The effects of blast air and cryogenic chilling on hot boned PSE pork cuts.

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Introduction

The search for pigs with low fat by the industry to satisfy the consumer, has been the driving force to the development of new breeds. This could be one of reasons of the great stress sensitivity of the modern pig population. These animals have high level of lean meat but are extremely susceptible to develop PSE properties. These properties are liable to put the consumer off and turns more difficult to the manufacturer to process the meat. The major problems are the poor water holding capacity and color that turns difficult to use this meat as a processed product or even to sell as a cut, mainly the loin and ham because their high commercial value.

A lot of study has been done on this subject, but there are controversies in some aspects. Some techniques are used to reduce the effect of this syndrome and one of them is quick chilling. This technique will be used in this work and the principle is that the quick drop in the temperature of muscle soon after bleeding, prevents the conditions of high temperature and low pH, that promotes the denaturing of proteins and consequently the damage to the cell membrane.

Materials and Methods

The investigations were performed by using eighteen Pietran pigs halothane positive (HP) recessive homozygous (locus Hal, nn) and 4 Large White x Pietran pigs halothane negative (HN) - heterozygous (Nn) . Pigs of 100 Kg live weight were stunned with electric shock (150 -160 V, 60 Hz) with electrodes positioned in the base of the ears during 5 to 6 seconds and after they were bled horizontally.

Studies were driven with pork cuts (*Longissimus dorsi*-LD and *Semimembranosus*-SM) vacuum packed and the temperatures near the surface and at the center, were measured with Ecklund CuCo thermocouples (diameter 1mm and 15,6 cm of length) introduced through silicon seals and read with a digital thermometer ECB.

The carcasses were submitted to three treatments: hot boning combined with chilling in cryogenic cabinet (-45°C) (treatment A), hot boning combined with chilling in freezing tunnel (-30°C) (treatment B) and conventional boning after chilling in cooling room (0°C) (treatment C). A normal animal with conventional chilling and boning was used as a control.

The DNA was isolated from samples of blood collected in EDTA. The extraction was accomplished mixing the blood with the lise buffer (0,32M sucrose, 10mM Tris-HCl pH 7,5, 5mM Mg Cl12 and 1% Triton X-100). After centrifugation the floating matter was discarded and the cells were washed in lise buffer. The precipitate was suspended in solution contends 50mM KCl, 10mM Tris-HCl (pH 8,3), 1,5mM MgC12, 1% Triton X-100 and 60ng/µl of K proteinase. The suspension was incubated at 55°C for 1 hour. Following the proteinase was inactivated for 10 minutes at 95°C and the material was maintained for -20°C until use. The amplified reactions were accomplished with PCR mix with 160ng of DNA approximately; 200µM of each dNTP; 0,2µg of the forward and reverse; 10mM of Tris-HCl (pH 8,3), 1,5mM MgCl2, 50mM KCl and 0,5 units of Taq DNA polimerase. The reaction consisted of 35 cycles of amplification of 40 s at 95°C, 30 s at 65°C, 30 s at 72°C, followed by a final extension of 3 min at 72°C. The product of PCR with 81 pairs of bases was digested with the enzyme Hhal and occasionally with the enzyme BsiHkal. The obtained fragments were separate in gel (agarose LMP) 3% and detected after gel coloration with ethidium bromide .

