Slaughter technology to improve the quality of pork

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In the Federal Republic of Germany presently the part of pork with "pale, soft and exudative" - quality ($pH_1 < 5,8$) is 30 - 50 % or more in some meat plants. The main reason for this unsatisfactory situation is the carcass classification and paying system. Until today, the producer of hogs wants to produce lean pigs with very good developped muscles, especially hams. Those kind of carcasses bring the greatest profit. As a rule, it is not the producer's loss, if such meat shows PSE-condition, but the producers of meat products and the consumer have to pay for it. The enormous economic losses, which result from PSE-meat, should be limited first of all by the breeders. But because of the negative correlation between pork quantity and pork quality and a breeding aim, which further favours the lean, well muscle - developped pig, there will be no clear improvement of pork quality by steps undertaken from the breeders in the next time.

Favourable environmental conditions are the second possibility, to influence meat quality in the right direction. That means keeping- and transport-conditions as well as handling and stalling in the slaughterhouse. Also the slaughter process itself and the treatment of the carcass after bleeding (TROEGER and WOLTERSDORF, 1986) are able to debase meat quality.

We examined the influence of the slaughter process in a narrow sense, that means stunning, shackling, hoisting and bleeding, on meat quality. The parameters of electrical stunning often are different in different meat plants (Tab. 1),

voltage	:	70 V	to	700 V
current	:	<1 A	to	2,6 A
time	:	1 sec	to	30 sec
placing the electrodes	:	different		

Tab. 1: Parameters of electrical stunning

although there is a clear influence of stunning on meat quality (OVERSTREET et al., 1975; WAL, van der et al., 1982). The conventional shackling and hoisting of the convulsively moving pigs may exhaust a lot of energy in the muscle (glycogen, ATP), which results in an increased formation of lactic acid. This assumption was confirmed by FISCHER and AUGUSTINI (1981); they found in the ham of the hoisted carcass side an accelerated postmortal glycolysis. When time between stunning and bleeding is longer than about 30 sec, the catecholamines, released from the sympathoadrenomedullary system by electrical stunning impulse, activate muscle glycolysis and thereby increase the availability of substrates for acid formation. In consideration of these facts, we changed the conditions of pig slaughtering in such a way, that stress was minimized.

Materials and methods

In plant A 81 pigs were slaughtered. Driving to the stunning box was done carefully in short ways, the animals had contact to one another, narrow runways were avoided. Electrical stunning was done by tongs (200 V, 10 sec). Immediately after stunning was finished, the pigs were sticked and bleeded in a prone position. Not before the convulsive movings had ended (ca. 2 min), the hogs were shackled and hoisted. In plant B 539 pigs were slaughtered in the same way discribed above, with the only difference that the stunning voltage was 240 V and stunning time 5 sec. In plant B, another group of 142 pigs was stunned automatically by a high voltage apparatus (700 V, 1,7 sec), after passing a restrainer-conveyor. The following steps of the slaughter process were identical with the method described for plant A.

About 45 min post mortem, pH_1-values were measured in m. semimembranosus and m. longissimus dorsi and colour (L*, a*, b*) was measured on m. semimembranosus.

Results and Discussion

Tab. 2 shows pH_1-values (means and standard deviations) of m. semimembranosus for the different slaughter technologies in the two slaughterhouses. In both plants, the pH_1-values were higher after bleeding in a prone position. The difference between the conventional slaughter technology and the examined method was up to 0,5 pH-units. The difference of 0,2 pH-units between the two stunning methods in plant B showed a detrimental effect of the driving system (restrainer-conveyor) and/or high voltage stunning, in comparison with careful driving and stunning with electrical tongs. In plant A, always the lower pH_1-values were measured. A higher stress suspectability of the pigs in this geographic region may be the main cause. Tab. 3 shows the pH_1-values of m. longissimus dorsi after different slaughter methods. Also in m. longissimus dorsi significantly higher pH_1-values were found after prone bleeding. The differences were 0,4 and 0,5 pH-units. The reduction of carcasses with PSE by the proposed slaughter method is shown in Tab. 4. In slaughterhouse B, the greatest reduction of PSE-incidence was found: The part of carcasses with quality injuries was reduced from about 40 % to below 10 %. Fig. 1 shows the shift of pH_1-values from the PSE in the normal range in plant B. After conventional slaughtering, the relative frequency of pH_1-values showed

exsanguination	meat plant	stunning	time between beginn of stunning and bleeding $\bar{x}$ (sec.)	s	pH-values $\bar{x}$	s
conventional hanging - bleeding	A	tongs, 200 V, 22*sec.	55	34	5,8	0,36
	B	restrainer, 700 V, 1,7 sec.	25	5	6,0	0,40
prone bleeding	A	tongs, 200 V, 10 sec.	12	1	6,1	0,37
	B	tongs, 240 V, 5 sec.	7	1	6,5	0,37
		restrainer, 700 V, 1,7 sec.	1,7	0	6,3	0,32

* mean

Tab. 2: pH_1-values (m. semimembranosus) after different slaughter technologies

exsanguination	meat plant	stunning	pH_1 - values $\bar{x}$	s
conventional hanging - bleeding	B	restrainer, 700 V, 1,7 sec.	5,9	0,41
prone bleeding	B	tongs, 240 V, 5 sec.	6,4	0,40
	B	restrainer, 700 V, 1,7 sec.	6,3	0,38

Tab. 3: pH_1-values (m. longissimus dorsi) after different slaughter technologies

two maximas, the one in the PSE-range pH 5,6 - 5,7, the other in the normal range pH 6,1 - 6,2. After the alternative slaughter method, the maximum in the PSE-range had disappeared, now the great majority of the values was found in the normal pH-range. Fig. 2 shows the effect of driving to the stunning place and of the stunning method: More favourable to meat quality was careful, calm driving to the stunning box on a short way and stunning with electrical tongs, in comparison with driving the pigs in a narrow, 20 metres long runway to a restrainer-conveyor with high voltage stunning.

