Electrolytes Supplementation through Drinking Water to Revive Broiler Production during Tropical Summer Stresses Management

Research Article

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ABSTRACT

This experiment was carried out for a period of 4 weeks with 240 day old straight-run broiler (Cobb-500) chicks to investigate the effects of administering electrolytes in drinking water on the productive performance (live weight, body weight gain, feed consumption, feed conversion and water consumption) and to determine the economic impact of using electrolytes. The chicks were randomly distributed into three different treatments: control (without electrolyte supplementation), continually supplemented electrolyte group and intermittently supplemented electrolyte group (when temperature rose to 30 °C or above). Statistically significant (P<0.001) differences in body weight and body weight gain were observed among treatments with the highest final body weight and body weight gain in birds that received electrolytes. Analysis of performance data showed significant difference in feed conversion (P<0.05) and also in water consumption (P<0.01). Birds of continuously supplemented electrolyte group and intermittently supplemented electrolyte groups showed significant improvement in feed conversion. Economic returns tended to be higher (P<0.05) in the continuously electrolyte supplemented group. Data suggest that both continuous and intermittent supplementations of electrolyte during summer improve the feed conversion in broilers. Thus electrolytes may be supplied to broilers during summer but additional feeding trial would be helpful to fully evaluate the impact of additional electrolytes.

KEY WORDS: broiler management, broiler production, electrolytes, summer stress.

INTRODUCTION

The broiler industry is growing rapidly in Bangladesh as an important part of commercial poultry enterprise and provides a large part of increasing demand for animal protein, cash income and creates employment opportunities. Poultry meat, especially chicken meat, is the most desirable animal protein and is acceptable for most of the people of all castes and religious. Broiler growers are interested in approaches that promote better growth and economic production. However, high ambient temperature is one of the most important problems for poultry production in tropical countries (Fox, 1980) and modern fast growing broilers are facing difficulties in coping with heat stress (Bohren et al. 1982). The continuous selection for fast growth has been associated with increased susceptibility of broilers to heat stress (Geraert et al. 1993; Cahaner et al. 1995 and Berong and Washburn, 1998). High temperature is the major limiting factor in poultry production in many tropical areas of the world and the problem becomes severe when high temperature is accompanied by high humidity (Charles et al. 1978). The consequences of heat stress are reduction in feed in-
take, retardation of growth rate (Howlider and Rose, 1987) and mortality (Arjona et al. 1988) growth rate, feed efficiency. It is assumed that in summer mortality and reduced performance of flock cause BDT 1240 millions of loss to the poultry industry in Bangladesh. Teeter et al. (2000) reported that one of the best methods used to control heat stress is the chemical management of the acid base balance by supplementing feed or water with different electrolyte salts such as sodium bicarbonate (NaHCO₃), potassium chloride (KCl), calcium chloride (CaCl₂) and ammonium chloride (NH₄Cl). These electrolytes in different amounts and proportions proved beneficial for broilers under different heat stress regimens. Supplementation of electrolytes in poultry diets is not normally practiced in Bangladesh. The application of electrolytes has captured the attention of poultry nutritionists in Bangladesh; however, it is not known whether supplementing broiler drinking water with electrolytes during the summer would have both cost and performance benefits. The objective of this study was: to study the effects of administration of electrolytes in drinking water on production performance of broilers and assess the comparative cost, return and profitability of producing broilers during summer. Taking above significance, the present study was conducted.

