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THE EFFECT OF TEMPERATURE DURING LAIRAGE AT THE SLAUGHTERHOUSE ON THE QUALITY OF PORK

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ABSTRACT

The aim of the experiment was to assess the impact of different temperature at the slaughterhouse on the pork quality. Two thousand eleven commercial pigs hybrids, weighing 100-130 kg were used in the experiment. Acidity of meat and muscle temperature were assessed 45 minutes after slaughter in *Longissimus muscle* between the next to last and last thoracic vertebrae *(musculus longissimus dorsi, pars thoracic)* – pH_1 MLD, and the geometric center *semimembranosus* thigh muscle *(musculus semimembranosus)* - pH_1 MSM. Pigs were divided into groups according to the temperature during housing in slaughterhouse using quartile distribution. As the mean temperature of outer environment increased, the average pH_1 MLD ($P<0.01$) values decreased. With the increase of the average outer temperature of the environment, the temperature of *musculus longissimus dorsi* MLD ($P<0.01$) also increased. Average values pH_1 MSM were higher in comparison with pH_1 MLD values. With average outer temperature increase, the mean value of pH_1 MSM decreased. With the growing average outer temperature the average T MSM ($P<0.01$) increased.

Keywords: Acidity of meat, pork, temperature

INTRODUCTION

For the consumers as well as for the meat industry, it is very important that the pork will be in good quality **(Šprysl *et al.*, 2010)**. The quality of pork is the result of a production system such as combination of genetic, rearing condition **(Hluchý and Eliáš, 2006; Hluchý *et al.*, 2007)**, age and weight at slaughter, handling, stress **(Majorano *et al.*, 2012)**, health **(Rolinec *et al.*, 2010; Kanka *et al.*, 2014)**, as well as cooking method **(Sinha *et al.*, 2009)**. Transportation conditions such as noise, loading and unloading, fighting due to the mixing of unfamiliar pigs and stocking too many animals in a truck mean severe stress for the animal resulting in an accelerated *post-mortem* glycolysis and impaired meat quality **(Smulders and van Laack, 1991)**. **Mota-Rojas *et al.* (2009)** find that the animals without any rest before slaughter can show hemodynamic and metabolic alterations that lead to hyperglycemia, lactic acidosis and to an abrupt descent of the pH value altering the carcass color. **Young *et al.* (2009)** had investigated that the physical load increased the temperature of muscles, but decreased CP and ATP, the content of glycogen, and especially pro-glycogen in the slaughtered pigs, when they were slaughtered immediately after the unload. They have found that just one hour of rest after the physical load was enough to normalize these effects. **Guardia *et al.* (2004)** reported that in summer the risk of PSE meat is almost twice the risk in winter because pigs are sensitive to high temperatures. **Demo (2002)** states that meat quality indicators are the features of low heredity and then the final quality of raw material mostly depends on the conditions of the outside environment, especially on the conditions before, during and after slaughter. **Pulkrabek *et al.* (2003)** claim that pork quality detection is fairly complicated and that this is the reason why it is often deduced in the common practice from the pH_1 values.
The objective of our study was assess the impact of different temperature at the slaughterhouse on the pork quality.

MATERIAL AND METHODS

Two thousand eleven commercial pigs hybrids, weighing 100-130 kg were used in the experiment. External temperature in °C was evaluated during housing of pigs at the slaughterhouse. Pigs were divided into four groups according to the average external temperature during housing of pigs at slaughterhouse using quartile distribution. Based on this distribution the following groups of pigs were created: S1 with value up to 2 °C, S2 with value over 2 °C up to 10.4 °C, S3 with value over 10.4 °C up to 16 °C and group S4 over 16 °C. Acidity and temperature of meat was assessed 45 minutes after slaughter in the longest back muscles between the next to last and last thoracic vertebrae *(musculus longissimus dorsi, pars thoracis)* - pH_1 MLD and T MLD in °C, and the geometric center *semimembranosus* thigh muscle *(musculus semimembranosus)* – pH_1 MSM and T MSM in °C. The right side of the carcass was used to perform meat quality measurements. Muscle pH and muscle temperature post mortem were measured using a portable apparatus TITAN x.

Statistical Analysis

The results were processed in the SPSS 11.0 program. Following variables - statistical values were calculated: minimum - min, maximum -max, arithmetic mean - x, standard deviation - s, variation coefficient in % - v% Differences between groups were tested using analysis of variance with contrast testing using Tukey HSD test.

RESULTS AND DISCUSSION

The influence of average outer temperature on pH_1 MLD values is listed in table 1. At average temperature of environment up to 10.4°C (groups S1 and S2) the highest mean value of pH_1 MLD (6.16) was detected. With the increase of average outer temperature of environment the meat values of pH_1 MLD decreased. Lower average value pH_1 MLD (6.02) was detected in group S4, with the highest average temperature of environment. Statistically significant differences ($P<0.01$) were confirmed between groups S1 and S3 and S4, S2 and S3, S2 and S4. Within all groups the pH_1 MLD values were within 5.4 and 6.9. Variability in groups at given qualitative indicator was low (the highest in group S1-4.87%).

