



EFFECT OF SODIUM BICARBONATE SUPPLEMENT IN JAPANESE QUAIL DIET ON SOME PHYSIOLOGICAL TRAITS DURING HEAT STRESS CONDITION

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Abstract

This study was conducted at the Poultry Researches Station/Department of Animal Resource / Directorate of Agricultural Researches/Ministry of Agriculture, during the period from 16/9/2018 to 1/10/2018 to study the effect of adding sodium bicarbonate powder in Japanese quail diet on some physiological traits exposed to heat shock. In this study, 225 Japanese quail at age of 45 day has been used, these birds has randomly distributed to 3 dietary treatments, each treatment has three replicated (25 birds/ replicates) T1 control treatment without adding sodium bicarbonate powder while T2 was used 0.05 g/Kg diet of sodium bicarbonate powder, T3 used 0.1 g/kg diet of sodium bicarbonate powder. The birds had been fed with one diet during the experiment period and the diets content were calculated as (NRC, 1994), the experiment continued for two weeks, the results of this study showed:

Before heat shock exposed: There is a high significant decreased ($P<0.01$) in plasma total protein and plasma globulin for adding treatment as it reached the best average in T3 treatment while reached a minimum average in T1 treatment and a highly significant decreased ($P<0.01$) in pH for T3 and T2 treatments when compared it with T1 treatment, and there were no significant differences in plasma albumin levels between treatments and control, while there is significant decreased ($P<0.05$) in plasma cholesterol and plasma LDL levels in T3 treatment compared with T1 treatment, while there is no significant differences between treatments in triglyceride, HDL and VLDL traits.

After heat shock exposed: There is a highly decreased ($P<0.01$) in plasma total protein and plasma globulin levels in for T3 treatment were compared it with T2 and T1 treatments, in the same time the results showed a significant difference ($P<0.05$) for plasma albumin level for T3 treatment compared with T1 treatment, while there were a high significant decreased ($P<0.01$) in pH level in T3 and T2 treatments compared with T1 treatment. And the results also showed a highly significantly decreased ($P<0.01$) in plasma cholesterol and plasma HDL levels in T3 and T2 treatments compared with T1 treatment, in the other hand T2 treatment showed a high significant decreased ($P<0.01$) for triglyceride trait when compared it with T3 and T1 treatments, and there were a high significant difference ($P<0.01$) in plasma LDL levels for T3 and T2 treatments compared with T1 treatment, for the pH trait the result showed that there were a highly decreased ($P<0.01$) in T2 treatment compared with T3 and T1 treatments.

Key words : Sodium Bicarbonate, physiological traits, heat shock, Japanese quail.

Introduction

Sodium bicarbonate (NaHCO_3) is an organic salt, white colored, crystalline powder, odorless and the degree of melting and boiling can't be determined (Bird *et al.*, 1995). Sodium bicarbonate has been used as an ergogenic aid for events that depend on the generation of energy via anaerobic glycolysis (McNaughton *et al.*, 2000), its swallow has been reported to improve competitive and laboratory based protocols of sustained exercise lasting 1–7 min. involving swimming (Gao *et al.*, 1988; Zajac

et al., 2009). A disadvantage of supplementation is the possibility of gastrointestinal upset, resulting in symptoms such as nausea, stomach pain, diarrhea, and vomiting (Burke and Pyne, 2007).

Sodium bicarbonate was widely used as a regulatory agent for birds to Dilution the deleterious effect of heat stress by maintaining acid base balance (Hayat *et al.*, 1999; Borges *et al.*, 2003, 2007).

Poultry are very sensitive animals to blood acid base disorders (Ergun, 1992) and thus, the blood pH should be

close to physiological limits of 7.35 to 7.45 (Dibartola, 1992; Carlson, 1997), this is necessary for the maintenance of protein structure and function, which is an essential condition for normal progression of metabolic events. A deviation from these physiological ranges may cause predisposition to many microbiological diseases, metabolic disorders and losses of productivity, etc. (Haskins, 1977; Dibartola, 1992; Carlson, 1997).

Extreme thermal condition can decrease growth performance and reproductive efficiency in domestic animals (Fuquay, 1981). Poultry production in many regions of the world is adversely affected by heat stress (St-Pierre *et al.*, 2003).

Differences in the acid-base balance occur in heat-stressed birds that have led to the inclusion of compounds in diet and water, common practices in mitigating adverse effects of heat, it's include sodium bicarbonate, ammonia chloride and ascorbic acid, bicarbonate and ascorbic acid are most common in tropical and subtropical regions (Yasothai, 2016).

