

# Effects of Sodium Bicarbonate Levels on the Performance of Broiler Chickens under Sudan Condition

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**ABSTRACT**— *This study was conducted in New Halfa town, Kassala State, Sudan, to investigate the effect of supplementing Sodium bicarbonate in the drinking water on the performance of broiler chickens under heat stress. Broiler chickens were randomly assigned to three treatment groups with three replicates of eight birds each. The birds were supplemented ad libitum with 0.5 g/L water sodium bicarbonate (B) and 1.0 g /L water sodium bicarbonate(C) throughout the experimental period during summer(37.3-42 °C) and winter (28.2-32.8°C) and the control group (A) was not supplemented. The duration of the experiment was 45 day. In the summer temperature caused reduction in feed consumption, leading to a reduction in live weight while the water consumption was significantly increased. 0.5% sodium bicarbonate in birds water in the experiment of summer did not record any significant differences in body weight, respiratory rate, body temperature and growth rates but in the winter led to a decrease in body temperature and low respiratory rate and a significant increase in body weight and an increase in weight gain and feed consumption. When comparing the summer and winter experiments the results showed that the low temperature in winter, led to a significant increase in the consumption of feed and weight also led to a significant decrease in respiration rates and body temperature. The study showed that the addition of (0.5%) sodium bicarbonate was superior on all measurements during winter.*

**Keywords**— Broiler, Performance, Sodium bicarbonate, Heat stress

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## 1. INTRODUCTION

Poultry production in Sudan suffers significant losses every year due to heat stress especially from sudden heat waves, which usually occur during summer . The summer temperature may approach 40°C and above and it may reach 30°C and above during winter. High temperature reduces feed intake in broiler chickens[1], weight gain, carcass weight and abdominal fat[2] and increases mortality[3]. Temperature increase by 4°C will lead to death in broilers. Periods of exposure to heat waves increase the broilers time to reach market weight. This situation led to high mortality, low mature body weight, negligible cash income and a negative attitude towards rearing broiler during summer season. The main pathway of heat dissipation for birds under hot environment is respiratory evaporation, especially when ambient temperatures approach the body temperature. Evaporative heat loss through panting is the most important mechanism to control body temperature under heat loss. Panting increase with increased ambient temperature. Respiration rate can increase from 25 breaths per minute under normal conditions to over 250 breaths per minute when birds are exposed to acute heat stress[4]. The increased respiratory rate causes higher losses of CO<sub>2</sub> that result in increased blood PH and disruption of acid-base balance[5]. When this balance is altered towards alkalosis or acidosis metabolic pathways are diverted to homeostatic regulation rather than used for supporting growth[6]. Electrolytes provided in diets are of great importance in maintaining acid -base balance, osmotic pressure and electrical potential of cell membranes and are also essential for intracellular- extracellular homeostasis[7].

Heat stress can be alleviated by the use of appropriate housing design, installation of cooling systems, feed formulation designed according to feed intake and weather conditions and the use of electrolytes, ascorbic acid, or acetylsalicylic acid in the drinking water of birds[8]. Different management methods have been used to minimize the harmful effects of heat stress on the performance of broiler chickens, such as ascorbic acid[9] and [10], Potassium chloride.

It was observed that both ammonium chloride and sodium bicarbonate had synergetic effect on broiler performance[11]. This study was conducted to investigate the effects of different levels of sodium bicarbonate on the performance of broilers under Sudan condition.

## 2. MATERIALS AND METHODS

### 2.1 Study Area:

The experiment was conducted in the Animal Production Farm, Faculty of Agriculture and Natural Resources, Kassala University in New Halfa, Kassala State, Sudan from May to July 2011. It is located at latitude 15° 19'N and longitude 35°36'E and is about 560km from Khartoum. Mean temperature and annual rainfall were 30° and 250-300mm, respectively.

### 2.2 Animal and Design:

A total of 72 one day old chicks were used in this study. Broiler chickens were obtained from commercial company reared in litter pens from 1 day to 45 day of age.

