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Cells, Animal and Therapeutics 2016 | Volume 2 | Issue 1 | pages 1-5

Effects of Heat Stress on the Performance of Hubbard Broiler Chicken

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Abstract
The research was conducted to observe the effect of heat stress on performance of Hubbard broiler chicken. A total of ninety (90) one day old (Hubbard) broiler chicks were obtained from local hatchery and randomly divided into two groups, the heat free and heat stress group. All the birds were reared in hot summer (35-38^{O}C) on the litter housing system. The parameters were observed were: feed intake, body weight gain, feed conversion ratio, water intake, dressing percentage and the economics.
The results revealed that feed intake, weight gain, water intake, feed conversion ratio and dressing percentage were significantly higher in heat free group compared to heat stress group. Economically heat stress loss whereas heat free group was profitable. It was concluded that heat stress has deleterious effect over the performance of broiler (HUBBARD) chicken.

Received April 06, 2016; **Revised** April 22, 2016; **Accepted** April 27, 2016
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Introduction

Heat stress is one of the most challenging environmental conditions which have adverse effect on poultry industry. Broiler chickens is sensitive to heat stress. Broiler have no sweat glands, a rapid metabolism, and high body temperature. Researchers have been investigating the effect of high environmental temperature on the performance of different poultry species, including broilers [1], and have found that high environmental temperatures have deleterious effects on productive performance. Poultry birds increase body temperature [2], water consumption [3] and decrease the feed consumption due to higher ambient temperature [4]. Poultry birds do not have sweat glands for heat releasing factor, if panting failed to reduce the high internal body temperature, birds become inactive, exhausted and mortality occurred because of the circulatory, respiratory and electrolytes imbalance [5]. Heat stress induces hormonal changings which increased corticoid secretion [6]. Broilers expose to ambient temperature, increase the body temperature [7] consequently released corticosterone into the blood circulation to help the metabolism [8]. This hormone might cause cell mediate and humoral immunity failure because of the changings in the plasma concentrations of corticosteroids and adrenocorticotropic hormone (ACTH) affect the lymphoid tissues; reduce the mass of spleen, thymus and bursa [9]. Heterophils are present in the blood, formed leukocytes in the bone marrow, which are phagocytic in nature and shield the body of the bird against harmful micro-organisms and leukocytes play a key role in keeping immunity higher. Heat exposure release excessive glucocorticoids, cause dissolution of lymphocytes which may cause lymphopenia. However, more heterophils are release in the blood circulation but heir phagocytic and bactericidal activities may decrease [9]. Heat stress is thought to have deleterious effect on an organism through the production of free radicals and reactive oxygen (ROS) within the body [10]. Free radicals and ROS are compound generated naturally within an organism during normal biological processes and are essential for several body processes, included immune function [11]. Increased production of free radicals and reactive oxygen species compounds can cause damage to the constituents of various biological tissues including lipids, proteins, and deoxyribose nucleic acid [12]. This research was practiced to observe the effect of heat stress on performance of Hubbard broiler chickens.

Materials and Methods

This research was conducted during the year 2015 to determine the effect of heat stress on the performance of HUBBARD broiler chickens. For this purpose 95 ninety (90), one day-old Hubbard broilers were purchased and was brought to the Experimental Station, Department of Poultry Husbandry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam. Birds equally divided into two groups, i.e. Heat free group and Heat stress group, both fed on basal diet. Heat free group reared on ideal temperature while Heat stress group was and reared at (35-38^{O}C) on litter housing system. Groups consisted of three replicates (15 broilers/replicate). Feed and water both provided ad libitum. Feeding program was consisted on starter diet (1-21days) and a finisher diet (22-42days).

