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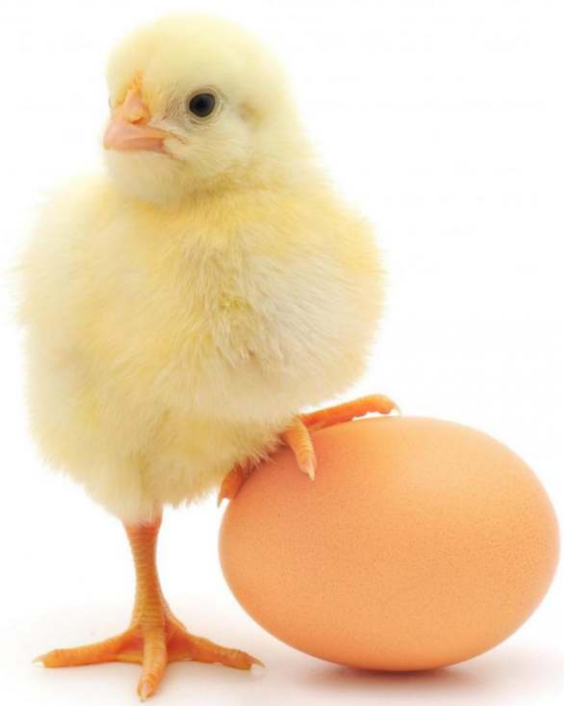

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Effects of High Environmental Temperature on the Productive Performance of Thai Indigenous, Thai Indigenous Crossbred and Broiler Chickens

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Abstract: The present study was conducted to determine the effect of high environmental temperatures and breed on live productive performances of Thai Indigenous (TIC), Thai Indigenous Crossbred (TICC) and Broilers (BC) Chickens. Twenty four TIC, TICC and BC, one kilogram of weight were used in this study. Chickens were housed in two conditions, i.e., 26±2°C and 38±2°C. At weeks 1, 2, 3 and 4 of experimental period, feed intake, average daily weight gain and feed conversion rate were investigated. The results revealed the following information: At thermoneutral, the productive performances of BC were higher than TICC and TIC ($p<0.05$), respectively. Under heat stress temperatures, the productive performance of the BC was higher than that of the TICC and TICC ($p<0.05$). The productive performance of chickens at thermoneutral was higher than that of chickens under heat stress ($p<0.05$). However, at week 4 the feed conversion rate of the BC was higher than that of the TICC and TIC ($p<0.05$) and high environmental temperatures did not affect the feed conversion rate of TICC ($p>0.05$). The result of the current trials indicates environment temperature and breed influence the productive performance of chickens.

Key words: Heat stress, productive performance, Thai indigenous chicken, Thai indigenous chicken crossbred, broiler

Introduction

During the summer season in Thailand, environmental temperatures can be between 36-40°C., a dangerous zone for broilers. Thai Indigenous Chickens (TIC), the wild birds that have been domesticated in the rural villages of Thailand over a long period of time, are familiar with high environmental temperatures. TIC, however, have a lower productive performance than broilers (BC), so breeders have improved the production of the TIC by crossbreeding them with chickens imported from overseas. Thai Indigenous Chicken Crossbreds (TICC) are a crossbred chicken of ½ TIC (cock) and ¼ Rhode Island Red and ¼ Plymouth Rock (hen). TICC have a higher productive performance than Thai indigenous chickens. Many reports have shown that high ambient temperatures depress feed consumption (Suk and Washburn, 1995; Yuming *et al*., 1998; Oliveira *et al*., 2000; Deeb and Cahaner, 2001; Xin *et al*., 2002) and growth rate (Eberhart and Washburn, 1993; Altan *et al*., 2000; Oliveira *et al*., 2000; Temin *et al*., 2000; Deeb and Cahaner, 2001) of BC. Moreover, the feed conversion rate (Suk and Washburn, 1995) of BC increases. Reports about the effects of heat stress on the productive performance of TIC and TICC have been limited. Therefore, the purpose of this experiment was to compare the effects of chronic heat stress on productive performance (feed intake, average daily weight gain and feed conversion rate) between TIC, TICC and BC. 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 TIC (12 males; 12 females), twenty four TICC (12 males; 12 females) and twenty four BC (12 males; 12 females), one kilograms of weight and infectious disease-free were obtained from a commercial farm near Mahasarakham University. The experiment was performed from April to July, 2005. The experiments were begun after a 7-day adaptation period. The chicks were fed a standard ration *ad libitum* with continuous light and water supply. 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 6 hours/day), the sub plot was 2×3 factorial i.e. sex (male and female) and 3 breeds of chicken (TIC, TICC and BC). Six TIC, six TICC and six BC were maintained at each environmental temperature. On weeks 1, 2, 3 and 4 of the experimental period, feed intake, average daily weight gain and feed conversion rate were investigated.

