The Role of Adding Sodium Chloride in Broiler Chicks Diets to Improve Production Performance and Antioxidant Status during Heat Stress

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Abstract

This study was conducted at the Poultry Research Station in the Livestock Research Department / Agricultural Research office / Ministry of Agriculture, where a 84 sexed chicks that brought from a local hatchery (AL-Shuker) in Abu Ghraib were used at one day old with initial weight of 40g of the breed (Ross 308). The continuous light method (24 hours/day) and the gas incubators were used to warm the hall in order to reach the required temperature of 38℃ until the end of the experiment at 42 days. The chicks were randomly distributed on 2 treatments, where each treatment included three replicates of (14 chicks / rep), the first one was the control treatment, and in the second treatment the chicks were given sodium chloride by 250 mg/kg feed. The findings of this study showed a significant superiority (P <0.05) for sodium chloride treatment over the control treatment in each of life body weight, weight gain, feed consumption, and a significant decreased in the mortality percentage compared to the control treatment. Furthermore, it can be noted from the lipid peroxidation measurements in broiler chicks, the NaCl's treatment was significantly decreased (P <0.05) in the maldehytomdialdehyde level, peroxide value, and free fatty acid percentage compared with the control. Finally, there were no significant differences between control treatment and sodium chloride treatment in enzyme activity of transaminases (Aspartate aminotransferase AST and Alanine aminotransferase ALT).

Keywords: Sodium Chloride, Production Performance, Antioxidant Status, Heat Stress

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Introduction

Heat stress is one of the problems that cause major economic losses in poultry production, which exceeds the breeder's ability to bear those expenses leading to the reluctance of many breeders from breeding during the high temperatures (Zaed et al., 2018a). (Mohammed et al., 2018a) explained that, the heat stress leads to a decrease in the anti-oxidative defense system in the body, resulting in an increase in the level of free radicals, which causes an increase in the oxidative processes, the occurrence of oxidative stress, and a decrease in immunity. Heat stress is one of the most important factors that impede poultry breeding in the summer season, where temperatures reach 40°C or more, in addition to high relative humidity that resulting in very high rate of chickens mortality (Brake and Balnav, 2005; Mohammed et al., 2018b). Heat stress also causes a disturbance in the basal, acidic, and balances the water in the body, as well as, a change in the endocrine gland function resulting in huge change in hormone secretion and an imbalance in the chemical balance of the body. Corticosterone is one of the most important hormones secreted by stress hormone, which is a Glucocorticoids hormone and when it secreted a decrease occurring in food intake, growth, immunity and raising blood glucose by stimulating it from non-carbohydrate sources (Glucogenesis) (Miller and Callaghan, 2002). Heat stress occurs as a result of high temperature and humidity, which are negatively affects the proper body heat regulation processes and this reduces immunity, feed consumption, food conversion efficiency, weight gain, and increases the mortality ratio (Abidin and Khatoon, 2013Zaed; et al., 2018b). Therefore, it was

necessary to use several ways and methods to alleviate the heat stress on birds like salts addition such as sodium chloride. Sodium chloride (table salt) is formed from two elements, sodium and chlorine, both are important to the body for the acid-base balance of the blood and to maintain the osmotic pressure in the tissues. As well as, chlorine and sodium also balance the external media of cells and maintain the bird body temperature (Borges et al., b 2003). (Summmers and Leeson 2001) observed that the addition of sodium chloride to the diet has led to maintains ion voltage for cell membranes and enzymatic activity, and these ions help to accelerate the transfer of nerve impulses to the body. (Mushtaq et al., 2005) observed during studying a 360 male chicks of broiler to determine the effect of increasing sodium and chlorine levels in broiler chick diets on growth under temperature between (32-39°C) and humidity of 58.2% by using sodium (0.20, 0.25, 0.30%) and chlorine at levels (0.30, 0.40, 0.50%), a significant superiority ($p<0.05$) in live weight and water consumption of birds which fed on diets containing sodium at a level of 0.25 and 0.30%, respectively. Therefore, the aim of this study was to know the role of adding sodium chloride to the diet in the productive, physiological performance and antioxidant status of broiler chicks.

