STUDIES ON CHANGES OF SOME SELECTED PORK MEAT QUALITY TRAITS IN RELATION TO THE TIME AFTER SLAUGHTER

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Background

One trait, which can be used to characterise meat technological quality, is meat pH measured 45 minutes after slaughter. This measurement is employed to reveal meat quality defects and is highly correlated with meat colour (Briskey 1964).
For many years two main pork meat quality defects have been discussed in literature, namely watery meat and acid meat. Their occurrence is associated with genetic factors and is attributed to the presence of RYR1 and RN^- genes (Fujii et al. 1991, Monin and Sellier 1985).
Meat colour is an important trait to be taken into account when assessing the commercial meat quality. With regard to the subjective meat colour assessment, the greatest attention is paid to its lightness, which is affected by the optical properties of the surface meat layer.

Objectives

The objective of the performed investigations was to determine changes in colour lightness, pH and electrical conductivity ascertained at different times after slaughter in the *longissimus lumborum* muscle *(m. LL)* in swine carcasses with normal and watery meat.

Materials and methods

The experimental material consisted of 1050 pork carcasses derived from different swine genotypes.
Within 45 minutes after stunning, pH was determined in the LL muscle at the level of the 1^{st} – 2^{nd} lumbar vertebra with the aim to select experimental carcasses. From the population, 25 carcasses with PSE meat ($pH_{45} < 6.0$) and 25 carcasses with normal meat (pH_{45} 6.50 – 7.00) were selected randomly for further investigations (Kortz 2001, Borzuta et al 1975).
In the LL muscles of both groups of carcasses pH values, electrical conductivity (LF) and colour lightness (L) measurements were performed at the following times after pig stunning: about 45 minutes and 2, 3 and 24 hours.
The values of pH were determined using the Radiometer PHM 80 Portable pH-meter equipped in a complex electrode, whereas electrical conductivity was measured using a pork meat quality tester of MT-03 type manufactured in Poland.
Meat colour lightness was determined in the *LL muscle* after cutting out a slice at the following times *post mortem*: 45 minutes and 2, 3 and 24 hours. The above-mentioned measurements were performed using the Minolta Chroma Metter CR 300 apparatus (Oziembłowski and Grashorn 1997).

Results and discussion

The pH values determined in the group of pigs with normal meat at the examined times after slaughter indicate proper acidification of the muscle tissue (Tab.1). Two and three hours after stunning pH values dropped, on average, by 0.37 unit (pH=6.36), while 24 hours after slaughter – by 0.91 unit. The obtained final pH_{24} – 5.82 value of these muscles indicates the proper process of glycolysis as confirmed by numerous publications (Lambooij et al. 2004, Bertram et al 2003, Kortz 2001).
The examined muscles were characterised by low electrical conductivity ranging from 2.93 to 3.45 mS, which was found not to be dependent on the measurement time after slaughter. The electrical conductivity obtained for this group of carcasses was typical for normal meat (Koćwin-Podsiadła et al 1998).
Furthermore, in this group of carcasses no significant differences were found between the meat colour lightness measured 45 minutes as well as 2 and 3 hours after slaughter. However, a significant brightening of the colour was observed 24 hours after slaughter.
In the group of carcasses with watery meat, the pH value remained on a similar level 2, 3 and 24 hours after slaughter (pH 5.64 to 5.83). The pH value determined 45 minutes after stunning was only slightly higher (by

0.19 unit). These observations are corroborated by data reported by Simek et al. (2004), who also did not record significant differences between the pH_{45} and pH_{24}. On the other hand, significant differences were found between the degree of tissue acidification of normal and PSE meat 45 minutes and 2 and 3 hours after slaughter. However, 24 hours after slaughter pH values of both groups of muscles were quite similar.
The analysis of values of electrical conductivities of the PSE meat revealed its significant increase during the initial hours after slaughter changes. An increase in the electrical conductivity of 3.10 mS was recorded in the period from 45 minutes to 2 hours after slaughter. On the other hand, between the second and third hour after slaughter only a slight, but statistically significant, increase in electrical conductivity (by 0.95 mS) was observed. In the period from 3 hours to 24 hours after slaughter, a significant drop in the LF of 2.61 mS was observed. Nevertheless, the difference in the electrical conductivity between normal and PSE meat became quite conspicuous already 45 minutes after slaughter (3.45 and 7.41 mS, respectively), which indicates that this measurement can be very useful for the identification of PSE meat already 45 minutes after slaughter. Also LF measurements 2, 3 and 24 hours after slaughter were significantly different between the two groups of carcasses.

45 minutes after slaughter the colour of PSE meat was uneven and pale with the colour brightness reaching 43.2%. The colour became much lighter in the following hours. In the period from 45 minutes to two and three hours after slaughter, a significant increase of the light reflection, on average by 8.6%, was recorded and 24 hours after slaughter this value increased by 11.5%, in relation to the colour lightness measured 45 minutes after slaughter. The PSE meat 24 hours after slaughter was usually pale and exudative on the entire slice surface.
During the analysed periods of time the percent of light reflected from the watery meat tissue was higher and differed significantly when compared with normal meat (<0.01). The recorded differences were as follows: after 45 min. – 4.08%, after 2 and 3 hours – 13.35%, after 24 hours – 8.26%. It is evident from the above-presented data that the measurement of colour 45 minutes after slaughter was not a good indicator for the identification of PSE meat as differences in the colour brightness were the smallest at this point in time. However, this indicator can certainly be used effectively already 2 hours post mortem.

Conclusions

- The pH of PSE meat after 45 minutes as well as 2, 3 and 24 hours after slaughter exhibited almost similar values, whereas in the case of normal meat, a gradual acidification of tissue occurred.
- The electrical conductivity of PSE meat increased the 3rd hour after slaughter, while that of normal meat remained at similar level during the entire 24-hour period. It was stated that the measurement of electrical conductivity 45 minute after slaughter could serve as a good parameter identifying PSE meat.
- The colour lightness of PSE meat, from the 2nd hour post mortem, increased progressively, but measured after 45 minutes was not a good indicator of PSE meat. In normal meat, colour lightness remained on a similar level during the period from 45 minutes to 24 hours after slaughter.

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Table 1. Measurement results of pH, LF and colour lightness L (%) in LL muscle

Time after slaughter	Normal meat						PSE meat						Significant differences		
	pH		LF		L		pH		LF		L		pH	LF	L
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD			
45 min	6,73^{A}	0,17	3,45	0,71	39,12^{A}	1,53	5,83	0,13	7,41^{A}	2,55	43,20^{A}	5,11	**	**	**
2 h	6,35^{B}	0,27	3,18	0,43	38,70^{A}	1,49	5,67	0,14	10,51^{B}	3,59	51,11^{B}	4,99	**	**	**
3 h	6,37^{B}	0,26	2,93	0,61	38,29^{A}	2,57	5,66	0,10	11,46^{C}	3,36	52,59^{B}	4,45	**	**	**
24 h	5,82^{C}	0,18	3,36	0,84	46,74^{B}	4,69	5,64	0,11	8,77^{D}	2,58	54,70^{C}	4,24	ns	**	**

** - significant differences between normal and PSE meat at $P \leq 0,01$
A,B,C,D - significant differences between time of measure at $P \leq 0,01$
ns - non-significant differences