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Effects of High Environmental Temperature on Packed Cell Volume of Thai Indigenous, Thai Indigenous Crossbred and Broiler Chickens

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Abstract: A study of the effects of high environmental temperatures on the packed cell volume of Thai Indigenous Chickens (TIC), Thai Indigenous Chickens Crossbred (TICC) and Broilers (BC) was made and a comparison of the effects to the 3 breeds was undertaken. One kilogram of representative males and females of each of the 3 breeds were maintained in the environmental temperature range of 26±2 and 38±2°C. Packed cell volumes were investigated on day 1, 7, 14, 21 and 28 of an experimental period. The results revealed the following information: On day 1, the packed cell volume of chickens maintained at 26±2°C was significantly lower than that of chickens at 38±2°C ($p<0.05$). On day 7, 14, 21 and 28, the packed cell volume of chickens maintained at 26±2°C was significantly higher than that of chickens at 38±2°C ($p<0.05$). On day 7, 14, 21 and 28 of experimental period, at 38±2°C, the packed cell volume of the TIC was significantly higher than that of the TICC and BC ($p<0.05$). This experiment showed that the TIC was more tolerant to high environmental temperatures than the TICC and BC.

Key words: High environmental temperature, packed cell volume, thai indigenous chickens, thai indigenous chickens crossbred, broilers

INTRODUCTION

After birds are exposed to a high ambient temperature, their body temperature rises to a higher than the normal body temperature (Aengwanich *et al.*, 2003). The environmental temperature was over 32°C, it induced broilers to heat stress (Cooper and Washburn, 1998). When birds were under heat stress, packed cell volume decreased (Yahav *et al.* 1997; Aengwanich, 2002; Aengwanich and Chinrasri, 2002; Aengwanich and Simaraks, 2003; Aengwanich and Chinrasri, 2004). At present, the packed cell volume is generally accepted as the indicator for heat stress in chickens.

Thai Indigenous Chickens (TIC), the wild birds that have been domesticated in rural villages in Thailand over a long time period, are familiar with high environmental temperatures. However, Thai indigenous chickens have a productive performance lower than that of broilers. To improve production, breeders have crossbred the TCI with chickens imported from overseas resulting in the Thai Indigenous Chicken Crossbreed (TICC) which is a crossbreed between ½ Thai indigenous chickens (cock) and ¼ Rhode Island Red and ¼ Plymouth Rock (hen). Knowledge about the effects of high environmental temperature on the packed cell volume of both the TIC and the TICC was limited. The purpose of this experiment, therefore, was to compare the responses to high heat between the TIC, TICC and Broilers (BC) by evaluating the packed cell volume. 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

Twenty four Thai indigenous chickens (12 male; 12 female), 24 Thai indigenous chickens crossbred (12 male; 12 female) and 24 broilers (12 male; 12 female), 1 kg of weight and infectious disease-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 chicks were fed a standard ration *ad libitum* with continuous light and water supplies. The experimental design was a split-split-plot design in CRD. The main plot had two temperature settings, 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 (Thai indigenous chickens, Thai indigenous chickens crossbred and broiler). Six Thai indigenous chickens, 6 Thai indigenous chickens crossbred and 6 broilers were maintained at each environmental temperature. On day 1, 7, 14, 21 and 28 of experimental period, blood samples (via wing vein: 0.75 mL) were collected and transferred to tubes containing EDTA as an anticoagulant (Ritchie *et al*., 1994). Packed cell volume was investigated using the standard manual technique using microhematocrit capillary tubes and centrifuging at 2,500 rpm for 5 min (Campbell, 1995). All data were analyzed by using the ANOVA procedure of Statistical Analysis System (1990). Means were separated by Duncan's multiple range tests. The level of significance was determined at $p<0.05$.

RESULTS AND DISCUSSION

The effects of high environmental temperature on the packed cell volume of the TIC, TICC and BC are shown in Table 1. Moreover, on day 1, the packed cell volume of chickens maintained at 26±2°C was significantly lower than that of chickens at 38±2°C ($p<0.05$). On day 7, 14, 21 and 28, the packed cell volume of the chickens maintained at 26±2°C was significantly higher than that of the chickens at 38±2°C ($p<0.05$) (Fig. 1).

At 38±2°C, on day 1, the packed cell volume of the TICC was significantly lower than that of the TIC and BC ($p<0.05$). On day 7, 14, 21 and 28 of the experimental period, the packed cell volume of the TIC was significantly higher than that of the TICC and BC ($p<0.05$) (Fig. 2).

On day 1, the packed cell volume of the chickens maintained at 26±2°C was lower than that of the chickens at 38±2°C (Fig. 1). The explanation for this occurrence is that at the initial period of heat exposure, chickens maintained at the high environmental temperature had a higher response to the high temperature by increasing their respiratory rate, which caused a decrease in water consumption and water loss through wet dropping (dehydration). 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 respiratory rate increases. In addition the kidney of heat stressed chickens is adapted to increase urine secretion. These factors helped the chickens reduce their body temperature. Therefore, at 38±2°C, the packed cell volume of chickens was higher than that of chickens at 26±2°C. In contrast, on day 7, 14, 21 and 28, the packed cell volume of chickens maintained at 26±2°C was higher than that of