MATERIALS AND METHODS

A feeding trial was conducted on 240 day old straight run broilers (Cobb 500) for a period of 28 days (from 14th March to 10th April, 2011) at Alutola Poultry Farm, Sylhet to investigate the effects of supplementation of electrolytes on the production performance of broilers during tropical summer stress. Birds were fed ad libitum on a basal starter diet (containing 11% moisture, 245 g/kg crude protein, 50 g/kg fat, 40 g/kg crude fibre, 14 g/kg lysine, 6.5 g/kg methionine, 12 g/kg calcium, 7.5 g/kg available phosphorus and 15.11 MJ metabolizable energy) up to 10 days of age. Thereafter, they were fed on a grower diet (containing 11% moisture, 240 g/kg crude protein, 50 g/kg fat, 40 g/kg crude fibre, 14 g/kg lysine, 6 g/kg methionine, 12 g/kg calcium, 7.5 g/kg available phosphorus and 14.65 MJ metabolizable energy) for 11-21 days and the rest of the days (22-28 days) with broiler finisher diet (containing 11% moisture, 240 g/kg crude protein, 50 g/kg fat, 40 g/kg crude fibre, 13 g/kg lysine, 6 g/kg methionine, 12 g/kg calcium, 7.5 g/kg available phosphorus and 14.65 MJ metabolizable energy) on ad libitum basis. The day of age broilers were divided into 3 treatment groups; each group contained 80 chicks and 4 replications in each, with 20 chicks per replicate. One group of chicks was maintained as a control (without electrolytes), the second group received electrolytes continuously, and the third group received intermittent electrolytes when the temperature was at ambient temperature of 30 °C or above in a Completely Randomized Design. Data recorded comprised body weight, feed consumption, water consumption and survivability for each replication. Temperature and relative humidity were recorded every 4 hours. The body weight gains, water consumption and feed conversion of broilers in each replication were calculated. Responses of birds to electrolyte supplementation in the drinking water were subjected to ANOVA to analyze if significant differences were present between the treatment groups (SAS, 1986).

RESULTS AND DISCUSSION

Final body weight

The data is presented in table 1 showing the differences in final body weight and weight gain of the birds. It appears that the differences in final body weight (g/bird) and body weight gain (g/bird) of birds receiving electrolytes in drinking water were higher (P<0.001) than in controls (T2) and than the intermittently electrolyte (T3) group. Initial body weight of day old broilers was higher (P<0.05) in the control group. The continuous electrolyte group displayed the highest body weight (1599.96 g; P<0.05) and were followed by the intermittently electrolyte group (1535.93 g). The birds of the control group had the lowest final body weight (1528.54 g). The significant effect of electrolytes on body weight gain did not agree with Nessa (2008) and Rondon et al. (2000) who did not find any beneficial effects of dietary electrolyte balances (DEB) of 300 mEq/kg diets in broilers. The present findings did also not agreed with Borges et al. (2004a) used colostomized male broiler chickens and reported no significant effect of the DEB treatments (140, 240, or 340 mEq/kg) on body weight gain in birds exposed daily to cyclic heat stress (22.5±3.5 °C for 14 h and 33±2.0 °C for 10 h). Improvements in growth performance recorded with KCl supplementation agree with those reported by Teeter and Smith (1986), Smith and Teeter (1987), Deyhim and Teeter (1992) and Osman (2000) who reported that KCl managed to improve growth performance of thermally stressed broilers. They attributed the beneficial effect of supplemental KCl to increased water consumption over the control which work as heat sink for broiler body heat, hence could combat heat stress. On the other hand, Ait-Boulahsen et al. (1995) suggested that the beneficial effect of KCl on growth rate may not be attributed to K⁺ alone due to severely depletion under heat stress, may be involved. Hurwitz et al. (1973) while studying the impact of cation / anion ratio (Na⁺/K⁺/Cl⁻) noticed that broiler growth rate was the greatest when blood pH was 7.28 and it reduced when pH values were greater than 7.30 or lower than 7.20. However, it is still to be defined whether the response was totally due to change in pH or to other electrolyte or metabolic effects.
Cohen and Hurwitz (1974) indicated that the dietary addition of Na⁺ (without Cl⁻) increased plasma HCO₃⁻ and pH, while Cl⁻ addition (without Na⁺) reduced plasma HCO₃⁻ and pH, whereas the addition of both as NaCl (salt) caused a little change in plasma HCO₃⁻ and pH.

