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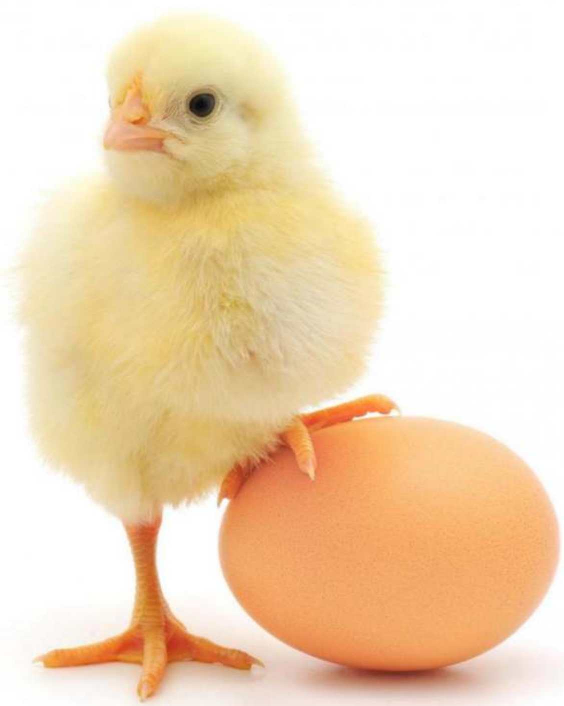

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Effects of High Environmental Temperature on Blood Indices of Thai Indigenous Chickens, Thai Indigenous Chickens Crossbred and Broilers

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Abstract: The purpose of this experiment was to determine the effects of high environmental temperature on the blood indices (mean corpuscular volume, MCV; mean corpuscular hemoglobin, MCH; mean corpuscular hemoglobin concentration, MCHC) of Thai Indigenous Chickens (TIC), Thai Indigenous Chickens Crossbred (TICC) and broilers (BC). One kilogram of male and female TIC, TICC and BC were maintained in an environmental temperature range of 26±2°C and 38±2°C. MCV, MCH and MCHC were investigated on days 1, 7, 14, 21 and 28 of an experimental period. The results revealed the following information: On day 14 of the experimental period, MCV of the chickens maintained at 38±2°C was significantly higher than that of chickens maintained at 26±2°C ($p<0.05$). MCH of the chickens maintained in the environmental temperature at 38±2°C was significantly decreased during days 1-14 and then increased on day 21 of the experimental period ($p<0.05$). The MCH of chickens maintained at 26±2°C was significantly decreased during days 7-21 and then increased on day 28 of experimental period ($p<0.05$). On days 1 and 21, the MCH of chickens maintained in the environmental temperature at 38±2°C was significantly higher than that of chickens at 26±2°C ($p<0.05$). The MCHC of chickens maintained at 38±2°C was significantly higher than that of chickens at 26±2°C ($p<0.05$). Moreover, the MCHC of the TICC changed less than that of the TIC and BC ($p<0.05$). This experiment showed that the high environmental temperature had an effects on the chickens blood indices and more specifically, the MCHC of the TIC and BC responsed to high heat greater than TICC.

Key words: Heat stress, blood indices, Thai indigenous chickens, Thai indigenous chickens crossbred, broilers

Introduction

During the summer season in Thailand, environmental temperatures are often between 36-40°C., a dangerous heat zone for Broiler Chickens (BC). The high summer temperatures have less effect on Thai Indigenous Chickens (TIC) because these wild birds have been domesticated in rural Thailand over the years and have become accustomed to the higher temperatures. Unfortunately, the TIC's have a lower productive performance than broilers. Breeders, however, have successfully improved the TIC production rate by crossbreeding them with high production chickens. The resulting Thai Indigenous Chickens Crossbred (TICC) is a chicken crossbred with TIC and chickens from overseas (Aengwanich, 2007). The productive performance of the TICC is higher than the TIC, but lower than broilers (Chinrasri and Aengwanich, 2007).

