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Effects of High Environmental Temperature on the Body Temperature of Thai Indigenous, Thai Indigenous Crossbred and Broiler Chickens

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Abstract: The effects of high environmental temperatures on the body temperature of Thai Indigenous Chickens (TIC), Thai Indigenous Chickens Crossbred (TICC) and Broilers (BC) were determined for the purpose of comparing the chickens' responses to the increased heat. One kilogram of representative males and females of each of the three breeds were maintained at the environmental temperatures of 26±2 and 38±2°C. Body temperature was investigated on days 1, 7, 14, 21 and 28 of the experimental period. The results revealed the following information: The body temperature of the chickens maintained at 38±2°C was significantly higher than that of the chickens at 26±2°C ($p<0.05$) and the body temperature of the BC maintained at 38±2°C was significantly higher than that of the TIC and TICC ($p<0.05$). At 38±2°C, on days 1, 7, 14, 21 and 28 of experimental period, the body temperature of the BC was significantly higher than that of the TICC and TIC, respectively ($p<0.05$). This experiment showed that the high environmental temperature had a greater effect on the BC than on the TICC and TIC, respectively.

Key words: Body temperature, heat stress, Thai indigenous chickens, Thai indigenous chickens crossbred, broilers

INTRODUCTION

Stressors common to poultry production include extreme environmental temperatures, disease, handling, beak trimming, vaccinations, crowding and inadequate ventilation. These stressors vary in intensity, duration and time and often occur concurrently with other stressors (Mckee and Harrison, 1995). The body temperature of domestic chickens is maintained within a relatively narrow range that is usually reflected by the upper and lower limits of a circadian rhythm in deep body temperature. In well-fed chickens that are neither dissipating heat to the environment nor gaining heat from the environment. The upper limit of the circadian rhythm is usually about 41.5°C and the lower limit is about 40.5°C (Daghir, 1995). After birds are exposed to a high ambient temperature, their body temperature rises above their normal body temperature. High heat caused tissue damage (Aengwanich *et al*., 2003) and an increase in the workload of the physiological system. When birds were under heat stress, body temperature increased (Donkoh, 1989; Boulahson *et al*., 1995; Cooper and Washburn, 1998; Whittow, 2000; Aengwanich and Chinrasri, 2002; Aengwanich and Simaraks, 2003; Aengwanich *et al*., 2003). When the environmental temperature was over 32°C, it induced broilers to heat stress (Cooper and Washburn, 1998). At present, body temperature is generally accepted as an indicator for heat stress in chickens.

Thai Indigenous Chickens (TIC) are wild birds that have been domesticated in rural villages in Thailand over a long period of time. They have become accustomed to high environmental temperatures. Thai indigenous chickens have a lower productive performance than broilers, so breeders improved their productive performance by crossbreeding them with chickens imported from overseas. Thai Indigenous Chickens Crossbred are a crossbred chicken between 1/2 Thai indigenous chickens (cock) and 1/4 Rhode Island Red and 1/4 Plymouth Rock (hen). Knowledge about the effects of high environmental temperature on the rectal temperature of TIC and TICC is limited. Therefore, the purpose of this experiment was to compare the responses to high heat between TIC, TICC and Broiler (BC) by using body temperature. Results from this preliminary study would 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, 84 days old; TICC, 70 days old and BC (rose strain), 28 days old, 1 kg of weight and infectious diseases-free were obtained from a commercial farm in Maha Sarakham Province, northeastern Thailand. Chickens were transferred to a laboratory at 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.

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 h day^{-1}). The sub plot was 2×3 factorial i.e., sex (male and female) and 3 breeds of chicken (TIC, TICC and BC). Six TIC, 6 TICC and 6 BC were maintained at each environmental temperature.

Body Temperature Measurement

Body temperature was measured on days 1, 7, 14, 21 and 28 of the experimental period by using a thermocouple thermometer. After inserting the thermometer into rectum at depths of 2.5 cm, the temperature was allowed to stabilize 60 sec before the reading was obtained (Boulahson *et al*., 1995).

Statistical Analysis

All data were analyzed by using the ANOVA procedure of SAS (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 effects of high environmental temperature on the body temperature of TIC, TICC and BC are shown in Table 1. The body temperature of the chickens (TIC, TICC and BC) maintained at 38±2°C was significantly higher than that of the chickens at 26±2°C ($p<0.05$) and the body temperature of the BC maintained at 38±2°C was significantly higher than that of the TIC and TICC ($p<0.05$) (Fig. 1).

At 38±2°C, on days 1, 7, 14, 21 and 28 of the experimental period, the body temperature of the BC was significantly higher than that of the TIC and TICC ($p<0.05$) (Fig. 2.).

Generally, the comfortable and normal body temperatures of broilers range between 21-26°C (Ewing *et al*., 1999) and 41-42°C (Donkoh, 1989), respectively. In present study, at 26±2°C, the body temperature of the TIC, TICC and BC were in the normal range (average; TIC = 41.12°C, TICC = 41.19 and BC = 41.37).