Research showed that used of sodium bicarbonate at high temperatures will stimulate water and feed consumption and provide an alternative source of sodium (Yasothi, 2016), that making poultry manure more dried (Yasothi, 2016), so the aim of this study the knowledge effect of added sodium bicarbonate to Japanese quail diet that grown up under heat stress to know the effect of sodium bicarbonate on some physiology traits during heat stress and heat shock.

Materials and Methods

Birds and Dietary treatment

This study was carried out at the poultry research/office of the agricultural research, Ministry of Agriculture for the period 16/9/2018 to 1/10/2018 on 225 Japanese quail at 45 day age has been used and randomly distributed to three dietary treatment with three replicated (25 birds/replicates), T1 control treatment without adding sodium bicarbonate powder while T2 was used 0.05 g/kg diet of sodium bicarbonate powder, T3 used 0.1 g/kg diet of sodium bicarbonate powder. The experiment continued for two weeks and all the treatments gave ad libitum diet and water in all the experiment period and the diet contents chosen as a (NRC, 1994), which showed in table 1.

Heat shock

The birds exposed to heat shock at 14th day of experiment for 2 hours by used hatcher and shut down fans and increased temperature to 38-40°C and observed the birds to report the mortality (It is worth mentioning the normal temperature in the hall 28-30°C).

Table 1 : Percentage composition of the experimental diets.

Types of diets	Percentage %
Corn	53
Wheat	9
Soybean Meal ¹	26
Protein ²	5
Hydrogenated Vegetable Fat	1.2
Dicalcium Phosphate	5.5
NaCl	0.3
Total	100
Chemical Calculated Values ³	
M.E. Kcal/ Kg Diet	2905
Crude Protein %	20.2
Fat %	3.9
Crude Fiber %	2.6
Lysine, %	1.13
Methionine Plus Cysteine %	0.76
Ca %	2.5
Available P %	0.72

¹Soybean cake used an Argentine source of crude protein content by 48% and 2440 Kcal/ Kg M.E.

²Protein Meal User Product From Netherlands Origin)Brocon(Contain 40% Crude Protein 0.2107 Kcal / Kg Protein M.E., 0.5% Crude Fat 2.20% Crude Fiber 5%, Calcium 4.68% ,Phosphorus 3.85% Lysine 4.12%, Methionine 4.12% , Methionine Plus Cysteine 0.42%, Tryptophan 0.38%, Threonine 1.70%. It Contains A Mixture of Vitamins and Minerals Needed Believes Rare Birds of These Elements.

³Based on NRC (1994).

Blood samples and analysis

At the termination of the study, at 12 days of experiments, 9 birds per group totaling 3 birds per treatment replication, was removed randomly for blood collection. Blood samples (1 mL/bird) were collected from the ulnaris wing vein into EDTA tubes. within two hours after blood samples were collected, they were centrifuged (3000 X g, for 10 min at room temperature) to separate plasma from blood cells, and plasma was then decanted and stored in Eppendorf safe-lock micro-centrifuge tubes at -20°C until assayed. Blood parameters analyzed in this study were: total protein, albumin, globulin, cholesterol, triglycerides, very low density lipoprotein (VLDL), high density lipoprotein (HDL), low density lipoprotein (LDL), ALT and AST levels.

Statistical analysis

Completely randomized design (CRD) was used to study the effect of different treatment in all traits Duncans (1955) and multiple range tests was used to compare the significant differences between means. Data were analyzed by using statistical analysis system (SAS, 2012).

Table 2 : Effect of treatments in total protein, albumin, globulin and pH.

Treatment	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	pH
T1	5.57±0.12 b	3.38±0.17 a	2.19±0.25 b	7.62±0.04 a
T2	5.78±0.22 b	3.27±0.14 a	2.5±0.29 b	7.43±0.009 b
T3	7.65±0.14 a	3.10±0.14 a	4.6±0.15 a	7.33±0.03 c
Significance	**	NS	**	**

Means having with the different letters in same column differed significantly ** (P<0.01), NS: Non-Significant.

Table 4 : Effect of treatments in Total protein, Albumin, Globulin and pH.

Treatment	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	PH
T1	4.95±0.007 c	3.15±0.07 b	1.80±0.07 c	7.48±0.02 a
T2	6.18±0.02 b	3.37±0.07 ab	2.81±0.09 b	7.23±0.007 b
T3	6.92±0.11 a	3.56±0.10 a	3.35±0.19 a	7.28±0.02 b
Significantly	**	*	**	**

Means having with the different letters in same column differed significantly* (P<0.05), ** (P<0.01).

Table 3 : Effect of treatments in Lipid profile.