They were vaccinated against IB disease in day six and Gumboro disease in day fourteen. All chicks were weighed and the mean initial body weight was 45g. Broiler chickens were randomly assigned to three treatment groups with three replicates of eight birds each. Each group was supplied with a trough feeder and drinker. Broiler chickens were provided with a pre starter feed (Table 2) at the first week as a preliminary period followed by finisher feed (Table 4) from the second week till the end of the experiment. The birds were supplemented ad libitum with Sodium bicarbonate (0.5 g/L water) and (1.0 g /L water) in the water throughout the experimental period and the control group was not supplemented and the water was changed every day. Temperature and humidity were recorded during experimental period (Table 1).

Respiratory rate, body temperature, Livability, feed intake, water intake, body weight and growth rate were recorded on a weekly basis throughout the study period. The duration of the experiment was 45 day.

### 2.3 Statistical Analysis:

All the means of experimental treatments were analyzed by ANOVA using SPSS program. Treatment means were separated by using Duncan's multiple range test.

## 3. RESULTS AND DISCUSSION

Table 5. Shows effect of Sodium bicarbonate level on body temperature, respiratory rate and survivability of broilers chickens. Sodium bicarbonate supplementation decreased body temperature of broiler chickens during summer and winter ( $P < 0.05$ ). The decrease in body temperature due to the increased water intake, which was stimulated by electrolyte supplementation [12]. Respiratory rate was decreased in sodium bicarbonate supplemented groups during summer and the difference was significant at group B compared to other two groups. In winter, respiratory rate was decreased ( $P < 0.01$ ) in broilers supplemented with sodium bicarbonate. The high ambient temperature in this study causes birds to increase heat dissipation to maintain a relatively constant deep body temperature through respiration (panting). The decrease in respiratory rate in supplemented groups indicates that sodium bicarbonate alleviate heat stress and the effect was more obvious in winter. The viability rate increased in groups supplemented with sodium bicarbonate during summer and winter compared to the control group but the difference was not significant. The greater viability in this study was similar to the lower mortality found by Roussan et al. [13] with supplementation of Sodium bicarbonate and betaine. This indicates that higher viability was due to decreased body temperature and heat stress by sodium bicarbonate supplementation.

Feed intake was increased significantly in supplemented group during summer and winter but there was no significant differences between 0.5 and 1.0 gram/L sodium bicarbonate. The significant increase in water intake in sodium bicarbonate supplemented groups during summer and winter compared to the control group was similar to that found by Sayed and Scott [12]. The greater water consumption may explain the higher viability of broilers supplemented with sodium bicarbonate.

Table 6 Shows effect of sodium bicarbonate level on the performance of broiler chickens. Supplementation with Sodium bicarbonate did not affect the live weight and growth rate during summer. These results are similar to those obtained by Junqueira et al. [14], who found no effect of sodium bicarbonate different levels on broilers weight gain. The beneficial effect of sodium bicarbonate supplementation was not obvious during summer this may be due to the high ambient temperature. In winter, supplementation with sodium bicarbonate increased live body weight but not significantly. Growth rate during winter was increased in supplemented groups. Live body weight and growth rate were better in group B compared with the other groups. The increase in growth rate and live body weight were due to increased feed consumption in supplemented groups.

## 4. CONCLUSION

Addition of sodium bicarbonate during summer and winter decreased body temperature, respiratory rate and increased broiler viability. Supplementation of sodium bicarbonate during summer and winter increased feed intake and water intake. Live weight and growth rate tended to improve with sodium bicarbonate supplementation during winter

while there was no effect during summer. The study showed that the addition of (0.5%) sodium bicarbonate was superior on all measurements during winter.

