

ISSN 1682-8356  
ansinet.org/ijps



INTERNATIONAL JOURNAL OF  
**POULTRY SCIENCE**

**ANSI***net*

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## Effect of Chronic Heat Stress on Broiler Performance in Jordan

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**Abstract:** An experiment was conducted in the poultry farm of the faculty of agriculture in the campus of Jordan University to evaluate the effect of heat stress on the performance and some physiological parameters of 4-8 week old *Isa Vedette* broilers. Environmental temperatures in controlled environmental rooms were constant 25 (control), 30 and 35±2°C, in addition to a variable-natural temperature, 24 - 28 ± 2°C in the open-sided poultry house. At the end of the experiment, a representative sample was randomly selected from each treatment and exposed to heat tolerance test at 40±2°C in the environmental physiology lab. The results showed that, growth rate, body gain, feed consumption and feed efficiency were significantly ( $p<0.05$ ) reduced of 4-8 week old broilers reared in hot-closed environment (30 and 35±2°C) and variable-natural temperature in open-sided environment. The heat tolerance test showed that, broilers reared at high environmental temperatures of 30 and 35±2°C had lower mortality rate and *R/Tr* than those reared at constant 25±2°C and variable-natural temperature (24 - 28°C) in closed and open-sided environment, respectively. Finally, it could be concluded that, environmental temperature above 25°C has a significant ( $p<0.05$ ) negatively effects on the performance of 4-8 week-old broilers reared in open-sided poultry house particularly, during summer season. Moreover, it will increase the market age and increase the productive cost. On the other hand, broilers reared in hot environment may improve their heat tolerance, which might acquire during the acclimation at high environmental-rearing temperature.

**Key words:** Acclimatization, broiler, heat stress, Jordan, performance, temperature

### Introduction

Broiler production in Jordan has been developed very fast in the last two decades to become the most important sector in animal production industry. The total broiler meat production increased from 69.000 ton in 1985 to 103.000 ton in 2005 (Ministry of Agriculture, 2006). Broiler production in Jordan as well as in all hot regions suffers great losses every year due to the effect of heat stress, particularly from sudden heat waves exceed 30°C which might occur during summer season. The only recorded case was that occurred in the Jordan University Farm in Jordan Valley, where mortality exceeded 40 % of the market age broilers during a heat wave of August, 1985 which lasted for 3 days. The highest environmental temperature was 45.8°C (Alfataftah, 1987).

The expression of heat stress in poultry production can be described as 'acute' or 'chronic'; acute heat stress refers to short and sudden periods of extremely high temperature, where as chronic heat stress refers to extended periods of elevated temperature (Emery, 2004). Chronic heat stress has detrimental effects on the performance of broiler birds reared in the open-sided poultry houses; principally through reducing feed intake, growth rate, negatively affect feed efficiency and carcass quality as well as health (Carmen *et al.*, 1991; Teeter *et al.*, 1992; Yahav *et al.*, 1996; Temim *et al.*, 2000; Har *et al.*, 2000). In addition, prolonged periods of

elevated ambient temperature increase the time to reach market weight and increase mortality (Howlinder and Rose, 1989).

Unfortunately, no documented data concerning these losses are available in Jordan (Ministry of Agriculture, 2006). Therefore, information on the deleterious effects of ambient temperatures is of great value and quite in need especially for broiler growers and for those interested in broiler production in Jordan. However, most previous thermal environment studies were conducted under cyclic or short-term heat stress neither indicated nor compared the effects of variable-natural with constant-chronic high temperatures. Therefore, this study was designed to evaluate the effects of chronic heat stress and variable-natural temperature on the performance of 4-8 wk old broiler birds and to investigate the effect of rearing temperature on some physiological factors that alleviate the effects of sudden heat waves during summer season on mortality rate in Jordan.

### Materials and Methods

#### Experimental Rooms

**Controlled Environmental Rooms:** A controlled environmental poultry house consists of 6 identical rooms located in the poultry farm of the Faculty of Agriculture in the campus of Jordan University was used in this study. Each room measures 7.70 x 3.50 x 2.60m.

