Effects of Photostimulation on Skeletal Muscle Weight and Histidine-Containing Dipeptide Content in Japanese Quail

Ai Egusa[1], Kanako Mayumi[1], Mamoru Totsuka[1], Jun-ichi Shiraishi[2], Nobuhiro Nakao[2]

[1] Department of Food Science and Technology, Nippon Veterinary and Life Science University, Tokyo, Japan
[2] Department of Animal Science, Nippon Veterinary and Life Science University, Tokyo, Japan

Introduction: Carnosine (Car) and anserine (Ans) are dipeptides consisting of α-alanine and L-histidine or β-alanine and 3-methyl histidine. Peptide concentrations as high as 2– 4 mmol/100 g meat have been found in the pectoral muscles of chickens. Car and Ans are reported to have anti-fatigue effects (Hoffman, et al. 2018) and to improve cognitive functions (Masuoka, et al. 2019), and some kinds of chicken breast meat are sold as foods with functional claims in Japan. The Japanese quail also belongs to the Phasianidae family and is popular for spawning, but its muscles have not been fully studied. The Japanese quail is a migratory bird that changes its behavior and physiology in response to changes in daylight hours. In this study, we investigated changes in skeletal muscle weight and the contents of Car and Ans of quails reared under different light conditions. We also investigated changes in the gene expression of enzymes involved in protein metabolism induced by light stimulation.

Material and Methods: Four-week-old male quail (n = 30), which had not reached sexual maturity, were reared for 4 weeks in a 6/18 h light/dark cycle. After they were 8 weeks old, they were divided into 2 groups so that the average weight and standard deviation were equal. The same conditions were applied to the short-day group. The light-stimulated period was changed to a 20/4 h light/dark cycle for 2 weeks for the long-day group until they were 10 weeks old. At the end of the study, the testes, liver, and skeltal muscles of both groups were collected and measured for their mRNA expression levels by real time RT-PCR. Body weights and food consumption were measured daily during the last week of the study period. This study was conducted under the approval of the Japanese Veterinary Life Science University Ethics Committee.

Results and Discussion: There were no differences in the daily food consumption and body weight across both groups. In the long-day stimulation group, testis weight increased to 1.2 g compared to 0.1 g in the short-day group, which is more than 10-fold, indicating sexual maturation. Correspondingly, there was a significant decrease in the weight of type II muscle-dominated skeletal muscles of the superficial pectoral and tensor fasciae latae muscles. In addition, Car decreased by 60% under long-day conditions. However, there were no changes in Ans in either group.

To clarify the reason why the pectoralis major muscle weight decreased under the long-day conditions, we measured the genes involved in muscle synthesis. The results showed that the expression levels of the IGF1 and MyoD genes were significantly suppressed under the long-day conditions. Long-day stimulation was thought to inhibit skeletal muscle synthesis at the genetic level because it mobilizes amino acids in the muscle for energy and increases the weight of the testes, which is required for reproduction. The gene expression level of carnosine synthase was also decreased, reflecting the decrease in Car in skeletal muscle under the long-day treatment.

Conclusion: This study revealed a decrease in skeletal muscle weight and carnosine content induced by long-day stimulation in quail.

Literature:

Hoffman, J.R., Varanoske A., & Stout, J.R. (2018). Effects of beta-Alanine Supplementation on Carnosine Elevation and Physiological Performance. Adv. Food Nutr. Res. 84, 183-206.

Masuoka, N., Yoshimine, C., Hori, M., Tanaka, M., Asada, T., Abe, K., & Hisatsune, T. (2019). Effects of Anserine/Carnosine Supplementation on Mild Cognitive Impairment with APOE4. Nutrients. 11,1626.