Research has shown that environmental temperatures over 32°C have induced broilers (BC) to heat stress (Cooper and Washburn, 1998). When broilers were under heat stress, their Mean Corpuscular Volume (MCV) increased. In contrast, the Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) of broilers decreased (Aengwanich, 2002; Aengwanich and Simaraks, 2003; Aengwanich and Chinrasri, 2004). Knowledge about the effects of high environmental temperature on MCV, MCH and MCHC of TIC and TICC is limited. Therefore, the purpose of this experiment was to study the effects of high environmental temperature on MCV, MCH and MCHC in TIC, TICC and BC. Results from this preliminary study should provide fundamental knowledge for improving poultry production by identifying a heat tolerant genetic resource for poultry production in tropical regions.

Materials and Methods

Birds: Twenty four TIC (12 males; 12 females), 84 days of age; twenty four TICC (12 males; 12 females), 70 days of age and twenty four BC (12 males; 12 females), 28 days of age, one kilograms of weight and infectious diseases-free were obtained from a commercial farm near Mahasarakham University and transferred to the laboratory of the Faculty of Technology, at Mahasarakham University. The experiment was performed during April-July, 2005. Experiments began after a 7-day adaptation period. The chickens were fed a standard ration *ad libitum* with continuous light and water supplies.

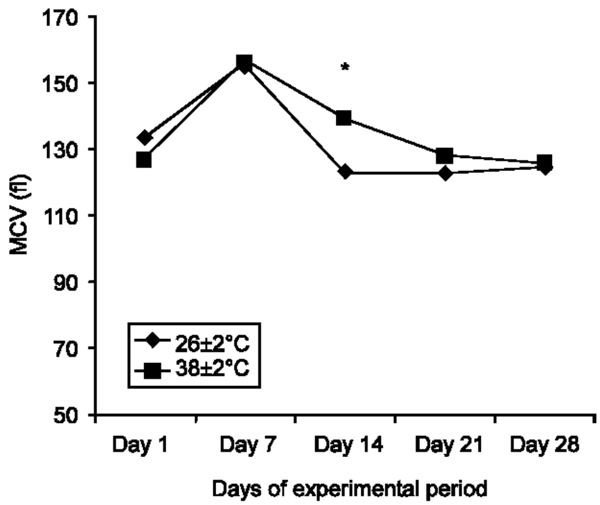

Fig. 1: MCV of chickens were maintained at 26±2°C and 38±2°C on days 1, 7, 14, 21 and 28 of experimental period

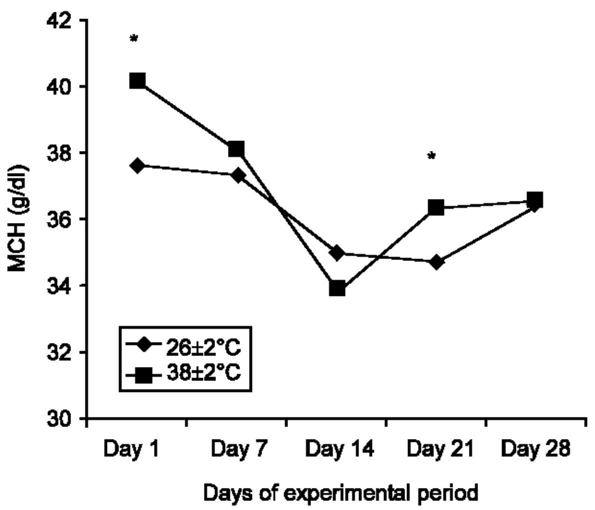

Fig. 2: MCH of chickens were maintained at 26±2°C and 38±2°C on days 1, 7, 14, 21 and 28 of experimental period

Experimental design: The experimental design was a split-split-plot design in CRD. The main plot was two temperatures i.e., 26±2°C (continuous temperature) and 38±2°C (cyclic temperature; 26+2°C-38+2°C-26+2°C; chickens were maintained at 38±2°C for 8 hours/day). The sub plot was 2×3 factorial i.e. sex (male and female) and three breeds of chicken. Six TIC, six TICC and six BC were maintained at each environmental temperature.

