BREAST MEAT QUALITY CHARACTERISTICS OF 5 DIFFERENT KOREAN NATIVE CHICKEN LINES

Young Sik Bae[1], Samooel Jung[1], Dinesh D. Jayasena[1], Jun Heon Lee[1], Hee Bok Park[2],

Kang Nyeong Heo[3], and Cheorun Jo[1]

[1]Department of Animal Science and Biotechnology, Chungnam National University, Daejeon 305-764, Korea

[2]Institute of Agriculture and Life Science, Gyeongsang National University, Jinju, South Korea

[3]National Institute of Animal Science, RDA, Seonghwan, South Korea

Abstract – Breast meat quality characteristics were investigated from 5 different Korean native chicken lines. A total of 597 chicken breast meat samples from the lines of Gray-Brown (G. n=110), Black (L, n= 90), Red-Brown (R, n=136), White (W, n=126), and Yellow-Brown (Y, n=133) were obtained. Surface color, $pH_{15\ min}$, pHu, water holding capacity, cooking loss, collagen content, and proximate composition of the breast meats were measured. The carcass weights of L and R were significantly higher than those of other lines. The least cooking loss and the highest $pH_{15\ min}$ were observed in line R. Other quality parameters and chemical composition were shown differences among the lines. The present study reveals the line difference within KNC. This difference may result in different nutritional and quality characteristics. This information will be useful to develop KNC-based new chicken breed.

Key Words – Breast meat, Korean native chicken lines, Quality characteristics

- INTRODUCTION

Recent increasing concern on health, consumers are pursuing meat with less fat and low cholesterol. Thus, the consumption of chicken meat, as a white meat, has been increased more than red meats [1]. In addition, people tend to prefer slow-growing native chickens to fast-growing broilers. Korean native chickens (KNC) showed much lower growth performance, feed efficiency, and lean meat-gain than broilers. Also, it is more difficult to remove feathers [2]. From these reasons, farmers in Korea avoided the KNC and broilers were prevailed in Korean poultry farms. However, National Institute of Animal Science, RDA, Korea restored the KNC from different regions for 20 years and established lines. Now, the governmental organization in Korea (i.e., National Institute of Animal Scienc, RDA, Korea) has focused on developing the high quality meat-type breed based on KNC.

The objective of this study was to investigate the quality characteristics of breast meat from 5 different KNC lines and to establish database that can be used in the development of high quality chicken breed from KNC.

- MATERIALS AND METHODS

Experimental animals and sample preparation

A two-generation resource pedigree using 5 lines of Korean native chicken was established and managed for this study. Within each line, three sires were mated to 14~15 dams to produce F_1 chicks. A total of 595 F_1 progeny from 70 full-sib families were used for this study including 5 different lines [Gray-Brown (G), Black (L), Red (R), White (W), and Yellow-Brown (Y)].

One-day-old mixed-sex KNCs were raised in National Institute of Animal Science, Korea.

Chickens were fed *ad libitum* with commercial formulated feed with 18.2% concentrated protein and 2859 kcal/kg metabolizable energy for 20 wks. Chickens were killed by conventional neck cut, bled for 2 min, removed feathers, and eviscerated. pH was measured at 15 min after completion of bleeding. Samples were vacuum-packed and stored in a freezer at -20°C. The frozen samples were thawed for 48 h in a refrigerator and breast meat (pectoralis) was dissected from the carcasses.

Surface color, pH, water holding capacity (WHC), cooking loss, and total collagen content

Lightness (L*), redness (a*), and yellowness (b*) of breast meat were measured using a spectrophotometer (CR-300, Minolta Inc., Japan).
The pH values at 15 min post-slaughter ($pH_{15\ min}$) were measured by inserting pH probe into breast sample (SevenGo, Mettler-Toledo Inti, Inc. Schwerzenbach, Switzerland). Ultimate pH values (pH_u) were measured after thawing the samples. After grinding the sample, 1 g was placed on a filter paper (No. 4, Whatman Ltd. Kent, UK), put into the centrifuge tube and centrifuged for 10 min at 6,710 × g (CR 20B2, Hitachi Koki Co., Ltd. Fukuoka, Japan) for measuring WHC. The filter paper absorbed the emitted water was weighed and calculated as a percentage of the initial moisture content.