Table 1 Comparison of variation –statistical values pH_1 MLD in relationship to average external temperature during pigs housing at slaughterhouse

group	n	min	max	x	s	v%
S1	546	5.4	6.8	6.16	0.30	4.87
S2	464	5.4	6.9	6.16	0.29	4.71
S3	528	5.4	6.7	6.06	0.27	4.48
S4	473	5.4	6.7	6.02	2.36	4.28

Legend: Statistically significant differences – S1:S3 (P<0.01), S1:S4 (P<0.01); S2:S3 (P<0.01), S2:S4 (P<0.01)

At the same time with pH_1 MLD, the muscle temperature (Tab. 2) was detected in *musculus longissimus dorsi*. Within the whole group of pigs, the MLD temperatures from 15.4 to 33°C were measured. The variability of obtained data was 11.72 % in individual groups. The lowest average temperature in MLD was detected in group S2 (25.77°C) which was statistically significantly lower in comparison with all groups. From table 2 is also possible to see that statistically significant was the highest mean temperature MLD in Group S4 (27.6°C). With the increase of average ambient temperature of environment, the temperature of muscled MLD also increased.

Table 2 Comparison of variation – statistical temperature MLD values (°C) in relationship to average external temperature in °C during pigs housing at slaughterhouse

group	n	min	max	x	s	v%
S1	546	17.6	32.3	26.24	2.66	10.12
S2	464	15.4	32.7	25.77	3.02	11.72
S3	528	18.3	33.0	26.64	2.52	9.47
S4	473	17.8	33.2	27.60	2.68	9.70

Legend: Statistically significant differences: S1:S2 (P<0.05), S1:S4 (P<0.01), S2:S3 (P<0.01) S2:S4 (P<0.01), S3:S4(P<0.01)

Average values pH_1 MSM were higher in comparison with pH_1 MLD values. Table 3 shows that the increasing average outer temperature does not lower meat pH_1 MSM values. The highest pH_1 MSM value was detected in group S3, but this difference in comparison with other groups was not statistically significant. Variability in groups at pH_1 MSM was within 4.94 to 5.47 %.

Table 3 Comparison of variation – statistical pH_1 MSM values in relationship to average outer temperature during pigs housing at slaughterhouse.

group	n	min	max	x	s	v%
S1	546	5.4	6.9	6.25	0.34	5.47
S2	464	5.4	6.9	6.25	0.34	5.40
S3	528	5.4	6.9	6.28	0.33	5.28
S4	473	5.4	6.9	6.25	0.34	4.94

Legend: Statistically significant differences – none

In table 4 the temperature MSM mean values are listed in thigh, the temperatures from 16 to 33°C were detected within all pigs. Statistically significant lower temperature MSM was in group S2 (P<0.01). With the increase of average outer temperature the mean temperature MSM value was also increasing. Significantly the highest (P<0.01) was in groups S4 (28.03°C).

Table 4 Comparison of variation-statistical values of MSM temperature (°C) in relationship to average outer temperature during pigs stabling at slaughterhouse.

group	n	min	max	x	s	v%
S1	546	17.9	31.3	26.77	2.55	9.52
S2	464	16.0	32.6	26.13	2.86	10.97
S3	528	19.0	33.0	27.05	2.45	9.08
S4	473	21.0	33.6	28.03	2.51	8.97

Legend: Statistically significant differences: S1:S2 (P<0.01), S1:S4 (P<0.01), S2:S3 (P<0.01) S2:S4 (P<0.01), S3:S4 (P<0.01)

Kameník and Steinhauser (2012) list that occurrence of PSE meat is higher in summer than in winter because pigs do not have sweat glands in skin and that is the reason why they are sensitive to higher temperatures which can act as stress factor. Similarly **Guardia *et al.* (2004)** stated that the PSE prevalence is expected to be higher in summer. Both high environmental temperatures in summer and temperature fluctuations affect the animal's ability to maintain body temperature which results in stress, a higher *post-mortem* muscle temperature and poorer meat quality **(Guardia *et al*., 2004; Santos *et al*., 1997; Warriss, 1991)**. These statements are in accordance with our findings because increasing average outer temperature statistically significantly affected the decrease in pH1 values in MLD and the increase in muscle MLD and MSM temperature. This is the reason why there should be available drinking water for housed pigs in hot summer season and the possibility to cool down by water **(Martinez-Rodriguez *et al.*, 2011)**. In contrast to our results, **Van de Perre *et al.* (2010)** found significant higher pH_1 in summer than in spring or autumn. As a result, significant lower prevalence of PSE meat was found in summer.

CONCLUSION

The quality of pork can be affected by various stressors which act on pigs before slaughter. The higher average outer temperature can also act as stress factor during housing of pigs at slaughterhouse. From presented results we can state that higher average outer temperature affected statistically significantly the pH_1 decrease of value in MLD and the muscle temperature increase in MLD and MSM. It had no statistical effect on pH_1 MSM values.

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