Hematological technique: On days 1 (initial experimental date), 7, 14, 21 and 28 of the experimental period, blood sample collections were performed after chickens were subjected to high environmental temperature for 2 hours. Chickens were restrained manually and two milliliters of blood samples were collected from cervical vein using a 3-ml syringe, 23-gauge needle, 1.5 inch of length then placed in a microtube with EDTA for determining hematological values. The samples were cooled to approximately 4°C, using icepacks and transferred to the laboratory within 2 hours after blood collection. Total red blood cell was determined by the manual method using a hemocytometer (Campbell, 1995). Packed cell volume was investigated by the standard manual technique using microhematocrit capillary tubes and centrifuged at 2,500 rpm. for 5 min. Hemoglobin concentration was measured by the Cyanmethemoglobin method (Ritchie *et al.*, 1994). Blood indices (mean corpuscular volume, MCV; mean corpuscular hemoglobin, MCH; mean corpuscular hemoglobin concentration, MCHC) were calculated by using the formulas guided by Campbell (1995).

Data analysis: All data were analyzed using the ANOVA procedure of Statistical Analysis System (1990). Means were separated by Duncan's multiple range tests (Duncan, 1955). The level of significance was determined at $p<0.05$.

Results and Discussion

The MCV of chickens maintained in the environmental temperature at 26±2°C and 38±2°C increased on day 7 and then decreased on day 14 of the experimental period ($p<0.05$). On day 14, the MCV of chickens maintained at 38±2°C was significantly higher than that of chickens maintained at 26±2°C ($p<0.05$) (Fig. 1).

This occurrence was in accordance with that reported by Aengwanich and Chinrasri (2004). They reported that when BC were maintained under heat stress their MCV increased on day 3 and then decreased to the normal range on day 14. It was also similar to the report of Aengwanich (2002), which found that when broilers were maintained at high environmental temperatures, their MCV increased. He suggested that after broilers had been exposed to high heat, they were under vascular hemolysis. Therefore, the MCV of birds at high environmental temperatures increased more than the MCV of birds at thermoneutral.

The MCH of chickens maintained in the environmental temperature at 38±2°C was significantly decreased during days 1-14 and then increased on day 21 of experimental period ($p<0.05$) (Fig. 2). This occurrence was in accordance with the reports of Furlan *et al.* (1999), Yahav *et al.* (1997), Borges *et al.* (1999), Aengwanich (2002), Aengwanich and Chinrasri (2002) and Aengwanich and Simaraks (2003). They found that when chickens were under heat stress, their hemoglobin concentration decreased. Aengwanich (2002) explained that when BC were under heat stress,

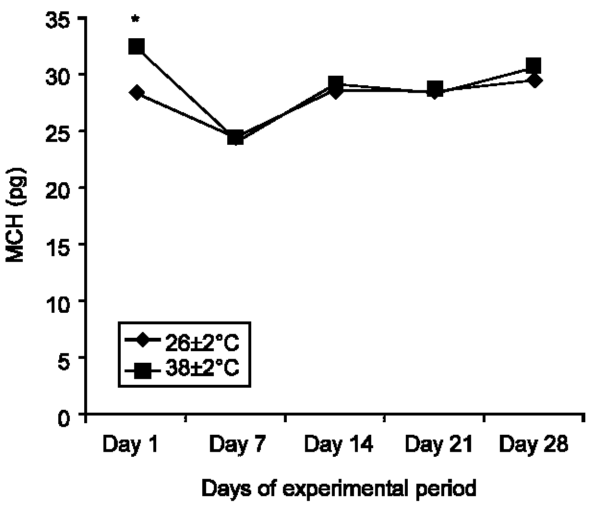

Fig. 3: MCHC of chickens were maintained at 26±2°C and 38±2°C on days 1, 7, 14, 21 and 28 of experimental period

