QUANTITATIVE SHARE AND TOPOGRAPHIC DISTRIBUTION OF PSE MEAT IN PORK CARCASS

Karol Borzuta, Jerzy Strzelecki, Eugenia Grześkowiak, Dariusz Lisiak, Henryk Wichłacz
Meat and Fat Research Institute, Poznań, ul. Głogowska 239

Key words: pork carcasses, PSE meat, proportion in carcass

Introduction

Quality defects of pork meat result in considerable economic losses during the production of meat and its products. Pospiech and Borzuta (1998) estimated that in Poland annual losses attributable only to quality defects of PSE and ASE (acid meat) type equal approximately 2.4% of the purchase costs of slaughter animals. Losses caused by PSE defects are a greater problem because this type of meat occurs in domestic raw material 2 to 3 times more frequently than ASE meat (Strzelecki and Borzuta, 2001). As indicated by Linke and Heinz (1972), PSE symptoms occur primarily in large, most active muscles. The authors found that the most frequent colour deviations typical for PSE meat occurred in ham, loin and sirloin. It also found that symptoms of wateriness and colour changes occurred most often in *musculus longissimus dorsi*. That explains why the majority of investigations on PSE meat is carried out on this muscle. On the other hand, there is not much information available in literature on the frequency of occurrence of PSE symptoms in other carcass muscles. In addition, earlier studies are based on slightly different measurements (pH, colour) than those practised recently (pH, electric conductivity) (Wismer-Pedersen 1966; Briskey 1968; Schwagele 1992).

Objective of research project

The purpose of this study was to determine the proportion by weight of watery meat in carcasses in which the pH_1 in *musculus longissimus dorsi* was lower than 5.7. Moreover, the performed investigations estimated topographic distribution of PSE meat in the entire pork half-carcass.

Methods

The experimental material comprised fattener carcasses from a slaughterhouse line, which were divided into two groups: group A (carcasses with PSE meat) and group B (carcasses with normal meat). Group A consisted of 16 carcasses with average weight of 84 kg and 50.3% meatiness, while group B – of 11 carcasses of 79 kg average weight and 51.2% meatiness.

Carcasses selected to group A were characterised by pH <5.7 which was measured at the back side of *musculus longissimus dorsi* 35-40 minutes after stunning. The pH of carcasses from group B was > 6.3, while their electrical conductivity 24 h after slaughter LF_{24h} <5 mS/cm. Quality groups were designed taking into consideration German investigations which showed that the correlation between pH_1 and LF_{24h} was as high as between pH_1 and colour lightness L_{24} (respectively, r = 0.88 and 0.86)(Honikel et al., 1993).

The pH_1 in left half carcasses was measured by means of a spike electrode of a pH meter 24 of Radiometer Co. in the following muscles *longissimus dorsi* (in neck, back and lumbar parts), *psoas major, triceps brachii, semimembranosus, biceps femoris, glutes medius, quadriceps femoris*. The same muscles were used to determine pH_{24} as well as electric conductivity LF_{24} using for this purpose a German apparatus PQM-1 /COMBI/. LF_{24} was also measured in the following other muscles: *masseter, supraspinatus, infraspinatus, semitendinsus, gracilis, triceps surae, intercostales, abligus abdominis, serratus dorsalis*.

After taking the above-mentioned measurements, the carcasses were divided into their basic cuts from which meat of normal colour and that with typical colour for PSE meat were cut out. After weighing meat with PSE symptoms, the results were referred to the weight of meat from the carcass estimated using an electronic PLE ruler applied for the classification of EUROP type carcasses. Samples of raw muscles in which pH_1 was determined were subjected to laboratory assays in which the following parameters were determined: colour lightness by means of Spekol 11 spectrophotometer at wave length of 690 nm and water holding capacity according to the method of Grau-Hamm.