Materials and methods of work

This study was conducted at the Poultry Research Station in the Livestock Research Department / Agricultural Research office / Ministry of Agriculture, where a 84 sexed chicks that brought from a local hatchery (AL-shuker) in Abu Ghraib were used at one day old with initial weight of 40g of the breed (Ross 308). The continuous light method (24 hours/day) and the gas incubators were used to warm the hall in order to reach the required temperature of 38℃ until the end of the experiment at 42 days. The chicks were randomly distributed on 2 treatments, where each treatment included three replicates of (14 chicks / rep), the first one was the control treatment, and in the second treatment the chicks were given sodium chloride by 250 mg/kg feed. The chicks were given free feed from the used diet that its components, percentages, and chemical composition explained in Table 1. As well as, water was provided to the birds freely. The daily mortality percentage, body weight, weight gain, feed consumption and feed conversion efficiency were measured at (7, 14, 21, 28 35 and 42) days as mentioned by Ross 308 Broiler Performance Objectives - Aviagen. Blood samples were collected at the age of 21 and 42 days at a rate of 3 birds per replicate, which means that 9 birds per treatment randomly from the brachial vein of the wing. Blood samples were then placed in a tube containing Ethglene Diamin Tetra Acetic acid Anticoagnlant (EDTA), The remaining blood samples were placed in the centrifuge device at 3,000 rpm for 15 minutes for the purpose of plasma separation, and were kept in the freezer at (- 21°C) for the purpose of estimating the liver enzyme activity of transaminases (AST, ALT) as stated on Kits purchased from Nanjing Jiancheng Institute of Bioengineering (Jiangsu, China). Statistical Analysis System-SAS (2012) was used for analyzing the study data, and to determine the effect of different treatments in the studied traits according to Completely Randomized Design (CRD). Finally, the significant differences between the averages were compared by the multiple range test Duncan (1955).

Table 1: The percentages and chemical composition of the diet components used in the study

Feed material	Starter diet (1-11)day %	Growth diet (1-22)day %	Finisher diet(23-42)day %
Yellow Maize	54.3	60	62.05
Soybean	35	29.5	27
Protein concentrate	5	5	5
Fat	3	3.55	4
Limestone	1.3	1.1	1.1
$CaHPo_4$	0.8	0.5	0.5
Salt	0.1	0.1	0.1
Methionine	0.3	0.15	0.15
Lysine	0.2	0.1	0.1
Total	100	100	100
Calculated chemical composition**			
crude protein	23.4	21.3	20.2
Dietary energy (k cal/kg)	3048	3155	3203

Methionine+ Cysteine%	1. 2	1.3	1.23
Lysine	1.53	1.3	1.23
Ca%	1	0.84	0.83
Available p	0.46	0.4	0.39
C/P ratio	130.38	158.06	157.94

(1) Soybean content used from Argentinian origin 48% crude protein and 2230 kcal / kg Dietary energy.

(2) Protein concentrate that used, animalistic produced by Holland company (imported) Wafi contains 40% crude protein, 2157.12 protein dietary energy (kcal/kg feed), crude fat 5%, 2.20% crude fiber, 4.20% Calcium, 2.65% phosphorus, 3.85% Lysine, 3.70% Methionine, 4.12% Methionine+ Cysteine. It contains a mixture of vitamins and rare minerals that provide for the needs of birds from these elements, according to the chemical structure and based on (NRC 1994).

Result and discussion

Production performance: Table 2 showed a significant superiority (P <0.05) of NaCl treatment over the control treatment in body weight, weight gain, and feed consumption, while the mortality percentage was about 0.00% for NaCl treatment which significantly decrease (P <0.05) over the control treatment (2.9). Furthermore, food conversion factor did not differ significantly compared with the control treatment. In a study on the effect of adding Na to the drinking water of broiler chicks to find its effect on some productive characteristic, (Cengiz, 2012) used four levels of (0.15, 0.20, 0.25 and 0.30%) , where the results showed that there was no significant effect on the weight gain, life body weight and the food conversion factor.

