COMPARISON OF MEAT QUALITY OF LOINS FROM DIFFERENT TWO-WAY CROSSBRED PIGS

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Abstract – This study was performed to determine the quality characteristics of the loins from 3 different two-way crossbred pigs, Yorkshire×Landrace (YL), Yorkshire×Berkshire (YB), and Yorkshire×Chester White (YC). The drip loss, cooking loss, and water holding capacity of the YB loins were significantly better than the others ($p<0.05$). YC loins had the lowest fat contents. The shear forces of YL loins were higher than YB or YC ($p<0.05$). The CIE color and TBARS values of the loins did not significantly differ by crossbred. YB and YC pork loins had higher content of linoleic acid (C18:2n-6) and PUFA than the YL. Free amino acids such as alanine, arginine, aspartic acid, glycine, isoleucine, leucine, and valine were lower in the YC loins than the others ($P<0.05$). YL pork loins had higher content of free glutamic acid than the YB ($P <0.05$). The sensory scores of the tenderness, juiciness, and overall acceptability of YL were ranked higher than the others ($p<0.05$). The result of this study could provide basic information that can be used to improve the meat quality of loins of different two-way crossbreds.

Key Words – Loins, Two-way crossbred, Quality

• INTRODUCTION

The majority of finishing pig production is based on the crossbreds and generally is three-way crosses with Landrace×Yorkshire×Duroc. These crossbred pigs retain the traits of an excellent growth rate, higher yields and bigger litter size than other crossbreds selected and tested [1]. Although pork quality are greatly affected by the factors e.g. animal nutrition, transport, handling, slaughtering process, breed also has been attributed to the most significant single factor influencing the meat quality characteristics [2][3]. When choosing the best animal breeding strategy, it is vital to recognize the meat quality characteristics depend on the breed [4]. Crossbreeding is extensively used in pig production to increase the total efficiency of pig production [5], and also to improve the quantity and quality of the meat [6]. Currently, commercial pigs are three-way crosses with Landrace and Yorkshire × Duroc in Korea. However, it is worth to investigate the meat quality of different types of crossbreds to fulfill consumers' changing requirements. In this respect, it is invaluable to study the effect of two-way crossbreeding on meat quality since the studies for the subject are very limited.

• MATERIALS AND METHODS

A total of 180 gilts were evaluated from three different crossbreeding schemes which included Yorkshire×Landrace (YL), Yorkshire×Berkshire (YB), and Yorkshire×Chester White (YC) with 60 animals in each scheme. The pigs were born and raised at a swine breeding farm of a breeding pig improvement center (Yeonggwang, Republic of Korea). Animals were fed the same commercial feed, raised under similar conditions and transported from the farm to the slaughterhouse. Sixty pigs from each crossbred were randomly selected from 110~120 kg range of marketing weight, slaughtered, and cooled at 0°C for 24 h in a

chilling room. The parts of loins on the left side of the cooled carcasses were used to measure meat quality parameters. All samples were placed in vacuum bags and subsequently transported to the laboratory. And they were frozen at -45°C until they were analyzed. Samples were divided in 3 portions, up, middle, and bottom, and then the middle portions of loins were used for experiment. The proximate composition, pH, water-holding capacity, drip loss, and cooking loss of each LD muscle were determined. CIE color values on the surface of samples and maximum shear force were measured. TBARS were analyzed by the procedure of [7]. After extracting lipids from meat samples, fatty acids were determined by the methods of Jung [8]. Free amino acid composition was analyzed using the method described by Hughes [9] with modification. During the sensory evaluation, 8 panelists recorded their preferences for cooked Hanwoo beef using a 9-point hedonic scale.

- RESULTS AND DISCUSSION

The pH values of the loins were lower in YC than in the other crosses ($P< 0.05$). The intramuscular fat (IMF) contents of the loins significantly lower in the YC pigs with the respect to the other crosses. YL was the highest value, which is favorably related to eating quality. [10] noted that the butts from the BD had higher IMF contents than YLB and YLD. It was suggested that a threshold of approximately 3% IMF is required for better eating quality [11]. In the present study, intramuscular fat content of two-way crossbreds ranged from 4.49% to 6.88% in loins. It seems that these results had sufficient intramuscular fat to meet the threshold they suggested.

