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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Effect of Ascorbic Acid and Potassium Chloride Supplementation on Performance and Some Physiological Parameters in Broiler Chicks Reared under Summer Condition

Ihsan T. Tayeb[1], Johnny S. Yokhana[1] and Vahel J.A. Amedy[2]
[1]Department of Animal Production, College of Agriculture, Dohuk University, Dohuk, Iraq
[2]College of Veterinary, Dohuk University, Dohuk, Iraq

Abstract: A total of 420, one day-old broiler chickens were randomly divided into 4 groups and kept under elevated summer temperature to investigate the effect of ascorbic acid and potassium chloride on the productive performance Live Body Weight (LBW), Body Weight Gain (BWG), Feed Consumption (FC), Feed Conversion Ratio (FCR), Mortality, Dressing Percentage (DP) and blood parameter (hemoglobin (Hb), Packet Cell Value (PCV), Red Blood Cell (RBCs), pH and serum glucose) and rectum temperature. Heat stress was associated with an increase in FCR and mortality and a decreased LBW, BWG and FC of birds. Ascorbic acid and potassium chloride supplementation during heat stress had a beneficial effect on LBW, BWG, FC, FCR, DP, mortality, pH, Serum Glucose and rectum temperature.

Key words: Ascorbic acid, potassium chloride, summer condition

INTRODUCTION

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 an extended periods of elevated temperature (Aengwanich, 2007).

The domestic fowl is a homoeothermic which can live comfortably only in a relatively narrow zone of thermo-neutrality extending from 18-24°C. Any deviation especially on the higher side depresses both the survival and the production (Tayeb, 2009). More emphasis stressed on the effect of heat stress on poultry production in the country (Abu-Dieyeh, 2006).

Heat stress is one of the most important factors adversely affecting overall poultry production in the tropics. In Iraq, temperature remains well beyond the thermo-neutral zone for along period of the year. And adverse effects of heat make poultry production a difficult and uneconomical pursuit.

It is generally agreed that heat stress reduces the body weight (Al-Neemy, 2002), immune response and also causes mortality (Younis, 2007a,b). Therefore, different therapeutic measures are used to minimize the harmful effects of heat stress on performance of broiler chicks such as ascorbic acid (Younis, 2007a,b), vitamin E (Sahin *et al*., 2003), acetylsalicylic acid (Naseem *et al*., 2005), potassium chloride and (Al-Khateeb, 2005), sodium bicarbonate, acetic acid (Hassan *et al*., 2009).

The purpose of present study is to determine the role of combined ascorbic acid and potassium chloride for minimizing the negative effects of heat stress on performance of broiler chicks.

MATERIALS AND METHODS

Experimental chicks: A total of four hundred twenty one-day old Rose chicks were assigned randomly to one of four treatment groups (n = 105). Control (no supplement) and the other three groups received 0.1% potassium chloride/L water, in addition to ascorbic acid at the rater of 200, 400, 600 Mg/Kg ration. Chicks were reared on deep litter, kept under 23 h light: 1 h dark and stocking density was 10 birds/m^2. Feed and water were provided *ad libitum*.

Exposure to chronic heat stress and water treatments: All groups of chicks was maintained at the required temperature (28-33±2°C) up to 21 days old, after that was exposed to chronic heat stress (summer condition) Table 1, up to the end experiment period (49 days).

Sample collection: At 3, 4, 5, 6 and 7 wks of age, twenty chicks from each group were randomly selected, Live Body Weight (LBW), Feed Consumption (FC), Feed Conversion Efficiency (FCE) were recorded every wks. 6 bird (3 male and 3 female) from each treatment were randomly collected to determine the carcass weight, internal organs and dressing percentage. Blood samples were collected in heparinized tubes for determinations PCV, Hb and pH, serum glucose, all viscera were removed carefully by hand and then carcass weight was recorded.

Statistical analysis: Results are expressed as means ±SEM for each group. Groups were tested for differences by Duncan protected significant differences test, using the CRD. Differences were considered statistically significant at $p<0.05$.

Corresponding Author: Johnny S. Yokhana, Department of Animal Production, College of Agriculture, Dohuk University, Dohuk, Iraq

Table 1: Average weekly room temperature and RH

Weeks	Minimum	Maximum	Average	HR
4	28.43±0.20	31.71±0.18	30.07±0.17	53.00±0.53
5	27.86±0.40	34.14±0.55	31.00±0.40	52.57±1.64
6	27.00±0.72	35.00±0.44	31.00±0.55	53.85±0.51
7	25.42±0.30	35.00±0.49	30.21±0.30	53.28±0.52
Average	27.18±0.30	33.96±0.33	30.57±0.20	53.17±0.45

Table 2: Effect of vitamin C and KCl supplementation via diet and drinking water on LBW and BWG of broiler chicks reared under summer conditions

