018 with the Kjeltec System 1002 Distilling Unit method. In the analysis of meat measured with a optical-needle device was used MATLAB Software. For the collected signals from the optical needle device 6 statistical measures were determined, harvested on the subsequent stages of signal processing.

Signal proccesing steps:

1. Collected input signal.
2. Smoothed pt 1 signal with smooth function from Matlab environment which uses moving average filter.
3. Filtered high frequencies from pt 2 signal using 6th order Butterworth filter with normalized cutoff frequency 0,6 Hz.
4. Differentiated pt 3 signal.
5. Calculated fast Fourier transform for pt 3 signal.

For processed data following metrics were calculated:

1. Standard deviation of pt1 signal.
2. Standard deviation of pt2 signal.
3. Standard deviation of pt3 signal.
4. Standard deviation of pt4 signal.
5. Medium of amplitude spectrum of pt5 signal.
6. Module of mean average of pt5 signal.

III. RESULTS AND DISCUSSION

Tab. 1. Results of meat quality evaluation in *longissimus dorsi* muscle

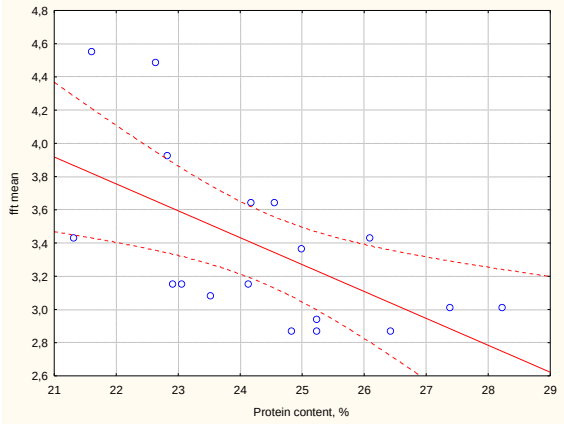
Trait	Mean	SD	Min.	Max.
Marbling evaluated visually, points	1.93	0.71	1.00	3.70
Water content, %	72.76	1.96	68.98	75.28
Extraction fat content, %	1.81	0.68	1.04	3.08
Protein content, %	24.37	2.01	21.23	28.54
Minolta L*(lightness)	49.34	2.36	44.54	53.21
Minolta a* (redness)	6.05	0.86	4.56	7.11
Minolta b* (yellowness)	-0.49	1.38	- 3.2	1.41

Tab. 2. Correlation coefficients between meat quality evaluation by optical-needle device and determination of chemical composition and colour of the *longissimus dorsi* muscle ($P \leq 0.05$)

Traits	std	std-smooth	std_ filterr	std_ diff	fff. amp	fft mean
Water content	0,13	0,15	0,13	0,38	0,36	0,54*
Fat content	0,18	0,16	0,18	0,18	0,36	-0,04
Protein content	-0,27	-0,28	-0,26	-0,56*	-0,58*	-0,59*
L*	0,16	0,19	0,17	0,42	0,49*	0,48*
a*	0,26	0,23	0,23	0,10	0,27	-0,05
b*	0,45*	0,49*	0,48*	0,57*	0,73*	0,48*
Colour, pts.	0,29	0,32	0,34	0,39	0,25	0,25
Marbling,pts.	0,27	0,24	0,26	0,31	0,47*	0,07

* - significant at $P \leq 0.05$
Std standard - deviation of input signal
std_smooth - standard deviation of smoothed input signal
std_filtered - standard deviation of smoothed and filtered (Butterworth 6,0.6) input signal
sdt_diff - standard deviation of smoothed, filtered (Butterworth 6,0.6) and differentiated input signal
fft_amplitude - medium of amplitude spectrum of smoothed and filtered (Butterworth 6,0.6) input signal
fft_mean_module - agarage's module of fast Fourier Transform of smoothed and filtered(Butterworth 6,0.6) input signal

Fig. 1. Diagnostic graph for correlation coefficients between protein content and parameter fff_mean (r = 0.59).



The selected experimental group was characterized by a average mean of the intramuscular fat content and high variation of this trait, which was manifested in the results of marbling evaluation and extraction fat content. The meat from experimental group was characterized by the good quality, on basis of the evaluation's results (Table 1). The highest correlation coefficients between investigated traits and fft_amplitude parameter were obtained for (Table 2):

- minolta b* (yellowness) x fft_amplitude r=0.73
- protein content x fft_amplitude r=0.58
- marbling evaluated visually x fft_amplitude r=0.47

Graph for correlation coefficients (r = 0.59) to between investigated traits and fft_mean was present on the Figure 1. Correlation at a fairly high level probably could indicate the possibility of estimating the protein content using this parameter. It needs to be stressed that from the point of view of pork producing examination the estimate the basic composition of meat at such an early stage is very important. Marbling of the meat and its color are a major quality attributes of meat, connected with its sensory value (Yang et al. 2006) and its suitability for the production of supreme products, e.g. raw maturing ham. A positive consumer examination score for intramuscular fat content has some limitations defined 3.5%. Studies by Young et al. (2006), who stated that correlation coefficient between IMF content and the number of fat lines at the cross-section of m. LD was only 0.58.

Results of this study are promising, since they indicate that with a relatively high probability meat quality may be estimated with the use of an optical needle device, at the same time used in the classification of porcine carcasses at the slaughter line. Thus the proposed solution does not cause disturbances in the operation of the technological line and it may be used in plants of different production scales.

CONCLUSIONS

1. The advanced analysis of optical signals generated by an optical-needle device makes it possible to estimate some quality traits (protein content, b* and marbling) in m. LD, because correlation coefficients between investigated traits were satisfactory, respectively: r = - 0.58; 0.73 and 0.47.
2. Developed method could be used in assessing of the quality of meat on the basis of a simple measurement, already on the slaughter line and provide to enhance EUROP carcasses classification with information about some traits of the quality of meat.
3. Results of this study are promising, but they are only a part of the larger studies and need to be supplemented by further investigated characteristics and increase the research material.

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