Each room was divided by a wire mesh into four identical units (1.750 x 2.40m). Each pen was supplied with a trough feeder and automatic-cup drinker. Each room was equipped with thermostatically- controlled electric heaters and an electric fan for the circulation of air. Air is removed from the rooms by the presence of one exhaust fan in the back area of the room. Relative humidity was uncontrolled inside the rooms, it was ranged between 39-51%. Continuous artificial light was used to illuminate the interior space.

**Open-sided poultry house:** The open-sided poultry house used contained 8 identical rooms measures 4.20 x 4.10 x 3.50 m. Each room was divided by a wire mesh into two equal pens. Each pen was supplied with a trough feeder and automatic cup drinker. Artificial light, during the night was used which was controlled by the automatic-clock timer switched on at 00190 hr and off at 0500 hr during the morning time. Environmental conditions inside the house were not controlled and thus varied with the outside natural conditions.

**Controlled - environmental chambers:** Two controlled environmental chambers were used in this experiment for heat tolerance test at  $40\pm 1^{\circ}\text{C}$ . They are located in the Environmental Physiology Lab. The dimensions of the two chambers are 2.70 x 2.10 x 2.34m and 1.80 x 2.40 x 2.34 m. Each chamber was equipped with thermostatically controlled electric heaters and an electric fan for the circulation of air. Two holes of 16-cm diameter in both sides of the chamber were made to provide enough ventilation. A battery of 8 individual cages arranged in two rows, were installed inside each chamber. Each cage measures 37 x 30 x 40 cm and supplied with separate drinker and feeder. Ambient temperature can be controlled to the accuracy of  $\pm 1^{\circ}\text{C}$ .

**Experiment:** This experiment was conducted to study the effects of four different ambient temperatures on broiler performance. The four environmental temperatures used were  $25\pm 2^{\circ}\text{C}$ ,  $30\pm 2^{\circ}\text{C}$ ,  $35\pm 2^{\circ}\text{C}$  with 45-58 % relative humidity in the controlled environmental rooms and  $24-28^{\circ}\text{C}$  natural variable temperature with a relative humidity of 46-51%.

At four weeks of age, a total of 640 *Isa Vedtte* chicken broilers were weighed and moved from the brooding house to the experimental rooms. There were 4 replicates of 40 birds each, for each treatment in the room; with 10 birds/m<sup>2</sup>. Birds were distributed in the different treatments at random basis. Feed and water were provided *ad libitum* throughout the experimental period.

**Heat tolerance test:** This test was conducted to investigate the effects of rearing-ambient temperatures on the heat tolerance time and rate of increase of rectal

temperature (*RITr*) of 8-week old broilers when exposed to acute heat stress of  $40\pm 1^{\circ}\text{C}$ .

At the end of the four weeks of the experiment, a representative sample was randomly selected from each treatment and moved to the environmental physiology lab where the two chambers set at  $40\pm 1^{\circ}\text{C}$ . The broiler samples were marked and randomly placed into the chambers and kept at  $40\pm 1^{\circ}\text{C}$  until the rectal temperature reached about  $45^{\circ}\text{C}$  or death occur. Rectal temperature of the broiler samples was measured before the beginning of the test and then at hourly intervals, or more frequently if approached  $45^{\circ}\text{C}$ , using an electric-thermocouple thermometer inserted approximately 3 cm accurate to  $0.1^{\circ}\text{C}$  (Yalcin *et al.*, 2001). No feed or water was offered during the test. The increasing rate of rectal temperature (*RITr*) during the test period was calculated by dividing the change of rectal temperature ( $^{\circ}\text{C}$ ) on the time period (hours) spent until rectal temperature reached  $45^{\circ}\text{C}$  or death occur. This expression was used by Sykes and Alfataftah (1986) as an indicator of heat tolerance improvement.

