Research Journal of Animal and Veterinary Sciences, 5: 58-63, 2010

Drinking Water Quality I: Effects on Broiler Chicks Performance During Summer Season

[1]T.E.E. Abbas, [2]E.A. ELzubeir and [3]O.H. Arabbi, [4]H.E. Mohamed

[1]Department of Poultry Production and Technology, Faculty of Agricultural Technology and Fish Science, University of Elneelein, Khartoum, Sudan, P.O.Box:12702
[2]Department of Poultry Science, Faculty of Animal Production, University of Khartoum, Khartoum North, Sudan, P.O. Box: 32
[3]Faculty of Animal Production, University of Gezira
[4]Department of Animal production, Faculty of Agricultural and Food Sciences, King Saud University, Kingdom of Saudi Arabia PO Box 2460; Riyadh 11451

Abstract: This experiment was carried out to examine the effects of different sources of water on broiler chick's performance during summer season. Samples of water were taken from different sources (commercial, Nile and well). Physical, chemical and bacteriological analysis of samples revealed that, levels of salinity, hardness, and alkalinity, Ca, Mg, Na and K in the well water were higher than those in the Nile and commercial water. Higher levels of sulphate and chloride were found in the commercial water. Total bacterial count was higher in the Nile water than in the commercial and well water. Water and feed consumption, water/feed consumption ratio, weight gain, feed conversion ratio, final live body weight and mortality rate of broiler chicks were not significantly (P> 0.05) affected by the different sources of water. Commercial water when given to broiler chicks during summer season resulted in significantly higher (P< 0.01) level of plasma potassium and inorganic phosphorous concentrations compared to well water. Nile and well water increased (P< 0.01) calcium concentration of plasma when offered to broiler chicks than did commercial water. Sodium and magnesium concentrations of plasma were not significantly (P> 0.05) affected by different treatments.

Key words: Drinking water, Broiler, Performance, Summer

INTRODUCTION

It is almost impossible to overemphasize the importance of water to poultry flocks. A chicken is 70 percent water; a loss of only 10 percent of that water will result in the bird's death. Ideally, water should be clear, odorless and tasteless for the poultry flock. It should have no bacteria in it. Certain levels of minerals and chemicals appear to have little or no effect on poultry flocks very much. But, when those levels exceed the norms, birds either sicken or stop drinking, or both. Additionally, bacteria in the water can have a serious impact on a flock. Most of the chemical reaction requires sufficient amount of water within the animal system. Deyhim and Teeter[6] found that drinking water supplemented with NaCl or KCl (0.067 mol/L) significantly increased mass gain and water consumption of broilers reared in cycling heat stressing environment, but had no effect on the plasma concentrations of Na^+, K^+ and aldosterone and rectal temperature. The results of this study indicated that broiler chickens in a heat stress environment are under osmotic stress and supplementing drinking water with 0.067 mol/L NaCl does not lessen this stress. Deyhim and Teeter[5] mentioned that, at 35ºC, supplementation drinking water with 0.39% NaCl decreased venous PCO_2 and HCO_3^-, increased PO_2 and had no effect on venous pH and water consumption relative to heat - distressed control. The authors suggested that, to a lesser extent NaCl reduces heat - distressed consequences by a mechanism as yet undefined. Hot summer, such as 32^0C days, will result in 2.5 - 3 times the water consumption of thermo-neutral days[2]. Therefore, effects of deviation in water contents are expected to be exaggerated during hot summer. Naseem *et al.*,[12] found that combination of potassium chloride

Corresponding Author: H.E. Mohamed, Department of Animal production, Faculty of Agricultural and Food Sciences, King Saud University, Kingdom of Saudi Arabia, PO Box 2460; Riyadh 11451
E-mail: hhgunied@yahoo.com

