Mitigating the effects of high temperatures in birds: involvement of epigenetic mechanisms

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Abstract Title:
Mitigating the effects of high temperatures in birds: involvement of epigenetic mechanisms

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Abstract text:

In recent decades, broilers have been selected on growth performance criteria, but the significant improvement in body weight and muscle growth has not been associated with a similar increase in specific visceral organs such as the heart and lungs. As a result, broilers have a reduced ability to cope with extreme environmental temperatures. To improve temperature tolerance and welfare without affecting growth, methods of early heat exposure (thermal conditioning) have been developed to improve heat tolerance in chickens later in life. For example, thermal manipulation during embryogenesis, corresponding to an increase in egg incubation temperature, has been shown to improve survival of male broilers exposed to thermal challenge at slaughter age. Another strategy, corresponding to postnatal heat exposure of chicks on day three or five of life, also promoted heat tolerance later in life. Recently, it has been shown that the molecular mechanisms contributing to the enhancement of heat tolerance in embryonic and postnatal strategies involve epigenetic reprogramming of gene expression. Epigenetics refers to modifications of gene activity that do not involve alterations in DNA sequence, such as covalent modifications of DNA and histone proteins. Epigenetic modifications are inherited from the cell cycle, are reversible in nature and are recognized as major contributors to environmental phenotypic plasticity. To date, several enduring epigenetic

mechanisms have been suggested to contribute to the heat response in chickens, including histone post-translational modifications in the thermal manipulation model and DNA methylation and hydroxymethylation, histone post-translational modifications and miRNAs in the postnatal model. The transmission of epigenetic modifications induced by perinatal heat exposure to the offspring is also under investigation. In this context, we are studying the transgenerational impact of embryonic thermal manipulation on another model bird species, the Japanese quail. Preliminary results suggest that embryonic thermal manipulation has transgenerational phenotypic impacts beyond the thermally manipulated generation. Genome-wide characterization of DNA methylation, histone marks, and gene transcripts is underway and preliminary data suggest that transgenerational epigenetic mechanisms are likely involved. Funding: Part of this work was funded by the French National Research Agency, Young Researcher Project ?QuailHeatE? (ANR-15-CE02-0009-01)

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