The **pH and temperature** monitoring were accomplished in the LD and SM muscles 45 min and 24 hours post stunning with equipment INGOLD WTW pH 91. **R value** was determined following methodology proposed by HONIKEL & FISHER, 1977. The **drip loss** test according to the methodology proposed by HONIKEL (1986) and the results were expressed in percentage (%). **Water holding capacity** was evaluated by the methodology described by GRAU & HAMM (1954) and modified by HOFFMANN et al. (1982). **Isolation of the myofibrillar proteins** was adopted from the technique described by EISELE & BREEKE (1981) with some modifications. From the fraction of myofibrillars proteins (decanted), it was obtained the protein portion by the method of Kjeldahl (AOAC, 1984). **Protein solubility** analysis was performed following methodology proposed by XIONG & BREKKE (1989), with some modifications. Samples of gels (myofibrillar protein fraction of the muscles LD and SM) were prepared in duplicate and the percentage of the protein solubility was determined from the ratio of the protein concentration in the floating matter and its original concentration. The **water holding capacity of the fraction of myofibrillar proteins** evaluations were made using the methodology described by XIONG & BREKKE (1989) with some modifications and calculated with [1-(weight of the separate water / weight of the myofibrillar fraction)] x 100. In all samples two measures were accomplished to evaluate **sarcomere length**, collected 24 hours and 8 days after the slaughter. It was used as a base for this experiment, the method developed by SWARTZ et al. (1993), with some modifications. It was used a scale of 1,0mm recorded in glass sheet divided in 100 parts of 0,01 mm. The data were analyzed with randomized blocks design , analysis of variance and treatment differences were tested with the Tukey test for significance at 5% level (STATISTICA for Windows- release 5.0 Copyright © Stat Soft, Inc. 1984-1995)

Results and discussions

pH and R value - The pH values measured at LD muscles were not significantly influenced by method of carcass boning or cooling. It was measured at bleeding, after scalding and every two hours during twenty- four hours post mortem, and the results didn't show statistical differences. Results obtained from analysis of R- value measured at LD muscle, during twenty four hours after bleeding at every two hours, showed that there was no difference between the treatments, even compared to an animal with no PSE propensity.

Color - Table 1 gives figures permitting a comparison on color brightness (L*), (a*) and (b*). The very quickly chilled samples are distinctly darker than the conventionally chilled ones. We can notice that the color brightness (L*) obtained are much lower than values found in literature related to PSE muscles (WALL, 1978 and WALTERSDORF & TROEGER, 1989) and comparing with the control we can see that they are almost the same slightly brighter.

Table 1. Color composition (L*a*b *) 24 hours post-mortem in SM and LD muscles as a function of treatments : A,B,C and Control

TREATMENTS	L*		a*		b*	
	SM	LD	SM	LD	SM	LD
A	44.107[a]	42.632[a]	7.808[a]	8.367[a]	1.963[a]	1.922[a]
B	46.188[a]	42.727[a]	7.985[a]	7.655[a]	1.975[a]	0.923[a]
C	48.235[a]	48.478[a]	9.807[b]	8.672[a]	4.360[a]	3.675[a]
Control	43.805	45.128	7.358	7.635	1.840	1.980

The values a and b represent the statistical difference, values with same index don't have significant difference.

Sarcomere Length (SL)- The average values of SL were in the range 2,0 and 2,1μm and the variance analysis showed that there were no significant differences in the effects of time and treatments. This is in agreement with FELDHUSEN & KÜHNE (1992) that studied the same muscle and verified that in the PSE condition, there is no alteration in SL, with rapid or conventional chilling. This occurs because PSE muscles are already in *rigor mortis* when the temperature is drastically reduced.

Water Holding Capacity -This property was not affected by the treatments and the results showed that all WHC values were in the range of PSE pork meat, proposed by RING & KORTAMANN (1988).

Drip Loss and Cooking Loss - The losses from dripping and cooking were not affected by the way of chilling and comparing this with results from MOLLER & VESTERGAARD, 1986, 1987, we observe that drip losses are in the range of PSE meat values and higher than the control. Cooking losses are similar to normal pigs and approximately the control.

The animals that showed high drip losses when cooked lose less water than the animals with low drip losses.

Muscle Protein Solubility – Muscle Protein Solubility (MPS) is affected by halothane phenotype and breed and sensitive pigs had a low MPS compared with normal pigs (OLIVER et al., 1993). As we can see in the Fig 1 and 2, the chilling treatment influenced significantly the solubility of myofibrillar proteins and the water holding capacity of the myofibrillar proteins. The quick cooling with blast freezing air or liquid N_2 cabinet of the muscle boned after the bleeding, showed better results than the conventional method of cooling and boning, increasing the muscle protein solubility of PSE muscles and hence his quality.

