Quality Traits of Cooked Press Hams Manufactured with Different Muscles on Pig

Seong P.N. [1], Jeong D.W. [2], Kang G.H. [1], Cho S.H. [1], Park B.Y. [1], Kim J.H. [1], Jeong S.G. [1], Kim H.S. [1], and Kim D.H. [1]

[1]National Institute of Animal Science, Rural Development Administration, Suwon, Korea
[2] Institution/Department, Affiliation, City, Country

Abstract— **This study was conducted to compare quality traits of cooked press hams by five muscles (*biceps femoris, semimembranosus, rectus femoris, gluteus medius and longissimus dorsi*) from pig. The five muscles were separated from three market-weighted crossbreed (LY×D), and the qualitative properties of cooked pork muscle hams were evaluated. *Rectus femoris* and *biceps femoris* ham had the highest pH, while pH of *longissimus dorsi* ham was the lowest among them ($p<0.05$). Protein content was the highest in *longissimus dorsi* ham among the five muscle hams ($p<0.05$), but no significant difference on salinity, calorie, calcium and total iron content ($p>0.05$). In the ham color, *longissimus dorsi* ham showed the highest and *rectus femoris* showed the lowest on Hunter L value ($p<0.05$). However, Hunter a and b values were not notably different between five muscle hams ($p>0.05$). In texture, the hardness was highest *in longissimus dorsi* ham ($p<0.05$), and springiness, cohesiveness, gumminess and chewiness were not significantly different among five ham products ($p<0.05$). Also, visual color, taste and texture of sensory evaluation were not significant different. ($p>0.05$). As these results, qualitative parameters of cooked press ham with each five muscles showed significant difference, depending on the muscles.**

Keywords— **Quality trait, press ham, pork muscles.**

I. INTRODUCTION

Pork belly and Boston butt are the most demanding and popular cuts in Korean markets and normally their retail prices are much higher than other parts. On the other hand, pork picnic shoulder and ham are often regarded as a lower value cuts and utilized for processed meat products. The majority 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).

Recently, pork industry in Korea has made various efforts to identify the potential value of the prime cuts. Particularly, shoulder and ham are well-suited for processed products in new product development. However, the general characteristics of industrial primal cuts are confounded by various individual muscles, and only little information is available to identify the value of individual muscles. Therefore, there are great needs for determining physical and chemical characteristics of individual muscles for the best use of individual muscles as meat and processed products. This study was conducted to provide the fundamental information for developing muscle-specific strategies to develop value added press ham and to improve the quality and value of low fat pork cuts with evaluating quality traits of cooked press hams manufactured with different muscles on pig.

II. MATERIALS AND METHODS

A total of three crossbred were sampled from a market-weighted industrial, and slaughtered at a commercial abattoir. Carcasses were chilled at 0℃ for 24h and were transported to the National Livestock Research Institute (NLRI) and kept at 2℃ for further 3 days. At 4 days postmortem, four muscles were dissected from both side of ham (m. *biceps femoris, gluteus medius, rectus femoris*, and *semimembranosus*) and loin (m. *longissimus dorsi*). Knife removable subcutaneous fat was trimmed off.

Muscles were ground through a 5 mm plate. Ground muscles were mixed with salt (1.2%; 12 g/1 kg of muscle), sugar (0.5%), phosphate (0.25%), sodium nitrite (200 ppm), white pepper (0.13%), garlic powder (0.08%) and onion powder (0.08%) for 30 min. The mixture was stored at 4℃ for 12h, and then stuffed into fibrous casing (45 mm diameter). The press hams dried in a preheated smokehouse (FMT2002, Berimex, Germany) at 55℃ for 20 min, and then smoked at 55℃ for 10 min. After smoking,

the press hams were cooked at 78℃ until the core temperature reached 70℃ and stored at 4℃ until analysis.

The pH was determined using a pH meter (SENTRON ARGUS-X, Netherland). Percentages of moisture, protein, fat, ash, Ca and Fe contents were determined by using the procedure of AOAC (1996). Salinity (% wet matter) was measured by using a salinity meter (Takemura, TM-30D, Japan). Calorie was measured by using a calorie meter (Model 1261, Parr Instrument Co., USA). Color of the press hams were measured using a Minolta Chroma meter CR-300 (Osaka, Japan) set for L* (lightness), a* (redness) and b* (yellowness). It was standardized with a white tile (D65 Y= 93.0, x = 0.3133, y = 0.3194). A texture analyzer (Instron Model 4465, Instron Corp, UK) was used to carry out a Texture Profile Analysis (TPA) (Malcolm, 1978). The press hams were evaluated for color, flavour, taste and texture. The color, flavour, taste and texture were evaluated using a 20-point descriptive scale. The results were analyzed using the General Linear Models (GLM) of the Statistical Analysis System (SAS, 1998). Significant differences were analyzed by Duncan's multiple range test at $p<0.05$.

III. RESULTS

1. Physicochemical properties

pH of raw muscles was within 5.79~6.11 and pH of press hams was 6.04~6.29 (Table 1). *Rectus femoris* and *biceps femoris* hams had the highest pH, while pH of *longissimus dorsi* ham was the lowest among them ($p<0.05$).