Results and discussion

In nine of the examined muscles and their segments, the determined acidity turned out to be significantly higher (by approximately 0.8 pH unit) 45 min. after slaughter in carcasses with PSE meat than in carcasses with normal meat. The greatest differences were observed in *musculus longissimus dorsi* along its whole length and in the *semimembranosus* muscle (by about 0.9 to 1.1 pH units), while the smallest ones (by about 0.6 pH unit) - in *psoas major, triceps brachii* and *quadriceps femoris* muscles (Tab.1). A similar phenomenon was observed in the case of electric conductivity, although here the LF_{3h} value in carcasses with PSE meat turned out to be approximately 3 times greater than in carcasses with normal meat. With the exception of *psoas major* and *quadriceps femoris* muscles, in all other ones the mean electrical conductivity was high (13-15 mS/cm) allowing them to be qualified as strongly watery (Honikel and Garrido, 1993).

Twenty four hours after slaughter meat acidity stabilised at pH 5.7-5.8 and differences between groups A and B in 5 of the examined muscles were statistically non-significant, while in 4 – pH was higher by approximately 0.1 unit in the group of carcasses with RFN meat. Muscle electrical conductivity after 24 h dropped by about 2 mS/cm in carcasses from group A, although it was still high and was approximately two times higher than that found in the control group. Majority of other, additionally examined, carcass muscles from group A did not show PSE symptoms, e.g. belly muscles (LF_{24}=4.4), neck muscles (LF_{24}=5.5), m. supraspinatus (LF_{24}=8.7), m. infraspinatus (LF_{24}=8.2), m. masseter (LF_{24}=3.7). Mean LF_{24} values of the same muscles in carcasses from group B ranged from 2.6-5.9 mS/cm. On the other hand, distinct PSE symptoms were observed in the following muscles: semitendinosus (LF_{24}=14.3), gracilis (LF_{24}=12.5) and triceps surae (LF_{24}=12.4).

The proportion of carcasses with PSE meat in group A varied depending on the examined muscles. Research results presented in Table 2 follow meat classification adopted by Kortz et al. (1968) and Krzywicki (1972) who mention three quality intervals depending on pH_1: lower than 6.0 for PSE meat, from 6.0-6.2 – for partially PSE meat and above 6.3 - for normal meat. It is evident from these data that PSE symptoms are most frequent in the following muscles: *longissimus dorsi, gluteus medius, psoas major, sesimembranosus* and *biceps femoris* (81 – 100% carcasses in group A). PSE symptoms were found only in 37% of carcasses in *quadriceps femoris* and *triceps brachii* muscles. Typical PSE symptoms or symptoms of partially PSE meat were observed in all the examined muscles of carcasses from this group.

On the other hand, no PSE meat was found in any of the examined muscles in carcasses from group B and only in two carcasses symptoms of partially PSE meat were observed in 2 muscles (*m. longissimus dorsi and psoas major*).

In the result of deboning of carcasses from group A, the average of 7290 g of meat with PSE symptoms was determined, while in group B – only 377 g which constitutes, respectively, 33.99% of the total meat weight of the carcass (min. 25.37%, max. 43.49%) and 1.95% (min. 0%, max. 4.66%). The highest proportion of PSE meat in group A was found in the loin (about 68% of loin meat), hip loin chop (about 59% of hip

loin meat) and leg(about 56% of leg meat) and less in the shoulder (about 16%) and neck (about 10%). Laboratory investigations confirmed numerous reports concerning worse water holding capacity and lighter colour of muscles derived from carcasses characterised by PSE. Mean water holding capacity of 9 examined muscles from group A was 36.53% and their colour lightness – 54.96%, while these values in group B were: 30.83 and 45.07% ($P<0.01$), respectively.

Conclusions

1. According to these studies it was found that in investigated pig carcasses with pH_1 below 5,7 in *m. longissimus dorsi* average quantity meat with PSE sumptoms was 34% ranging from 25 to 43%.
2. PSE symptoms were observed most frequently in the following muscles: *longissimus dorsi, semimemranosus, biceps femoris, gluteus medius, psoas major, semitendinosus, gracilis triceps surae.*
3. The experiments confirmed a significantly worse water holding capacity and greater colour lightness of all the examined carcass muscles from the PSE group.