Rondon et al. (2001) and Murakami et al. (2001) established with modern broiler strains and practical diets, an optimal DEB for the starter phase between 246 and 315 mEq/kg and for the grower one between 249 and 257 mEq/kg. Fixter et al. (1987) mentioned that optimal DEB for growing broilers varied with ambient temperature, at 250 mEq/kg for moderate temperatures (18 to 26 °C) and 350 mEq/kg for higher temperatures (25 to 35 °C).

**Feed consumption**

The highest feed intake was for the broilers in the control group (P>0.05) 2130.60 g and this was followed by continuously supplied (T₂) electrolyte group (2113.93 g) and intermittently supplied (T₃) electrolyte group (2057.45 g) respectively.

This result concur with those of Nessa (2008), who concluded that use of dietary electrolyte balance (DEB) of 300 mEq/kg could not affect feed intake. The present findings also agree with Borges et al. (2003a) who observed that DEB 240 mEq/kg reduced feed intake and weight gain.

Rondon et al. (2000) observed the best EB as 250 mEq/kg when Na⁺ levels varied and 319 mEq/kg when K⁺ was manipulated. Similarly, in growing (21-42 d) broilers maximum feed intake was noted by Borges et al. (2004b) in DEB 264 mEq/kg treatment, when Na⁺ level was increased in the diet, and 213 mEq/kg, when K⁺ and Na⁺ levels were concurrently increased in the diet. This indicates that there is a limit over which feed intake is depressed as a function of excessive Na⁺ and / or K⁺.

**Feed conversion ratio**

The results of feed conversion showed significant (P<0.05) differences between electrolyte supplemented and control groups.

Feed conversion was best in the continuously electrolyte supplied group (1.32), intermediate in the intermittent group (1.34) and worst in the control group (1.39). The results of feed conversion almost agreed with the findings of Nessa (2008), who showed significant (P<0.05) differences between electrolyte supplemented and control groups but did agree with the findings of Vieites et al. (2004). They reported that supplementation of electrolytes (KCl and NaHCO₃) in drinking water to male Ross chicks from 1 to 21 days of age at a constant DEB (dietary electrolyte balance) of 250 mEq/kg diet during the extreme summer stress may improve the feed conversion of broiler. In contrast, the findings of Flemming et al. (2001) differed from those reported here, their comparison of three different DEB (Na⁺ K⁺ Cl⁻) levels i.e., high, medium and low, in male broilers during the summer season found that feed conversion was not affected by the DEB. Borges et al. (2003a) noticed that DEB 240 mEq/kg gave the best body weight gain and feed conversion ratio versus DEB 0, 120, and 360 mEq/kg, in broiler rose during summer season (max. 31 °C, min. 23 °C; RH 75.5%). The DEB 340 mEq/kg resulted in worse feed conversion that may be due to excess Na⁺ (0.45%) in the diet (Ahmad and Sarwar, 2006).

**Survivability**

There was no significant variation (P>0.05) in survivability among treatments and control groups. During the experimental period, two birds died from Colibacillosis infection in continuous electrolyte supplied group for Colibacillosis, another two birds died in control group due to heat stroke and only one bird died in intermittent electrolyte supplemented group due to heat stroke. This results of survivability showed that supplementation of electrolytes had no effect on mortality. The results of survivability almost agreed with the findings of Nessa (2008) who showed that sup-

