

## INFLUENCE OF THE TIME OF HOUSING ON THE QUALITY OF PIG MEAT

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Original scientific paper

**Abstract:** In the experiment, 367 hybrid meat pigs were tested. Transport of all observed pigs took 1 hour to get to a slaughterhouse. The housing period of the observed groups in the slaughterhouse took 1, 2, 4, 12, 13, 14, 16, 17, and 41 hours. The pH value was measured in the *musculus longissimus dorsi* (MLD) as well as in *musculus semimembranosus* in the thigh meat (MSM) 45 minutes after slaughter. The highest average pH MLD value (6.36) was recorded in the group of pigs that were housed in the slaughterhouse for the shortest period of time. The average pH MLD value in pigs with the shortest period of housing was statistically arguably higher ( $P < 0.01$ ) in comparison with the groups that were housed in the slaughterhouse from 4 – 17 hours. The group of pigs with the shortest housing period of time had also achieved the highest average value ( $6.45 \pm 0.27$ ) of the pH MSM indicator. Compared to that group, a provably lower average of pH MSM values were recorded in groups with the length of housing 13, 14, and 17 hours ( $P < 0.01$ ). It has resulted from the experiment that after a short - lasting transport it is desirable, in terms of pork quality, to slaughter the animals as soon as possible after their arrival to the slaughterhouse. An animal that is slaughtered after a 12-hour housing might mean a threat for the increased occurrence of the PSE meat due to the consequence of stress caused during the stay in the slaughterhouse.

**Key words:** length of housing, meat quality, pH, PSE meat

### Introduction

Slovakia has built a long-term tradition in pig breeding and pork consumption. Pork consumption in Slovakia takes first place, and it represents more than 50% in comparison with other kinds of meat.

For consumers but also the meat industry are important indicators of meat quality such as physical and chemical requirements, sensory, hygienic,

microbiological and technological meat quality. Some changes of meat quality can be caused mainly by stress and by the genetic predisposition to stress.

Pre-slaughter stress is generally thought to be of some influence on meat quality parameters, mostly with a negative effect. However, results of the published experiments are not unequivocal (*Küchenmeister et al., 2002*). *Demo (2002)* states that quality meat indicators are the features of low heredity and that the final quality of raw material mostly depends on the conditions of the outside environment, especially on the conditions before, during and after slaughter.

Currently, it is typical for the raised and tested breeds, as well as for utility breed pigs, that the bacon thickness is small and that often achieves the values below 10 mm in the spots significant for quality assessment of the meat portion in the slaughtered bodies. Even the extreme portion of muscles can bear the risk in terms of the lowered resistance of animals against the physical load and stress during transportation and the pre-slaughter work. The given fact can significantly result in the physical – technological characteristics of the meat quality (*Lagin and Bobko 2004*).

*Pulkrábek et al. (2003)* claim that PSE meat detection is fairly complicated and that this is the reason why its coincidental occurrence is often deduced from the common practice based on the pH<sub>1</sub> values. The given pH<sub>1</sub> values will be stated 45 – 60 minutes after the animal slaughter. If the measurement achieves the value of 5.8 and less, it points to an eventual mistake, which is the PSE meat.

The aim of the experiment was to assess the influence of the time of housing on the quality of pig meat.

## Materials and Methods

In the experiment, the meat quality was evaluated of 367 pigs. The meat hybrid pigs that were tested in the experiment were the crossbred of the White thoroughbred and Landrass pig breeds with the terminal, extremely heavy-muscled hogs. Their weight went from 100 to 130 kg. The measurements were provided in nine slaughter groups with different amounts of animals. Transport of all pigs to the slaughterhouse took an hour. The period of their housing in the slaughterhouse was different, which was the basis for dividing them into individual groups (Table 1).

**Table 1. Arrangement of animals into the groups according to the length of housing**

Group number	Number of animals in group	Length of housing in hours
1	30	1
2	69	2
3	44	4
4	10	12
5	20	13
6	25	14
7	137	16
8	22	17
9	10	41
Total	367	-

We were observing the influence of the duration of rest on the final after-slaughter meat quality. The meat quality was judged on the basis of the pH value measured 45 minutes after the slaughter of animals. Measuring the acidity rate in the carcass halves was observed in the thorax part of the longest back muscle between the next to last and the last breast vertebrae (*musculus longissimus dorsi, pars thoracis*– MLD) and from the geometric center of the semimembranous thigh muscle (*musculus semimembranosus* – MSM). The actual pH acidity in muscles was stated directly in the muscle tissue by means of the contact electrode, the TITANx apparatus. The method measuring the pH value 45 minutes after slaughter enable to identify the PSE meat (pale-, soft-, exudative), if the pH value falls down below 5.8 (Demo, 2002). The results were processed in the SPSS programme. Differences between groups were tested using analysis of variance with contrasts testing using Tukey HSD test.