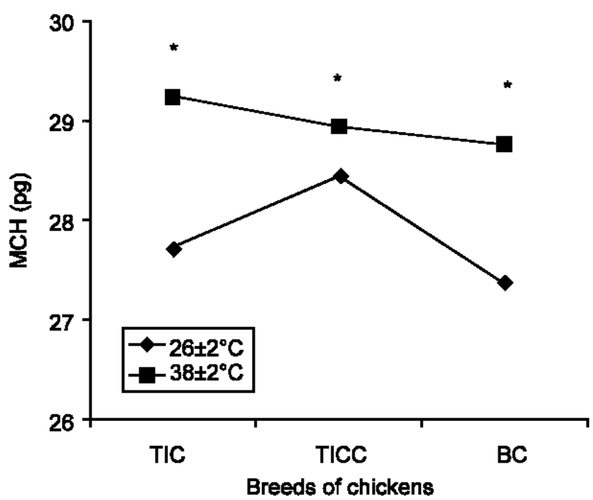

Fig. 4: MCHC of chickens (TIC, TICC and BC) were maintained in the environmental temperature at 26±2°C and 38±2°C

bilirubin concentration, relative bile volume and bile contamination in the feces of BC increased. This indicated that chickens under heat stress lost hemoglobin. Moreover, the MCH of chickens maintained at 26±2°C was significantly decreased during days 7-21 and then increased on day 28 of experimental period ($p<0.05$) (Fig. 2).

On days 1 and 21 of the experimental period, the MCH of the chickens maintained in the environmental temperature at 38±2°C was significantly higher than that of chickens at 26±2°C ($p<0.05$) (Fig. 2). This occurrence explained that during the initial period of heat exposure, chickens maintained at the higher temperatures responded by decreasing the period of time between their consumption of water and increasing their loss of water through accelerated wet dropping. The documents which support this hypothesis are reported by Aengwanich *et al.* (2003) and Aengwanich and Simaraks (2004). They found that when chickens are under heat stress, their kidneys, which adapt to heat stress by increasing the secretion of urine, help reduce their body temperature Therefore, chickens at initial heat exposures were under dehydration and cases of MCH rose.

The MCHC of chickens maintained in an environmental temperature at 38±2°C decreased on day 7 ($p<0.05$) and increased on day 14 of experimental period ($p<0.05$) (Fig. 3). This occurrence was similar to the report of Aengwanich and Chinrasri (2004). They found that when broilers were maintained under heat stress, MCHC decreased on day 3 and then increased to the normal range on day 14 of the experimental period.

The MCHC of chickens maintained at 38±2°C was significantly higher than that of chickens at 26±2°C ($p<0.05$) (Fig. 4). The explanation for this phenomenon is similar to the explanation of the effects of high environmental temperatures on the MCH at the initial time of heat exposure. Moreover, the MCHC of the TICC changed less than that of the TIC and BC ($p<0.05$) (Fig. 4). This occurrence showed that high environmental temperature influenced the MCHC of the TIC and BC more than it influenced the MCHC of the TICC.

Conclusion: Blood indices were determined in TIC, TICC and BC maintained in high environmental temperatures and thermoneutral. The results found that in the middle period of heat exposure, the MCV of chickens maintained at a high environmental temperature was higher than that of chicken at thermoneutral. At the initial period of heat exposure, the MCH of chickens maintained in the high environmental temperature was higher than that of chickens at thermoneutral and decreased at the middle period of heat exposure and then increased to the normal range at the end of the period of heat exposure. The MCH of chickens maintained at high environmental temperature was higher than that of chickens at thermoneutral. Lastly, the MCHC of chickens at high environmental temperatures increased especially at the initial period of heat exposure and the influence of high heat on the MCHC of the TIC and BC was greater than TICC.

Acknowledgments

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