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control (T₁)</th>
<th>Continuously electrolyte (T₂)</th>
<th>Intermittently electrolyte (T₃)</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean±SD</td>
<td>Mean±SD</td>
<td>Mean±SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial body weight (g/bird)</td>
<td>39.00±0.14⁴</td>
<td>38.30±0.28⁴</td>
<td>38.41±0.46⁴</td>
<td>*</td>
</tr>
<tr>
<td>Final body weight (g/bird)</td>
<td>1528.54±47.79⁶</td>
<td>1599.96±15.38⁴</td>
<td>1535.93±52.42⁴</td>
<td>***</td>
</tr>
<tr>
<td>Body weight gain (g/bird)</td>
<td>1489.55±47.66³</td>
<td>1516.6±15.33³</td>
<td>1497.5±52.63³</td>
<td>***</td>
</tr>
<tr>
<td>Feed consumption (g/bird)</td>
<td>2130.60±86.79</td>
<td>2113.93±22.29</td>
<td>2057.45±60.04</td>
<td>NS</td>
</tr>
<tr>
<td>FCR (g feed/gain)</td>
<td>1.39±0.02⁴</td>
<td>1.32±0.01⁴</td>
<td>1.34±0.05⁴</td>
<td>*</td>
</tr>
<tr>
<td>Survivability (%)</td>
<td>97.92±2.41</td>
<td>97.92±2.41</td>
<td>98.96±2.09</td>
<td>NS</td>
</tr>
<tr>
<td>Water consumption (mL/bird)</td>
<td>4335.17±86.46⁵</td>
<td>4739.95±20.06⁴</td>
<td>4556.70±72.60⁵</td>
<td>**</td>
</tr>
</tbody>
</table>

The means within the same row with at least one common letter, do not have significant difference (P>0.001; P>0.01 and P>0.05).

*** P<0.001; ** P<0.01; * P<0.05 and NS: non significant.
plementation of electrolytes had no effect on survivability (P>0.05).

The present findings also agree with Borges et al. (2003a) who observed non-significant effects of DEB treatments (0, 120, 240, 360 mEq/kg) on mortality in broilers reared under moderately high ambient temperature and relative humidity’s, in both starter (0-21 d) and finisher (21-42 d) phases. Similarly, Deyhim and Teeter (1995), showed that supplementing drinking water with isomolar (0.067 mol/L) KCl or NaCl did not affect survivability of broilers reared in thermo neutral and cycling heat stressing environments. Borges et al. (2004b) did not notice any significant effect of DEB (40, 140, 240 and 340 mEq/kg) on the livability of growing (21-42 d) broilers reared in mild environment.

Musthaq et al. (2005) reported non-significant effect of increasing levels of dietary Na (0.20, 0.25, and 0.30%) and Cl (0.30, 0.40, and 0.50%) on mortality (0 to 2.78%) in heat stressed (32-39 °C) 28-days-old broilers.

**Water consumption**

Water consumption was highest (P<0.01) in the continuously electrolyte (T2) supplied group (4739.95 mL), intermediate in intermittently electrolyte (T1) supplied group (4556.70 mL) and lowest in the control (T3) group (4335.17 mL). Water consumption showed an apparently linear increasing trend with the supplementation of electrolyte during heat stress period.

The results of water intake almost agreed with the findings of Nessa (2008), who showed an apparently linear increasing trend with the supplementation of electrolyte during heat stress period. The present findings agreed with Borges et al. (2004a) reported increased water consumption in colostomized male broiler chickens by 22.4% from 254 to 300 mL/kg0.75 in heat stress (22.5±3.5 ˚C) for 14 h and 33±2.0 ˚C for 10 h) compared to thermo neutral environment.

**Cost of production**

The cost items included expenditures on chick, feed, litter, electrolyte, vaccines, labor, electricity and miscellaneous items. From Table 2, it is clear that net profit per bird and net profit per kg bird were different between treatments (P<0.05).