Basal Diet Formulation

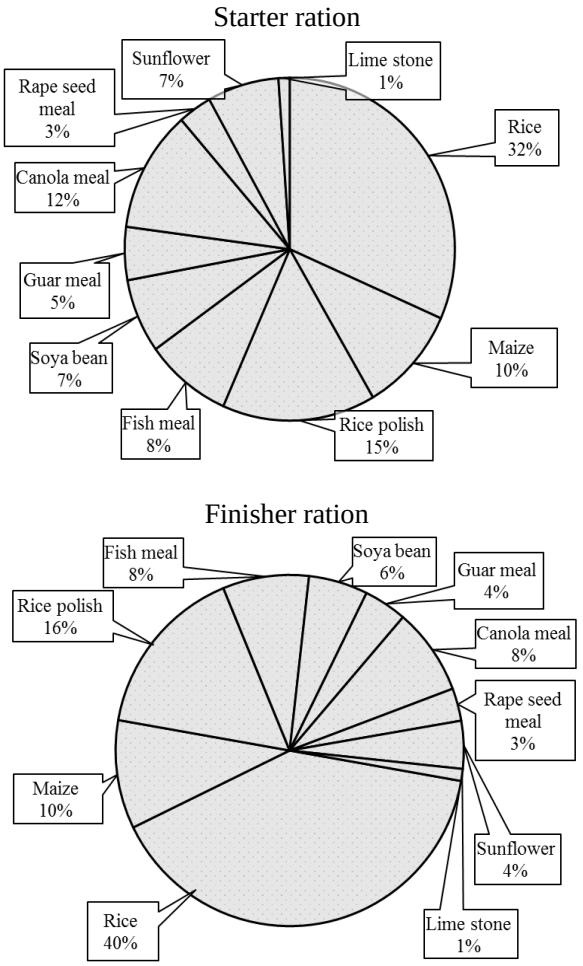

Figure 1: Feed (Basal diet) formulation heat stress and heat free broiler chickens.

Housing Management

Firstly, the house was entirely cleaned, washed and sanitized before arrival of the day old chicks. Then house was painted with lime stone and dried for 24 hours. One squire feet per bird floor space under deep litter housing system was provided to each chick in the shed.

The control group was provided ideal temperature of 95^{o}F for first week during brooding then reduce weekly until it reach 70^{o}F in 6th week. The wooden dust was used as litter at 2-4 inches depth. Turning of litter practiced twice a day to minimize the gas production in the shed and maintained proper ventilation.

Feeding programme consisted over starter (1-21 days) and finisher ration (22-42 days). Water and feed both provided *ad libtium*.

Vaccination Programme

The Vaccination schedule which was practiced during this research trial is mentioned in Table 1.

Table 1: Following vaccination program was adapted for heat free and heat stress broiler chicken.

Days	Vaccines	Route
2nd	N.D* + I.B*	Eye Drop
10th	I.B.D*	Drinking Water
22nd	N.D*	Drinking Water
28th	I.B.D*	Drinking Water

*N.D (New castle disease), *I.B (Infectious bursal disease), *I.B.D (Infectious bursal disease)

Feed intake

Broilers were provided feed twice in a day, and refusal of feeding checked, weighed and then calculated the consumed feed this was routinely practiced.

$$\text{Feed} = \frac{\text{Feed offered-Feed refused}}{\text{No of Birds}}$$

Water Intake

Required quantity of fresh water was provided twice/day. Refused water collected, measured and subtracted from offered. Water was recorded using this formula.

$$\text{Water} = \frac{\text{Total water offer- Total water refuse}}{\text{Total broilers}}$$

Body weight gain

Six birds were randomly selected from each group than initially and weekly weighted, using digitale weighing scale.

Body weight gain

FCR was calculated using the below formula.

$$\text{FCR} = \frac{\text{Feed intake}}{\text{Live weight}}$$

Dressing percentage

Dressing percentage calculated with below formula.

$$\text{Dressing (\%)} = \frac{\text{Carcass Weight(kg)}}{\text{Live Bird weight(kg)}} \times 100$$

Economics

Economic data was measured by subtracting total expenditures from total profit.

Data Analysis

The raw data was tabulated in Microsoft excel then analyzed in one way analysis of variance (ANOVA) with (JMP, software 7.0 Version) and significant differences were compared through Student's comparison test.

Results and Discussions

Feeding

The result regarding feed intake of heat free and heat stress broiler chicken is presented in Figure-2. The feed intake was significantly higher in heat free group and lowest for heat stress group. Heat stress decreased efficiency of feed utilization with increased environmental temperatures [13]. Lower environmental temperature enhanced growth rate and feed consumption [14].