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 $p<0.05$.

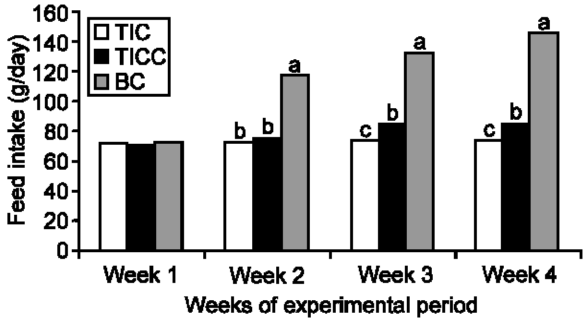

Fig. 1: Feed intake pattern of TIC, TICC and BC were maintained at 26±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other (p<0.05)

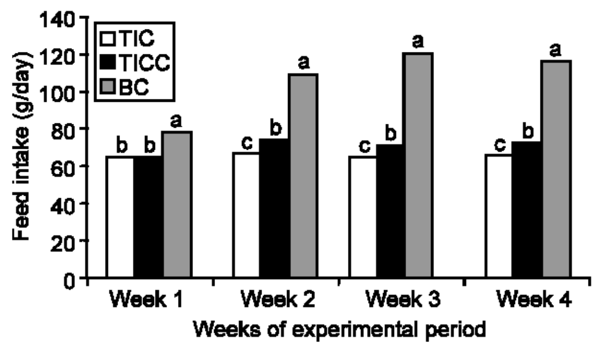

Fig. 2: Feed intake pattern of TIC, TICC and BC were maintained at 38±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other (p<0.05)

Results and Discussion

Feed intake: At 26±2°C, on weeks 2, 3 and 4 of the experimental period, feed intake of the BC was significantly higher than that of the TIC and TICC (p<0.05). On weeks 3 and 4, the feed intake of TICC was significantly higher than TIC (p<0.05) (Fig. 1).

At 38±2°C, on weeks 1, 2, 3 and 4, feed intake of BC was significantly higher than that of TIC and TICC (p<0.05). On weeks 2, 3 and 4, the feed intake of TICC was significantly higher than that of TIC (p<0.05) (Fig. 2).

On weeks 2, 3 and 4, feed intake of chickens maintained at 26±2°C was significantly higher than that of chickens at 38±2°C (p<0.05) (Fig. 3).

In both conditions, feed intake of BC was higher than that of the TIC and TICC. Moreover, the feed intake of chickens at 26±2°C on weeks 2, 3 and 4 of experimental period was higher than that of chickens at 38±2°C. The results from this study were similar to the reports of Stilborn *et al.* (1988), McFalane *et al.* (1989), Michell and Carlisle (1992), Teerter *et al.* (1992), Kutlu and Forbes (1993), Mckee and Harrison (1995), Mckee *et al.* (1997), Belucio *et al.* (1999), Mehta and Shingari (1999), Yuming *et al.* (1998), Oliveira *et al.* (2000), Deeb and Cahaner (2001) and Xin *et al.* (2002). These occurrences explain that chickens maintained at the higher temperatures responded by increasing their respiratory rate. Therefore, the period of time between their consumption of feed decreased.