## Results and Discussion

The highest pH MLD value ( $6.36 \pm 0.27$ ) was recorded in the group of pigs with the shortest period of time in the stable. The average pH MLD value of pigs with the shortest period of housing was statistically higher ( $P < 0.01$ ) in comparison with the groups which were housed in the slaughterhouse from 4 to 17 hours. There were no statistically approvable differences in the pH MLD indicator among the groups with the length of housing 1, 2, and 41 hours. The lowest average pH MLD value ( $5.90 \pm 0.19$ ) was recorded in the group slaughtered 17 hours after arrival in the slaughterhouse. There were no statistically arguable differences in the pH MLD indicator among the groups with the 12, 13, 14, 16, and 17 hour length of housing. These were characterized by the lowest average values in this indicator (from 5.90 to 6.04) (Table 2).

**Table 2. Meat quality of pigs in the observed animal groups**

Group number	pH MLD		pH MSM	
	x	s	x	s
1	6.36 <sup>A</sup>	0.27	6.45 <sup>A</sup>	0.27
2	6.20 <sup>B</sup>	0.25	6.26	0.26
3	6.15 <sup>C</sup>	0.23	6.37 <sup>B</sup>	0.31
4	6.03 <sup>D</sup>	0.25	6.25	0.31
5	6.04 <sup>E</sup>	0.22	6.07 <sup>C</sup>	0.28
6	6.00 <sup>F</sup>	0.20	6.14 <sup>D</sup>	0.29
7	6.03 <sup>G</sup>	0.26	6.26	0.35
8	5.90 <sup>H</sup>	0.19	6.04 <sup>E</sup>	0.36
9	6.20 <sup>I</sup>	0.33	6.25	0.20
Total	6.10	0.27	6.25	0.33
Significant differences	A:C,D,E,F,G,H ++; B:F +; B:G,H ++; C:H ++; H:I +		A:C,D,E ++; B:C +; B:E ++	

Legend: x-average, s-standard deviation, + P<0.05, ++ P<0.01

The groups of pigs whose length of housing in the slaughterhouse was from 1 to 4 hours were also characterized by a low occurrence of the PSE meat in MLD, which was from 2.27 to 5.80% (Table 3). We recorded one animal with the PSE meat in MLD (10%) in the group with the length of housing 41 hours. The highest frequency of the PSE meat occurrence in MLD was recorded in the groups housed from 12 to 17 hours, where the average of PSE meat occurrence was almost 32% in the group housed for 17 hours. The frequency of the PSE meat occurrence in MLD was 12.53% within the whole group of animals.

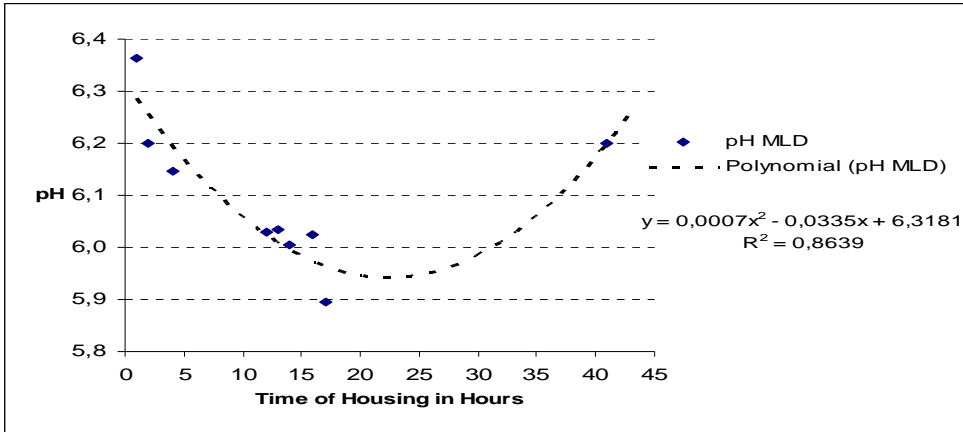
**Table 3. Occurance of PSE meat in the observed animal groups**

Group number	PSE-MLD		PSE-MSM	
	n	%	n	%
1	1	3.33	1	3.33
2	4	5.80	2	2.90
3	1	2.27	2	4.55
4	1	10.00	1	10.00
5	3	15.00	3	15.00
6	4	16.00	2	8.00
7	24	17.52	13	9.49
8	7	31.82	6	27.27
9	1	10.00	0	0.00
Total	46	12.53	30	8.17

Legend: n-number of animals with PSE meat in the group, %-the occurrence of the PSE meat in the group in %

