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The Role of Zinc Supplementation in Reducing Oxidative Stress via Histone Modifications in Heat-Stressed Broiler Chickens

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Abstract

Heat stress (HS) significantly impacts the welfare of broiler chickens, which play a vital role in the global meat industry. The effects of heat stress on the colon of chickens are not yet fully understood. This study aimed to determine whether the inclusion of zinc in the diet of heat-stressed broilers could enhance their ability to manage with heat stress. Specifically, we investigated the impact of organic zinc supplementation on colon histology and the expression of heat stress-related genes in broiler chickens. A total of 1024 Xueshan chickens were assigned to four experimental groups: control, heat stress (HS), 90 mg/kg zinc, and HS with 90 mg/kg zinc. The results demonstrated that zinc intake significantly improved villus height (VH) and the VH:crypt depth (CD) ratio in the colon compared to the HS group, while a decrease in crypt depth and villus width was observed in both zinc-supplemented groups. Additionally, zinc administration led to higher levels of GSH, CAT, and SOD along with reductions in MDA and ROS compared to the HS group. It also significantly enhanced the relative ATP levels and enzymatic activities of complexes I, III, and V as compared to the HS condition. Furthermore, the protein expression of TFRC, ACSL4, PRX, and LPCAT3 were notably reduced in the HS+Zn group relative to the HS group. Zinc intake also decreased the enrichment of transcriptional regulators SRC1, P300, and RORγ at the promoter regions of PRX, LPCAT3, and ACSL4. A significant reduction in histone active marks, including H3K27ac and H3K9ac were observed at the loci of LPCAT3 and ACSL4 in the HS+Zn group compared to the HS group. This research highlights the potential of organic zinc as a strategy for modulating the oxidative genes TFRC, ACSL4, PRX, and LPCAT3 in the colon of chickens through the regulation of nuclear receptor RORγ and histone modifications.

Key words: *Oxidative stress; histone modification; colon; zinc; broiler chicken*