## 5. REFERENCES

- [1] Smith,M.T.,and R.G.Teeter" Influence of feed intake and ambient temperature stress on relative yield of broiler parts",Nutr.Rep.Int.,35,pp.299-306,1987.
- [2] Pourreza,J. and Edriss,M.A."The effects of high vs. normal temperatures on the physical characteristics of the broilers carcass", J.Agric.Sci.Technol.,1,pp.35-41,1992.
- [3] Belay,T. and Teeter,R.G"Effect of environmental temperature on broiler mineral balance partitioned into urinary and fecal loss", Br,Poult.Sci., 37,pp.423- 433,1996.
- [4] Teeter ,R.G. and T.Belay"Broiler management during acute heat stress", Anim.Feed Sci.Technol.58,pp.127-142,1996.
- [5] Toyomizu,M.,Tokuda,M.,Ahmad,M.andAkib,Y. Journal of Poultry Science,42,pp.110-118,2005.
- [6] Mongin,P."Recent advances in dietary cation-anion balance: application in poultry", In Proceedings of the Nutrition Society, 40,pp.285- 294,1981.
- [7] Borges,S.A.,Fisher D.A.Silva,A.V.,Ariki,J.,Hooge,D.M.and Cummings .K.R"Dietary electrolyte balance for broiler chickens under moderately high ambient temperature and relative humidities", Poult.Sci., 82,pp.301-308,2003.
- [8] Smith,M.T.,and R.G.Teeter"Effects of potassium chloride supplementation on growth of heat distressed broilers" J.Appl. Poult.Res.1,pp.321-324,1992.
- [9] Naseem, M. T.,S.Naseem,M.Younus,I.C.Zafar,Aamir,A.Asim, and S.Akhter"Effect of Potassium chloride and Sodium bicarbonate supplementation on thermo tolerance of broilers exposed to heat stress", Int. J.Poult.Sci.4,pp.891-895, 2005.
- [10] Stilborn,H.L., G.C.Harris,W.G.Bottje, and P.W. Waldroup" Ascorbic and acetylsalicylic acid(aspirin) in the diet of broilers maintained under heat stress conditions" ,Poult.Sci.67,pp.1183-1187,1988.
- [11] Teeter,R.G.,M.O. Smith,F.N.Owens,S.C.Arp,S.D. Sangiah and J.E.Brenzile"Chronic heat stress and respiratory alkalosis occurrence and treatment in broiler chicks" ,Poul.Sci64,pp.1060-1064,1985.
- [12] Sayed, M.AM., and Scot" Maintaining electrolyte and water balance to alleviate heat stress in broiler chickens",In Proceeding of the 19th Australian Poultry Science Symposium,New South Wales,Australia,2008.
- [13] Roussan, D.A., G.Y. Khwaldeh, R.R.Haddad,I.A.Shaheen,G.Salameh and R. AlRifai"Effect of ascorbic acid, acetylsalicylic acid, sodium bicarbonate and potassium chloride supplementation in water on the performance of broiler chickens exposed to heat stress" ,J.Appl. Poult. Res.17,pp.141-144,2012.
- [14] Junqueira OM,Fonseca LEC,Araujo LF,Duarte K F,Araujo cs da S,Rodrigues EAP" Feed restriction on performance and blood parameters of broilers fed diets with differed sodium levels",Rev.Bras.Cienc.Avic.vol.no.2Campinas may/Aug.,2003.

Table 1. Shows the average temperature and humidity

| No of weeks                  |        | 1    | 2    | 3    | 4    | 5    | 6    |
|------------------------------|--------|------|------|------|------|------|------|
| Average room temperature(°c) | Summer | 42   | 40.5 | 40.3 | 40.8 | 40.2 | 37.5 |
| Average room humidity(%)     |        | 10   | 25.7 | 29.6 | 31.6 | 32.8 | 38.5 |
| Average room temperature(°c) | Winter | 30.3 | 31.0 | 28.1 | 31.9 | 28.4 | 32.3 |
| Average room humidity(%)     |        | 65   | 44.9 | 37.2 | 58.3 | 27.4 | 59.8 |

Table 2 Shows the chemical composition of the pre starter ration

| Ingredients   | %             |
|---------------|---------------|
| CP            | %22.5         |
| Carbohydrates | %35           |
| Crude fat     | %7            |
| Crude fiber   | %2.5          |
| Ash           | %5.3          |
| Vitamin A     | 17.5 I.U/kg   |
| Vitamin D3    | 3.500 I.U /kg |
| Vitamin E     | 90 MG /kg     |
| Cobalt        | 22.5 MG /kg   |
| ME            | 3075 Kcal /kg |

