THERMAL CONDITIONING AT THE POSTNATAL STAGE - A POSSIBLE TRAETMENT TO INCREASE THERMOTOLERANCE IN FAST GROWING CHICKENS

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Following a tremendous genetic improvement during the last decades, broiler chickens improved significantly their growth rate in a relatively short period. It coincided with higher metabolic rate and increased sensitivity to sub-optimal conditions, such as high ambient temperature (T_a) or extreme relative humidities (rh). Acclimation to elevated T_a impairs broilers' performance and partially diminishes the genetic improvement. However, short-term exposure to mild heat stress (thermal conditioning - TC) during the first week post hatch was found to improve both the acquisition of thermotolerance and performance. The technique of TC takes advantage of the immaturity of the mechanism to regulate body temperature (T_b) in young chicks during their first week of life. Thermal conditioning to mild heat stress during the first week of life (T_a=37.5±1.0°C; 70-80% rh; for 24 h at the age of 3 days) resulted in growth retardation followed by an immediate compensatory growth, which resulted in complete compensation for the loss of weight gain, leading to higher body weight and breast muscle of the conditioned chickens at the age of 42 days. TC causes an increase in skeletal muscle satellite cell activity, necessary for further muscle hypertrophy. An immediate increase was observed in satellite cell DNA synthesis in culture and in breast muscle tissue (removed from dead chicks) in response to TC, to levels that were significantly higher than that of non-treated chicks. This was accompanied with the induction of insulin-like growth factor-I (IGF-I), but not hepatocyte growth factor (HGF) in the TC chicks, followed by a significant elevation of number of cells per gram of muscle. To study the effect of TC on thermotolerance acquisition, chickens at the age of 42 days (the approximate market age) were thermally challenged (6 h exposure to T_a=35±1.0°C and 20-30% rh). Thermal challenge resulted in hyperthermia and mortality. However, while in the control chickens hyperthermia reached T_b of 45.3±0.08C, in TC chickens T_b increased to only 44.3±0.23°C with significantly lower mortality. TC chickens demonstrated lower plasma triiodothyronine and thyroxine concentration suggesting a reduction in heat production. It coincided with significantly higher heat loss by radiation and convection. During thermal challenge the stress effect in the TC chickens was significantly lower as suggested from plasma concentration of corticosterone, glucagon and IGF-II. A significantly lower induction of heat shock proteins (70 and 90 kDa) synthesis in heart muscle and lung tissues (removed from dead birds) of TC chickens further suggests that these birds suffer less from heat stress. It can be concluded that thermal conditioning at the age of 3 days post hatch improves dramatically the ability of the mature chickens to thermoregulate during exposure to acute heat spells and even improves chick performance.

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