Literature

1. Pospiech E., Borzuta K., Łyczyński A., Płókarz W., 1998: Meat defects and their economic importance. Pol. Journ. of Fd and Nutr. Sci., 7/484(s), 7-20.
2. Strzelecki J., Borzuta K., Grześkowiak E., Lisiak D., 2001: Zmiany wartości rzeźnej tuczników z dostaw rynkowych w ostatnich trzech latach. Trzoda Chlewna, 5.
3. Linke H., Heinz G., 1972. Qualitatsabweichungen bei Schweinefleisch – Topographie der Farbaufhellung bei wassrigen, blassem Fleisch. Die Fleischwirtschaft, 2, 208-212.
4. WismerPedersen J., 1966. Wassriges Fleisch in Theorie und Praxis. Die Fleischwirtschaft 46, 787.
5. Briskey E.J., 1968. Summary of certain experiments on PSE muscles. Symp. „Recent Points in the Condition and Meat Quality of Pigs for Slaughter", Zeist
6. Schwagele F., 1992. Die electrische Leitfahigkeit von Schweinefleisch im Schlachthof und Zerlegebetieb als Qualitatskriterium. Die Fleischwirtschaft 72, 493-497.
7. Honikiel K.O., Garrido M.D., 1993. Beziegungen zwischen fruh – postmortalen Merkmalen bei Schweinefleisch.Mitteilungsblatt der Bundesanstalt fur Fleischforschung Kulmbach, 32, 120, 170-176.
8. Krzywicki K., 1972. Badania nad wodnistością i środkami ograniczającymi jej występowanie w mięsie świń. Roczn. IPM., IX, 2, 5-42.
9. Kortz J., Krajewska S., Różyczka J., Barzdo E., 1968 Wartość diagnostyczna pH mierzonego w mięśniu 45 minut po uboju dla oceny występowania mięsa wodnistego u świń. Med. Wet. 24, 325.

Tab.1. Mean results of pH and electrical conductivity measurements (LF) of different carcasses from group A (PSE) and B (RFN)

Name of muscle	pH_1			pH_{24}			Electrical conductivity mS/cm					
	PSE carc.	RFN carc.	P	PSE carc.	RFN carc.	P	3 h			24 h		
							PSE carc.	RFN carc.	P	PSE carc.	RFN carc.	P
Longissimus dorsi-neck part	5,72	6,60	xx	5,67	5,76	0,03			xx			xx
Lingissimus dorsi-back part	5,60	6,75	xx	5,61	5,74	0,01	14,1	4,7	xx	11,8	3,7	xx
Lingissimus dorsi-lumbar part	5,74	6,67	xx	5,63	5,72	NS	13,4	4,7	xx	11,3	4,7	xx
Psoas major	5,85	6,48	xx	5,83	5,95	NS	9,5	3,6	xx	8,4	5,0	0,01
Triceps brachii	5,97	6,64	xx	5,93	6,02	NS	12,2	4,1	xx	10,3	4,7	xx
Biceps femoris	5,85	6,67	xx	5,76	5,80	NS	15,0	4,7	xx	12,2	5,3	xx
Semimembranosus	5,79	6,75	xx	5,71	5,73	NS	15,2	4,0	xx	11,8	5,1	xx
Quadriceps femoris	5,97	6,66	xx	5,94	6,12	0,04	9,5	4,2	xx	8,5	5,1	xx
Gluteus medius	5,83	6,64	xx	5,73	5,84	0,02	14,9	4,5	xx	11,4	4,6	xx
T o t a l	**5,81**	**6,65**		**5,76**	**5,85**		**13,0**	**4,4**		**10,8**	**4,8**	

xx/ - differences significant at $P < 0,01$
NS – differences statistically non-significant

Tab.2. Percentage share of carcasses with PSE symptoms in relation to examined muscles

Name of muscle	PSE carcasses			RFN carcasses		
	PSE meat	Partially PSE meat	RFN meat	PSE meat	Partially PSE meat	RFN meat
Longissimus dorsi – back part	100	0	0	0	0	100
Longissimus dorsi – neck part	87	13	0	0	18	82
Longissiumus dorsi – lumbar part	94	6	0	0	0	100
Gluteus medius	91	9	0	0	0	100
Psoas major	87	13	0	0	9	91
Semimembranosus	81	19	0	0	0	100
Biceps femoris	81	19	0	0	0	100
Quadriceps femoris	37	63	0	0	0	100
Triceps brachii	37	63	0	0	0	100