#### Measurement of performance parameters:

**Body weight and body gain (gram/bird):** At 8-weeks of age all the birds of each treatment weighed as group using a 50 kg-balance. The total weight is divided by the number of weighed birds. The average body weight gain was calculated by subtracting the average weight at the beginning of the experiment (4-week old broilers) from the average weight at the end of the experiment (8-week old broilers).

**Feed intake (gram/bird):** Feed intake is calculated for each treatment. At the end of the experiment, the residual amount of feed was weighed and subtracted from the known weight of feed at the beginning of experiment. The product figure is divided by the total number of birds.

**Feed conversion ratio (gram feed/gram gain):** Feed conversion ratio is calculated at the end of experiment (8-week old broilers) as the amount of feed consumed per unit of body gain.

**Mortality rate (%):** Accumulated mortality rate is calculated by subtracting the number of live birds at the end of the experiment from the total number of birds at the beginning of the experiment. The resulted figure is divided by the total number of birds at the beginning of the experiment and the product is multiplied by 100 to obtain the percentage of mortality rate.

**Statistical analysis:** All the means of experimental treatments were analyzed by ANOVA using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS). When a significant *F* statistic was noted,

Table 1: Ingredients and calculated composition of the basal diets

Ingredients and composition	Starter (%)	Finisher (%)
Yellow Corn	63.80	72.20
Soy bean meal (44%CP)	28.00	21.50
Fish meal (72%CP)	5.00	3.00
Lime stone	1.60	1.60
Dicalcium phosphate	1.00	1.20
Premix (Vitamin+Minerals)*	0.10	0.10
DL-Methionine	0.20	0.10
Sodium Chloride	0.30	0.30
Coccidiostat	0.05	0.05
Calculated Composition		
Metabolizable Energy (kcal/kg)	2921	2994
Crude Protein %	21.40	18.10
Lysine %	1.19	0.93
Methionine %	0.55	0.33
Methionine and Cystine %	0.89	0.62
Calcium %	1.09	1.08
Total Phosphorus %	0.98	0.68

\*Supplies the required vitamins and microminerals.

treatment means were separated using Duncan's multiple range test (SAS Institute, 1987).

**Rations:** Standard broiler starter and finisher diets were fed from 0 to 4 and 5 to 8 weeks of age, respectively. Feed ingredients and composition are shown in Table 1.

## Results

**Broiler performance:** Data on growth performance of finisher-broiler birds are presented in Table 2. Means of heat tolerance test are shown in Table 3. The results show clearly the significant ( $p < 0.05$ ) effect of increasing ambient temperatures above 25°C on broiler performance. Also, it shows the effect of variable-natural ambient temperature versus constant. Broilers reared at 35°C, had significantly ( $p < 0.05$ ) the lowest growth rate and feed consumption. On the contrary, broilers kept at 25°C had significantly ( $p < 0.05$ ) the highest growth rate, the lowest and best feed conversion ratio compared with the birds kept at the other heat treatments; and the birds kept at 35°C had significantly ( $p < 0.05$ ) the highest and the poorest feed conversion ratio (FCR). Moreover, mortality rate was increased significantly ( $p < 0.05$ ) in heat stress groups. The birds kept in the open-sided house were also, significantly ( $p < 0.05$ ) affected by variable-natural temperature (24-28°C) but they exhibited higher ( $p < 0.05$ ) live body weight, body gain, feed intake and better feed conversion ratio (FCR) than birds maintained in hot environment at constant 30 and 35°C. The indicators of heat tolerance test (*RITr*, mortality rate and survival time) showed that, birds reared at high ambient temperatures are more heat tolerant than birds reared at lower ambient temperatures.

## Discussion

The results illustrate very clearly the significant ( $p < 0.05$ ) effect of increasing ambient temperatures on broiler performance. At the end of 4 weeks of experiment (8 weeks of age) the body weights of birds in different treatments were 1839.0±63, 2288.3±29, 2531.0±22 and 2587.3±13 gram at 35°C, 30°C, natural (24-28°C) and 25°C, respectively. Growth rate of broilers reared at 30, 35°C and at the natural (24-28°C) treatments was depressed by -18, -44 and -7 %, respectively compared with the 25°C group. Data in Table (2) showed that broilers kept at 25°C had significantly ( $p < 0.05$ ) higher live body weight and body gain than at 30 and 35°C; broilers reared at 35°C had the lowest body gain compared with other treatments.