(El-Deek et al., 2009) pointed out that there were no significant differences in food conversion efficiency, feed consumption and weight gain when using table salt in broiler chick diets at different levels (0.3 and 0.5%). (Mushtaq et al., 2005) observed in a study in which 360 male chicks of broiler chicks were used to determine the effect of increasing the sodium and chlorine level in the broiler chicks diets on growth under a temperature of (32-39°C) and 58.2% humidity. Where sodium used at level (0.20, 0.25, 0.30%) and chlorine at level (0.30, 0.40, 0.50%), and the study results show a significant superiority (p <0.05) in live weight and water consumption from birds that fed on diets containing sodium at 0.25 and 0.30%, respectively. Sodium chloride dilutes the respiratory alkalosis due to the high respiratory rate during heat stress, which causes a decreasing of carbon dioxide level in blood and bicarbonate ions. Salts also increase water and feed consumption, it is the main reason for increasing the life body weight and compensating for the loss of electrolytic solutions, so stress hormone secretion in the body will decrease (Richard and Preston, 2006; Mushtaq et al., 2007). The addition of sodium chloride led to an increase in the water and feed consumption, which is the main reason for increasing the body weight and the weight gain. The salts should be added to the broiler chick diets that stressed by heat, it has produced positive and important results unless this salts are organic, so this increasing their bioavailability, thus improving the productive performance and health status of birds (Mushtaq et al., 2007).

Table 2: The effect of adding sodium chloride to the diet on broiler chick's production performance

Treatments	Production performance				
	Body weight (g)	Weight gain (g)	feed consumption (g)	food conversion efficiency	Mortality %
Control	75.7±1365B	211±1326B	212±2294b	0.058±1.78	a2.18±2.9
250 mg NaCL	0.948±2010A	0.948±1973A	3.23±3317a	0.002±1.68	0.00±0.0b
LSD	0.05	0.05	0.05	N.S	0.05

Measurements of lipid peroxidation in broiler chicks liver tissue

Table 3 shows the effect of adding sodium chloride to the diet in the measurement of lipid peroxidation in broiler chicks liver tissue. It was observed that there was a significant decrease in the treatment of NaCl (P <0.05) compared to the control treatment at the MDA, PV and FFA level in the broiler chicks liver tissue. The results also showed that the efficacy of sodium chloride to control the lipid peroxidation was significantly superior (P <0.05) compared with treatment control. The reason for this superiority was that the addition of sodium chloride to the diets work to dilution the blood alkalinity, which leads to a decrease in the free radicals production, increase in the water and food consumption, and compensate for the loss of electrolytic solutions, which reduces the heat stress on birds and thus reduces the secretion of Corticosterone hormone, which reduces the peroxides destruction that Malonaialdehyde (MDA) is one of its secondary products (Pokorny et al., 2001).

Table 3: The effect of adding sodium chloride to lipid peroxidation measurements in broiler chicks liver tissue

Traits	Treatments		LSD
	Control	sodium chloride 250 mg/kg	
Malonaialdehyde (MDA) dry matter	0.132±0.890a	0.007±0.150B	0.05
Peroxides (pv) meq/kg fat	0.916±2.41a	0.178±1.02B	0.05
Fatty acid % (FFA)	0.326±2.27a	0.138±1.23B	0.05

Activity of liver enzyme of transaminases (AST, ALT)

Table (5) shows the effect of adding sodium chloride to the diet on the activity of liver enzymes of transaminases (AST and ALT). There were no significant differences between the treatments in the enzymes activity levels of AST and ALT. This is a good indicator because the high activity of ALT and AST enzymes will promotes the Gluconeogenesis process from non-carbohydrate sources, especially proteins, leading to an increase in the process of protein degradation to provide the necessary amino acids and thus convert to keto acids used to Gluconeogenesis. AST enzyme promotes the inhibition the transaminases from aspartic amino acid, while ALT enzyme promotes the transaminases from Alanine amino acid, leading to increased glucose level, as a result, there is also a decreases in protein levels in plasma (Table 15) (Nelson and Cox, 2004).

