CHANGES IN MYOFILAMENT SPACING AND MUSCLE QUALITY TRAITS IN BIOPSY AND POST-MORTEM PIG MUSCLE

Rudolf Lahucky[1], Penka Marinova[2], T. Astruc[3], Xavier Vignon[3] and Gabriel Monin[3]

[1] Research Institute of Animal Production, Hlohovska 2, 949 92 Nitra, Slovakia.
[2] Research Institute of Animal Production, Kostinbrod, Sofia, Bulgaria.
[3] Station de Recherches sur la Viande, I.N.R.A., Theix, 63122 CE YRAT, France.

Keywords: muscle, pig, myofilament spacing, meat quality.

BACKGROUNDS AND OBJECTIVES

Halothane sensitivity is characterised by events such as a fast pH fall and a decrease in water holding capacity in post mortem muscle. These events can be simulated on biopsy muscle samples as it was shown by Lahucky et al.(1994). After slaughter, the distribution of water in muscle tissue undergoes large changes. An effect of pH fall on myofibrillar spa cing as measured by X-ray diffraction was shown by Irving et al. (1990) in post mortem porcine longissimus dorsi muscle.
The aim of the present study was to investigate further the relationship between some biophysical and biochemical characteristics and myofilament spacing in both biopsy and post mortem muscle samples.

MATERIAL AND METHODS

Pietrain piglets were halothane-tested at a liveweight of about 30 kg. Five halothane-negative and 7 halothane-positive animals were used in the experiment. They were killed at a liveweight of about 95 kg. Samples were obtained from the Longissimus lumborum of 5 halothane-negative and 7 halothane-positive pids as follows: 1) just before slaughter, a biopsy was performed using the shot biopsy device and a half of the biopsy sample (sample 1) was immediately used for analysis; 2) the other half of the biopsy (sample 2) was incubated at 39°C with 0.5 ml of 150 mM KCl for 1 h before use; 3) muscle was cut from the carcass at 1 hour after slaughter (sample 3) and at 24 hours after slaughter (sample 4) pH, R-value and WHC value were measured in the incubated biopsy and the 1h post-mortem samples. pH was measured after homogenisation in 0.005 M iodoacetate. R-value (ATP/IMP) was determined according Honikel & Fischer (1977). WHC was expressed as the volume of supernatant (fluid volume) in ml described by Cheah et al. (1993).
Myofilament spacing was assessed in all samples. Small blocks of muscle (1-2 mm^3) were fixed in glutaraldehyde, postfixed in osmium tetroxide then dehydrated through ethanol gradient before embedding in epoxy resin. Ultrathin sections (80-90 nm) were stained with uranyl acetate and lead citrate before observation at an accelerating voltage of 80 KV in a Philips EM electron microscope. The space between thick filaments was measured at a print magnification of x 25000 from 6 prints from different parts of the sample. Hundred measurements were made on each photograph (10 myofibrills x 10 sets of 10 filaments).

RESULTS AND DISCSSION

The changes in pH, WHC, R value and myofilament spacing were parallel in post mortem muscle (Table 1).

Tab 1. Changes in some meat quality traits and myofilament spacing in biopsy and post mortem pig muscle.

TRAIT*	HAL	Biopsy	Inc.Biopsy	PM, 1 h	PM, 24 h
pH	HN	-	5.95 ± 0.08^{a}	5.72 ± 0.15	-
	HP	-	5.66 ± 0.02^{b}	5.54 ± 0.05	-
WHC	HN	-	0.44 ± 0.02	0.49 ± 0.04	-
	HP	-	0.50 ± 0.02	0.52 ± 0.03	-
R value	HN	-	1.08 ± 0.02^{a}	1.12 ± 0.03	-
	HP	-	1.16 ± 0.02^{b}	1.19 ± 0.02	-
Myof. spacing (nm)	HN	29.82 ± 1.07^{X}	$29.14 \pm 0.79^{A,X}$	$25.02 \pm 0.93^{A,Y}$	$22.62 \pm 0.73^{a,Y}$
	HP	27.20 ± 0.88^{X}	$25.27 \pm 0.72^{B,X}$	$21.72 \pm 0.21^{B,Y}$	$20.82 \pm 0.41^{b,Y}$

Results are given as means ± SEM. Means with different supescripts in the same line or the same column are significantly different. Effect of halothane-sensitivity: ^{a,b} $P<0.05$; ^{A,B} $P<0.01$;Effect of sample condition: ^{x,y} $P<0.05$; ^{X,Y} $P<0.01$.
*Inc.Biopsy: biopsy after 1 h incubation at 39°C; PM: post mortem

Correlations betweem traits measured on incubated biopsies and meat quality parameters were in some cases high significant ($P<0.01$), which confirms previous observations of Lahucky et al. (1994). Significant correlations were observed between: pH in biopsied samples and myofilament spacing in incubated biopsies ($r=0.67;P<0.01$) and in samples taken 1 h post mortem ($r=0.83;P<0.01$); pH and myofilament spacing in 1 h post mortem samples ($r=0.72;P<0.01$); myofilament spacing 1 h post mortem and both WHC ($r=-0.64;P<0.05$) and R value ($r=-0.70;P<0.01$) in biopsied samples; myofilament spacing and R values ($r=-0.74;P<0.01$) in 1 h post mortem samples. The results are in agreement with the findings of Irving et al. (1990) about the linear relationship between filament spacing changes and pH drop below 6.4 in spite of that myofilament spacing values was lower in present study.

CONCLUSIONS

Changes in myofilament spacing are fairly related to changes in pH, WHC and R value in both incubated biopsy samples and post mortem samples, although they are slower in the former. The results of the present study suggest that slaughter stress could exaggerate the rate of changes in myofilament spacing occuring with pH fall in anoxic muscle.

ACKNOWLEDGEMENTS

This study was performed owing to grants attributed to R. Lahucky and Penka Marinova by Institut National de la Recherche Agronomique.

REFERENCES

HONIKEL, K.O. & FISCHER, C. (1977). J. Food Sci., 42, 1633.

CHEAH,K.S., CHEAH, A.M., LAHUCKY, R., MOJTO, J. & KOVAC, L. (1993). Meat Sci., 34, 179.

IRWING, T.C., SWATLAND, H.J. & MILLMAN, B.M. (1990). Can. Inst. Food Sci. Technol. J., 23, 79.

LAHUCKY, R., TALMANT, A. & MONIN, G. (1994). Proceed. of 40th ICoMST, The Hague, paper S-IVA.09.