The above results showed that growth rate of broilers was significantly ( $p < 0.05$ ) reduced by increasing the environmental temperature above 25°C. These results are in agreement with the previous researches (Harris *et al.*, 1977; Reece and Lott, 1983; Cerniglia *et al.*, 1983; Deaton *et al.*, 1984; Simmons and Deaton, 1989; Smith, 1993; Zulkifeli *et al.*, 1994; Njoya, 1995; Yahav *et al.*, 1996).

Harris *et al.* (1977) found that the best environmental temperatures for optimum performance of broilers from 3 to 8 weeks of age were a constant 24°C or diurnal cyclic from 18 to 24°C. The same findings were recorded by Deaton *et al.* (1984). who found that lowering the portion of the temperature cycle from 26.7 to 21°C during 24-hr period significantly increased broiler body weight at 48 days of age. Also Yoon *et al.* (1995) found that the growth rate of 4-week broilers reared at 21°C was significantly ( $p < 0.05$ ) higher than those reared at 27°C. Hacina *et al.* (1996) found that the body weight of broilers reared at 32°C was significantly less than at 22°C by 47 %. Yahav *et al.* (1996) found that the body weight of Cobb broilers was reduced by 18 and 10 % when kept at 30°C and cycling temperature ranged between 10 and 30°C from 4-8 weeks of age, also they found that, the body weight of broilers kept at 35°C reduced by 33 % compared with its corresponding groups reared at 25°C.

The depression in the growth rate and body weight gain at high environmental temperatures (30 and 35°C) illustrated in the results (Table 2) might be due to many factors which include decreasing feed consumption (Emmans and Charles, 1989), inefficient digestion (Har *et al.*, 2000), impaired metabolism (Farrell and Swain, 1978), genetic make up of birds (Cahaner *et al.*, 1995), and temperature *per se* (Hacina *et al.*, 1996; Abu-Dieyeh, 2006). Summers *et al.* (1990) reported that some of the feed energy used for muscle contraction associated with panting might be another factor. Furthermore, Keshavarz and Fuller (1980) reported that, a decrease in growth rate at high environmental temperature is accompanied with a reduction in thyroid size and thyroxin secretion. They reported that optimum performance is obtained

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Table 2: Mean±S.E of live body weight (gram/bird), body gain (gram/bird), feed consumption (gram/bird), feed conversion ratio (FCR) and mortality rate expressed in percentages of 4-8 week old broilers reared at different ambient temperatures

Performance Parameter	Environmental Rearing Temperature Treatments			
	Variable-Natural Temperature (24-28°C)	Constant Temperature (25±2°C)	Constant Temperature (30±2°C)	Constant Temperature (35±2°C)
Live body weight	2531.0 <sup>b</sup> ±22	2587.3 <sup>a</sup> ±13	2288.3 <sup>c</sup> ±29	1838.0 <sup>d</sup> ±63
Live body gain	1701.0 <sup>b</sup> ±34	1829.3 <sup>a</sup> ±34	1499.5 <sup>c</sup> ±34	1025.0 <sup>d</sup> ±34
Total feed consumption	4158.4 <sup>a</sup> ±90	3988.7 <sup>a</sup> ±90	3642.6 <sup>b</sup> ±90	3004.5 <sup>c</sup> ±90
Accumulated FCR	2.44 <sup>b</sup> ±0.04	2.17 <sup>c</sup> ±0.04	2.45 <sup>b</sup> ±0.04	2.95 <sup>a</sup> ±0.04
Mortality rate (%)	5.73 <sup>ab</sup> ±2.60	2.53 <sup>b</sup> ±2.60	5.16 <sup>ab</sup> ±2.6	11.79 <sup>a</sup> ±2.6

a,b,c,d. Means with different superscripts in the same row are significantly different at (p<0.05).