Treatment	Cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL(mg/dl)	VLDL(mg/dl)
T1	164.16±5.70 a	151.00±3.55	37.45±1.90	96.51±4.63 a	30.20±0.71
T2	148.83±7.90 ab	152.83±5.67	33.00±1.75	85.26±6.67 ab	30.56±1.13
T3	139.63±2.67 b	141.96±2.90	32.20±2.35	79.03±1.94 b	28.39±0.58
Significance	*	NS	NS	*	NS

Means having with the different letters in same column differed significantly* (P<0.05), NS: Non-Significant.

Results

Before heat shock

Noticed from table 2 a high significant difference (P<0.01) in plasma total protein and plasma globulin for T3 treatment compared with T2 and control T1 and a high significant decreased (P<0.01) for T3, T2 treatments when compared with T1 treatment in pH trait, in the other hand there was no significant differences between treatments (T2, T3) and control T1 in plasma albumin trait.

The results showed from table 3 a significant decreased (P<0.05) in plasma cholesterol and plasma LDL levels for T3 treatment compared with control T1, and the results showed there were no significant different for plasma triglyceride, plasma HDL and plasma VLDL levels between treatments T2, T3 and control T1.

Table 4 showed a high significant difference (P<0.01) in plasma total protein and plasma globulin for T3 treatment when compared it with T2 treatment and control T1, and the results also showed a significant different (P<0.05) in plasma albumin and for T3 treatment compared with control T1, while pH decreased highly significantly (P<0.01) in T3 and T2 treatments compared

with T1 treatment.

The results from table (5) showed a high significant decreased (P<0.01) in plasma cholesterol in T3 and T2 treatments compared with control T1, and highly significant different (P<0.01) in plasma triglyceride for T3 and T1 treatments compared with T2 treatment, while the results showed a high significant different (P<0.01) in plasma HDL in control T1 compared with T2 and T3 treatments, and a high significant decreased (P<0.01) in plasma LDL for control T1 compared with T2 and T3 treatments, and a high significant decreased (P<0.01) in plasma VLDL and for T2 treatment compared with control T1 and T3 treatment.

Discussion

When birds exposed to heat stress, respiratory rate of birds rises causing higher losses of CO₂ that causes increase in blood pH and disturbs acid-base balance (Toyomizu *et al.*, 2005) and growth performance of broilers was found to be the highest when blood pH was 7.28, whereas a decrease in growth was exhibited when pH values were greater than 7.30 or lower than 7.20 (20). Which can be used as an effort to combat heat stress in poultry birds (Ahmad, 1997; Mushtaq *et al.*, 2005).

Table 4 : Effect of treatments in Lipid profile.

Treatment	Cholesterol (mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
T1	163.33 ± 1.22 a	154.83 ± 5.62 a	122.66 ± 0.66 a	10.00 ± 1.18 b	30.83 ± 1.13 a
T2	145.16 ± 1.40 b	130.50 ± 4.33 b	92.00 ± 5.66 b	27.16 ± 5.09 a	26.00 ± 0.85 b
T3	143.50 ± 0.76 b	164.50 ± 0.76 a	86.33 ± 0.88 b	24.33 ± 0.21 a	32.83 ± 0.16 a
Significantly	**	**	**	**	**

Means having with the different letters in same column differed significantly** (P<0.01).

Sodium bicarbonate provides sodium and positively affects blood pH supplying bicarbonate ions (Ahmad and Sarwar, 2006), also found a significant increase in plasma bicarbonate level due to the inclusion of NaHCO₃ in the diet of birds exposed to heat stress. Serum pH was significantly reduced, nearer to the normal physiological value, by the dietary addition of sodium bicarbonate in heat stressed birds (Abbas *et al.*, 2017). These results are compatible to the findings of Ahmad and Sarwar (2006), as well as make metabolism easily so insurance more growth and products (Ahmad and Sarwar, 2006).

When birds exposed heat stress so the hypothalamus and pituitary glands will play a role in decline in the secretions of Triiodothyronine and Thyroxin (Anjum, 2000), whereas the higher concentration of these hormones results an improved in birds performance. As dietary inclusion of sodium bicarbonate in the results of present study has shown to reduce heat stress. And, dietary addition of bicarbonate might have caused an increase in concentration of these hormones in the blood of treated birds resulting in reduction of heat stress and these hormones leads to improvement in total protein accompanied by improvement in albumin and globulin levels in serum (Al-Daraji *et al.*, 2012), these results are similar with Remus (2001).

And this may be due to that sodium bicarbonate exhibited significantly lower serum lipid concentration profile low density lipoproteins (LDL), cholesterol and triglycerides level in their serum. That decrease in the concentrations of these parameters may be that sodium bicarbonate might have stimulated the synthesis of bile acids from cholesterol, leading to decreased concentration of serum cholesterol in these birds (Naviglio *et al.*, 2011).

Conclusion

From the results of this study, we conclude that use sodium bicarbonate in Japanese quail exposed to heat stress will improvement birds performance.

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