Treat.	21 days	28 days	35 days	42 days	49 days
Live body weight (gm)					
T1	690.19±12.53^{a}	1096.08±61.74^{a}	1553.76±61.30^{a}	2002.66±50.66^{b}	2443.77±47.71^{b}
T2	717.71±6.23^{a}	1179.57±5.49^{a}	1634.66±19.35^{a}	2156.31±5.21^{a}	2653.08±5.86^{a}
T3	686.80±8.63^{a}	1106.91±23.09^{a}	1566.53±32.01^{a}	2046.25±43.58^{ab}	2494.26±62.46^{b}
Control	718.71±19.95^{a}	1190.25±3.25^{a}	1650.23±21.46^{a}	2114.20±20.54^{ab}	2576.08±33.72^{ab}
Body weight gain (gm)					
Treat.	21-28 days	28-35 days	35-42 days	42-49 days	21-49 days
T1	405.89±50.35^{a}	457.68±4.54^{a}	448.90±10.4^{b}	441.10±16.49^{a}	1753.58±38.35^{c}
T2	461.86±5.15^{a}	456.09±13.87^{a}	520.64±17.12^{a}	496.77±10.98^{a}	1935.37±71.92^{a}
T3	420.11±14.46^{a}	459.61±15.03^{a}	479.72±17.39^{ab}	448.01±22.64^{a}	1807.45±53.90^{b}
Control	471.54±21.51^{a}	459.99±21.31^{a}	463.95±14.38^{b}	461.88±13.27^{a}	1857.37±52.41^{b}

RESULTS AND DISCUSSION

The data of ambient temperature and relation humidity during the experiment are presented in Table 1 no significant effect of treatment on LBW was noticed at 21 and 28 days old. However, a significant difference ($p<0.05$) among treatment groups was detected at 42 and 49 days old; yet the highest LBW was achieved by chicks in treatment 2. The results of the present study were in agreement with those of Vathana *et al.* (2002), Sahin *et al.* (2003), Farooq *et al.* (2005), Kadim *et al.* (2008), Roussan *et al.* (2008). It is generally known that an ambient temperature of 32-35°C is most appropriate for brooding chicks (Gietema, 1996) and therefore young chicks are more adaptable to high temperatures than mature ones (Payne and Wilson, 1999). Apparently, beneficial effects of Vitamin C supplementation would be most expressed under high ambient temperature.

Daily gain in weight for different treatment groups are presented in Table 2, it appears that treatment had no significant effect during the periods 21-28, 28-35 and 42-49 days old, However, T2 achiieved significant mean highest (1935.37±71.92 gm) gain whereas the lowest gain was recorded for the T1 group (1753.57±38.35 gm). This result was in agreement with the finding of Younis (2007a,b) and Tayeb (2009). Poultry have ability to synthesize ascorbic acid, but this ability was inadequate under stress condition, such as high environmental temperature, high humidity, a high productive rate and parasitic infestation (Roussan *et al.*, 2008).

Chicks in control group consumed significantly more food at all ages compared with the other groups (Table 3). However, the differences among other groups were not significant except at 42 and 49 days old, being higher in T2 and T1, respectively. The results of this study agreed with those reported by Vathana *et al.* (2002), Naseem *et al.* (2005), Farooq *et al.* (2005) and Rousan *et al.* (2008). Heat stressed birds reduced feed consumed to lower the thermogenic effect associated with nutrients absorption assimilation and utilization (Kadim *et al.*, 2008).

No significant differences among treatment groups were noticed in FCE at 28 and 35 days old chicks (Table 3). However, feed efficiency noted 1.72±0.01, 1.62±0.01, 1.64±0.04 and 1.77±0.02 Kg/Kg for T1, T2, T3 and control group, respectively (Table 3). Duncan test revealed a significant difference between groups being the least in T2 and highest control group.

The results of the present study were in agreement with Vathana *et al.* (2002), Sahin *et al.* (2003), Lohakare *et al.* (2005), Farooq *et al.* (2005), Kadim *et al.* (2008) and Roussan *et al.* (2008). The depression in growth rate and body weight gain at high environmental temperature (30-33°C), might have been caused by many factors, including decreased feed consumption, in efficient digestion, impaired metabolism and genetic background (Tayeb, 2009).

Live body weight, carcass and organ weights, dressing percentage and mortality rate of chicks are given in (Table 4). Result revealed that treatment had no significant effect on LBW, carcass and organ weights. However, dressing percentage was significantly higher in T3 compared to T1. The highest mortality rate (19.04±2.51) was recorded for the control and the lowest (3.80±2.51) was noticed for birds in T3 (Table 4). This finding is in accordance with those reported earlier by Al-Neemy (2002), Younis (2007a,b) and Tayeb (2009). Who showed that the supplementation of Ascorbic acid lead to increase the immunity of birds and tolerance heat and potassium chloride increased the water consumptions of bird decreased and body temperature (Fig. 1) and finally mortality rate is reduced.