Table 3: Mean±S.E of onset of panting (minute), mortality rate (%), survival time (minute) and rate of increase of rectal temperature (RITr) °C/hour) of 8 week old broilers exposed to 40°C at the end of experiment

Parameter measured	Environmental Rearing Temperature Treatments			
	Variable-Natural Temperature (24-28°C)	Constant Temperature (25±2°C)	Constant Temperature (30±2°C)	Constant Temperature (35±2°C)
Onset of panting (minute)	7.25 <sup>a</sup> ±1.2	5.75 <sup>a</sup> ±1.2	6.0 <sup>a</sup> ±1.2	9.0 <sup>a</sup> ±1.2
Mortality rate (%)	63 <sup>a</sup> ±13	38 <sup>a</sup> ±13	25 <sup>a</sup> ±13	18 <sup>a</sup> ±13
Survival time (minute)	88 <sup>b</sup> ±11	91 <sup>b</sup> ±11	120 <sup>ab</sup> ±11	129 <sup>a</sup> ±11
RITr °C / hour	2.46 <sup>a</sup> ±.3	1.95 <sup>ab</sup> ±.3	1.80 <sup>ab</sup> ±.3	1.23 <sup>b</sup> ±.3

a,b. Means with different superscripts in the same row are significantly different at (p<0.05).

only when broilers are kept in an environmental temperature within the zone of comfort for respective age.

The total amounts of feed consumption by birds in the four weeks of the experiment at the different ambient temperature treatments were 4158.4, 3988.7, 3642.6 and 3004.5 gram/bird at the natural variable temperature (24-28°C), 25, 30 and 35°C, respectively. These values are significantly (p<0.05) different when compared with each other. Thus, increasing the ambient temperature to 25, 30 and 35°C reduced feed consumption after 4 weeks of experiment by 4.0%, 12.4% and 28%, respectively of the feed consumption at the natural variable temperature (24-28°C). Therefore, the results show that the thermoneutral zone for broilers is less than 25°C, because, the feed consumption decreased significantly (P<0.05) about this temperature. This is confirmed by the results of Leeson *et al.* (1992). They reported that the optimum environmental temperature range in which broilers are able perform to their maximum genetic potential is between 12.7 and 26.7°C from 4 to 9 weeks of age.

The results of this experiment were in agreement with the results of Marsden and Morris (1987); Reece and Lott (1983); Meltzer (1986); Knight *et al.* (1994); Kyarisiima and Balnave (1996); and Yahav *et al.* (1996). Yahav *et al.* (1996) found that a reduction of feed consumption for broilers kept at 30°C and 35°C compared with the corresponding groups kept at 20 and 25°C. They found that a reduction of feed consumption by 10, 20 and 46% when the environmental temperature increased from 20°C to 25, 30 and 35°C, respectively. Also they found that broilers reared at linear cyclic temperature ranged from 15 to 30°C consumed more

feed than birds reared at 10-30 and 15-30°C cyclic temperatures. In addition, Knight *et al.* (1994) found that broilers of 4 weeks of age exposed to a 5-day period of constant high temperature of 31°C consumed significantly (p<0.01) less feed compared with those birds kept at 23°C. Moreover, feed consumption decreased in a curvilinear manner as air temperatures rose above 24 to 27 and 30°C, while it increased with increasing ambient temperature from 15 to 18 and 21°C. Under heat stress, there is heat exchange between the birds and the environment. The birds loose heat to the environment mainly by evaporative heat loss and at the same time they gain heat from the environment. In addition, there is another source of heat level on the birds from heat produced by feed metabolism. Thus, under heat stress, birds should loose heat to the environment by all means to prevent the rise in body temperature. Since decreasing the heat stress by decreasing the ambient temperature is beyond the control of birds, they use their physiological mechanisms to decrease the heat load during the heat stress. This can be achieved by reducing metabolic heat production. This decrease in metabolic heat production might be one of the reasons for the significant decrease in the feed consumption of the birds recorded under high ambient temperatures in this experiment. Leeson *et al.* (1992) reported that feed consumption is depressed in hot environment in order to reduce the metabolic rate and hens body heat load. There was a 1.5% reduction in appetite for each 1°C rise between 21 and 30°C and about 4.6% per degree rise between 32 and 38°C in layers. High environmental temperature stimulates the peripheral thermal receptors to transmit suppressive nerve impulse to the appetite center in the

