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Effect Adding of Sodium Bicarbonate in Broiler Water On Performance and Immune Response

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ABSTRACT

This experiment was carried out in the Poultry Farm in the holy city of Kerbala and use 50 one day old chicks, from 1/2/2018 to 8/3/2018. They were arbitrarily allocated into two experimental groups. Each group consists of 25 chicks. Where sodium bicarbonate was added in drinking water to the treatment group and the other group was considered a control group. Results (1-6 weeks) showed a substantial elevation ($P < 0.05$) in body mass, weight increment, feed intake, and feed efficiency ratio, as well as antibodies titer against Newcastle Disease and Infantile Bursal Disease. Compared to control group. Therefore, sodium bicarbonate is very useful for the economic production of poultry.

Keywords: *sodium bicarbonate, broiler water, immune response*

1. INTRODUCTION

The poultry business has assumed a prominent position among agricultural sectors globally, serving as the primary supplier of animal nutrition for the human population. The significance of chicken farming in Iraq is evident, as nearly every household in both rural and urban regions relies on it.

Poultry farming faces not just a range of viral, bacterial, parasitic, and fungal infections but also other noninfectious issues, including harsh environmental conditions, inadequate management, and substandard feed quality. Electrolytes are essential for sustaining physiological processes in hot conditions (Brake et al., 1994). These can be categorized into cations and anions. The principal cations are sodium, potassium, calcium, and magnesium. Anions primarily consist of bicarbonate, chloride, biphosphate, and sulfate ions (McDonald et al., 1999).

2. LITERATURE REVIEW

Bicarbonate is a crucial molecule that regulates acid-base equilibrium by functioning as a buffer (Alka and Casey 20104). Carbon dioxide (CO2) is a significant byproduct of energy metabolism in living organisms and functions as a conjugate acid. The enzyme carbonic anhydrase catalyzes the reaction between CO2 and water, yielding carbonic acid (H2CO3). Carbonic acid subsequently dissociates into bicarbonate (HCO3) and hydrogen ions (H+), the latter of which are excreted by the kidneys. HCO3 can also bind excess H+, resulting in the formation of carbonic acid. All reactions are reversible and can proceed in either way.

Sodium bicarbonate (NaHCO3) is one of the limited pharmacological compounds designed to replicate the physiological properties of bicarbonate (HCO3). Sodium bicarbonate is extensively utilized in various clinical contexts, including cardiac arrest (Dybvik et al 1995, Vukmir and Katz 2006), prevention of contrast-induced renal failure (Brar et al 2008), and treatment of diverse metabolic acidoses, such as lactic acidosis and diabetic ketoacidosis (Forsythe and Schmidt 2000),

despite the presence of limited and contentious evidence regarding its efficacy.

In recent years, the sodium content in broiler diets has been elevated, as adequate dietary sodium enhances feed intake and the growth rate of poultry (Borges et al., 2003; Watkins et al., 2005; Mushtaq et al., 2007). The principal salt source in chicken diets is often sodium chloride, whereas sodium bicarbonate serves as an alternative during very hot summer months (Branton et al., 1986; Hooge et al., 1999). The impacts of sodium bicarbonate and sodium chloride on broiler chicks are often analogous, both under thermal stress (Ahmad et al., 2006) and at optimal temperature conditions (Jankowski et al., 2011a). Sodium sulfate, known as Glauber's salt and employed as a laxative, has been assessed as an alternative sodium source in multiple studies (Hooge et al., 1999; Ahmad et al., 2006). The combined effect of increasing sodium and chloride levels in the diet leads to enhanced water consumption and elevated moisture levels in excreta, necessitating further investigation into alternative sodium sources for broiler nutrition (Kidd et al., 2003; Mushtaq et al., 2005). Increased excreta moisture, linked to heightened dietary salt intake as demonstrated in previous investigations (Jakowski et al., 2011a, b), may be associated with functional gastrointestinal disorders. Multiple studies have shown the advantageous effects of sodium bicarbonate (NaHCO3) dietary supplements on the performance and feed consumption of broilers raised under thermoneutral conditions. Sodium (Na) is the primary cation in extracellular fluid and is closely associated with chloride and bicarbonate (HCO3) in the regulation of acid-base balance. The concentration of electrolytes (Na+, K+, and Cl-) in milliequivalents per kilogram must adhere to permissible limits (Hooge, 1995).