(1.5%) and sodium bicarbonate (0.5%) solutions supplementation alleviated the negative effects of heat stress (95 - 98.6 ؛F) in broilers, through improved weight gain and feed conversion ratio, and significantly increased serum K^+ and HCO_3^- levels. Branton *et al*.,[4] mentioned that in acute heat exposure, water and feed consumption of broilers were unaffected by supplementation of either NH_4Cl (6.25g/L) or $NaHCO_3$ (3.15g/L) to the drinking water. Water consumption was increased in birds given water containing 6.25g of $NaHCO_3$/L, while both feed and water consumption were severely limited by NH_4Cl at 31g/L. Water is a critical nutrient that receives little attention until a problem arises, and it should be kept in desirable levels and standards for better production. This experiment was conducted to examine the effect of different sources of water on broiler chick's performance and minerals content of plasma during hot summer.

MATERIALS AND METHODS

Poultry, Housing and Feeding: This experiment was conducted in these premises of Poultry Unit which belongs to the Department of Poultry Production, Faculty of Animal Production, University of Khartoum, Shambat, on a deep litter floor system. The house was an open-sided poultry house. A total of 72, one - day - old, unsexed commercial broiler chicks (Arbor acres) were purchased from a commercial farm. The mean environmental temperature in week 1, 2, 3, 4, 5, and 6 were 34.9, 34.7, 35.9, 35.8, 35.8, and 34.3^{0}C, respectively.

Experimental Design: Chicks were assigned into 18 pens in group of 4 birds in a pen. Experimental water was supplied to 6 replicates. All groups of chicks had approximately equal weights. Feed and water were provided *ad -libitum* throughout the experimental period. The same diet was fed to the all chicks which were formulated to meet or exceed the NRC[13] requirements of broiler chicks. Routine and occasional management, vaccination and medication were carried out as and when due.

Treatments: Water from different sources, river (Nile), well and commercial water (Crystal) were dealt with in this experiment. The first source of water was the tap water that comes from the Nile River, at Poultry Unit which belongs to Faculty of Animal Production, University of Khartoum, Shambat. The second source of water was the well at Khalifa Station, Karari (its depth is about 550 feet). It was obtained directly from the well. The third one, which used as the control, was commercial water (Crystal) from Arak Company for Food Industries.

Water first allowed running for several minutes to allow a representative fresh sample to reach the water outlet. Then a sterilized container was rinsed several times with the water to be sampled. Physical, chemical and bacteriological analysis of water were carried out to determine appearance, colour, odour, temperature, pH, total dissolved solids, total suspended solids, electric conductivity, turbidity, nitrate, nitrite, ammonia, hydrogen sulphide, sulphate, fluoride, iron, chromium, manganese, chloride, hardness, alkalinity, potassium, sodium and bacterial population[7,9].

Feed consumption, weight gain and feed conversion ratio were recorded weekly for the individual replicate of each treatment. Water consumption was recorded daily at 10:00 Am. At seventh day was recorded three times, at 10:00 Am, 2:00 Pm and 5:00 Pm. Water/ feed consumption ratio was calculated. Also upper and lower temperatures were measured daily. Mortality was recorded as it occurred. At the end of sixth week, blood samples were taken to measure plasma minerals concentration (sodium, potassium, calcium, magnesium and inorganic phosphorous).

Proximal analysis of the diet was carried out according to official method of analysis of AOAC[3]. Tables 1 and 2 showed the calculated composition and determined analysis (as % dry matter) of experimental diets. The data generated from the experiment was subjected to analysis of variance. Least Significant Difference (LSD) test was used to assess significance of difference between means as described by Little and Hills[10].

RESULTS AND DISCUSSION

Tables 3 and 4 show that levels of total dissolved solids and electric conductivity (salinity), hardness, alkalinity, calcium, magnesium, sodium and potassium in the well water were higher than those in the Nile and commercial water. Higher levels of sulphate and chloride were found in the commercial water. The concentration of chloride in the well water was higher than that in the Nile water. Total bacterial count was higher in the Nile water than in the commercial and well water.