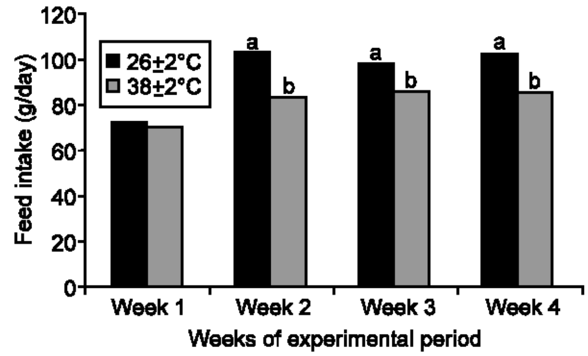

Fig. 3: Feed intake pattern of chickens were maintained in the environmental temperature at 26±2°C and 38±2°C on weeks 1, 2 3 and 4 of experimental period; means with different superscripts are significantly different from each other (p<0.05)

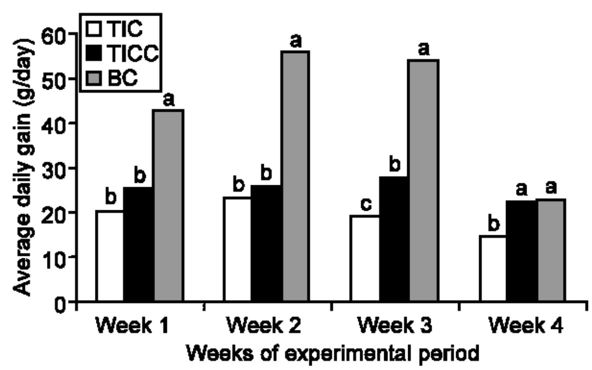

Fig. 4: Average daily weight gain of TIC, TICC and BC were maintained at 26±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other (p<0.05)

Average daily weight gain: At 26±2°C, at weeks 1, 2 and 3 of the experimental period, the average daily weight gain of the BC was significantly higher than that of the TIC and TICC (p<0.05). On week 4, the average daily weight gain of BC and TICC was not significantly different (p>0.05). On weeks 3 and 4, the average daily weight gain of TICC was significantly higher than that of TIC (p<0.05) (Fig. 4).

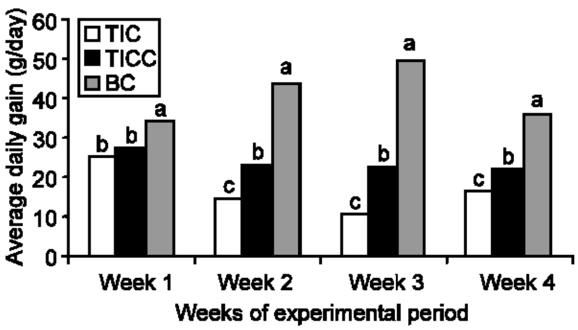

Fig. 5: Average daily weight gain of TIC, TICC and BC were maintained at 38±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other ($p<0.05$)

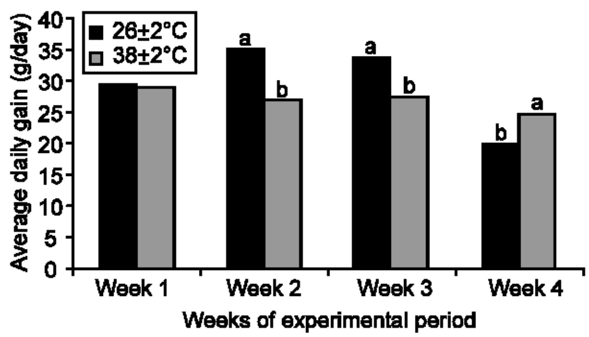

Fig. 6: The average daily weight gain of chickens maintained at 26±2°C and 38±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other ($p<0.05$)

At 38±2°C, on weeks 1, 2, 3 and 4 of the experimental period, the average daily weight gain of the BC was significantly higher than that of TIC and TICC ($p<0.05$). On weeks 2, 3 and 4, the average daily weight gain of TICC was significantly higher than that of the TIC ($p<0.05$) (Fig. 5).

On weeks 2 and 3 of the experimental period, the average daily weight gain of chickens maintained at 26±2°C was higher than that of chickens at 38±2°C ($p<0.05$). On week 4, the average daily weight gain of chickens maintained at 38±2°C was higher than that of chickens at 26±2°C ($p<0.05$) (Fig. 6).

