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Short Communication

A New Insight into Cold Stress In Poultry Production

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Since about 1950, numerous examples of extreme climate events have been recorded. These include not only the increase in temperature which has caused frequent and intense heat waves, melting ice caps, and high sea level, but also an extreme low winter temperature along with higher precipitation in different regions in the world. Further changes in the climate system are predicted to increase over the course of the 21st century.[1] Since growing animals are vulnerable to extreme temperature, climate changes become an important critical constraint to several species in the world.[1,2] In poultry production, while heat stress has been a rising concern for producers and scientists, cold stress has also caused economic loss worldwide. In China, winter conditions and low temperature caused almost 20 million poultry deaths and an economic loss of 100 million (Chinese currency) in 2008.[3] Early research in poultry exposed to acute cold stress has shown a clear suppression in development, survival and egg production.[4-6]

At the molecular level, an acute hypothermal condition significantly up-regulated gene expression of hepatic leptin and muscle UCP in 5-wk-old broilers.[7] Exposure at 4 ˚C for 24 hours resulted in changes in some genes involved in lipid metabolism in broilers pituitary. This suggests that cold stress can affect lipid metabolism.[3] At younger age (7-14 days old), although a chronic cold stress (20 ˚C) did not affect body weights and feed intake, it significantly increased chick body heat production and *avUCP* gene expression in the leg muscle.[8] Birds exposed to cold stress had severely injured liver and increased gene expression of AMPKα–PPARα pathway.[9] Moreover, there is clear evidence that cold stress affects thyroid hormones (T3 and T4) which play a key role in energy expenditure and body temperature homeostasis.[8,10] Yet, the effect of cold exposure on growth performance is still controversial. Indeed, Baarendse and colleagues[11] observed that moderate cold exposure (28 ˚C, reducing 1 ˚C every day in five-day period) during the early post-hatching period caused long-term negative effects on chicken growth performance. However, Shinder and colleagues reported that acute cold exposure at late embyogenesis improved growth performance.[10,12] These discrepancies might be due to several factors including experimental conditions (environmental temperature, age, chicken strain, and/or exposure duration). We recently investigated the effect of Chronic Mild Cold Conditioning (CMCC) and its underlying molecular mechanisms on growth performances in broilers. Our data show that CMCC improved the growth performance of chicks during the first week post-hatch and their later lives in terms of body weight gain and Feed Conversion Ratio (FCR).[13] Plasma cholesterol and creatine kinase (CK) levels increased indicating a potential role of CK in maintaining high ATP turnover in a hypothermal condition.[14] Hypothalamic orexigenic neuropeptide Y (NPY) and anorexigenic cocaine and amphetamine regulated transcript (CART) gene expression were significantly down-regulated in the brain of cold group which may explain the reduction of feed intake in CMCC compared to the control group. CMCC also modulated the hepatic expression of lipogenic genes, which implies the inhibition of fatty acid synthesis in cold stress chicks.[13] Moreover, CMCC enhanced muscle fatty acid β-oxidation through affecting the gene and protein expression of carnitine palmitoyl transferase-1 (CPT-1) and phosphorylated mTOR.[16,17]

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In summary, the CMCC used in our study could improve later growth performance of young chicks (body weight gain and FCR). This is new evidence that gives us a broader view of how young birds can adapt to and prepare for changes in their environment. In addition, gene expression analyses provide insight into the roles of the AMPK-mTOR pathway in cold acclimation; thus further studies are needed to understand the regulation of these genes for better management *via* genetic selection and/or nutritional strategies to improve cold tolerance and feed efficiency.

CONFLICTS OF INTEREST: None.

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