For cooking loss, the ground sample (5 g) was vacuum packed and boiled in the water bath until the temperature reached 72□. Cooking loss was calculated and expressed as percentage.
Total collagen content was measured by the method of Jung et al. [3].

Proximate analysis

The moisture, crude protein, crude fat, and crude ash composition of the breast meat sample was determined according to AOAC methods (1999).

Statistical analysis

The data were analyzed using the General Linear Model (GLM) of Analysis of Variance (ANOVA) procedure in Minitab Statistical Package, version 15.

- RESULTS AND DISCUSSION

Carcass weight

The carcass weights of line L (1119.1 g) and R (1119.4 g) were significantly higher than other lines (Fig. 1). Tang et al. [4] found that difference in carcass weight among the type of chicken due to growth rate by genetic effect, rearing environment, and feeding system.

Figure 1. Carcass weight of 5 Korean native chicken lines

Physiochemical characteristics

The color of meat is a critical quality factor and affects consumer preferences and palatability. Among the 5 different lines of KNC breast meat, there was significant differences on color L*-value between the lines G and W (Table 1). Breast meat sample of line G were less red than that of L and R, whereas that showed higher b*-values than lines L, W, and Y. Meat color was influenced by various factors including type of bird, heme pigments, myoglobin, pre-mortem

stress, age, and environment during slaughter [5].

The $pH_{15\ min}$ value of the breast meat in line R was significantly higher than those of lines L and Y. However, the pHu of line L was significantly higher than those of lines G and Y. Previous study reported that the $pH_{15\ min}$ value was depending upon lactate content at 15 min post-mortem [6]. The initial and ultimate pH of meat is also influenced by the biochemical state as muscle glycogen content affected by the time slaughter and pre-slaughter stress [6, 7].

Quality parameters

Huff-Lonergan and Lonergan [8] reported that WHC was influenced by early postmortem including the rate and extend of pH decline as well as proteolysis of muscle protein including desmin, synemin, and talin. Among the 5 different lines of KNC breast meat, there was a no significant effect on WHC (Table 2). However, the cooking loss of the sample from line R was significantly less than those of lines G and W. During thermal processing of the meat, the cooking loss was caused by the chemical and physical changes of muscle structure [9]. The higher $pH_{15\ min}$ value may be related with lower cooking loss of line R.

Among the 5 different lines of KNC breast meat, Collagen content was higher in line G than line R. Jeon et al. [10] reported the difference in collagen content among strains, KNC and broiler (Ross), and reported that much higher content of collagen was present in KNC than broiler in both breast and thigh meats. Dawson et al. [11] also reported that genotype and/or age of breed result in different collagen content in chicken meat.

The moisture content of samples from line G was significantly lower than those of lines R and Y (Table 2). Moisture content was higher in the sample from line R and Y than that of G. In the contrast, the crude protein content was higher in line G than R. No difference was found in crude fat and crude ash content among the lines. Previous study showed that KNC breast had lower crude protein and higher crude fat than commercial broiler [2] but there was no data available for line effect within KNC. The present study reveals the line difference within KNC. This difference may result in different nutritional and quality factors. This information will be useful to develop KNC-based new chicken breed.

Table 1 Color and pH of breast meat from 5 Korean native chicken lines

	G	L	R	W	Y	SEM[1)]
L^*	59.39^{b}	59.45^{ab}	59.78^{ab}	60.36^{a}	60.09^{ab}	0.246
a^*	6.74^{c}	8.11^{a}	7.86^{ab}	7.20^{bc}	7.43^{abc}	0.196
b^*	21.92^{a}	21.00^{b}	21.76^{a}	20.29^{c}	21.24^{b}	0.154
$pH_{15\ min}$	6.17^{ab}	6.12^{b}	6.26^{a}	6.21^{ab}	6.15^{b}	0.029
pH_u	5.77^{b}	5.87^{a}	5.84^{ab}	5.81^{ab}	5.80^{b}	0.019

[1)]Standard errors of the least squares mean

[a,b]Values with different letter within the same row differ significantly ($p<0.05$).