Water and feed consumption, water/feed consumption ratio, weight gain, feed conversion ratio, final live body weight and mortality rate were not significantly ($P > 0.05$) affected by the different sources of water, as shown in Table 5. Table 6 shows that the broiler chicks received commercial water significantly increased ($P < 0.01$) plasma potassium and inorganic phosphorous concentrations compared to well water. Nile and well water significantly increased ($P < 0.01$) calcium concentration when offered to broiler chicks

Table 1: Calculated composition of experimental diets (%)

Ingredients	Broiler chicks		Layer hens
	Starter	Finisher	
Sorghum	61	63	57
Groundnut meal	30	25	15
Wheat bran	2	5	12
Super-concentrate (Provimi)	5	5	5
Lime stone	1	1	10
Salt	1	1	1
Calculated nutrient composition of the diet:			
Metabolizable energy (MJ\kg)	12.55	12.68	11.92
Crude protein (%)	23	21	17.2
Lysine (%)	1.25	1.00	0.70
Methionine (%)	0.41	0.40	0.45
Calcium (%)	1.00	1.00	3.62
Available phosphorous (%)	0.50	0.50	0.50

Table 2: Determined analysis (as % dry matter) of experimental diets

	Broiler chicks		Layer hens
	Starter	Finisher	
Dry matter (%)	93.8	93.47	93.69
Moisture (%)	6.20	6.53	6.31
Crude protein (%)	24	19	17.38
Ash (%)	12.64	9.73	8.33
Crude fiber (%)	5.26	6.06	8.80
Ether extract (%)	4.83	5.03	5.20
Nitrogen free extract (%)	47.07	53.65	53.98
Calculated metabolizable energy (MJ\kg)	12.11	12.60	12.44
Calcium (%)	1.29	1.2	3.7
Total phosphorous (%)	0.72	0.60	0.62

Table 3: Physical and bacteriological analysis of water obtained from different sources

Parameters	Commercial (Crystal)	Nile	Well
Appearance	Clear	Turbid	Clear
Turbidity (NTU)	0.16	35.7	0.82
Colour	Nil	28	Nil
Odour	-ve	-ve	-ve
pH	7.0	7.5	7.4
Temperature (ºc)	29	25	25
Electric conductivity (µs\cm)	180	207	400
Coliform (colonies\ 100 ml)	Zero	Zero	Zero
Total count (colonies\ 5 ml)	Zero	Uncountable	15

Table 4: Chemical analysis of water from different sources

Parameters	Commercial (Crystal)	Nile	Well
Total dissolved solids (mg\L)	90	104	200
Total suspended solids (mg\L)	Nil	32	Nil
Hardness (mg\L)	72	80	156
Alkalinity (mg\L)	35	90	200
Calcium (mg\L)	16	22.4	40
Magnesium (mg\L)	7.68	5.76	13.44
Sulphate (mg\L)	25	8	8
Chloride (mg\L)	16	8	12
Sodium (µg/ml)	15.97	13.50	23.32
Potassium (µg/ml)	0.55	1.70	3.83
Iron (mg\L)	Nil	0.01	0.01
Nitrite (mg\L)	Nil	0.001	0.001
Nitrate (mg\L)	Nil	6.16	7.48
Ammonia (mg\L)	Nil	0.16	0.01
Fluoride (mg\L)	Nil	0.19	0.22
Hydrogen sulphide (mg\L)	Nil	Nil	Nil
Manganese (mg\L)	Nil	Nil	Nil