Table 3: Effect of vitamin C and KCl supplementation via diet and drinking water on FC and FCE gain of broiler chicks reared under summer conditions

Treat.	28 days	35 days	42 days	49 days	21-49 days
Feed consumption (gm)					
T1	628.40±5.15^{b}	670.82±22.55^{b}	811.48±50.44^{c}	919.75±25.75^{b}	3030.46±50.56^{b}
T2	626.66±3.54^{b}	687.69±2.88^{b}	838.48±6.87^{b}	891.18±4.21^{bc}	3044.03±6.68^{b}
T3	617.96±3.62^{b}	687.20±5.04^{b}	811.05±9.78^{c}	843.32±14.78^{c}	2959.54±1.94^{b}
Control	664.60±21.11^{a}	718.55±10.51^{a}	918.84±28.45^{a}	991.85±3.27^{a}	3293.85±55.87^{a}
Feed conversion efficiency					
T1	1.60±0.21^{a}	1.46±0.03^{a}	1.81±0.15^{ab}	2.08±0.05^{ab}	1.72±0.01^{ab}
T2	1.35±0.01^{a}	1.51±0.05^{a}	1.61±0.05^{b}	1.79±0.04^{c}	1.62±0.01^{c}
T3	1.47±0.05^{a}	1.49±0.05^{a}	1.69±0.07^{b}	1.89±0.08^{bc}	1.64±0.04^{bc}
Control	1.41±0.02^{a}	1.56±0.05^{a}	1.98±0.03^{a}	2.15±0.05^{a}	1.77±0.02^{a}

Table 4: Effect of vitamin C and KCl supplementation via diet and drinking water on DP, mortality and blood parameter of broiler chicks reared under summer conditions

Treat.	LBW (gm)	Carcass (gm)	Organs (gm)	DP (%)	Mortality (%)
T1	2469.16±114.02^{a}	1900.83±82.47^{a}	117.66±1.45^{a}	77.00±0.32^{b}	9.52±0.95^{b}
T2	2429.16±111.18^{a}	1899.16±94.00^{a}	123.33±1.45^{a}	78.15±0.30^{ab}	8.57±1.64^{b}
T3	2436.66±32.02^{a}	1906.66±25.67^{a}	121.33±1.85^{a}	78.24±0.32^{a}	3.80±2.51^{b}
Control	2418.33±189.07^{a}	1866.00±154.44^{a}	119.33±3.28^{a}	77.10±0.40^{ab}	19.04±2.51^{a}
Blood parameter	Hb	PCV	pH		Serum glucose
T1	9.23±0.17^{b}	29.00±0.57^{b}	7.62±0.04^{b}		209.98±1.92^{b}
T2	9.80±0.05^{a}	30.33±0.44^{b}	7.51±0.01^{bc}		205.18±2.21^{b}
T3	9.93±0.17^{b}	34.00±1.00^{a}	7.44±0.02^{c}		188.72±3.54^{c}
Control	8.50±0.05^{c}	25.50±0.28^{c}	7.90±0.07^{a}		221.74±1.74^{a}

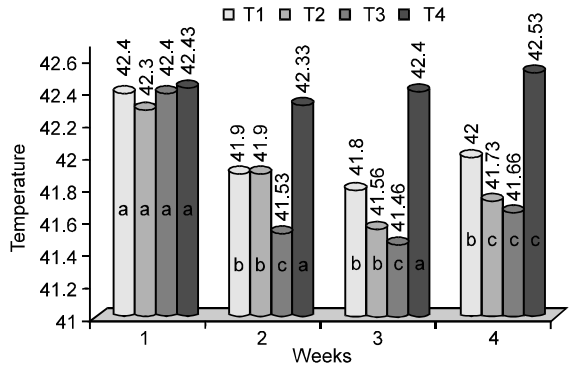

Fig. 1: Effect of vitamin C and KCl supplementation via diet and drinking water on rectum temperature of broiler chicks reared under summer conditions

In the current work, Hb and PCV was significantly lower (8.50±0.05 and 25.50±0.28) in the control group compared with other treatment groups (Table 4). Similarly, a significant effect on pH was noticed being lowest in T3 (7.44±0.02) and highest in control groups. On the other hand, glucose was significantly highest in control groups compared with the treatment groups. The result disagree with that of Mehmet (2005), Usman *et al.* (2008). How showed that 500 mg/kg of ascorbic acid provides the greatest performance of birds reared under hot conditions until the fourth week.

A non significantly effect of treatment on rectal temperature (Table 4) was recorded at fourth week of the experiment. However, the rectal temperature of birds on T3 group was significantly lower than other groups at weeks 5, 6 and 7. These findings are consistent with that of Ahmad *et al.* (2008) who reported an improvement in heat tolerance of chickens that drank water supplemented with 0.1% KCl. It is well known that supplementation of diet or drinking water with electrolytes improved the water consumption in birds reared under heat stress conditions. Also the vitamin C increase the activity of chicks body and metabolic function therefore increase in efficiency of body temperature balance (Tayeb, 2009).

Conclusion: KCl supplementation via drinking water and ascorbic acid via diet, showed a significant effect on overall performance of heat stressed 21 days broiler. However, supplementation of 0.1% KCl with 400 Mg Vitamin C showed better performance for broilers reared under ambient temperature ranged between (25.42-35.00°C).

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