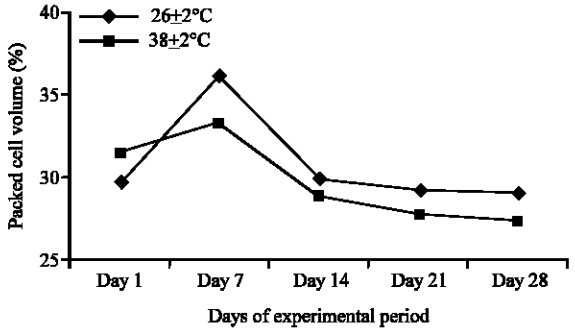

Fig. 1: Packed cell volume of chickens were maintained at 26±2 and 38±2°C on day 1, 7, 14, 21 and 28 of experimental period

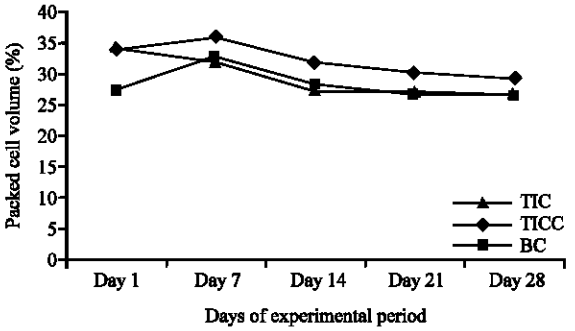

Fig. 2: Packed cell volume pattern of Thai indigenous chickens, Thai indigenous chickens crossbred, broilers were maintained at 38±2°C on day 1, 7, 14, 21 and 28 of experimental period

Table 1: Packed Cell Volume (PCV) of male and female Thai indigenous chickens, Thai indigenous chickens crossbred, broilers were maintained at 26±2°C and 38±2°C, on day 1, 7, 14, 21 and 28 of experimental period

		Environmental temperature at 26±2°C						Environmental temperature at 38±2°C						
		TIC		TICC		BC		TIC		TICC		BC		
Parameter	Days	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	SEM
PCV	1	29.33^{cde}	30.00^{bcde}	29.33^{cde}	27.67^{de}	31.33^{bcd}	30.33^{bcde}	33.83^{ab}	33.33^{ab}	26.83^{e}	27.17^{e}	35.67^{a}	32.17^{abc}	1.19
	7	37.50^{a}	38.33^{a}	34.50^{abcd}	34.67^{abcde}	36.33^{ab}	35.83^{abc}	35.50^{abc}	35.83^{abc}	32.83^{bcd}	32.17^{cd}	32.17^{cd}	31.17^{d}	1.21
	14	30.83	31.00	32.17	26.33	30.17	28.50	31.17	31.67	27.67	28.33	29.00	25.17	1.51
	21	30.50^{a}	30.17^{a}	28.50^{abc}	28.17^{abcd}	28.50^{abc}	29.33^{abc}	29.67^{ab}	30.0^{a}	27.67^{abcd}	25.50^{d}	26.67^{cd}	26.83^{bcd}	0.88
	28	30.83^{a}	30.17^{ab}	30.0^{ab}	26.17^{cde}	28.17^{abcde}	28.83^{abcd}	29.33^{abc}	29.00^{abc}	28.17^{abcde}	25.00^{e}	27.17^{bcde}	25.50^{de}	1.02

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

the chickens at 38±2°C. and on day 7, the packed cell volume of the male BC at 26±2°C was higher than that of the male BC at 38±2°C. This was in accord with the report of Yahav *et al.* (1997), Aengwanich (2002), Aengwanich and Chinrasri (2002) and Aengwanich and Simaraks (2003). Aengwanich (2002) explained that when broilers were under heat stress, they were under vascular hemolysis. Bilirubin concentration, relative bile volume, bile contamination in feces and the MCV of broilers under heat stress increased, while the total red blood cell and PCV decreased. At 38±2°C, on day 1, the packed cell volume of the TICC was lower than that of the TIC and BC. On day 7, 14, 21 and 28 of experimental period, the packed cell volume of the TIC was higher than that of the TICC and BC. These occurrences showed that at the initial period to high heat exposure, the TIC had a higher response to the high environmental temperature than the TICC and BC. After the TICC and BC were maintained at prolonged high ambient temperatures, their packed cell volume decreased. This finding showed that there was a destruction of red blood cells in the TICC and BC that was greater than that of the TIC, so their packed cell volume decreased. Whereas, on day 14, 21 and 28, packed cell volume of the TIC, TICC and BC maintained at 26±2°C and 38±2°C were not different (Table 1). These occurrences demonstrated that the TIC, TICC and BC could adapt to high heat after day 14 of the experimental period. This was in accord with the report of Aengwanic (2002). He reported that the packed cell volume of broilers at high environmental temperatures was lower than that of broilers at thermoneutral on day 7 and then on day 14 and 21 of experimental period, the packed cell volume of the broiler maintained in both conditions was not different. Moreover, Aengwanich and Chinrasri (2004) reported that when broilers were under heat stress, their packed cell volume decreased on day 7 and 14 of experimental period and then increased to normal range on day 21. Above documents were in accord with the report of Moberg and Mench (2000), they found that when animals were subjected to repeated stress, in the first few first days after exposure they usually show an increased response and then later the response decreased.

CONCLUSION

The results of the present study clearly demonstrate that time, breed and environmental temperature have an effect on the packed cell volume of chickens. When TIC, TICC and BC were exposed to prolonged high ambient temperature, they could adapt to this condition. Finally, high ambient temperature had an effect on the BC that was greater than its effect on the TICC and TIC.

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