hypothalamus causing the decrease in feed consumption. Thus fewer substrates become available for enzymatic activities, hormone synthesis and heat production, which minimize thermal load.

Feed conversion ratio at 35°C was significantly ( $p < 0.05$ ) higher than at the other three lower ambient temperatures (30, 25°C and natural 24-28°C). The accumulated feed conversion ratio (FCR) was 2.95, 2.45, 2.44 and 2.17 at 35, 30, natural (24-28°C) and 25°C heat treatments, respectively. The birds kept at 25°C had significantly ( $p < 0.05$ ) the lowest and the best feed conversion ratio compared with the birds kept at the other heat treatments; and the birds kept at 35°C had significantly ( $p < 0.05$ ) the highest and the poorest feed conversion ratio. Leeson *et al.* (1992) reported that the best values of feed efficiency and feed conversion for broilers are obtained under optimum environmental temperature (12.7-26.7°C), meanwhile decreasing or increasing the environmental temperature from the optimum is associated with decrease in feed efficiency utilization and increase in feed to gain ratio. Furthermore, feed conversion ratio was found to improve as ambient temperature increased within the range of 13-24°C. The feed efficiency utilization was found to increase with ambient temperature and reach the maximum at 27°C and then decreased between 27 and 34°C (Hurwitz *et al.*, 1980). Also, Meltzer (1986) reported that ambient temperature above 28°C had a negative effect on feed gain ratio of broilers; while Reece and Lott (1983) reported a similar feed to gain ratio of broilers reared at a temperature of 28°C compared to those reared at 21°C. However, Washburn and Eberhart (1988) found that feed conversion ratio was significantly lower at 31°C than at 20°C but the feed conversion ratio of birds at 33.5°C was significantly higher than at 22°C. It could be concluded from the results of this experiment that broilers reared at 30 or 35°C need longer time (4-11 days) to reach the same slaughter weights of the birds reared at 25°C; thus the market age at 30 and 35°C will be longer compared with those at 25°C. Howliger and Rose (1989) also found that broilers kept at 31°C took longer time to reach the same slaughter weight of those at 21°C; they took 33, 42, 53, 65 and 81 days to reach the body weight of 1, 1.5, 2, 2.5 and 3 kg, while the broilers kept at 21°C took 32, 40, 48, 56 and 67 days to reach the same slaughter weights, respectively. The poor conversion ratio obtained at 30 and 35°C in this experiment might be related to decreased feed consumption, decreased feed utilization (insufficient digestion). Previous researchers reported that high ambient temperatures caused a reduction in the efficiency of utilization of feed energy for productive purposes. (Deaton *et al.*, 1978; Hurwitz *et al.*, 1980; Alfataftah, 1987; Hacina *et al.*, 1996; Yahav *et al.*, 1996). McDowell (1972) explained the reason for reduced feed efficiency at high ambient temperature by saying "in

warm climates, generally, chemical costs for a unit of production are higher than cooler climates because a portion is siphoned off for the process required to dissipate body heat".

