PHYSICAL AND CHEMICAL CHARACTERISTICS OF TWENTY-ONE PORK MUSCLES

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Introduction

Pork belly and boston butt are the most demanding and popular cuts in Korean markets and consequently their retail prices are much higher than other cuts (KMTA, 2007). On the other hand, pork picnic shoulder and ham are often regarded as low-value cuts and utilized for processed meat products. Most previous studies compared physical, chemical and textural characteristics between three to eight pork muscles (Lin et al., 1985; Topel et al., 1966; Briskey et al., 1960). The previous studies focused on differences in pH, moisture content, fat content, myoglobin content and shear force.

Recently, pork industry in Korea has made efforts to identify the potential value of the prime cuts, especially the shoulder and ham that are well-suited for processed products in new product development. However, the general characteristics of industrial primal cuts are confounded by individual muscles, and little information is known on the value of individual muscles. Therefore, there are great needs for determining physical and chemical characteristics of individual muscles for the best of use as meat and meat-processed products. The objective of the present study was performed to evaluate or compare the pH, water holding capacity (WHC), cooking and drip loss, Warner-Bratzler shear force (WBSF) and collagen content of twenty-one selected pork muscles.

Materials and Methods

A total of ten crossbred (five gilts and five barrows) were sampled from a market-weighted industrial population (carcass weight: 86.00±5.7 kg), and slaughtered at a commercial abattoir. Carcasses were chilled at 0℃ for 24 h and were transported to the National Livestock Research Institute (NLRI) and kept at 2℃ for further 3 days. At 4 days postmortem, twenty one muscles were dissected from both side of each shoulder (*m. infraspinatus, pectoralis profundi* (tube), *pectoralis profundi* (Fan), *brachiocephalicus*, *latissimus dorsi*, *subscpularis*, *supraspinatus*, *triceps brachii*), ham (*m. adductor, biceps femoris, gastrocneminus, gluteus medius, gluteus superrificialis, gracilis, rectus femoris, semimembranosus, semitendinosus, vastus intermedius, tensor fasciae latae, vastus lateralis*) and loin (*m. longissimus dorsi*). Knife removable subcutaneous fat was trimmed off. Muscles of left hand sides were cut into 2.54 cm portions, vacuum-packaged at 4℃ for 36 hours and muscles of right hand sides were homogenized by using a grinder (MN-22S, Hankook Fujee Industries Co. Korea).

The pH was determined using whole muscles by pH meter (SENTRON ARGUS-X, Netherland). WHC was determined by a centrifugation method (Park et al., 2005). Cooking loss was determined by calculating the weight difference in steaks before and after cooking, expressed as percentage of initial weight. Purge loss was determined by weighing the muscle portions before vacuum-packaging and after 36 hours to calculate percentage weight losses. WB-shear force was measured on steaks (2.54 cm thick) cooked in a pre-heated water bath (Hwang et al., 2004) by a texture analyzer (Model 4465, Instron Corp. UK). The conditions for the texture analyser was load cell speed of 120mm/min, distance of travel at 80.0%, and plunger diameter of 0.5inch. Collagen content was determined using the method described by Kolar (1990).

As there was no sex effect, pooled data were analyzed using the General Linear Models (GLM) of the Statistical Analysis System (SAS, 1998). Significant differences among muscles were analyzed by Duncan's Multiple Range test at $p<0.05$.

Results and Discussion

The *Subscpularis* muscle had the highest ($P < 0.05$) pH, while *gluteus superrificialis* muscle was significantly lower ($P < 0.05$) than other muscles. The *M. subscpularis* was found to have the highest WHC, whereas the *M. supraspinatus* and *M. triceps brachii* had the lowest. The M. *Subscpularis* had the lowest ($P < 0.05$) cooking loss and the *M. biceps femoris* had the highest ($P < 0.05$) when compared to other muscles. The *M. gastrocneminus* had the lowest ($P < 0.05$) purge loss, while the M. *gluteus superrificialis* was significantly

higher ($P < 0.05$) than other muscles. The *M. subscpularis* had the lowest numerical WBSF values. The *M. infraspinatus* had the highest ($P < 0.05$) total collagen content when compared to other muscles.

Table 1. Means for pH, WHC, cooking loss, drip loss, Warner-Bratzler shear force and collagen content of individual pork muscles