Conclusions

The present findings that rapid cooling reduces the PSE effects on pork cuts is in accordance with previous reports. With respect to the way of cooling, the results showed that there is no difference between cryogenic and air blast freezing tunnel , showing that the major hurdle to the flow of heat is caused by the meat. The use of quick chilling is positive to control some properties of PSE pork cuts, increasing the water holding capacity of the proteins and enhancing the color.

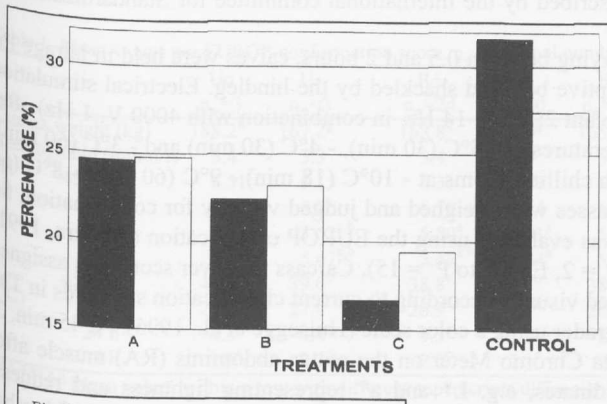

Fig. 1 Muscle protein solubility as function of treatments : A, B, C and control.

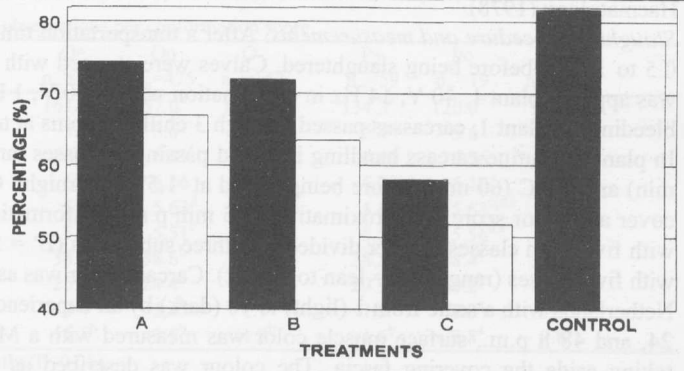

Fig.2 Water holding capacity of myofibrilar proteins as a function of treatments A, B, C and control.

Semimembranosus Longissimus dorsi

AOAC (1984), *Association of Official Analytical Chemists*: Official Methodos of Analysis. 14 ed. Arlington, VA.

Eisele & Breeke (1981), *Journal of Food Science* , v. **46** ,n. 4, p. 1095- 1102.

Feldhusen, F.; Kühne, M. (1992). *Meat Science*, Barking, v.**32**, p.161-171.

Grau, R. & Hamm, R. (1954) *Fleischwirtschaft*, **34**, 36.

Honikel,K. & Fisher, C. H.(1977) *Fleischwirtschaft*, **57**, 1015.

Honikel, K.O. (1986) Fleischphysikalische Merkmale der Fleischquality.Kulmbacher Reike. Baundg, 67

Hoffmann, K.; Hamm, R.; Bluchel, E.(1982). *Fleischwirtschaft*, **62**, 87

Moller, A. J. & Vestergaard,, T. (1986)*Meat Science*, **18**, 77.

Moller, A. J. & Vestergaard,, T. (1987)*Meat Science*, **19**, 27

Moller, A. J & Kirkegaard, E. (1987) *Meat Science*, **21** , 275.

Oliver, M. A. ; Gispert , M. ; Diestre, A (1993). *Meat Science*, **35**, 105

Swartz, Greaser & Marsh (1993) *Meat Science*, Barking, v.**33**, p.157 -190.

Wall van der , (1978) *Meat Science*, Barking, v.**2**, p.19

Waltersdorf & Troeger, (1989), *Fleischwirtschaft*, **69**, (5) , 875

Xiong & Brekke (1989). *Journal of Food Science*, v. 54, n.5, p 1141-1146