Monovalent electrolytes are essential for maintaining the body's acid-base balance (NRC, 1994).

3. MATERIALS & METHODS

Fifteen one-day-old Cobb broiler chicks were weighed and randomly assigned to two groups of 50 birds each, with each group subdivided into two replicates of 25 chicks each. Each replication measured three square meters and included one tube feeder and one drinker.

The control group (C) was given a meal free of additives, whereas the treated group (T) received a daily supplementation of 0.5% sodium bicarbonate (NaHCO3) in their drinking water.

Chicks were reared in a climate-regulated environment with unlimited access to sustenance and hydration. The temperature was kept at 32°C for the first two days, then lowered to 22°C at a rate of 2°C per week, and remained at this temperature for the rest of the experiment. Light was provided continuously. At the end of the experimental period (35 days of age), five birds from each replication were randomly selected, weighed, and blood samples were collected from the heart in test tubes devoid of anticoagulant from 10 broilers in each group randomly. The blood was allowed to coagulate and thereafter centrifuged for 10 minutes at 3000 rpm to get serum, which was then stored in a deep freeze at -20°C (Al-Daraji 2008). Weekly records were maintained for feed intake, body weight, and weight gain, and the feed conversion ratio was computed. Data were assessed for the treatment of each group using analysis of variance (ANOVA). The least significant difference (LSD) among multiple group means at the 5% significance level was employed (Snedecor and Cochran, 1980).

4. RESULTS AND DISCUSSION

The results for body weight (BW), body weight growth (BWG), feed intake (FI), and feed conversion ratio (FCR) are displayed in Tables 1, 2, 3, and 4. The performance indicators are frequently superior in treated birds relative to the control group.

The experiment's findings demonstrated a significant ($P<0.05$) increase in antibody titers against the ND virus and IBD virus in the NaHCO3 group relative to the control group, as illustrated in Tables 5 and 6.

During the study period (1-5 weeks old), data revealed a significant ($P<0.05$) elevation in mean live body weights in the treatment group relative to the control group (1997), which had a mean of (1825). In contrast, the body weight gain is considerably ($P<0.05$) increased in the treatment group relative to the control groups. The treated groups demonstrated a significant increase ($P<0.05$) in feed intake and feed conversion ratio relative to the control group.

Table (1) Effect of Sodium Bicarbonate supplement to the water on body weight (gm) (mean ± SE).

Groups / Age by week	Control	Sodium Bicarbonate
1st week	155.97 ± 0.73 B	169.78 ± 0.53 A
2nd week	377.95 ± 0.66 B	399.73 ± 0.85 A
3rd week	895.45 ± 1.34 B	929.50 ± 1.57 A
4th week	1273.94 ± 2.32 B	1387.88 ± 2.12 A
5th week	1825.73 ± 2.63 B	1997.57 ± 2.21 A

Different letters in the same row signify substantial differences between treatments at a level of ($p \leq 0.05$).

Table (2) Impact of Sodium Bicarbonate supplementation in water on body weight increase (gm). (mean ± SE).

Groups / Age by week	Control	Sodium Bicarbonate
1st week	129.95 ± 0.5 B	121.75 ± 0.43 A
2nd week	238.98 ± 0.69 B	228.77 ± 0.88 A
3rd week	448.25 ± 1.45 B	456.45 ± 2.73 A
4th week	433.57 ± 2.22 B	496.78 ± 2.14 A
5th week	623.71 ± 3.74 B	668.11 ± 2.63 A

Different letters in the same row signify substantial differences between treatments at a level of ($p \leq 0.05$).

Table (3) Effect of Sodium Bicarbonate supplement to the water regarding feed consumption (gm). (means ± SE).

Groups / Age by week	Control	Sodium Bicarbonate
1st week	173.83 ± 0.61 B	159.5 ± 0.51 A
2nd week	355.15 ± 1.45 B	353.87 ± 0.96 A
3rd week	668.2 ± 3.41 B	633.85 ± 1.32 A
4th week	817.35 ± 1.57 B	773.0 ± 1.79 A
5th week	1181.5 ± 1.75 B	1112.0 ± 2.50 A

Different letters in the same row signify substantial differences between treatments at a level of ($p \leq 0.05$).