Whole sale cut	Muscles	pH	WHC (%)	Cooking loss(%)	Drip loss (%)	Warner Bratzler Shear force(kg)	Collagen (mg/g)
Foreleg	*Infraspanatus*	6.20^{abcd*}	53.59^{bc}	19.94^{cd}	3.34^{defgh}	3.25^{ij}	9.04^{a}
	Pectoralis profundi(tube)	5.98^{cdefg}	53.60^{bc}	25.67^{ab}	4.82^{bcde}	3.79^{ghi}	4.93^{fgh}
	Pectoralis profundi(fan)	6.00^{cdefg}	55.65^{bc}	22.28^{bc}	4.06^{cdefg}	4.71^{efg}	4.87^{fgh}
	Brachiocephalicus	6.06^{cdefg}	54.53^{bc}	23.33^{bc}	5.89^{bc}	4.95^{def}	7.09^{bc}
	Latissimus dorsi	6.23^{abc}	56.84^{b}	21.71^{bc}	3.31^{defgh}	3.82^{ghi}	5.19^{efg}
	Subscpularis	6.34^{a}	61.46^{a}	16.74^{d}	3.83^{cdefg}	2.81^{j}	8.24^{ab}
	Supraspinatus	6.14^{abcde}	52.62^{c}	23.74^{bc}	2.85^{efgh}	3.50^{hij}	6.82^{cd}
	Triceps brachii	6.08^{bcdefg}	52.41^{c}	23.66^{bc}	1.94^{gh}	4.64^{efg}	6.62^{cd}
Hind leg	*Adductor*	6.14^{abcde}	53.88^{bc}	23.64^{bc}	3.69^{defgh}	5.76^{bcd}	2.69^{k}
	Biceps femoris	5.90^{efg}	53.96^{bc}	28.22^{a}	4.53^{bcdef}	7.31^{a}	5.19^{efg}
	Gastrocneminus	6.13^{abcdef}	54.28^{bc}	24.18^{abc}	1.61^{h}	3.87^{ghi}	8.41^{a}
	Gluteus medius	5.95^{defg}	53.24^{bc}	24.14^{abc}	5.29^{bcd}	5.29^{cde}	3.72^{hijk}
	Gluteus superrificialis	5.86^{g}	53.96^{bc}	24.27^{abc}	8.43^{a}	4.28^{fgh}	4.03^{ghij}
	Gracilis	6.32^{ab}	54.40^{bc}	20.03^{cd}	2.00^{gh}	3.18^{ij}	5.52^{def}
	Rectus femoris	6.10^{abcdefg}	55.45^{bc}	22.89^{bc}	1.65^{h}	3.88^{ghi}	3.51^{ijk}
	Semimembranosus	5.96^{defg}	53.58^{bc}	25.65^{ab}	4.82^{bcde}	6.57^{ab}	3.35^{ijk}
	Semitendinosus	6.19^{abcd}	54.54^{bc}	23.45^{bc}	3.52^{defgh}	3.90^{ghi}	4.13^{ghi}
	Vastus intermedius	6.18^{abcd}	54.22^{bc}	24.73^{ab}	2.62^{fgh}	4.27^{fgh}	5.56^{def}
	Tensor fasciae latae	6.00^{cdefg}	53.77^{bc}	22.01^{bc}	3.61^{defgh}	4.27^{fgh}	6.32^{cde}
	Vastus lateralis	6.03^{cdefg}	54.28^{bc}	25.05^{ab}	4.64^{bcdef}	5.28^{ced}	4.52^{fghi}
Loin	*Longissimus dorsi*	5.88^{fg}	55.48^{bc}	25.88^{ab}	6.32^{b}	6.06^{bc}	2.74^{jk}
SEM		0.02	0.25	0.32	0.39	0.10	0.15

$^{a-j}$: Values with different superscripts in the same column differ significantly($P<0.05$)
*Mean

Conclusions

With a better understanding of individual muscle characteristics, meat industry may be able to maximize potential from individual muscles to help increase quality and consistency in pork products. This process should open new opportunities in value-enhanced and new product development.

References

1. Briskey, E.J., Hoekstra, W.G., Bray, R.W., and Grummer. R. H. (1960). A comparision of certain physical and chemical characteristics of eight pork muscles. *J. Anim. Sci. 19*, 214-225.
2. Hwang, I.H., Park, B.Y., Cho, S.H., and Lee, J.M. (2004). Effects of muscle shortening and proteolysis on warner-bratzler shear force in beef *longissimus* and *semitendinosus*. Meat Sci. *68*, 497-505.
3. Kolar, K. (1990). Colorimetric determination of hydroxyproline as measure of collagen content in meat and meat products: NMKL collaborative study. *J. ASSOC. OFF. ANAL. CHEM. 73*, 54-57.
4. Korea meat trade association. (2007). The survey of consum and distribution of meat – pork (2007. 1). http://www.kmta.or.kr/board/data/report01_3573_200702_p.pdf.
5. Lin, R.R., Carpenter, J.A., and Reagan, J. O. (1985). Chemical, cooking and textural properties of *semimembranosus*, *semitendinosus* and *biceps femoris* muscles of pork. *J. Food Qual. 7*, 277-281.
6. Park, B.Y., Kim, J.H., Cho, S.H., Hwang, I.H., Jung, O.S., Kim Y.K., Lee, J.M., and Yun, S.G. (2005). Effects of a dietary chitosan-alginate-Fe(Ⅱ) complex on meat quality of pig *longissimus* muscle during ageing. *Asian-Aust. J. Anim. Sci. 18*, 414-419.
7. SAS. SAS/STAT. 1998. SAS/STAT User's Guide: Statistics. SAS inst., Cary, NC.
8. Topel, D.G., Merkel, R.A., Mackintosh, D.L., and Hall, J.L. (1966). Variation of some physical and biochemical properties within and among selected porcine muscles. *J. Anim. Sci. 25*, 277-282.