Table 3. Shows Chemical composition of concentrate

| ME         | Kcal/kg 2000 |
|------------|--------------|
| Cp         | 40%          |
| Ca         | 10%          |
| Lysine     | 12%          |
| Methionine | 3.7%         |
| CF         | 3%           |
| P          | 5.8%         |

Table 4. Shows the ingredients of the diet fed to broiler chickens

| Ingredients    | %     |
|----------------|-------|
| Sorghum        | 65.00 |
| Wheat bran     | 2.00  |
| Groundnut cake | 25.25 |
| Concentrate    | 5.00  |
| Oyster shell   | 1.00  |
| Vitamin        | 0.25  |
| Salt           | 0.25  |
| Plant oil      | 1.00  |
| Mineral mix    | 0.25  |
| CP             | 22.2  |
| ME Kcal/kg     | 3247  |

Table 5. Shows effect of Sodium bicarbonate level on body temperature, respiratory rate and viability

| Season<br>Parameter               | Summer                  |                         |                         | Winter                  |                         |                         |
|-----------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                   | Sodium bicarbonate %    |                         |                         | Sodium bicarbonate%     |                         |                         |
|                                   | A                       | B                       | C                       | A                       | B                       | C                       |
|                                   | 0.0                     | 0.5                     | 1.0                     | 0.0                     | 0.5                     | 1.0                     |
| Body temperature                  | 42.1±0.109 <sup>A</sup> | 41.8±0.109 <sup>B</sup> | 41.8±0.109 <sup>B</sup> | 41.5±0.109 <sup>C</sup> | 41.4±0.109 <sup>D</sup> | 41.3±0.109 <sup>E</sup> |
| Respiratory rate (breaths/minute) | 90.4±3.08 <sup>A</sup>  | 85.8±3.08 <sup>B</sup>  | 89.3±3.08 <sup>A</sup>  | 84.4±3.08 <sup>B</sup>  | 76.8±3.08 <sup>C</sup>  | 73.0±3.08 <sup>C</sup>  |
| Viability(%)                      | 91.7±2.946              | 91.7±2.946              | 100.0±2.946             | 95.8±2.946              | 100.0±2.946             | 100.0±2.946             |

Means with the same letter within a row were not significantly different at  $P \geq 0.01$ .

Different letter within a row denote significant differences at  $p \leq 0.01$ .

Table 6. Show effect of sodium bicarbonate level on the performance of broiler chickens

| Season<br>Parameter        | Summer                   |                          |                          | Winter                   |                          |                          |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                            | Sodium bicarbonate %     |                          |                          | Sodium bicarbonate%      |                          |                          |
|                            | A                        | B                        | C                        | A                        | B                        | C                        |
|                            | 0.0                      | 0.5                      | 1.0                      | 0.0                      | 0.5                      | 1.0                      |
| Feed intake (kg/bird/week) | 0.443±0.020 <sup>C</sup> | 0.457±0.020 <sup>B</sup> | 0.463±0.020 <sup>B</sup> | 0.454±0.020 <sup>C</sup> | 0.522±0.020 <sup>A</sup> | 0.509±0.020 <sup>A</sup> |
| Water intake (L/bird/week) | 0.207±0.013 <sup>B</sup> | 0.228±0.013 <sup>A</sup> | 0.212±0.013 <sup>A</sup> | 0.170±0.013 <sup>E</sup> | 0.188±0.013 <sup>D</sup> | 0.192±0.013 <sup>C</sup> |
| Live weight(kg)            | 1.155±0.068              | 1.137±0.068              | 1.139±0.068              | 1.105±0.068              | 1.313±0.068              | 1.258±0.068              |
| Growth rate(kg/day)        | 0.0258±0.014             | 0.0254±0.014             | 0.0256±0.014             | 0.0238±0.014             | 0.0278±0.014             | 0.0268±0.014             |

Means with the same letter within a row were not significantly different at  $P \geq 0.01$ .

Different letter within a row denote significant differences at  $p \leq 0.01$ .