EFFECT OF PROCESSING TECHNOLOGY ON MEAT QUALITY OF PIGS

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Abstract

The aim of our study was to investigate the effect of slaughtering technology as a complex factor on meat quality of pigs. In the experiment we compared a large-scale slaughtering technology with a small-scale one. 40 pigs were transported for 1.5 hours, and lairaged for 16 hours. The large-scale processing was a fully automated technology; the conventional one was carried out more or less manually. The cooling technology was the same in both cases; the carcasses were brought to cooler at 50-55. minutes after stunning. The following meat quality parameters were measured: pH_{45}, pH_{24}, L, a*, b*, core temperature, drip loss.*
The processing technology significantly influenced the meat quality parameters measured at 45th minute in the ham, such as the pH (A: 6.28±0.24; B: 6.47±0.14; $P<0.05$) and core temperature (A: 42.12±0.54; B: 40.93±0.40; $P<0.001$). However the pH_{24} and drip loss differed significantly at a low level, but no difference was found in case of parameters sensible for consumers, such as the meat color.
According to our results, it can be stated that the large-scale slaughtering technology influences the intensity of the post mortem processes. The cooling technology has an outstandingly important role in the development of meat quality, and this operation can eliminates the effect of all the previous factors.

1. Introduction

The quality of pork covers several properties, which have to meet the increasing demands of consumers and processors. The main attributes of interest are color, pH and water-holding capacity.

Perimortal factors from farm to and at abattoir can have a major influence on meat quality. Behavioural, physiological and metabolic responses to aversive situations depend on genetic background and antecedent experience of animals. Nevertheless, the effect of different phases of perimortal factors has not absolutely cleared yet, and we can find conflicting results in the literature. Many studies have been conducted under experimental conditions to assess a number of factors involved. However, investigations on factors in relation to influences at the packing plant may impose serious problems. Pilot studies conducted under experimental conditions often fail to simulate practical conditions: where handling is usually gentler and the stress levels encountered are lower than at commercial plants, if the throughput of several hundred pigs per hour is not reached (*Brown et al.*, 1998). On the other hand, experiments involving commercial plants often are not able to standardize pre-processing factors such as genetic background of the pigs or duration of transport and lairage (*Gispert et al*., 2000).

It is clear that the temperature of the carcasses affects the post-slaughter glycolytic rate. Any factors which influence the temperature of the carcasses have the potential to cause PSE. The recommended maximum time from stunning of the animal to entry of the carcasses into the cooler is 45 minutes (*D'Souza et al., 1998*). Although the average time from stun to cooler in most slaughter-houses is below 45 minutes, but sometimes delay can be experienced.

The aim of our study was to investigate the effect of slaughtering technology as a complex factor on meat quality of pigs. In the experiment we compared a large-scale slaughtering technology with a small-scale, conventional technology.

2. Materials and methods

Pigs of the same genotype at the HAL loci, i.e. NN were reared under similar feeding and housing conditions. A total of 40 pigs were transported on lorry to abattoir. The last feeding was 4 hours prior to transportation. The distance between the pig farm and the slaughter-house was 70 km, which lasted for 1.5 hr. Having arrived 40 animals were weighted, then they was divided into two groups: (1) large-scale technology and (2) small-scale, conventional technology. The lairage conditions were the same in both groups, the lairage time was 16 hours. During lairage the animals were allowed to drink water containing 3 % glucose.

Table 1 shows an overview of the main characteristics of the two different slaughtering technology.

Table 1. Description of the slaughtering technology

	Large-scale slaughtering	**Small-scale slaughtering**
Distance from lairage pen to stunning	50 m	5 m
Moving of animals from lairage pen to stunning	With electric goad	Without electric goad
Stunning	Cardiac arrest stunning	Only head stunning
Scalding	Automatic	Manual
Time from stunning to chilling	51 minutes	49 minutes
Chilling	Pre-chilling tunnel than store at +4°C	Pre-chilling tunnel than store at +4°C

Meat quality parameters were measured two times: 45 minutes post mortem and after chilling for 24th. The first measurement included pH and core temperature determinations in the most valuable muscles: *m. longissimus dorsi* (LD) and *m. semimembranosus* (SM). 24 hours p. m. pH_u and meat colour (L^*, a^*, b^*) were measured at 3 three different points of the loin: at the (1) cranio-lateral and (2) cranio-medial points, and at the (3) caudal end of the loin.

Temperature was measured by common meat industrial core thermometer, pH measurement using WTW 330 portable pH meter (WTW GmbH., Germany) attached with WTW SenTix sp electrode and colour with Minolta Chromameter CR-300 (Minolta Co., Japan).

Drip loss was measured according to the Honikel-test by suspending a 2 cm thick slice of the loin eye area (lumbar region) in a net for 24 h at 4 °C. The surface/thickness relation was standardized.

3. Results

The effect of slaughtering technology on meat quality parameters measured at 45th minute is in Table 2. The large-scale slaughtering enhanced the core temperature of the ham, which caused a marked decline in the pH measured in the same muscle. The findings did not reveal any significant difference in case of the meat quality parameters measured in the loin.