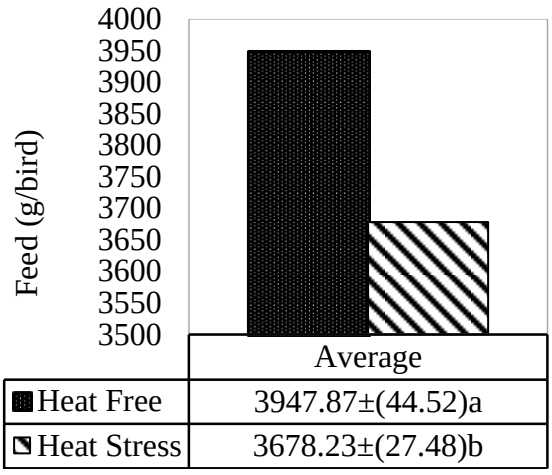

Figure 2: Feed intake of heat free and heat stress broiler chicken.

Water

The result regarding water intake of heat free and heat stress broiler chicken is presented in Figure-3.

The water intake was significantly higher in heat stress group and lowest for heat free group. The obtained result of present study revealed that heat free group intake lower feed resultantly consumed lowered level of water, while ambient temperature caused painting in birds which was observed during this research trial and previous studies resulted painting when body temperature observed higher in the heat stress exposure birds, heat stress consequently increased body temperature, while broilers maintain their body temperature by increasing water consumption.

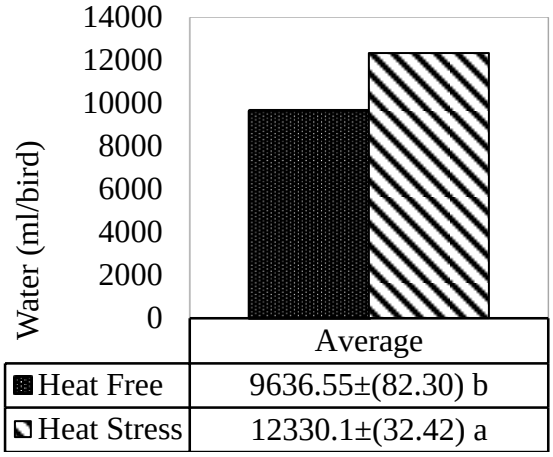

Figure 3: Water intake of heat free and heat stress broiler chicken.

Weight

The result regarding weight gain of heat free and heat stress broiler chicken is presented in Figure-4. The weight gain was significantly higher in heat free group and lowest for heat stress group. A portion of the negative effects seen during hyperthermia may be related to the increased production of free radicals and reactive oxygen species (ROS). Reactive oxygen species are known to have deleterious effects on the constituents of biological tissues (protein, amino acids, lipids, and DNA), leading to cell damage and ultimately death [12]. Elevated production of ROS during increased environmental temperatures may be due to disruption of the assemblies of the electron transport chain [15]. Reactive oxygen species production linked to heat stress has been reportedly associated with poor performance in broiler chickens [16].

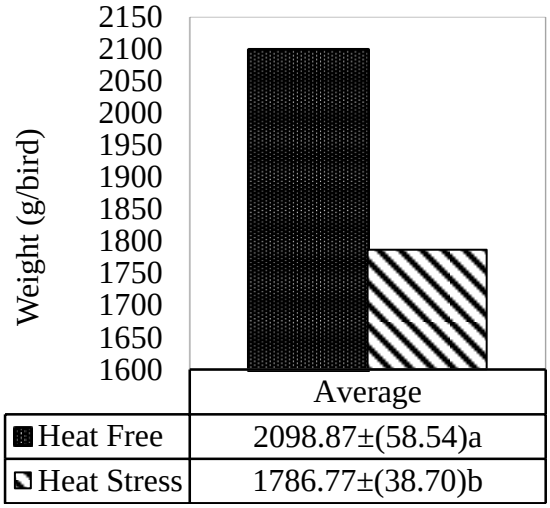

Figure 4: Weight gain of heat free and heat stress broiler chicken.

Feed conversion ratio

The result regarding feed conversion ratio of heat free and heat stress broiler chicken is presented in Figure-5. The feed conversion ratio was significantly higher in heat free group and lowest for heat stress group. The stress of high ambient temperature in the tropics may negatively influence the performance of broiler chickens by reducing feed intake, live weight gain and feed efficiency. During the periods of heat stress, most of the production energy is diverted to thermoregulatory adaptations that results in to decreased weight gain, poor immunity, oxidative stress predisposing birds to various infectious diseases and high mortality rates [17,18]. High ambient temperature and relative humidity are major environmental stressors that influence performance of broilers by reducing feed intake, feed efficiency, nutrient utilization and feed conversion ratio [19].

