GLYCOGEN METABOLISM AND METMYOGLOBIN REDUCTASE ACTIVITY AS AFFECTED BY SLIGHT, MEDIUM AND EXTREME RIGOR STATE HOG CARCASS

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Introduction

Pale, soft, and exudative pork and dark, firm, and dry pork caused economical losses for the pork industry. The unfavorable result was influenced by pre-slaughter stress situation. According to Chang (2003) by different rigor degree separated the slight, medium, and extreme rigor degree hog carcass. Numerous experiments show during stress period the epinephrine, cortisol and lactate grade were increased in blood and rapidly glycogen metabolism could increase temperature and rate of pH decline in carcass early postmortem (Hambrecht et al., 2004). Specifically, changes in the extent or rate of glycolysis can create unfavorable muscle pH. A high rate of pH decline and a low ultimate pH result in muscle discoloration and diminished meat quality parameters. Although understanding the factor of many influenced glycogen depletion and meat discoloration. And the glycogen depletion was suffered by glycogen phosphorylase, and metmyoglobin reductase was one of enzymatic factor of influenced metmyoglobin accumulation in meat. Therefore by investigating glycogen phosphorylase and metmtoglobin reductase activity could be understood the correlation with glycogenolysis and discoloration of the slight, medium, and extreme rigor state hog carcass.

Materials and Methods

Preparatment of Materials The hog carcass separated to slight, medium, and extreme rigor postmortem and the muscle samples was performed as described by Chang (2003). From abattoir selected two hundred pigs crossbreed Landrace, Yorkshire, and Duroc. Pigs reared up to 5-6monthes and were slaughter by electrical stunning, and then measured the pulling force value of rigor degree of postmortem hog carcass. The M. *longissimus dorsi* (LD) and M. *Semimembranosus* (SM) muscles were obtained from 45 minute post-mortem carcasses of fifteen pigs of three rigor hog carcass individually.

Analysis of Items andMethods The muscle were measured with a Hunterlab colorimeter to determine lightness (L*), redness (a*) and yellowness (b*) by Lyon *et al.*(1980). Furthermore, the glycogen phosphorylase, lactate dehydrogenase and metmyoglobin reductase activity in LD and SM was measured according to Storey (1987) and Mikkelsen et al.(1999) then the total metmyoglobin, glycogen, and lactate measured by Trout (1989) and Hartschuh *et al.* (2002).

Results and Discussion

Physioloical Metabolism in LD and SM. The value of glycogen phosphorylase and lactate dehydrogenase activity and glycogen and lactate content in LD and SM show in Table 1.The extreme rigor of hog carcass had significantly higher GP and LDH activity, and lower glycogen and lactate content than slight rigor mortis. The fast glycogenolysis of extreme rigor of hog carcass lead glycogen depletion and formed the lactate. The higher lactate accumulation of extent rigor of hog carcass had higher LDH activity and the lower pH value. Further, the extent rigor of hog carcass induced the water holding capacity decreasing and poor meat quality. The situation were consistent with Hambrecht et al., (2004) that higher slaughter stress led to impaired pork quality parameters, with high muscle energy levels aggravating the negative effect of pre-slaughter stress..

Table 1. The value of GP and LDH activity and glycogen and lactate content in *longissimus dorsi* and *Semimenbranosua* muscle a t 45mins post mortem among different rigor mortis detgree hog carcass.

	Longissimus dorsi			*Semimembranosus*		
	Slight	Medium	Extreme	Slight	Medium	Extreme
GP activity	18.98±1.37	20.92±1.41	21.06±1.37	17.23±1.37	19.18±1.37	19.51±1.37
Glycogen content	234.58±9.22 ^{a}	192.42±8.78 ^{ab}	182.79±4.06 ^{b}	255.50±8.23 ^{d}	243.21±8.04 ^{d}	199.85±5.26 ^{e}
LDH activity	1143.9±33^{a}	1185.5±33^{ab}	1226.85±33^{b}	1117.29±33^{d}	1158.21±33 ^{de}	1199.58±11.3^{e}
Lactate cotent	324.05±6.1 ^{a}	355.25±6.1^{ab}	380.61±6.1^{b}	251.90±5.0 ^{d}	285.05±5.0 ^{de}	304.55±5.0 ^{e}

$^{a–f}$ Means in the same row without a common superscript letter differ significantly ($P < 0.05$).