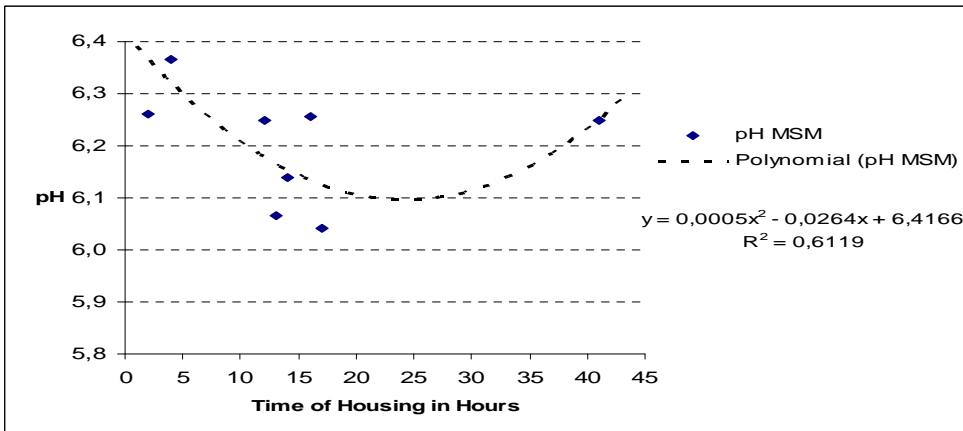
Within all evaluated animals, a higher average pH value was recorded in MSM on the level of  $6.25 \pm 0.33$ . The group of pigs with the shortest period of housing also achieved the highest average value ( $6.45 \pm 0.27$ ) in the pH MSM indicator. Approvably lower average pH MSM values were recorded, in comparison with that group, in the groups with the 13, 14, and 17 hour housing ( $P < 0.01$ ). The lowest average pH MSM value was recorded in the group with the length of housing 17 hours ( $6.04 \pm 0.36$ ). This group had an approvably lower pH MSM value in comparison to the group housed for 4 hours ( $P < 0.01$ ). The second lowest average pH MSM value was recorded in the group housed for 13 hours ( $6.07 \pm 0.28$ ), which was approvably lower in comparison with the group housed for 4 hours ( $P < 0.05$ ). The lowest occurrence of the PSE meat in MSM was in animals housed in the slaughterhouse for 1, 2, 4, and 41 hours and it moved from 0.00 to 4.55 % (Table 2). The highest share of the PSE meat in MSM was recorded in the group with the length of housing for 17 hours and achieved the highest value of 27.27%. The occurrence of PSE meat in MSM within all evaluated animals was on the level of 8.17%. *Mlynek et al. (2010)* found out that the lowest occurrence of the PSE meat was in the groups of pigs after 12 to 16 hours of rest in the slaughterhouse. They recorded the highest occurrence of the PSE meat in the group of individuals slaughtered up to 4 hours. This different finding could have been caused by the fact that the groups of animals being observed had had a different length of transportation (from 1 to 4 hours). *Mota-Rojas et al. (2009)* studied the effects of the pre-slaughter transport and housing on the chemical serological profile of swine as well as its relationship with the qualitative aspects of meat: pH, color and temperature. Their results indicate 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 load. They have found out that just one hour of rest after the physical load was enough to normalize these effects. These results are in accordance with our experiment because a low occurrence of the PSE meat was recorded in the pigs slaughtered one hour after their stay in the stables.



**Graph 1. Influence of the length of housing on the average pH MLD values**

Development of the average pH MLD values according to time is shown in Graph 1. We can see from the graph that the average pH MLD values decrease with the increased time of housing. After some time we can expect the growth of the average pH MLD values again in the way as it is described by the polynomial regression function of the second degree. The determination index is high ( $R^2=0.86$ ) which means that the length of housing significantly influences the quality of meat. It results from the calculated regression function that the lowest average pH MLD values can be expected in the slaughtered pigs approximately after 24 hours from being in the stables.



**Graph 2. Influence of the length of housing on the average pH MSM values**

The influence of the length of housing on the average pH MSM values is shown in Graph 2. The time of housing has a significant impact on the meat quality MSM ( $R^2=0.61$ ) also in this case, whereby the lowest average pH MSM values can be expected approximately 26 hours after housing the animals in the slaughterhouse.

The issue of the pre-slaughter impact on the physiological indicators of pigs was studied by *Costa et al. (2009)*. They have found out that prolonging the length of the housed pigs, such as taking over 3 hours, doesn't have any influence on their heart rate or on the level of glucose and salivary cortisol, but it has an impact on the level of blood lactate. Even though we haven't monitored the level of the blood lactate we found out that lengthening the period of housing can cause decrease of the meat pH values in consequence to the increased production of the lactic acid in the muscles. The results of the experiment show that in terms of the meat quality of pigs it is appropriate, after a short transport, to slaughter the animals as soon as possible after their arrival to the slaughterhouse. If the animals are slaughtered after twelve hours of housing, there is a threat of an increased occurrence of the PSE meat due to the stress during the period of housing in the slaughterhouse (mixed groups, lack of space, limited access to a water source, forced manipulation, etc.).