The drip and cooking loss of the loins were lower in YB than in the other crosses ($P< 0.05$). Loins from Berkshire had less cooking loss than those from Landrace. WHC of the loins was higher in YB than in the other crosses, which might be due to the meat quality features that Berkshire breed has an excellent WHC. Shear force values of the loins was lower in YB and YC than in YL ($P< 0.05$). Warner–Bratzler shear force value is a moderate indicator of chewiness. Interestingly, off flavors, metallic flavors, and chewiness increased while sweetness decreased with increased shear force. TBARS values of all crossbreds increased during storage ($P< 0.05$), but there were no significant differences in TBARS values in the loins and butts among the crossbreds. Despite of different fat contents, lipid oxidation proceeded affected by only storage time.

Table 1 Composition, physicochemical traits, and micro-compounds of loins from two-way crossbred pigs

	YL	YB	YC	SEM[1]
pH	5.35[ab]	5.43[a]	5.30[b]	0.02
Fat[2]	6.88 [a]	6.14 [a]	4.49 [b]	0.32
Drip loss[2]	1.45 [a]	0.58 [b]	1.80 [a]	0.19
Cooking loss[2]	14.15 [a]	9.23 [b]	13.40 [a]	0.77
Shear force[3]	10.25 [a]	7.89 [b]	8.01 [b]	0.47
TBARS[4]	1.08[a]	1.10[a]	0.92[a]	0.04
Linoleic acid[2]	10.52[b]	12.92[a]	12.78[a]	0.41
Glutamate[5]	20.81[a]	11.11 [b]	14.53[ab]	1.83

Acceptance[6]	4.40 [a]	2.40 [b]	2.33 [b]	0.39

[1] Standard error of means
[2] Unit: %, [3] Unit: kgf, [4] Unit: mg MDA/kg, [5] Unit: mg/100g, [6] Unit: 1: extremely bad ~ 9: extremely good
[a,b] Means with different superscript within the same row differ significantly (P<0.05)

The major fatty acids in the pork muscles were oleic (C18:1n-9), palmitic (C16:0), stearic (C18:0), linoleic (C18:2n-6), vaccenic (C18:1n-7), palmitoleic (C16:1), and myristic (C14:0) acid, which are listed from the most prevalent to the least. These seven fatty acids accounted for over 95% of the total fatty acids in the intramuscular fat (IMF). Other minor fatty acids were lauric (C12:0), linolenic (C18:3), arachidonic (C20:4n-6), EPA (C20:5n-3), and DHA (C22:6n-3) acid. The difference by crossbred effects was shown in many fatty acids. In particular, loins of YB and YC crossbreds had higher percentage of linoleic acid (C18:2n-6), PUFA, n-6 fatty acids, and ratio of PUFA and saturated fatty acids (P/S) than YL. Stearic acid (C18:0) and arachidonic acid (C20:4n-6) were much lower in the YB loins than the other crosses (P<0.05).
The profile of free amino acids is important for its contribution to taste (Kato et al., 1989). It is classified into 4 categories amino acid in relation to saccharinity (threonine, serine, glycine, alanine), amino acid with sulfide (methionine, cystine), fragrant amino acid (phenylalanine, tyrosine), and essential amino acid (threonine, valine, methionine, isoleucine, leucine, phenylalanine, histidine, lysine, arginine) (Kurihara, 1987). Except for a few amino acids, loin muscles showed a similar pattern in free amino acid composition. Alanine, arginine, aspartic acid, glycine, isoleucine, leucine, and valine in loins were much lower in the YC loins with the respect to the other crosses (P<0.05). YB loins had lower percentage of glutamic acid than YL (P<0.05). YC pigs had lower percentage of aspartic acid in loins than the other crosses (P<0.05).