pH value,Color difference in LD and SM. The value of pH, L*, a*, b*, metmyoglobin content, and metmyoglobin reductase activity in LD and SM show in Table 2. The extreme rigor of hog carcass had significantly lower pH value, a* value and metmyoglobin reductase activity (MRA), and higher L* and Metmyoglobin content (Table 1). But the b* was no differences among the different rigor mortis degree of hog carcasses. The extreme rigor of hog carcass had lower pH value due to rapidly glycogenolysis and the lactate content accumulation. And the lower pH value in meat resulted the protein denatured and decreased the water capability, and furthermore to increase the L*. The color of meat depends on the concentration of the meat pigments, especially the state of myoglobin. Metmyoglobin reducing form influenced by metmyoglobin reducing mechanism, which influenced by enzymatic (muscle type, temperature, pH value, spices, and oxygen-utilising

enzyme) and non-enzymatic (NADH concentration, and vitamin E) influenced factors. The Extent rigor mortis had significantly lower metmyoglobin reducing activity (MRA), and higher metmyoglobin formed during postmortem 45 min. Further, the rigor mortis state and pH value had negative correlation, and had positive correlation with metmyoglobin content(Fig. 1). According to the result of the extreme rigor of hog carcass had the poor color and lower pH value which caused poor meat quality and influenced the consumer purchasing inclination.

Table 2. The value of pH, L*, a*, b*, MetMb content ,and MRA activity in *longissimus dorsi* and *Semimenbranosua* muscle a t 45mins post mortem among different rigor mortis state hog carcass.

	Longissimus dorsi			*Semimembranosus*		
	Slight	Medium	Extreme	Slight	Medium	Extreme
pH value	6.23±0.05^{a}	6.07±0.05^{ab}	5.94±0.05^{b}	6.60±0.05^{d}	6.43±0.05^{de}	6.33±0.05^{f}
L*	44.94±0.94^{a}	45.85±0.94^{ab}	46.79±0.94^{b}	38.27±1.09^{d}	41.37±0.94^{de}	44.47±0.94^{f}
a*	8.07±0.57^{b}	7.94±0.57^{ab}	6.45±0.57^{a}	10.09±0.57^{f}	9.42±0.57^{de}	9.10±0.67^{d}
b*	8.42±035	8.44±0.35	8.67±0.35	8.53±0.41	8.62±0.35	9.45±0.35
MetMb	19.73±1.02^{a}	22.69±1.02^{ab}	23.60±1.02^{b}	17.75±1.02^{d}	17.96±1.02^{d}	19.86±1.02^{e}
MRA	1.411±0.033^{a}	1.252±0.051^{ab}	1.041±0.033^{b}	1.589±0.07^{d}	1.426±0.07^{de}	1.156±0.07^{e}

$^{a–f}$ Means in the same row without a common superscript letter differ significantly ($P < 0.05$).

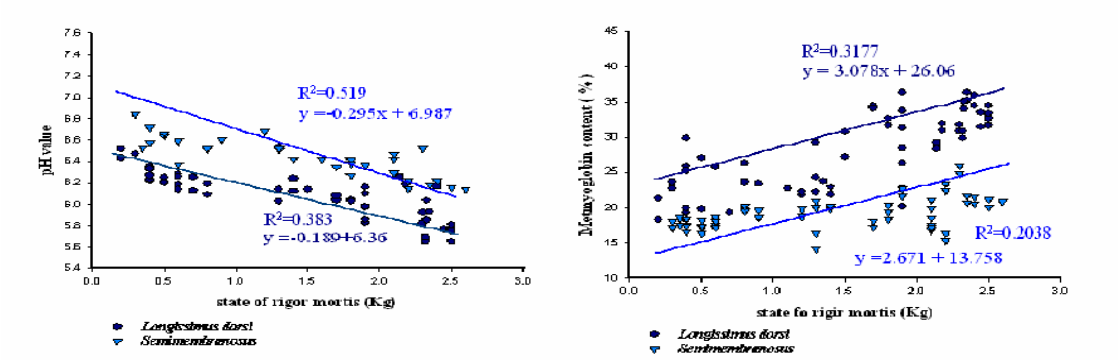

Figure 1. In *longissimus dorsi* and *Semimenbranosua* muscle the regression for pH value and metmyoglobin content of different rigor mortis state hog carcass a t 45mins post mortem.

Conclusions

Glycogen phosphorylase activity was not significantly difference among the different rigor mortis hog carcasses. But Glycogen phosphorylase activity in extreme rigor mortis carcasses was higher than in the slight rigor mortis. On the other hand, exteme rigor mortis had significantly lower glycogen and glucose content, and lactate dehydrogenase activity, and lactate content of exteme rigor mortis had significantly higher (p<0.05) than slight rigor mortis. In color difference, extreme rigor mortis had highter metmyoglobin content (p<0.05) and lower metmyoglobin reductase activity (MRA) (p<0.05). As a result of understanding that extreme rigor mortis carcasses had the faster rate of the glycogenolysis, higher lactate dehydrogenase activity, and lactate content accumulate, and resulted the pH values decreasing fast. By the conclusions, we could understand to elevate the rigor mortis of carcass not only resulted the poor meat quality , appearance and reduced consumer purchasing, but also economical loss.

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