Comparison of the quality of chicken breast meat between fast- and slow-growing chicks during the neonatal period

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Objectives: Control of meat quality (e.g., meat color, drip loss, tenderness, taste, flavor of cooked meat) is important for poultry meat production. However, there are individual differences in meat quality even among samestrain broiler chickens.

By comparing fast-growing strain and slow-growing strain, it has been considered that the growth rate is one of the major factors that affect the meat quality of broiler chickens. In same-strain broiler chickens, we previously found individual differences in growth rate due to differences in their muscle protein degradation levels.

After proteins are degraded to free amino acids, most of them are reused for protein synthesis, and a part of the remaining free amino acids are further degraded. In this process, glutamic acid serves as either an amino group acceptor or its donor.

Since glutamic acid is a taste-active component of meat, contributing to an "umami" taste, we hypothesized that individual differ- ences in growth rate and muscle protein degradation levels are associated with their meat quality. In this study, we investigated whether either growth rate or muscle protein degradation level during the neonatal period are related to the individual differences in meat quality, by comparing fast- and slowgrowing chicks among the same strain.

Materials and Methods: Fifty-four female chicks (*Gallus gallus domestics*, Ross 308) at 1 day of age were provided with water and a semi-purified diet with no animal protein *ad libitum*. At 5 days of age, the chicks were divided into two groups based on their body weight gain from 1 to 5 days of age (i.e., slow-growing group and fast-growing group). At 49 days of age, after 5 chicks were randomly chosen from each group, they were slaughtered and dissected to collect the breast muscle. To investigate the differences in metabolic characteristics between the slow- and the fast-growing groups of chickens, we performed an untargeted GC-MS-based metabolomics analysis. And then, the breast muscles were stored at 4℃ for 48 hours for analyses of chemical and physical meat characteristics (contents of free amino acids, color tone, drip loss, cooking loss, and shear force).

Results and Discussion: Although the initial body weight at 1 day of age was not different between the slow- and the fast-growing groups of chicks, the final body weight of the slow-growing group was significantly lighter compared with their fast-growing counterparts. The breast muscle weight was lighter in the slow-growing group than that of their fast-growing counterparts at 49 days of age. In addition, the plasma N^{τ}-methylhistidine concentration, which is an index of muscle protein degradation, was significantly higher in the slowgrowing compared with their fast-growing counterparts. Thus, there was a positive correlation between the body weight during the neonatal period and the final body weight before slaughter. In addition, it was suggested that protein degradation levels of the slow-growing chicks are higher than that of their fastgrowing counterparts at 49 days of age (i.e., market age).

Untargeted GC-MS-based metabolomics analysis identified a total of 116 metabolites in the breast muscle of the chickens. Of these metabolites, 13 were significantly affected by the growth rate. 10 metabolites were higher in the slow-growing chicken group than those of their fast-growing counterparts, of which 5 were amino acids or their related metabolites. In addition, quantitative pathway analysis using the pathway-associated metabolite sets included in MetaboAnalyst 5.0. considered that six pathways affected by the growth rate were associated with protein and/or amino acid metabolism. These results suggest that protein and amino acid metabolisms are major metabolic differences between the slow- and the fastgrowing groups of the chickens.

The free glutamic acid and leucine contents in the breast muscle were significantly higher in the slowgrowing group than those in the fast-growing group. In addition, the free tyrosine and phenylalanine contents in the breast muscle tended to be higher in the slow-growing groups ($P < 0.1$). The increases in these free amino acids in the slow-growing group might be due to their higher pro- tein degradation levels in muscles. Especially, the mean difference in glutamic acid between these two groups was about 50 μg/g muscle. This result raises the possibility that growth rate during neonatal period might affect the taste characteristics of chicken meat. Therefore, we need to conduct a taste sensory evaluation to investigate whether this difference in muscle glutamic acid con- tent between these two groups contributes to taste characteristics of their meat. On the other hand, color value, drip loss, cooking loss, and shear force value in the breast muscle were not statistically different between the fast and slow-growing groups.

Conclusion: In summary, differences in protein degradation during the neonatal period were maintained until market age and affected the amino acid contents in breast muscle. In particular, the amount of glutamic acid was remarkably affected, suggesting that either individual growth rate or protein degradation levels may associate with the taste characteristics of meat.

Key words: Broiler chicken, Meat quality, Growth rate