INFLUENCE OF MYOSIN ISOFORMS ON HISTOCHEMICAL PROPERTIES AND MEAT QUALITY IN PIGS

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Introduction

Myosins are hexamers, which are composed of two myosin heavy- (MHC) and four light chains (MLC) isoforms. The variety of possible myosin isoforms is reflective of the structural and functional diversity inherent in the skeletal muscles, such as contractility and energetic properties. Myosin content is significantly lower in slow-twitch than in fast-twitch fibres (Reggiani *et al.*, 2000). In addition, MHC isoform contents affect the post-mortem metabolic rate and meat quality (Choi *et al.*, 2006). Therefore, we examined the influence of MHC and MLC isoform content on histochemical properties and meat quality in the porcine *longissimus dorsi* muscle.

Materials and Methods

A total of 69 crossbred (Yorkshire × Landrace × Duroc) pigs (45 gilts and 24 castrated male pigs) were evaluated. Within 45 min postmortem, muscle samples were obtained from the porcine *longissimus dorsi* muscle for myosin and histochemical analyses. At 24h postmortem, muscle samples were taken in order to evaluate meat quality. Both MHC and MLC contents were determined using SDS-PAGE (Choi *et al.*, 2006; Joo *et al.*, 1999, respectively). The muscle sections were stained for myofibrillar ATPase reactivity after preincubation at pH 4.7 (Brooke and Kaiser, 1970). Meat colour was evaluated, using a Minolta chromameter (CR-300, Minolta Camera Co., Japan). Drip loss was also assessed in accordance with the procedure of Honikel (1987), and filter paper fluid uptake was measured as described by Kauffman *et al.* (1986). Protein solubility was assessed in accordance with the method developed by Joo *et al.* (1999). The Pearson correlation coefficients were evaluated using the partial correlation coefficients. The data were classified into two groups (low and high) on the basis of the MHC fast/slow isoform ratios. Least squares analyses were conducted using the GLM procedure of the SAS statistical package (2001).

Results and Discussion

The MHC 1 isoform content was positively correlated with the density of type I fibres ($r = .71$) (Table 1). Moreover, the MHC fast/slow ratio evidenced a correlation with fibre type I and IIB density ($r = -.64$ and .35, respectively). The MLC 1s isoform content was positively correlated with the mean of fibre area and density of type I fibres ($r = .26$ and .32, respectively), whereas the MLC fast/slow isoform ratios evidenced the opposite tendency ($r = -.25$ and -.34, respectively). Muscles with higher MHC fast/slow ratios were found to have lower ultimate pH values and also showed an excessive degree of protein denaturation, hence exhibiting a paler surface and higher drip loss than was observed in muscles with lower MHC fast/slow ratios ($P < 0.05$) (Table 2).

Table 1: Correlations between contents of the myosin isoforms and histochemical properties in the porcine *longissimus dorsi* muscle.

	Myosin heavy chain isoform			Myosin light chain isoform			
	1	2	Fast/slow ratio	1s	1f	3f	Fast/slow ratio
Muscle fibre area (μm^2)							
Mean	-.07	0.07	-.06	.26*	.03	-.08	-.25*
Type I	-.13	0.12	.17	.32**	-.35*	.04	-.34**
Type IIA	.21	-0.25*	-.33**	.20	-.03	-.05	-.18
Type IIB	-.01	0.05	-.13	.20	.08	-.07	.20
Muscle fibre density per mm^2							
Sum	.08	-0.07	.03	-.26*	.02	.12	.25*
Type I	.71***	-0.70***	-.64***	-.07	.22	-16	.05
Type IIA	-.01	0.01	-.11	-.07	.14	-.24*	.10
Type IIB	-.12	0.12	.35**	-.25*	-.08	.01	.28*

Levels of significance: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 2: Meat quality measurements of the porcine *longissimus dorsi* muscle in groups categorized by myosin heavy chain fast/slow ratio

	Myosin heavy chain fast/slow ratio		Levels of Significance
	Low (N = 46)	High (N = 23)	
Meat quality traits			
Drip loss (%)	5.91[a] (0.39)[1]	3.98[b] (0.27)	***
Filter-paper fluid uptake (mg)	62.32[a] (4.91)	48.85[b] (3.44)	*
Lightness (L^*)	47.80[a] (0.64)	46.28[b] (0.45)	*
Muscle $pH_{24\ h}$	5.55[b] (0.01)	5.66[a] (0.01)	*
Protein solubility (mg/g)			
Total protein solubility	179.16[b] (4.47)	194.05[a] (3.00)	**
Sarcoplasmic protein solubility	69.20 (2.10)	73.13 (1.41)	NS
Myofibrillar protein solubility	109.96[b] (3.17)	120.92[a] (2.13)	**

[1] Standard error of least-square means.
Levels of significance: NS = not significance, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.
[a,b] Least-square means with different superscripts in the same row significantly differ ($P < 0.05$).

Conclusions

In this study, the results indicate that both the MHC and MLC isoforms may potentially serve as determinants of certain muscle fibre characteristics in the porcine *longissimus dorsi* muscle. Moreover, MHC isoform contents appear to influence both extent of protein denaturation and overall quality in pork.

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