The average daily weight gain of BC maintained in both 26±2°C and 38±2°C was higher than that of TIC and TICC. This showed that the average daily weight gain of commercial chickens from a temperate zone was higher than that of indigenous chickens from a tropical zone. Moreover, the average daily weight gain of chickens at thermoneutral was higher than that of chickens under heat stress. This phenomenon was similar to the

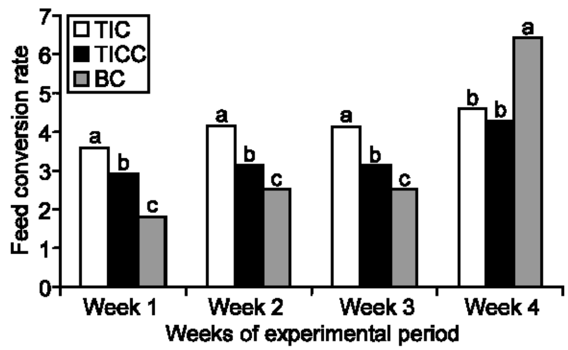

Fig. 7: The feed conversion rate of TIC, TICC and BC was maintained at 26±2°C on weeks 1, 2, 3 and 4 of experimental period; means with different superscripts are significantly different from each other ($p<0.05$)

reports of Pardue *et al.* (1985); Stilborn *et al.* (1988); McFalane *et al.* (1989); Cahaner and Leenstra (1992); Michell and Carlisle (1992); Kutlu and Forbes (1993); Eberhart and Washburn (1993); Yahav *et al.* (1997); Mckee *et al.* (1997); Cooper and Washburn (1998); Yuming *et al.* (1998); Mehta and Shingari (1999); Altan *et al.* (2000b); Oliveira *et al.* (2000); Temin *et al.* (2000) and Deeb and Cahaner (2001). They found that when birds were under heat stress, their average daily weight gain decreased. In a surprise turn of events, at week 4, the average daily weight gain of chickens at 38±2°C was higher than that of chickens at thermoneutral because the average daily gain of the BC at 38±2°C had increased. Therefore, the mean of average daily weight gain of chickens maintained at high environmental temperature increased.

Feed conversion rate: At 26±2°C, on weeks 1, 2 and 3 of the experimental period, the feed conversion rate of BC was significantly lower than TIC and TICC ($p<0.05$) and the feed conversion rate of the TICC was significantly lower than that of the TIC ($p<0.05$), respectively. On week 4, the feed conversion rate of BC was significantly higher than TIC and TICC ($p<0.05$) (Fig. 7).

At 38±2°C, on weeks 2, 3 and 4 of the experimental period, the feed conversion rate of TIC was significantly higher than that of TICC and BC ($p<0.05$). At weeks 2 and 3, the feed conversion rate of TICC was significantly higher than that of BC ($p<0.05$). Conversly, on week 4, the feed conversion rate of BC was higher than that of TIC and TICC ($p<0.05$) (Fig. 8).

On week 2 and 3 of the experimental period, the feed conversion rate of chickens maintained at 38±2°C was significantly higher than that of chickens at 26±2°C ($p>0.05$). On week 4, the feed conversion rate of chickens maintained at 26±2°C was significantly higher than that of chickens at 38±2°C ($p>0.05$) (Fig. 9).

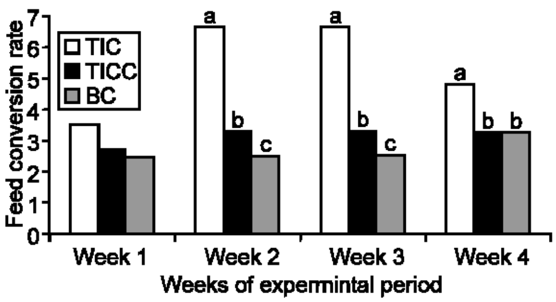

Fig. 8: Feed conversion rate of TIC, TICC and BC maintained at 38±2°C on weeks 1, 2, 3 and 4 of the experimental period; means with different superscripts are significantly different from each other (p<0.05)