Color, tenderness, juiciness and acceptability were higher in YL than the others in loins and butts (P<0.05). Flavor was higher in YL than the others in butts, whereas one was lower in YB (P<0.05). Flavor is one of the most important qualities of meat and meat products. Tenderness was higher in YL than the others (P<0.05). The high tenderness in YL corresponded well with a high shear force values in YL. In the present study, YL pigs produced more tender and juicy meat and this was due to its high marbling fat was associated with higher tenderness and juiciness scores [12]. The sensory evaluation could be also affected by free amino acid composition. Low sensory scores in YB pigs were due to its lower aspartic and glutamic acids in loins, which could have negative effects on the sensory traits of pork. YL pigs had the highest sensory evaluation.

- CONCLUSION

The results from the present experiments show the possibility to alter the meat quality traits, fatty and amino acid composition by two-way crossbreeding in pigs. There were differences in meat quality parameters for crossbreeding. Loin muscle traits were different in YB as compared to other pig crossbreds. YB pigs in loins had better WHC, less drip and cooking loss, low shear force and higher fat content. YL pigs had the lowest percentage of PUFA, n-6 and P/S and the highest C18:0 and c20:4. However, Sensory quality of pork was better in YL pigs. It can be concluded that crossbreeds could affect the meat quality and fatty composition.

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REFERENCES

- Hong, K. C., Kim, B. C., Son, Y. S. & Kom, B. K. (2001). Effects of the mating system on fattening performance and meat quality in commercial pigs. Journal of Animal Science and Technology 43: 139-148.
- McLaren, D. G., Buchanan, D. S. & Johnson, R. K. (1987). Growth performance for four breeds of swine: crossbred females and purebred and crossbreed boars. Journal of Animal Science 64: 99-108.
- Martel, J., Minvielle, F. & Poste, L. M. (1988). Effects of crossbreeding and sex on carcass and pork quality traits in Duroc and Landrace pig I: Breed effects. Journal of Animal Science 66: 41-46.
- Ruusunen, R., Puolanne, E., Sevon-Aimonen, M., Partanen, K., Voutila, L., & Niemi, J. (2012). Carcass and meat quality traits of four different pig crosses. Meat Science 90: 543-547.
- Bennet, G. L., Tess, W. M., Dickerson, G. E. & Johnson, R. K. (1983). Simulation of breed and crossbreeding effects on costs of pork production. Journal of Animal Science 56: 801-813.
- Sellier, P. (1998). Genetics of meat and carcass traits. In M. F. Rothschild & A. Ruvinsky (Eds.), The genetics of the pig (pp. 463-510). New York: CAB international.
- Ahn. D. U., Olson, D. G., Jo. C., Chen. X., Wu. C., & Lee, J. I. (1998). Effect of muscle type, packaging, and irradiation on lipid oxidation, volatile production, and color in raw pork patties. Meat Science 49, 27-39.
- Jung, S., Han, B. H., Nam, K., Ahn, D. U., Lee, J. H. & Jo, C. (2011). Effect of dietary supplementation of gallic acid and linoleic acid mixture or their synthetic salt on egg quality. Food Chemistry 129: 822-829.
- Hughes, M. C., Kerryb, J. P., Arendtb, E. K., Kenneallyc, P. M., McSweeneya, P. L. H. & O'Neilla, E. E. (2002). Characterization of proteolysis during the ripening of semi-dry fermented sausages. Meat Science 62: 205-216.
- Kim, H. S., Yang, H. S., Lee, J. I., Joo, S. T., Jeon, J. T., & Lee, J. G. (2007). Effects of the mating system on retail cut yield and meat quality in commercial pigs. Journal of Animal Science and Technology 49: 379-386
- Affentranger, P., Gerwig, C., Seewer, G. J. F., Schwiirer, D., & Kiinzi, N. (1996). Growth and carcass characteristics as well as meat and fat quality of three types of pigs under different feeding regimens. Livestock Science 45: 187-196.
- Wood, J. D., Richardson, R. I., Nute, G. R., Fisher, A. V., Campo, M. M., & Kasapidou, E. (2003). Effects of fatty acids on meat quality: A review. Meat Science 66: 21-32.