

Study on early nutritional factors associated with metabolism
disorders in modern broilers

-Gluconeogenesis specificity and the relation between
systemic metabolic control regulation and 25-
hydroxycholecalciferol in newly hatched chicks

Abstract of Doctoral Thesis

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[Objective] While modern broilers have improved productivity through breeding improvements, new myodegeneration, such as White striping (WS) and Wooden Breast (WB) has been observed, but its pathogenesis remains unclear. Therefore, in this study, we investigated factors contributing to myodegeneration, examined the glucose (GLU) content of embryos and gluconeogenesis specificity of newly hatched chicks, examined the effect of vitamin D₃ (VD₃) on broiler growth, which has been suggested to be related to metabolic induction of tissue formation, and then examined the effect of 25-hydroxycholecalciferol (25(OH)D₃) on the metabolic control system.

[Materials and Methods] In experiment 1, Ross commercial male broilers at 42 days of age were used to select WB probable broiler and non-probable broiler. Gross observations were performed to determine TGF- β , decorin, and vitamin-D receptor (VDR) mRNA expression in pectoral major muscle. In experiment 2-5, Cobb broiler hatching eggs were used to determine the GLU concentration in embryonic tissues. In experiment 6, the dose-response of metformin was confirmed. Then in experiment 7, the GLU concentration in embryonic tissue was measured based on the results of experiment 6. In Experiment 8, Ross broiler hatching eggs were used and distilled water, soybean oil, or VD₃ was in ovo administered to determine the mRNA expression and tibial length of IGF-1 and IGF-1 receptors in the liver and pectoral major muscles at 28 days of age. In Experiment 9, 4 group feeds combined with VD₃ and 25(OH)D₃ were fed using Ross broiler chicks. VDR mRNA expression levels in pectoral major muscle were measured, and POMC expression levels, AgRP expression, NPY expression, and VDR mRNA expression levels in the diencephalon were measured. Furthermore, sugar tolerance test was performed in each section in experiment 10.

[Results and Discussion] TGF- β and decorin in the pectoral major muscle showed a strong positive correlation, and TGF- β also showed a correlation with VDR, suggesting that VD was related to muscle metabolism. Administration of metformin did not affect the blood GLU concentration, suggesting that strong feedback may be associated with muscle proteolysis. Although the tibial length at 28 days of age was significantly longer in males, the IGF-1 mRNA of the liver was higher than in the control group, but the IGF-1R mRNA of the superficial pectoral muscle was different only in females in the VD₃ group, suggesting that the occurrence of WBs was unlikely in females and the relationship between the occurrence of WBs and the soundness of muscle metabolism. The POMC mRNA involved in catabolism correlated with VDR mRNA, and the addition of 25(OH)D₃ affected the insulin sensitivity of chicks, suggesting that 25(OH)D₃ should be evaluated instead of VD₃.

These results suggested new guidelines for relevant areas of WB pathogenesis mechanism in broilers and the possibility of WB pathogenesis control in early gluconeogenesis control and catabolism regulation using 25(OH)D₃.