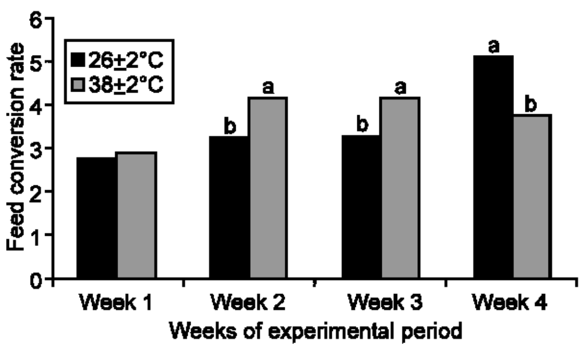

Fig. 9: Feed conversion rate of chickens maintained at 26±2°C and 38±2°C on weeks 1, 2, 3 and 4 of the experimental period; means with different superscripts are significantly different from each other (p<0.05)

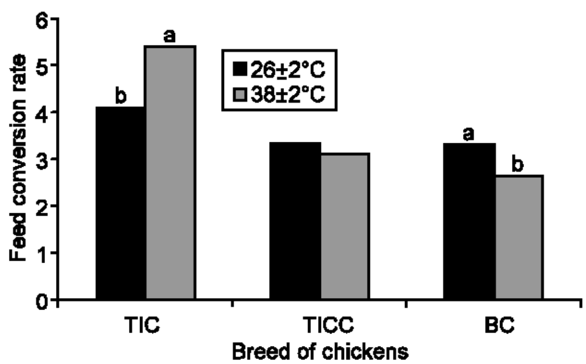

Fig. 10: Feed conversion rate of TIC, TICC and BC maintained at 26±2°C and 38±2°C; means with different superscripts are significantly different from each other (p<0.05)

The feed conversion rate of the TIC maintained at 38±2°C was significantly higher than that of TIC at 26±2°C (p<0.05). The feed conversion rate of TICC maintained at 26±2°C and 38±2°C was not significantly different (p>0.05). Moreover, the feed conversion rate of the BC maintained at 26±2°C was significantly higher than that of BC at 38±2°C (p<0.05) (Fig. 10).

At 26±2°C, on weeks 1, 2 and 3 of the experimental period, the feed conversion rate of the BC was lower than that of TICC and TICC, respectively. This showed that the commercial breed utilized their diet better than the indigenous or indigenous crossbred chickens. At week 4 however, the feed conversion rate of the broilers was higher than that of the TIC and TICC. At 38±2°C, on weeks 2 and 3, the feed conversion rate of the BC was lower than that of the TIC and TICC and in week 4, the feed conversion rate of BC and TICC were not different, but lower than the TIC. This phenomenon showed that under thermo neutral and heat stress temperatures, the feed conversion rate of high growth and crossbred chickens was lower than that of indigenous chickens. On weeks 2 and 3, the feed conversion rate of chickens at thermoneutral was lower than that of chickens maintained at heat stress. These were similar to the report of Suk and Washburn (1995). On week 4, the feed conversion rate of chickens at 26±2°C was higher than that of chickens at 38±2°C. This phenomenon explained that on week 4, chickens (especially BC) at 38±2°C were fed less than the chickens at 26±2°C, while their average daily weight gain was higher than that of chickens at 26±2°C. Therefore, on week 4 of the experimental period, the feed conversion rate of the chickens at high environmental temperature was lower than that of chickens at thermoneutral. This was similar to the report of Deaton *et al.* (1968). Finally, the feed conversion rate of TIC under heat stress was higher than that of TIC at thermoneutral while the feed conversion rate of the heat stressed BC was lower than that of the BC at thermoneutral. This occurrence showed that high heat affected the feed conversion rate of the TIC more than the BC, while high environmental temperatures did not influence the feed conversion rate of the TICC.

Conclusion: When comparing breeds at thermoneutral and high environmental temperatures, the study shows that the productive performance of the BC was higher than that of the TICC and TIC. When comparing environmental conditions, the productive performance of chickens at thermoneutral was higher than that of chickens at high ambient temperatures. However, in week 4, the feed conversion rate of chickens at high environmental temperatures was lower than that of chickens at thermoneutral. Lastly, ambient temperatures did not affect the feed conversion rate of TICC.

Acknowledgments

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