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EFFECT OF STUNNING METHODS(ELECTRICAL VS CO_2) ON INCIDENCE OF PSE PORK

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Introduction

Postmortem metabolic rate has a significant effect of meat quality through its effect of protein denaturation and proteolysis, while pork has a faster postmortem metabolic rate than beef and sheep(March et al., 1972). Pearson(1987) reported that pork quality was largely affected by postmortem changes in muscle temperature and pH. Mitchell and Heffrom(1982) showed that pH decline was not significantly determined by stress gene, but pH decline itself has more than three times effect on PSE incidence.

Park et al. (2003) reported that approximately 45% of pork produced by Korea industry was PSE-like meat and that was largely related to pre-slaughter transit stress, feed restriction as well as stunning method. From the animal welfare viewpoint, it has been recommended that pig should be stunned prior to slaughter (Council Directive 93/119/CEE, 1993). Stunning method has a significant effect on pork quality despite the effect have varied depending on experimental design and purpose of studies(Gregory, 1994; Cannon et al., 2002; Casteels et al., 1995). Electronic and CO2 have been largely used by pork industries across world, while the former method has been dominant in Korean pork industry, with only three slaughter plans have adopted the latter stunning method.

Objectives

The current study was conducted to investigate the effects of stunning methods (electrical vs CO2 method) on PSE incidence and general pork quality.

Methodology

Animals, experimental design and treatment: date set comprised two separate experiments; 1) PSE incidence of five biggest slaughter house in Korea from 2003. 9. to 2004. 6. where electrical stunning method was applied and 2) comparison of electrical and CO2 stunning methods from the same places conduced at 2003. 6. The number of animals are presented in Tables, 1, 2 and 3.

Objective meat quality and PSE incidence: After slaughter carcasses were placed at a 5 chiller longer than 18 hours and 4th/5th ribs were cut. Meat color, texture,

intramuscular fat, moisture score and separation score between muscles were determined by carcass graders from the Korean Animal Products Grading Service (APGS, 2001). For the determination of PSE incidence, carcass with color number 1 or 2, texture number 3 and moisture score 3 was determined as severe PSE, while carcass of color number 3, texture or moisture score number 2 was considered as light PSE. The rest carcass was considered to be normal. The data set was examined to determine the effect of stunning method on meat quality and PSE incidence using SAS package(SAS, 2001) by applying Duncan test and Chi-Square procedure.

Results & Discussion

Table 1 shows number of animals, carcass characteristics and PSE incidence. Pigs resulted in normal carcass traits were lighter weight with 74. 6 kg than those for severe and light PSE of 76.9 and 77 kg, respectively. Average backfat thickness for normal, severe and light PSE were 16.2, 17.1 and 17.4 mm, respectively. The results indicated that PSE incidence was associated with heavier carcass weight with thicker backfat while intramuscular fat content was lower, suggesting that fast growth rate could result in PSE meat, as reported by an early study (Webb et al., 1982).

Table 2 presents the effects of various electrical stunning methods on PSE incidence. The results was rather expected, but demonstrated that a higher voltage increased the frequency of PSE, with 12.3, 17.41, 24.91, and 43.12% for 220, 240, 250, and 430 voltage, respectively. The data again indicated that high voltage stunning has a high risk of PSE incidence and that was likely related to a higher rate of postmortem metabolic rate when carcass temperature maintained near physical temperature which could resulted in protein denaturation. This result was similar to our early study(Park et al., 2002) where 230 voltage stunning resulted in a significantly lower PSE incidence with 42.3% than 500 voltage of 66.7%. Similarly Grandin(1994) recommended a 300 voltage system for big pigs and a lower voltage for more a lighter pig.

In order to identify the practical problem associated with stunning method in PSE incidence, 500 voltage system which has been largely used by Korean pig industry was compared with CO_2 method with putting an emphasize on PSE incidence. Table 3 presents the comparison between two methods on PSE incidence. The result indicated that CO_2 method reduced approximately 33% of PSE incidence by reducing 72.9% for 500 voltage system to 39.3% for CO_2 stunning system. As the current study was industrial based examination, biological aspects of the stunning methods were not examined in details, but the data might indicated that the latter method reduced stunning stress and consequently alleviated metabolic rate during rigor development.

Conclusions

Therefore, the result from this study suggested that the stunning methods had a significant effect on the incidence of PSE pork. Also, the low-voltage stunning and CO_2 stunning methods were highly recommended to control and maintain the pork quality.

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Table 1. Comparison of carcass and meat properties for normal, light and severe PSE pork

Item	Normal	Severe PSE	Light PSE
Number of animal	68,697	9,995	2,457
Carcass weight	$74.63^{b} \pm 0.03$	$76.87^{a} \pm 0.08$	$76.96^{a} \pm 0.16$
Backfat thickness(mm)	$16.17^{c} \pm 0.02$	$17.13^{b} \pm 0.05$	$17.43^{a} \pm 0.11$
Color score	$3.51^{a} \pm 0.00$	$2.44^{c} \pm 0.01$	$3.19^{b} \pm 0.01$
Texture score	$1.12^{c} \pm 0.00$	$2.61^{a} \pm 0.01$	$2.00^{b} \pm 0.00$
Marbling score	$2.09^{a} \pm 0.01$	$1.43^{c} \pm 0.01$	$1.61^{b} \pm 0.02$
Moisture %	$15.64^{c} \pm 0.07$	$85.86^{a} \pm 0.20$	$73.57^{b} \pm 0.10$
Moisture score	$1.02^{c} \pm 0.00$	$2.69^{a} \pm 0.01$	$2.00^{b} \pm 0.00$
Separation score between muscles	$1.03^{c} \pm 0.00$	$1.20^{a} \pm 0.00$	$1.11^{b} \pm 0.01$

[a-c]Means having different letters in the same row are significantly different($p<.05$).

Table 2. Incidence rate of PSE pork by using different electric voltage for stunning

Stunning Voltage	Normal	PSE			Total numbers of animal
		Severe	Light	Total	
220V	87.19	10.86	1.95	12.81	58,867
240V	84.64	9.08	6.28	15.36	8,771
250V	76.33	18.22	5.46	23.68	10,716
430V	63.26	30.55	6.19	36.74	2,795

Chi-Square:3505.99($p<.0001$).

Table 3. Incidence rate of PSE pork by using high electrical voltage or CO_2 stunning methods

Stunning methods	Normal	PSE pork		
Stunning methods	Normal	Severe	Light	Total
High electrical stunning (500V)	27.14(19)[1)]	14.29(10)	58.57(41)	72.86(51)
CO_2 stunning	60.71(34)	16.07(9)	23.21(13)	39.28(22)

[1)] ( ) : frequency