Table 5: Effect of different sources of water on broiler chick's performance

	Sources of Water			±SE	LSD	
	Commercial (Crystal)	Nile	Well		5%	1 %
Water Consumption (ml/bird/week)	974.69[a]	983.2[a]	984.84[a]	56.36	169.84	234.88
Feed Consumption (gm/bird/week)	344.38[a]	370.9[a]	367.6[a]	9.05	27.29	37.72
Water/ Feed Consumption Ratio (ml/gm)	2.83[a]	2.65[a]	2.67[a]	0.13	0.39	0.53
Weight Gain (gm/bird/week)	159.2[a]	167.42[a]	165.05[a]	5.24	15.81	21.87
Feed Conversion Ratio (kg feed/ kg weight)	2.17[a]	2.22[a]	2.24[a]	0.05	0.15	0.21
Final Live Body Weight (gm/bird/week 6)	1022.22[a]	1065.28[a]	1035.42[a]	31.89	96.1	132.91
Mortality (%)	4.2	4.2	0.0	NS		

-Values are mean of six replicate groups of four birds each
SE: Standard error of the mean difference
a-c values in the same raw with different superscripts are significantly different.
**: Highly significantly different ($p < 0.01$)
NS : Not significant

than did commercial water. Sodium and magnesium concentrations were not significantly ($P > 0.05$) affected by different treatments.

There was no effect of higher level of Cl in the commercial water on the water and feed consumption, water/feed consumption ratio, weight gain and feed conversion ratio of broiler chicks during summer. This finding is similar to the results observed by Mushtag *et al.*[11], who reported that under subtropical summer conditions there was no effect of dietary Cl (0.5%) on water and feed consumption, water/feed consumption ratio, weight gain, feed conversion ratio or mortality rate of broiler chicks. Deyhim and Teeter[5] found similar response at high temperature that;

Table 6: Effects of different sources of water on Plasma minerals of broiler chicks

	Sources of Water			±SE	LSD	
	Commercial (Crystal)	Nile	Well		5%	1 %
Sodium (meq/ l)	128.0[a]	128.4[a]	127.3[a]	1.73	5.22	7.22
Potassium(meq/ l)	3.76[a]	3.63[ab]	3.50[b]	0.058	0.17[**]	0.24
Calcium (mg/100ml)	7.27[b]	7.65[a]	7.78[a]	0.115	0.35[**]	0.47
Magnesium (mg/100ml)	1.88[a]	1.79[a]	1.88[a]	0.055	0.17	0.23
Inorganic phosphorus (mg/dl)	3.95[a]	3.70[ab]	3.52[b]	0.091	0.28[**]	0.38

- Values are mean of six replicate groups of four birds each
SE: Standard error of the mean difference
a-c values in the same raw with different superscripts are significantly different.
**: Highly significantly different ($p < 0.01$).
meq/l: ml - equivalent per liter
Mg/dl: Milligram per deciliter

supplementation of 0.39% NaCl to the drinking water of broiler chicks had no effect on water consumption relative to the control. In contrast to these results, Deyhim and Teeter[6] observed that the addition of 0.067 mol/L NaCl and 0.067 mol/L KCl to the drinking water of broiler chicks increased mass gain and water consumption. In addition, Teeter and Smith[14] found that during heat stress supplementing drinking water with 0.15% KCl increased live weight gain and feed efficiency of broiler chicks.

An increase in plasma Ca concentration of broiler chicks given well water during summer may be due to higher level of K in the water as reported by Ait-Boulahsen *et al.*[1] who found that during heat stress addition of 0.6% KCl to the drinking water of male chickens resulted in higher plasma Ca concentration. Lower plasma K concentration of broiler chicks given well water during summer in spite of higher level of K in the water, may be due to the increase in plasma Na concentration of broiler chicks given well water, and there are inverse relationship between Na^+ and K^+ excretion as explained by Houpt[8] who reported that an increase in K^+ results in aldosterone release, which increases K excretion in urine and a fall of plasma K consequence.. In contrast to these results, Ait-Boulahsen *et al.*[1] reported that during heat stress addition of 0.6% KCl to the drinking water of male chickens resulted in higher plasma K concentration. Deyhim and Teeter[6] indicated no effect of K water on its level in plasma in broiler chicks. It could be concluded that different sources of water with different contents had no significant effect on broiler chick's performance during summer season.

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