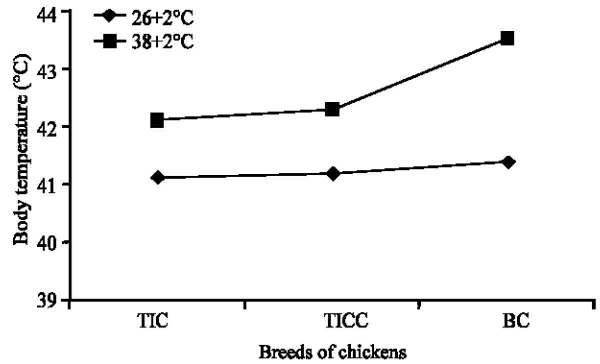

Fig. 1: Body temperature pattern of chickens breeds of chickens (TIC, TICC, BC) maintained at the environmental temperatures of 26±2 and 38±2°C

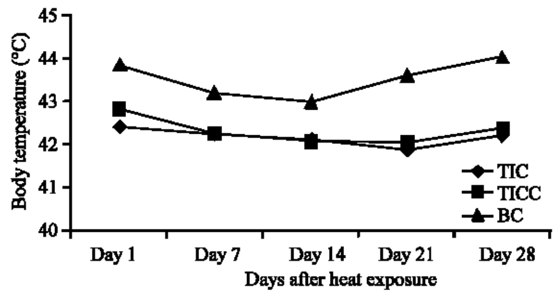

Fig. 2: Body temperature pattern of TIC, TICC and BC on days 1, 7, 14, 21 and 28 of the experimental period maintained at 38±2°C

Table 1: Body temperature (BT) of male and female Thai indigenous chickens, Thai indigenous chickens crossbred, broilers were maintained at 26±2 and 38±2°C, on days 1, 7, 14, 21 and 28 of the experimental period

	Environmental temperature at 26±2°C						Environmental temperature at 38±2°C						
	TIC		TICC		BC		TIC		TICC		BC		
Days	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	SEM
1	40.92^{d}	40.75^{d}	41.00^{d}	40.92^{d}	40.92^{d}	41.08^{d}	42.67^{b}	42.17^{c}	42.79^{b}	42.83^{b}	43.85^{a}	43.83^{a}	0.15
7	40.88^{c}	41.08^{c}	41.04^{c}	40.96^{c}	41.00^{c}	41.04^{c}	42.38^{b}	42.13^{b}	42.21^{b}	42.29^{b}	43.38^{a}	43.00^{a}	0.19
14	41.49^{cd}	41.46^{cd}	41.53^{cd}	41.42^{d}	41.63^{cd}	41.54^{cd}	42.17^{b}	42.08^{b}	42.25^{b}	41.92^{bc}	43.13^{a}	42.83^{a}	0.15
21	41.08^{d}	41.17^{cd}	41.29^{cd}	41.13^{d}	41.33^{cd}	41.04^{d}	41.84^{b}	41.63^{bc}	42.04^{b}	42.00^{b}	43.67^{a}	43.46^{a}	0.14
28	41.42^{cde}	40.93^{e}	41.42^{cde}	41.21^{de}	42.38^{b}	41.71^{bcd}	42.17^{b}	41.96^{bc}	42.42^{b}	42.33^{b}	44.21^{a}	43.84^{a}	0.23

a, b, c, d and e within row, mean with no common superscript differ significantly ($p<0.05$). SEM = standard error of the mean

On days 1, 7, 14, 21 and 28, at 26±2°C, the body temperature of the TIC, TICC and BC was not different; whereas, on day 28, at 26±2°C, the body temperature of the male BC was higher than that of the male and female TIC and TICC and the female BC (Table 1). It was noted that on the 28th day of the experimental period, the body size of the BC was larger than that of the TIC and TICC (Chinrasri and Aengwanich, 2007). Whittow (2000) reported that the basal metabolic rate of birds depends on the size and growth rate of the fowl. Therefore, the body temperature of the male BC at 26±2°C was higher than that of the male and female TIC and TICC and the female BC. On days 1, 7, 14, 21, 28, at 38±2°C, the body temperature of the BC was higher than that of the TICC and TIC (Fig. 2). This phenomenon showed that in high environmental temperatures, the BC (average = 43.52 °C) produced a body temperature higher than TIC (average = 42.31°C) and TICC (average = 42.17°C).

On days 1-28, the body temperature of the male and female TIC, TICC and BC maintained at 38±2°C was higher than that of the male and female TIC, TICC and BC at 26±2°C (Fig. 1). This observation was in accord with that reported by Aengwanich *et al*. (2003). They found that broilers maintained at 25, 26 and 27 degrees had body temperatures of 41.42, 41.23 and 41.50°C, respectively, while broilers maintained at 36°C, had a body temperature of 43.69°C. In this experiment, the average body temperature of the TIC, TICC and BC at 26±2°C VS at 38±2°C were 41.12 °C VS 42.17°C, 41.19°C VS 42.31°C and 41.37°C VS 43.52°C, respectively.

On day 21, the body temperature of the female TIC maintained at 26±2°C was the same as that of the female TIC at 38±2°C and the body temperature of the female TIC maintained at 38±2°C was lower than that of the male TIC, male and female TICC and BC at the same environmental temperature (Table 1). Moberg and Mench (2000) reported that when animals were subjected to repeated stress, in the first few days after exposure, they usually showed increased response and then later the response decreased. Therefore, this occurrence showed that on day 21 of the experimental period the female TIC could adapt to the high environmental temperature quicker than the male TIC and the male and female TICC and BC.

CONCLUSIONS

The results of present study clearly demonstrate that the body temperature of chickens maintained at high environmental temperature was higher than that of chicken at thermoneutral. At heat stress temperature, the body temperature of the BC was higher than TICC and TIC, respectively. Finally, when chickens were maintained at a prolonged high environmental temperature, their body temperature decreased. This occurrence indicated that chickens could adapt to a high environmental temperature.

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