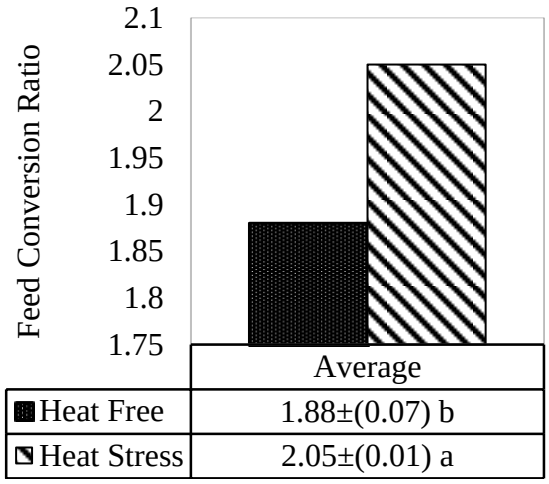

Figure 5: Feed conversion ratio of heat free and heat stress broiler chicken.

Dressing percentage

The result regarding dressing percentage of heat free and heat stress broiler chicken is presented in Figure-6. The dressing percentage was significantly higher in heat free group and lowest for heat stress group. Broiler chickens subjected to cyclical heat stress 21-42 days of age displayed a decrease breast meat and leg quarter yield as well as dressing percentage. These studies clearly illustrate the significant affect of heat stress exerts on muscle protein synthesis, reducing muscle protein accretion and effecting not only RNA content but translational efficiency as well [20]. Broiler chickens subjected to environmental conditions of 32°C for a period of two hours showed an increase in plasma creatine kinase activity, an indicator of skeletal muscle damage. There was also an increased incidence of breast muscle hemorrhages in heat treated birds compare to those raised at 21°C. These experiments demonstrate the negative effects that high environmental temperatures can exert on body protein accretion and utilization as well as muscle integrity in broiler chickens [21].

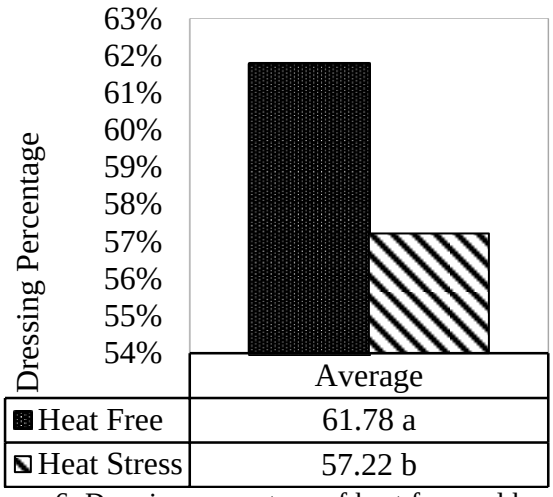

Figure 6: Dressing percentage of heat free and heat stress broiler chicken.

Economics

Economics of heat free and heat stress group were presented in Table-2. The net profit revealed that heat stress caused deleterious effect on weight gain and feed conversion ratio of broiler chicken resultantly decreased the production and cause the loss 7.11 PKR whereas heat free group results shows highest feed intake and weight gain, while good feed efficiency make broilers more productive and we profit 29.6 PKR.

Table 2: Economics of heat free and heat stress broiler chicken.

S. No	Particulars	Heat Free	Heat Stress
1.	Cost of chick	20 Rs/bird	20 Rs/bird
3.	Cost of feed	160.3 Rs/bird	149.42
5.	Litter cost	7 Rs/bird	7 Rs/bird
6.	Vaccination cost	3 Rs/bird	3 Rs/bird
7.	Labor cost	15 Rs/bird	15 Rs/bird
8.	Miscellaneous	15 Rs/bird	15 Rs/bird
9.	Total expenditure	200.3 Rs/bird	189.42 Rs/bird
10.	Average weight	2098g	1786.7g
11.	Sale rate	110 Rs/Kg	110 Rs/Kg
12.	Total income	229.9 Rs/Kg	196.53 Rs/Kg
13.	Net profit	29.6 Rs/Kg	-7.11 Rs/Kg

Conclusion

From the present study, it is concluded that, under tropical countries climatic conditions, especially Pakistan, heat stress condition have very harmful and adverse effect on the productivity of

Hubbard broiler chicken, in this regard broiler chicken rearing is not profitable.

Conflict of interest

The authors disclose no conflicts of interest for the present research.

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