Table (4) Effect of Sodium Bicarbonate supplement to the water regarding feed conversion ratio. (means ± SE).

Groups / Age by week	Control	Sodium Bicarbonate
1st week	1.40 ± 0.004 A	1.25 ± 0.004 B
2nd week	1.59 ± 0.005 A	1.39 ± 0.004 B
3rd week	1.59 ± 0.003 A	1.42 ± 0.004 B
4th week	1.77 ± 0.005 A	1.60 ± 0.004 B
5th week	1.89 ± 0.006 A	1.71 ± 0.004 B

Different letters in the same row signify substantial changes between treatments at a significance level of ($p \leq 0.05$).

Table (5) Effect of Sodium Bicarbonate supplement to the water on ELISA antibody titer against Newcastle disease virus Chicks aged 35 days. (means±SE).

Groups / Age of chicks	Control	Sodium Bicarbonate
35	3435.7 ± 19.53 B	3785.7 ± 16.83 A

Different letters in the same row signify substantial changes between treatments at a significance level of ($p < 0.05$).

Table (6) Effect of Sodium Bicarbonate supplement to the water ELISA antibody titer against IBD virus in 35-day-old chicks. (means ± SE).

Groups / Age of chicks	Control	Sodium Bicarbonate
35 days	9989.73 ± 19.53 B	1278.5 ± 513.5 A

Different letters in the same row signify substantial changes between treatments at a significance level of ($p \leq 0.05$).

The notable enhancement in performance parameters may be attributed to sodium bicarbonate (NaHCO3), which is crucial for the creation of tissue proteins, enzymatic processes, and osmotic regulation. The combined impact of increased salt and chloride levels in the diet produces in increased water intake and higher moisture content in excreta, prompting increased interest in alternative sodium sources for broiler nutrition. The optimum electrolyte balance of Sodium bicarbonate (Borges et al., 2003).

Activity at 0.5% that promotes protein synthesis through the avian enzymatic system. This corresponds with the research of Keskin and Durgan (1997), which shown that bicarbonate levels in quails under heat stress increased when supplemented with 1% NaHCO3 in their diet, compared to the group receiving a basal diet with 1% KCl.

Feeding regimens, sources of electrolyte salts, and avian genotype are factors that influence the needs and equilibrium of specific electrolytes in the diet (Ahmad and Sarwar, 2006). All environmental factors (e.g., temperature, housing, management, stress) and host immunity influence the outcome of a disease. Stress caused by poor treatment or infection may generate a metabolic requirement for the bicarbonate ion (HCO3-). Infections generally result in the discharge of acidic cellular components into the intestinal lumen or the destruction of cells that secrete the hormone secretin, which regulates bicarbonate ion (HCO3-) secretion from the pancreas and affects electrolyte function in the body (Hooge et al., 1999).

Sodium bicarbonate (NaHCO3) has been employed in food formulations as a sodium source to reduce mortality rates and improve the performance of birds during episodes of heat stress (Balnave & Gorman, 1993). Silva et al. (1994) observed no significant effects on weight gain, feed consumption, or feed conversion when birds were given 0.5% and 1.0% NaHCO3 in their diet from 1 to 49 days. The incorporation of 0.60%, 1.20%, and 1.80% NaHCO3 into broiler diets resulted in a linear increase in weight gain (Rostagno, 1995).

5. CONCLUSIONS

The addition 0.5% of Sodium bicarbonate (NaHCO3) in drinking water may be useful for economic strategy by beneficial influence on performance and feed intake of broilers. The results of this study suggested supplement (NaHCO3) at levels up to 5% of broiler in drinking water improve broiler performance and health status.

6. RECOMMENDATIONS

- From the conclusions, it can recommend the followings:
- Supplement Sodium bicarbonate at a seem levels of layer hens.
- Using Sodium bicarbonate under thermo neutral conditions in laying hens and broiler.
- Investigate the impact of varying concentrations of sodium bicarbonate on different poultry species.

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