*Ingr (2000)* also indicates that the original demand on at least a 12 hour rest of animals was overruled.

## Conclusion

The highest average pH MLD value ( $6.36\pm 0.27$ ) was recorded in the group of pigs that were housed in the slaughterhouse for the shortest period of time. In comparison with the groups that were stabled in the slaughterhouse from 4 to 17 hours, it can be stated that the average pH MLD value of the pigs in the slaughterhouse for the shortest period of time was statistically higher ( $P<0.01$ ). The lowest average pH MLD value ( $5.90\pm 0.19$ ) was recorded in the group slaughtered 17 hours after arrival in the slaughterhouse.

The highest average pH MSM value ( $6.45\pm 0.27$ ) was recorded in the group of pigs with the shortest period of housing. In comparison with the groups whose length of housing was 13, 14, and 17 hours ( $P<0.01$ ), the appreciably lower average pH MSM values were recorded. The lowest average pH MSM value was found out in the group with the 17 hour length of housing ( $6.04\pm 0.36$ ).

The results from experiment show that in terms of meat quality it is convenient after short-term transport to slaughter the animals as soon as possible after their arrival to the slaughterhouse. Slaughtering the animals after 12 hours of housing could cause a threat of an increased occurrence of the PSE meat due to the stress period during the stabling in the slaughterhouse.

## Acknowledgment

This article has been created by the execution of the Project "Excellence Centre of the Protection and Utilization of Agrobiodiversity, the Operational Programme: 2620002 OP Research and Development, code of the ITMS project: 26220120032", is based on the support of the Operational Programme Research and Development, funded by the European Fund for Regional Development and with the support of VEGA 1/0462/10-The Valuation of Production and Ethological Parameters of Animals with Regard to Nutrition, Technique and Technology of Breeding.

## Uticaj vremena držanja svinja u klanici na kvalitet mesa

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## Rezime

U eksperimentu je testirano 367 svinja mesnate rase. Za prevoz ispitivanih svinja do klanice bilo je potrebno jedan čas vremena. Merenja su urađena u okviru devet grupa klanja. Vreme držanja posmatranih grupa u klanici bilo je 1, 2, 4, 12, 13, 14, 16, 17, i 41 časova. Posmatran je uticaj dužine vremena u držanju svinja u klanici na kvalitet mesa. 45 minuta nakon klanja izmerena je pH vrednost u *musculus longissimus dorsi* (MLD), kao i u *musculus semimembranosus* u butu mesa (MSM). Najviša prosečna pH vrednost MLD ( $6,36 \pm 0,27$ ), zabeležena je u grupi svinja koje su bile u klanici u najkraćem vremenskom periodu. Možemo konstatovati da u poređenju sa grupama koje su bile u klanici od 4 do 17 časova, prosečna pH vrednost MLD svinje sa najkraćim vremenom držanja je statistički veća ( $p < 0,01$ ). Ocenjeno je da je najnižu pH vrednost MLD ( $5,90 \pm 0,19$ ) u grupi koja je zaklana 17 časova nakon dolaska u klanicu. Prosečna pH vrednost MLD se smanjuju zbog povećanja vremena držanja. Posle nekog vremena možemo očekivati porast prosečne vrednosti pH za MLD. Ovo se može objasniti polinomnom regresijom drugog stepena ( $R^2=0,86$ ). Ovi rezultati o dužini držanja svinja značajno utiči na kvalitet mesa. To proizilazi iz ocene regresione funkcije da najniža prosečna pH vrednost MLD se očekuje kod zaklanih svinja posle 24 časova držanja. Grupa svinja sa najkraćim periodom držanja je takođe postigla najveću prosečnu vrednost ( $6,45 \pm 0,27$ ) pH MSM. U odnosu na tu grupu, niža prosečna pH vrednost MSM zabeležena je u grupama sa dužinom držanja od 13, 14 i 17 časova ( $P < 0,01$ ). Najniža prosečna pH vrednost MSM određena je u grupi sa 17 časova držanja ( $6,04 \pm 0,36$ ). Takođe, u ovom slučaju vreme držanja ima značajan uticaj



na kvalitet mesa MSM ( $R^2 = 0,61$ ) kod kojeg najniža prosečna pH vrednost MSM se očekuje oko 26 sati nakon držanja životinja u klanici. Možemo videti iz rezultata našeg eksperimenta o kvalitetu svinjskog mesa da je odgovarajući kratak period prevoza do klanice i da klanje životinja treba da bude što je pre moguće nakon dolaska u klanicu. U opasnosti od povećane pojave PSE mesa zbog stresa koji nastaje kod životinja tokom držanja u klanici, preporučuje se klanje tek posle 12 časova držanja u klanici.

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