

YONGCAI ZHU : EFFICACY OF DIETARY ANTIOXIDANTS ON GUT FUNCTION AND HEALTH IN HEAT-STRESSED BREEDER HENS. THESIS ADVISOR: ASSOC. PROF. SUTISA KHEMPAKA, Ph. D., 173 PP.

Keyword: HEAT STRESS/BREEDER HEN/TRANSCRIPTOME/DIETARY ANTIOXIDANT/GUT HEALTH

Heat stress (HS) negatively affects intestinal integrity and nutrient absorption in breeder hens. This study aimed to explore the molecular response of the small intestine in heat-adapted and heat-sensitive breeder hens using transcriptomic techniques, and to evaluate the efficacy of synthetic (a combination of vitamin E, vitamin C, Se, and L-carnitine) and phytogetic (a combination of clove, green tea pomace, and Vietnamese coriander) antioxidants in mitigating the adverse effects of HS. This study was comprised of three experiments as follows:

Experiment 1 consisted of two trials. Trial 1: This trial aimed to explore the molecular response of the small intestine to acute HS in heat-sensitive breeder hens. A total of fifty hens, aged 28 weeks, were used and divided into two groups: a control group (maintained at 23°C) and a heat-treated group (exposed to 36°C for a 6-hour), with 25 birds each. A total of 138 differentially expressed genes (DEGs) were identified, comprising 75 upregulated and 63 downregulated genes. Functional analysis through gene ontology (GO) classification, pathway mapping via the Kyoto Encyclopedia of Genes and Genomes (KEGG), and protein interaction (PPI) networks revealed several key regulatory genes involved in thermal response (HSPA8 and HSPA2), and energy homeostasis and fat metabolism (PDK4, PPARA, and CD36). The following genes were identified as candidate biomarker genes in the jejunum for HS response: HSPA2, HSPB9, IL-18BP, and CD36. Trial 2 aimed to investigate the expression of candidate genes (HSPA2, HSPB9, CD36, and IL18BP) in heat-sensitive hens supplemented with synthetic or phytogetic antioxidants. One hundred hens, aged 33 weeks, were randomly housed under thermoneutral (TN; 23°C) or HS conditions (36°C, 4 h/d). The experiment was divided into four groups: 1) basal diet under TN; 2) basal diet under HS; 3) basal diet supplemented with synthetic antioxidants under HS; and 4) basal diet supplemented with phytogetic antioxidants under HS. Results showed that supplementation with

either antioxidant sources increased the expression of the CD36 gene in the jejunum, while the expression of the HSPB9, HSPA2, and IL18BP genes decreased compared to the HS group without supplementation.

Experiment 2, this study used transcriptomic analysis to compare gene expression jejunum of heat-adapted and heat-sensitive hens under acute HS (36°C for 6 hours). Fifty hens (28 week-old, 25 of each breed) were used. A total of 284 DEGs (155 upregulated and 129 downregulated genes) were identified. GO analysis revealed significant enrichment in 555 categories, while KEGG pathway revealed that upregulated genes were involved in VEGF signaling, MAPK signaling, steroid biosynthesis, neuroactive ligand-receptor interaction, and cell cycle pathways. Downregulated genes were related to cell adhesion molecules. The PPI analysis identified PLK1, CDC7, CDC20, HSPA2, IL6, SLC22A19A, LBFABP, and SLC2A2 as key core nodes, which may play crucial roles in regulating the effects of HS on cell division, immune function, energy and lipid metabolism, and nutrient transport.

Experiment 3: One hundred heat-sensitive hens aged 38 to 52 weeks (the same hens used in trial 2). The results showed that under HS condition, , both antioxidant sources increased the expression of genes related to antioxidants (SOD and GSH-Px), tight-junction protein (CLDN1), and anti-inflammatory cytokine (IL-10) in the jejunum. In addition, the total concentration of SCFAs increased, while the expression of HSPs (HSP70 and HSP90), immunity-related genes (IL-6, TNF- α , NF- κ B, and TLR4), and ammonia production were reduced. Furthermore, antioxidant supplementation led to an increase in SCFA-producing bacteria, such as *Firmicutes*, *Lachnospiraceae*, *Ruminococcaceae*, and *Megamonas*, compared to the non-supplemented group.

In conclusion, this study provides valuable insights into the distinct molecular responses of breeder hens to HS. Both synthetic and phytogetic antioxidants demonstrate potential as strategic interventions to mitigate heat-induced damage in poultry.

School of Animal Technology and Innovation

Academic Year 2024

Student's Signature

Yongcai Zhu

Advisor's Signature

Sutisa Khempaka

Co-advisor's Signature

S. Kuba