Table 2. Effect of slaughtering technology on meat quality parameters measured at 45th minute

Parameter	Small-scale slaughtering		Large-scale slaughtering		P
	Mean	SD	Mean	SD	
$pH_{45\ loin}$	6.21	0.20	6.21	0.28	0.979^{NS}
$pH_{45\ ham}$	6.47	0.14	6.28	0.21	0.002^{**}
T_{loin}	40.23	0.86	40.03	0.98	0.680^{NS}
T_{ham}	40.93	0.40	42.17	0.52	0.000^{***}

The results of the ultimate meat quality measurements are shown in Table 3 and 4. The differences were significant at a low level in case of the pH measured at three different points. The ultimate pH was lower in case of large-scale slaughtering due to increased post mortem metabolism. The drip loss was more favourable in case of small-scale slaughtering.

The meat color was not influenced by the slaughtering technology. Only the lightness and yellowness measured at the cranio-medial point altered significantly. The large-scale slaughtering caused a slightly lighter meat at this measuring point. The differences experienced in the ultimate meat quality are minimal and not sensible for the consumers.

Table 3. Effect of slaughtering technology on pH and drip loss measured at 24th hour

Parameter	Small-scale slaughtering		Large-scale slaughtering		P
	Mean	SD	Mean	SD	
$pH_{24\ (1)}$	5.84	0.18	5.71	0.10	0.027*
$pH_{24\ (2)}$	5.78	0.16	5.67	0.09	0.024*
$pH_{24\ (3)}$	5.72	0.12	5.63	0.06	0.024*
Drip loss	4.05	0.99	4.81	1.22	0.037*

Table 4. Effect of slaughtering technology on meat color

Parameter	Small-scale slaughtering		Large-scale slaughtering		P
	Mean	SD	Mean	SD	
$L^*_{(1)}$	51.07	4.45	50.40	5.94	0.691^{NS}
$a^*_{(1)}$	9.12	3.23	8.62	3.73	0.655^{NS}
$b^*_{(1)}$	9.68	1.76	8.86	2.39	0.221^{NS}
$L^*_{(2)}$	50.45	2.29	54.54	2.26	0.023 *
$a^*_{(2)}$	7.19	2.10	7.25	2.05	0.926^{NS}
$b^*_{(2)}$	8.45	2.29	9.86	2.26	0.050 *
$L^*_{(3)}$	53.24	3.48	52.86	5.04	0.789^{NS}
$a^*_{(3)}$	6.52	2.44	6.80	3.23	0.767^{NS}
$b^*_{(3)}$	8.86	1.55	9.38	2.03	0.385^{NS}

Table 5. Correlation coefficients between pH and core temperature measured at 45th minute

	1	2	3	4
pH_{45loin} (1)		0.34	-0.19	-0.27
pH_{45ham} (2)			-0.08	-0.46*
T_{loin} (3)				0.48*
T_{ham} (4)				

**Marked correlations are significant at P<0.05 level*

Table 6. Correlation coefficients between ultimate pH, drip loss and meat lightness

	1	2	3	4	5	6	7
$pH_{24\,(1)}$ (1)		0.91*	0.53*	-0.55*	-0.70*	-0.65*	-0.74*
$pH_{24\,(2)}$ (2)			0.73*	-0.53*	-0.77*	-0.75*	-0.78*
$pH_{24\,(3)}$ (3)				-0.40*	-0.47*	-0.64*	-0.62*
Drip loss (4)					0.62*	0.57*	0.46*
$L^*_{(1)}$ (5)						0.60*	0.56*
$L^*_{(2)}$ (6)							0.68*
$L^*_{(3)}$ (7)							

All correlations are signficant at P<0.05 level.

Table 5 and 6 shows that correlations between individual meat quality traits were low to moderately high. None of the parameters measured at 45th minute showed significant correlations with any of the ultimate meat quality parameters, that's why these coefficients are not presented in the correlation matrixes.

4. Conclusions

According to the results of present study it can be stated that the slaughtering technology may influence the meat quality. The large-scale slaughtering can increase the core temperature which contributes to a more rapid pH decline post mortem. The important role of cooling procedures was confirmed: the differences experienced at 45th minute were more or less eliminated till the 24th hour. In case of the ultimate meat quality parameters significant difference was experienced only in case of the pH and drip loss. The meat color, which is the most important property for the consumer is not influenced by the slaughtering technology. It can be explained by the effect of cooling, which was the same in both groups.

Correlations between the parameters measured at the 45th minute and ultimate meat quality traits such as drip loss or meat colour were low which is in agreement with other studies (Kauffman et al., 1993; van der Wal et al., 1995). In these studies, pH proved to be the most valuable single predictor of meat quality traits.

Further conclusion could be that during large-scale, commercial slaughtering and processing the preslaughter factors have much lower effect on meat quality than among experimental circumstances. Sometimes the processing technology (singe, dehairing, etc.) increase the carcass temperature to extremely high (the core temperature can be above 41-42 °C), which accelerate the pH decline significantly. In our opinion these major factors eliminate the effect of pre-slaughter handling.

The perimortal effects on meat quality and animal welfare have been investigated in comprehensive studies. It is generally accepted, that the different environmental factors have a stronger impact than the genetic background. On the other hand the decreasing variance of Hal and RN genes, moreover the elimination of these genes makes it necessary to reevaluate the effect of environmental factors. Many studies showed differences in case of these effects only when the experiments were carried out with halothane negative pigs. For the future, one of the most important tasks to understand how post slaughter processing and pres-laughter factors interact in relation to pork quality. We have to give a huge number of tools to control pork quality and hereby meat quality demands for tomorrow.

5. References

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