Table 2 Water holding capacity (WHC, %), cooking loss (CL, %), collagen content (mg/g), and proximate composition (%) of breast meat from 5 Korean native chicken lines

	G	L	R	W	Y	SEM[1)]

WHC	64.78	65.05	64.38	64.24	65.54	0.836
CL	21.16[a]	20.26[ab]	20.13[b]	21.24[a]	20.98[ab]	0.267
Collagen	4.52[a]	3.90[ab]	3.66[b]	4.16[ab]	4.20[ab]	0.194
Moisture	72.77[b]	72.94[ab]	73.12[a]	72.99[ab]	73.07[a]	0.079
Protein	24.50[a]	24.43[ab]	24.27[b]	24.35[ab]	24.37[ab]	0.052
Fat	0.72	0.66	0.68	0.69	0.67	0.020
Ash	1.42	1.42	1.42	1.4	1.42	0.020

[1)]Standard errors of the least squares mean
[a,b]Values with different letter within the same row differ significantly ($p<0.05$).

- CONCLUSION

In the present study, the nutritional and quality factors of breast are different within the lines of KNC. This information will be useful to develop KNC-based new chicken breed.

ACKNOWLEDGEMENTS

This work was supported by a grant from the Next-Generation BioGreen 21 Program (No. PJ0081330), Rural Development Administration, Republic of Korea.

REFERENCES

- Jaturasitha, S., Srikanchai, T., Kreuzer, M. & Wicke, M. (2008). Difference in carcass and meat characteristics between chicken indigenous to northern Thailand (black boned and Thai native) and imported extensive breeds (Bresse and Rhode Island Red). Poultry Science 87: 160-169.
- Choe, J. H., Nam, K., Jung, S., Kim, B., Yun, H. J. & Jo. C. (2010). Differences in the Quality Characteristics between Commercial Korean Native Chickens and Broilers. Korean Journal for Food Science of Animal Resources 30: 13-19.
- Jung, Y., Jeon, H. J., Jung, S., Choe, J. H., Lee, J. H., Heo, K. N., Kang, B. S. & Jo. C. (2011). Comparison of quality traits of thigh meat from Korean native chicken and broilers. Korean Journal for Food Science of Animal Resources 31: 684-692.
- Tang, H., Gong, Y. Z., Wu, C. X., Jiang, J. Wang, Y. & Li, K. (2009). Variation of meat quality traits among five genotypes of chicken. Poultry Science 88:2212-2218.
- Fletcher, D. L. (1999). Broiler breast meat color variation, pH, and texture. Poultry Science 78:1323-1327.
- Berri, C., LeBihan-Duval, E., Debut, M., Sante-Lhoutellier, V., Baeza, E., Gigaud, V., Jego, Y. & Duclos, M. J. (2007). Consequence of muscle hypertrophy on characteristics of pectoralis major muscle and breast meat quality of broiler chickens. Journal of Animal Science 85: 2005-2011.
- Wattanachant. S. (2008). Factor affecting the quality characteristics of Thai indigenous chicken meat. Suranaree Journal of Science and Technology 15:317-322
- Huff-Lonergan, E. & Lonergan, S. M. (2005). Mechanisms of water-holding capacity of meat: The role of post mortem biochemical and structural changes. Meat Science 71: 194-204.
- Murphy, R. Y. & Marks, B. P. (2000). Effect of meat temperature on properties, texture, and cook loss for ground chicken breast patties. Poultry Science 79: 99-104.
- Jeon, H. J., Choe, J. H., Jung, Y., Kruk, Z. A., Lim, D. G. & Jo, C. (2010) Comparison of chemical composition, textural characteristics, and sensory properties between north and south Korean native chickens and commercial broilers. Korean Journal for Food Science of Animal Resources 30: 171-178.
- Dawson, P. L., Sheldon, B. W. & Miles, J. J. (1991). Effect of aseptic processing on the texture of chicken meat. Poultry Science 70: 2359-2367.