Table 5: The effect of adding sodium chloride to the diet on enzymes activity of transaminases in plasma of broiler chicks

Traits	Treatments		LSD
	Control	sodium chloride 250 mg/kg	
enzyme activity of ALT (IU/L)	25.20 ± 1.02	25.80 ± 0.635	N.S
enzyme activity of AST (IU/L)	65.56 ± 1.44	65.00 ± 2.88	N.S

References

- Abidin, Z., A. Khatoon. 2013. Heat stress in poultry and the beneficial effe- Cts of ascorbic acid (vitamin C) supplementation during periods of heatstress world's poultry science Association.World's Poutry Science Journal 69 (01).
- Borges, S.A., A.V. Fischer desilva, J.Ariki, D.M. Hooge, and K.R.Cummings. 2003b. Dietary Electrolye Balance for broiler chickens exposed to Thermoneutral or heat stress environments.poult .sci.82:428-435.
- Brake, J., Ferket, P., Grimes, J.,Balnave, D.,Gorman, J. &Dibner, J .J. 2004. Optimum arginine: lysine ratio changes in hot weather. Pp: 82-104 in Carolina. Poultry nutr. Conference, Charlotte, NC Proceedings of the 21.

- Cengiz, O., Hess, J. B., and Bilgili, S. F. 2012. Influence of graded levels of dietary sodiumon the development of footpad dermatitis in broil Broiler chickens. Journal of Applied Poultry Research, 21:770-775 775.
- Duncan ,D.1955.Multple rang and multiple F.Test .Biometrics,11:1-24.
- El-Deek, A.A., El-Deen, M.S., Hamdy,S.M., Asar ,M.A.,Yakout, H.M. and Attia, Y. A.2009. Effect of Different Dietary Levels of Nacl and Kcl On Performance of Broiler Chicks Fed Plant Diets. Journal of Egypt Poultry Science, 29 (Iv): 907-921.
- Mushtaq, T., M.A. Mirza, M. Athar, D.M. Hooge, T. Ahmad, G. Ahmad, M .M.H. Mushtaq and U.Noreen.2007. Effect and interactions of dietary Sodium and chloride on broiler starter performance 28-42 days of age under sub-topical summer conditions .J. Appl. poult. R.Res., 16:161-170.
- Mushtaq, T., M. Sarwar, H. Nawaz, M. Aslam Mirza, and T. Ahmad. 2005. Effect and Interactions Dietary sodium and chloride on Broiler starter Performance (Hatching to Twenty-Eight Days Of Age) Under Subtropical summer Conditions. Poultry Scion Science 84:1716–1722.
- Nelson, D. L. and M. M. Cox. 2004. Lehninger principles of Biochemist –Ry. Fourth ed. Copyright by: W. H. Freeman and Company.
- NRC. 1994. Nutrient Requirements of poult. 9 rev. ed. National Academy Press, Washington. DC.
- Richard, A., and M.D. Preston. 2006. Acid-base, fluids and electrolytes made ridiculously simple. University of miami school of Medicine med master, Inc., Miami. USA.
- SAS. 2012. SAS. TAT. User's Guide version 6.4th ed. SAS Institute Inc. Garg, NC.
- Mohammed Th. T, Farhan S.M , Majid AA , Mohammed Saeid Z,J and Abdulateef FM .2018a. Effect of vitamin C and natural antioxidants on the production performance and antioxidant status of laying hens through heat, Journal of Research in Ecology , 2018 | Vol 6 | No 2. 2364-2375
- Zaed J. M. Saed, Th. T. Mohammed and S. M. Farhan.2018a.Effect of ginger and celery seeds as feed additives on reproductive performance of broiler breeder males Plant Archives Vol. 18 No. 2, 2018 pp. 1823-1829.
- Mohammed Th. T., Z. J. Mohammed Saeid1, Z. T. M. Al-Dhanki1 and F. M. H. AL-Khalani.2018b,Effect of adding the antioxidants on some biochemical blood plasma traits of brown layer during hot season in Iraq. Plant Archives Vol. 18 No. 2, 2018 pp. 2834-2841.
- Zaed J. M. Saed, S. M. Abdulateef, Th. T. Mohammed1 and F. M. H. AL-Khalani.2018b.Effect of dried tomato pomace as alternative to vitamin c supplemented diets in hematological indices and oxidative stability of egg yolk of laying hens in high-ambient temperature Biochem. Cell. Arch. Vol. 18, No. 2, pp. 1647-1652, 2018.