<table>
<thead>
<tr>
<th>Cost items</th>
<th>Control (T1) Mean±SD</th>
<th>Continuous electrolyte (T2) Mean±SD</th>
<th>Intermittent electrolyte (T3) Mean±SD</th>
<th>Level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chick Cost (Tk/bird)</td>
<td>37.00±0.00</td>
<td>37.00±0.00</td>
<td>37.00±0.00</td>
<td>NS</td>
</tr>
<tr>
<td>Feed cost (Tk/bird)</td>
<td>72.44±2.95</td>
<td>71.87±0.76</td>
<td>69.95±2.04</td>
<td>NS</td>
</tr>
<tr>
<td>Maintenance cost (Tk/bird)</td>
<td>22.79±0.00</td>
<td>22.79±0.00</td>
<td>22.79±0.00</td>
<td>NS</td>
</tr>
<tr>
<td>Electrolyte cost (Tk/bird)</td>
<td>0.00±0.00</td>
<td>0.85±0.00a</td>
<td>0.60±0.00b</td>
<td>**</td>
</tr>
<tr>
<td>Total Cost (Tk/bird)</td>
<td>132.23±2.95</td>
<td>132.51±0.76</td>
<td>130.34±2.04</td>
<td>NS</td>
</tr>
<tr>
<td>Total Cost (Tk/kg BW)</td>
<td>86.52±1.06a</td>
<td>82.82±0.72a</td>
<td>84.92±2.69a</td>
<td>*</td>
</tr>
<tr>
<td>Sale price (Tk/kg BW)</td>
<td>115.00±0.00</td>
<td>115.00±0.00</td>
<td>115.00±0.00</td>
<td>NS</td>
</tr>
<tr>
<td>Sale price (Tk/bird)</td>
<td>175.78±5.50b</td>
<td>183.99±1.77a</td>
<td>176.63±6.03b</td>
<td>***</td>
</tr>
<tr>
<td>Profit (Tk/bird)</td>
<td>43.55±2.85b</td>
<td>51.48±1.59a</td>
<td>46.29±5.62b</td>
<td>*</td>
</tr>
<tr>
<td>Profit (Tk/kg BW)</td>
<td>28.47±1.07b</td>
<td>32.17±0.72a</td>
<td>30.07±2.69b</td>
<td>*</td>
</tr>
<tr>
<td>Increase in profit as compared to T1 (Tk/bird)</td>
<td>-</td>
<td>7.93</td>
<td>2.74</td>
<td>-</td>
</tr>
<tr>
<td>Increase in profit as compared to T1 (Tk/kg BW)</td>
<td>-</td>
<td>3.70</td>
<td>1.60</td>
<td>-</td>
</tr>
</tbody>
</table>

The means within the same row with at least one common letter, do not have significant difference (P>0.001; P>0.01 and P>0.05).

*** P=0.001; ** P=0.01; * P=0.05 and NS: non significant.

BW: body weight.
Net profit per bird and per kg broiler was slightly higher (P<0.05) in the treatment T2 were Tk 51.48 and 32.17 respectively than treatment T3 Tk 46.29 and Tk 30.07 respectively but treatment T2 was significantly higher from the treatment T1 Tk 43.55 and Tk 28.47 respectively.

The cost involvement for electrolyte supplementation showed significant differences (P<0.01) between T2 and T3. It was only Tk 0.85 and Tk 0.60/bird, respectively. Increase in profit in T2 and T3 as compared to T1 was Tk 7.93 and Tk 2.74/bird respectively and Tk 3.70 and Tk 1.60/kg respectively. The results of profit did not agree with the findings of Nessa (2008) who showed that net profit per bird and net profit per kg bird were similar in different treatments (P>0.05). The results of cost of electrolyte supplementation almost agreed with the findings of Nessa (2008) who showed significant differences (P<0.01) between T2 and T3 however it was only Tk 0.75 and Tk 0.50/bird respectively.

**CONCLUSION**

The result of the experiment indicated that the supplementation of continuous electrolytes in drinking water to broilers during summer improves highest body weight, feed conversion efficiency, increase water consumption and involves very little cost and relative profit.

**REFERENCES**


Mushtaq T., Sarwar M., Navaz H., Mirza M.A. and Ahmad T. (2005). Effect and interactions of sodium and chloride on...
broiler starter performance (one-to-twenty-eight days) under subtropical summer condition. Poult. Sci. 84, 1716-1722.