The total mortality rate during the periods of the experiment (4 weeks) at the different ambient temperatures was 11.79, 5.73, 5.16 and 2.53% at 35°C, natural (24-28°C), 30°C and 25°C, respectively. This indicates clearly that a significant ( $p < 0.05$ ) high mortality rate occurred when ambient temperature reached 35°C. Therefore, to avoid high mortality, ambient temperature should not exceed 30°C and to obtain normal mortality rate, ambient temperature should not exceed 25°C. The results obtained in this experiment are in agreement with the findings reported by previous researchers. (Alfataftah, 1987; Smith, 1993; Yoon *et al.*, 1995; Wiernusz and Teeter, 1996). High mortality of broilers in hot environments might be due to inefficient evaporative cooling which lead to accumulation of heat inside the body. This accumulation of heat caused continuous increase in the body temperature until it reached the lethal level, where birds die from heat prostration. This heat prostration death might be due to cardiovascular failure or adrenal cortical insufficiency or imbalance of ions (sodium, chloride, potassium, calcium, phosphate, sulfate and magnesium) in the blood (Deaton *et al.*, 1984).

**Heat tolerance test:** The heat tolerance indicators (*RITr*, mortality rate and survival time) (Table 3) showed that, birds reared at high ambient temperatures are more heat tolerant than birds reared at lower ambient temperatures. Broilers reared at high environmental temperatures of 30 and 35°C had lower mortality rate and lower *RITr* than those reared at lower ambient temperatures (25°C and natural variable temperature 24-28°C). Also, the survival time of birds reared at 35°C was significantly ( $p < 0.05$ ) higher than birds reared at 25°C and natural variable temperature (24-28°C). This indicates that there is an improvement in heat tolerance acquired during the acclimation at high environmental temperature.

These results are in agreement with the results of Reece *et al.* (1972) who demonstrated that broilers could acclimatize in 3 days and resist extremely high mortality from heat prostration. They exposed broilers for 3 days at 24-35°C before a temperature stress of 40°C was imposed. This treatment reduced mortality from 33 to 0%. They also found that exposure of birds at a cyclic temperature from 21 to 32°C improved heat tolerance and reduced mortality from 29% to less than 10% when birds were tested at 40°C.

The improvement of heat tolerance of broilers reared at high ambient temperatures (30, 35°C) is due to heat acclimatization of birds acquired during the rearing period. This acclimatization may increase the upper

critical temperature which, is may be indicated by the longer time of onset of panting of birds reared at high ambient temperatures (30 or 35°C) by which their heat production was reduced to decrease the heat load on the birds and thus, the birds could dissipate the heat through evaporative cooling (panting) and therefore, they were able to slower the rate of increase of rectal temperature as a result of acclimatization, Also, acclimatization led to decrease feed consumption of heat stress treatments and thus heat load. The significance of the increase of the respiratory rate during exposure to heat stress is that it enables the birds to dissipate the excess body heat by evaporative cooling at the surface of the mouth and respiratory passage ways, which accounts for about 80% of the total heat dissipation. The results of this experiment are in agreement with the results of Elhadi and Sykes (1982) who found well-developed panting at rates of up to 150 / minute at an ambient temperature of 35°C. Also they found that panting commenced within 45 minutes when the birds exposed to 38°C. Teeter *et al.* (1992) reported that at least 50% of the hypothermic effect of acclimatization immediately prior to heat stress might be attributed to a reduction in feed consumption in response to the stress. Heat acclimatization is brought about by a reduction in heat production rather than by an increase in heat loss. This was confirmed by the results of Sykes and Alfataftah (1986) who reported that, the failure to acclimatize following transfer of birds from a hot (30°C) to a cool (20°C) environment was due to an increase in feed consumption and heat production. Finally, it could be concluded that, environmental temperature above 25°C has a significant ( $p < 0.05$ ) negatively effects on the performance of 4-8 week-old broilers reared in open-sided poultry house particularly, during summer season. Moreover, it will increase the market age and increase the productive cost. On the other hand, broilers reared in hot environment may improve their heat tolerance, which might acquire during the acclimation at high environmental-rearing temperature.

### Acknowledgments

The authors wish to thank the Deanship of Scientific Research and the Head of Animal Production Department in the University of Jordan for their valuable support, facilities and advice.

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This study was derived from a master thesis prepared by Z.H. Abu-Dieyeh and supervised by Dr. Abdur-Rahman A. Alfataftah.