The measurement of colour (Tab. 5) after the different slaughter methods showed no big differences. Hams of carcasses conventionally slaughtered were brighter (L*-value greater). The values of the red (a*) and yellow (b*) saturation of ham showed a tendency in favour of prone bleeding and stunning with electrical tongs. In general there were only insignificant correlations between the colour-values and the pH_1-values. In consequence, a PSE-diagnosis, based only on colour measurement, is not reliable, because mainly the pH-value is decisive for waterholding capacity and suitability for processing of the meat.

meat plant	stunning	m. semi-membranosus	m. long. dorsi
A	tongs (200 V, 10 sec.)	76 % → 39 %	57 % → 26 %
B	restrainer (700 V, 1,7 sec.)	38 % → 5 %	41 % → 14 %
	tongs (240 V, 5 sec.)	→ 6 %	→ 7 %

Tab. 4: Reduction of PSE - incidence by prone bleeding

Conclusions

The proposed slaughter method resulted in a significant reduction of carcasses with accelerated, postmortal glycolysis. The following points during the slaughtering process seem to be important to minimize PSE incidence: Short, carefully driving (no restriction in narrow runways or restrainers), duration of electrical stunning must be adjusted to the used voltage, immediately sticking and bleeding after stunning, in a prone position. If the hogs shall be transported in hanging position to the scalding tank, shackling and hoisting is allowed not until the convulsively movings have ended. Another practical solution in order to maintain a continuous working run is the use of a conveyor-table. Such arrangement may eliminate the normal shackling, hoisting and dropping of the pigs into the scalding tank, because the conveyor-table can discharge the pigs after prone bleeding directly into the scalding tank.

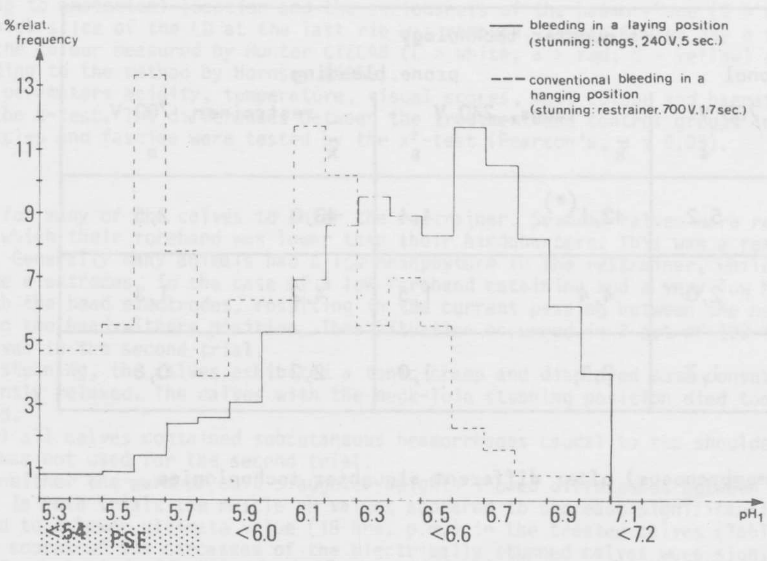

Fig. 1: Distribution of pH_1-values (m. semimembranosus) after different slaughter technologies

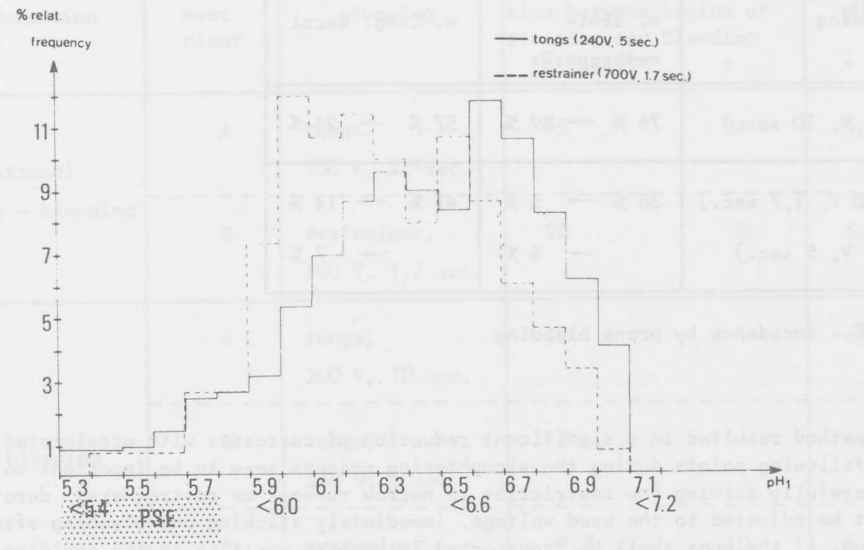

Fig. 2: Distribution of pH_1-values (m. semimembranosus) after different stunning methods and prone bleeding

	slaughter technology					
	conventional		prone bleeding			
	restrainer 700 V		tongs, 240 V		restrainer, 700 V	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
L_1*	43,5	5,2	42,1 (*)	4,4	43,0	2,5
a_1*	4,3	2,0	4,4	1,5	4,2	1,3
b_1*	2,4	1,7	2,1	1,0	2,3	0,8

(*) $P \leqslant 0,1$

Tab. 5: Colour (m. semimembranosus) after different slaughter technologies

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