PREDICTION OF MEAT QUALITY USING MYOSIN HEAVY CHAIN ISOFORMS FROM LIVE PIGS

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I. INTRODUCTION

Muscle contractile properties of living or slaughtered animals are distinguished by patterns of oxidation reactions and glycolysis. In addition, muscle fibers can be classified according to their size, color, and glycogen and lipid content [1]. Muscle contraction and metabolic characteristics vary depending on muscle fiber types, and meat quality is related to fiber type composition [2]. The classification of muscle fibers is based on metabolic activity, composition, myosin heavy chain isoform, and myosin ATPase activity. Myosin heavy chain (MHC) fast isoform content in myosin isoforms is positively correlated with lactic acid glycolysis and negatively correlated with glycogen content and muscle pH. MHC slow isoform content is positively correlated with glycogen content and muscle pH [3]. In this study, a correlation analysis was performed for the MHC isoform ratio from biopsied longissimus dorsi muscle, tissue ratio of postmortem muscle fibers, and pork quality.

II. MATERIALS AND METHODS

1) Collection of biopsy sample: A small amount of longissimus dorsi muscle (LD) was collected from a living domestic pig (15 weeks) using a core biopsy instrument (C1410B, BARD MAX-Core, U.S.A). The specimens were put into a tissue embedding cassette and then stored by putting it into liquid nitrogen in the frozen state.
2) SDS PAGE: The pretreatment of the biopsy specimens for a quantitative analysis of MHC isoforms was performed according to the method of Talmadge and Roy (1993) [4], and the concentration of the extracted muscle fiber protein was adjusted to the same level (1.0 mg/ml) using the method of Bradford (1976) [5]. The MHC isoforms were separated into slow (MHC I) type and fast (MHC II) type by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). The density for each band was measured to be expressed in composition (%) by sample.
3) Histochemical analysis: After collecting biopsy specimens, the individuals were cutting LD muscle of hog (26 weeks) into pieces of 0.5 x 0.5 x 1.0 cm to be frozen by nitrogen liquid. Muscle fiber staining was performed according to myofibrillar adenosine triphosphate [6].
4) Meat quality measurements: The LD Muscle which were chilled at 4℃ for 24hour were taken to evaluate meat quality traits (pH, Drip loss, Meat color, Drip loss, Cooking loss, Filter paper Fluid Up take, NPPC color and Marbling score).

III. RESULTS AND DISCUSSION

This study analyzed the correlation between sample collected from the collected samples using biopsy and LD of the hog carcass. The MHC Slow isoform was positively correlated with Type I of fiber area percentage and showed a negative correlation with IIb. The MHC fast isoform was negatively correlated with Type I of fiber area percentage and showed a positive correlation with IIb. The results of the fiber number percentage (%) also showed the same tendency as the fiber area percentage.
Table 2 shows the correlation between MHC isoforms and quality of slaughtered individuals. The MHC slow isoform was positively correlated with pH 45 (min) and negatively correlated with drip loss (24 hour). Moreover, the MHC fast isoform was negatively correlated with pH 45 (min) and positively correlated with drip loss (24 hour).

Table 1 Correlation coefficients between MHC isoform and muscle fiber type characteristics

Measurements	Total fiber Number	Fiber Density	mean area (μm^2)	Fiber area(μm^2)			Fiber area percentage(%)			Fiber number percentage (%)		
				I	IIa	IIb	I	IIa	IIb	I	IIa	IIb
MHC slow isoform	0.00	-0.14*	0.14*	0.08	0.10	0.12*	0.35*	-0.03	-0.28*	0.41*	-0.05	-0.32*
MHC fast isoform	-0.37	-0.36	0.36	0.25	0.30	0.33	-0.25*	0.00	0.22*	-0.28*	-0.02	0.25*
slow/fast ratio	-0.18*	-0.18*	0.18*	0.11	0.11*	0.16*	-0.55*	0.05	0.44*	-0.62*	0.05	0.50*

Significance: *$P < 0.05$

Table 2 Correlation coefficients between MHC isoform and meat quality traits

Measurements	PH45 min	PH24 hr	L*	a*	b*	ffu	Drip loss 24hr	Cooking loss (%)	NPPC color	NPPC marbling
MHC slow isoform	0.42*	0.03	-0.05	0.03	-0.04	-0.10	-0.11*	0.05	-0.04	-0.03
MHC fast isoform	-0.23*	-0.02	0.03	0.04	0.00	0.09	0.10*	0.03	-0.06	0.17*
Slow/fast ratio	0.58*	-0.07	0.09	0.01	0.05	0.11*	0.20*	0.04	-0.02	0.09

Significance: *$P < 0.05$

IV. CONCLUSION

MHC isoforms are classified into slow MHC isoform and fast MHC isoform. This classification method uses differences in response (contraction) rate of muscle fibers after being stimulated. It has been reported that MHC isoform content is strongly correlated with muscle fiber forms. In this study, MHC isoforms are correlated with the analysis results of muscle fibers collected from the slaughtered carcass. In addition, it is considered possible to predict meat quality of living pig using this result.

In the correlation between MHC isoforms and meat quality, there was a correlation between pH and drip loss at the early stage of postmortem metabolism. It has been known that metabolic changes in early pH generally affect meat quality. It was confirmed that this was associated with meat quality based on the results of pH 45 min and drip loss. It is considered possible to improve pig using the results of this study.

ACKNOWLEDGEMENTS

This work was supported by a grant (PJ013587) from the Rural Development Administration “Export strategy for Jeju Black pork including fresh pork, meat products, and by-products”.

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