Table 1. pH of raw muscles and press hams

Muscles	Raw muscle	Press ham
Rectus femoris	6.11±0.08*	6.29±0.03a
Biceps femoris	6.02±0.13	6.21±0.06a
Semimembranosus	5.95±0.13	6.17±0.06ab
Gluteus medius	5.88±0.07	6.17±0.04ab
Longissimus dorsi	5.79±0.08	6.04±0.05b

a,b : Values with different superscripts in the same column differ significantly ($p<0.05$)
*Mean±standard error

Protein contents was the highest (25.00%) in *longissimus dorsi* ham among the five muscle hams ($p<0.05$), but there was any significant difference on moisture, fat and ash content ($p>0.05$)(Table 2).

Table 2. Proximate chemical composition of press hams (unit: %)

Muscles	Moisture	Protein	Fat	Ash
Rectus femoris	70.36 ±0.54*	22.63 ±0.03b	2.73 ±0.36	1.67 ±0.22
Biceps femoris	69.16 ±0.65	22.10 ±0.17b	3.66 ±1.03	1.62 ±0.25
Semimembranosus	70.02 ±0.38	22.61 ±0.43b	3.27 ±0.40	1.63 ±0.26
Gluteus medius	70.19 ±0.30	22.86 ±0.66b	3.29 ±0.01	1.64 ±0.22
Longissimus dorsi	69.40 ±0.13	25.00 ±0.71a	2.58 ±0.61	1.66 ±0.25

a,b : Values with different superscripts in the same column differ significantly ($p<0.05$)
*Mean±standard error

Table 3 shows the nutritional properties of five muscles press hams. There were no significant differences in the nutritional properties between muscles press hams ($p>0.05$).

Table 3. Nutritional properties of press hams

Muscles	Salinity(%)	Calorie (cal/g)	Ca(ppm)	Fe(ppm)
Rectus femoris	1.72 ±0.09*	1492.00 ±81.00	239.11 ±12.82	27.30 ±5.80
Biceps femoris	1.61 ±0.05	1648.00 ±125.00	242.27 ±12.90	28.36 ±13.53
Semimembranosus	1.77 ±0.06	1633.50 ±152.50	178.59 ±72.26	29.72 ±13.40
Gluteus medius	1.58 ±0.11	1670.50 ±133.50	216.79 ±45.26	30.56 ±13.04
Longissimus dorsi	1.51 ±0.13	1597.50 ±119.50	201.69 ±13.31	20.71 ±10.17

*Mean±standard error

2. Color

Table 4. Color parameters of press hams

Muscles	Hunter L	Hunter a	Hunter b
Rectus femoris	59.43±1.20c*	10.36±0.87	6.24±0.56
Biceps femoris	59.75±0.87bc	10.21±0.62	6.58±0.22
Semimembranosus	62.65±0.62ab	8.35±1.29	6.86±0.40
Gluteus medius	62.30±1.06abc	8.68±1.25	7.06±0.45
Longissimus dorsi	65.27±0.72a	8.26±0.44	6.36±0.42

a-c : Values with different superscripts in the same column differ significantly ($p<0.05$)
*Mean±standard error

From the ham color analysis, *longissimus dorsi* ham showed the highest and *rectus femoris* showed the lowest on Hunter L value ($p<0.05$). However, Hunter a and b values were not significantly different between five different muscle hams ($p>0.05$).

3. Texture

In texture, hardness was highest in *longissimus dorsi* ham ($p<0.05$), and springiness, cohesiveness, gumminess and chewiness were not significantly different among five ham products ($p<0.05$).

Table 5. Texture properties of press hams

Muscles	Hardness	Springiness	Cohesivene ss	Gummine ss	Chewiness
Rectus femoris	5.76ab	76.96	0.72	4.10	84.19
Biceps femoris	5.16b	82.44	0.86	4.44	79.44
Semimembranosus	6.00ab	77.97	0.75	4.47	90.81
Gluteus medius	6.01ab	76.35	0.61	3.63	75.11
Longissimus dorsi	6.74a	74.26	0.52	3.52	74.66

a,b : Values with different superscripts in the same column differ significantly ($p<0.05$)

4. Sensory properties

The sensory properties of five muscles press hams are shown in Table 6. The visual color, taste and texture of sensory evaluation were not significant difference ($p>0.05$).

Table 6. Sensory properties of press hams

Muscles	Color	Flavor	Taste	Texture
Rectus femoris	15.19 ±0.25	15.62 ±0.31	15.67 ±0.66	15.67 ±0.42
Biceps femoris	15.90 ±0.27	15.71 ±0.00	15.57 ±0.29	15.24 ±0.50
Semimembranosus	15.19 ±0.33	15.62 ±0.25	15.48 ±0.46	15.33 ±0.63
Gluteus medius	15.86 ±0.16	15.67 ±0.34	16.09 ±0.29	15.48 ±0.66
Longissimus dorsi	15.57 ±.22	15.57 ±1.07	14.48 ±1.10	13.67 ±0.88

*Mean±standard error

IV. CONCLUSIONS

To summarise the analysis, qualitative parameters of cooked press ham with each five muscles showed significant difference depending on the muscles.

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