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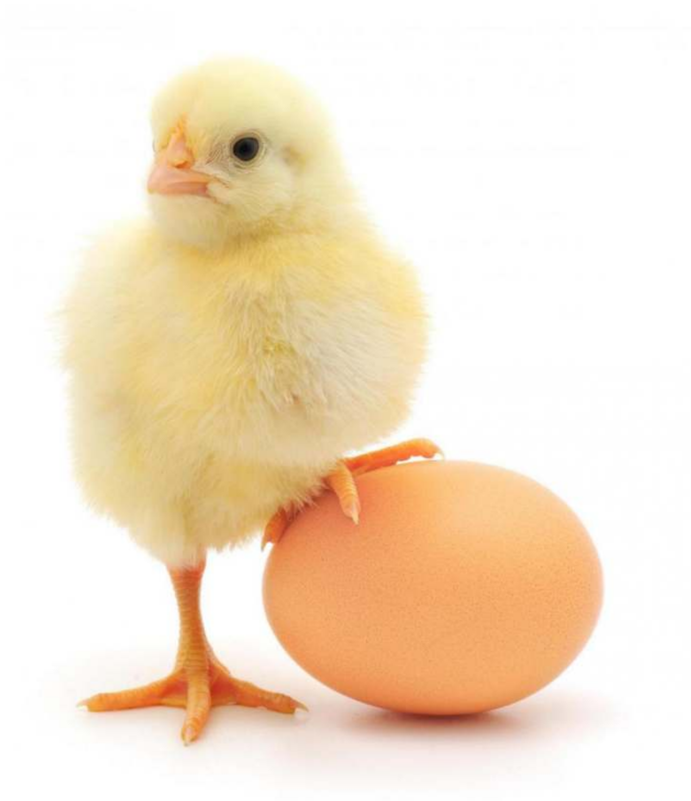

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Drinking Water Quality and its Effects on Broiler Chicks Performance During Winter Season

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Abstract: 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, 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. Then an experiment was carried out to detect the effects of different sources of water on broiler chicks performance and on plasma minerals contents. Broiler chicks given Nile water had significantly increased ($P<0.05$) water consumption than those given commercial water, also had significantly improved ($P<0.01$) feed conversion ratio and increased ($P<0.01$) water/feed consumption ratio than broiler chicks given commercial or well water. Commercial and Nile water resulted in a significantly higher ($P<0.01$) plasma sodium concentration than well water. Plasma potassium concentration was significantly higher ($P<0.05$) in birds given well and Nile water than birds consumed commercial water. A significant increased in ($P<0.05$) inorganic phosphorous concentration was observed in birds given commercial water than those birds given Nile water. Plasma calcium and magnesium concentrations of birds given different sources of water showed no significant differences ($P>0.05$).

Key words: Drinking water, broilers, plasma, minerals

Introduction

Water makes up a large proportion of the body of the chicken, from 55% to 75%, therefore it is essential for life (Nesheim *et al.*, 1979). Chickens are able to survive much longer without feed than without water (Scott *et al.*, 1982). A rule of thumb for water is that the bird consumes from 1.5 to 2 times as much water as it does feed (Kellems and Church, 2002). Therefore it is expected that deviation in water contents will affect broiler performance more than its occurrence in feed contents.

Quality of surface and ground water depends upon the naturally occurring inclusions such as cations, anions, heavy metals and inadvertent inclusions such as pesticides, herbicides and wash off of excessive organic or inorganic fertilizers and microorganisms. Drinking water is of concern to poultry producers due to its great variability in quality and its potential for contamination. Naturally occurring surface and ground water always containing inclusions ranging from low to very high concentrations (Zimmermann, 1998).

Watkins *et al.* (2005) observed that, levels of Na and Cl in drinking water and in the diet significantly affected live performance of broilers, with a significant interaction between dietary and water levels. The authors noticed that, water sources of Na and Cl can be used to provide part or all of a chick's need for these minerals and adjustments in dietary levels of Na and Cl should be made based on levels of these minerals in the drinking water.

Damron and Flunker (1993) performed two broilers experiments of 21 - day duration. A 5.25% sodium hypochlorite solution was used to provide chloride. The authors found that, water consumption was reduced by 100 p.p.m. chloride and body weight by 300 p.p.m.

Barton (1996) pointed out that, magnesium had an adverse effect on feed conversion of broilers and positively correlated with body weight. Magnesium was beneficial to feed conversion of turkeys, positively correlated with body weight and condemnation and negatively correlated with livability.

This experiment was performed to observe the effect of different sources of water with different contents on broiler chicks performance during winter season.

Materials and Methods

Experimental water: 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

Table 1: Calculated composition of experimental diets (%)

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

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

Broiler chicks	Starter	Finisher
Dry matter (%)	93.8	93.47
Moisture (%)	6.20	6.53
Crude protein (%)	24	19
Ash (%)	12.64	9.73
Crude fibre (%)	5.26	6.06
Ether extract (%)	4.83	5.03
Nitrogen free extract (%)	47.07	53.65
Calculated metabolizable energy (MJ\kg)	12.11	12.60
Calcium (%)	1.29	1.2
Total phosphorous (%)	0.72	0.60

the well at Khalifa Station, Karari (It's depth is about 550 feet). It was obtained directly from the well. The third one, which used as the control, was a commercial water (Crystal) from Arak Company For Food Industries.

Analysis of water: Water first allowed to run 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 (HACH, 2003; Lenore *et al.,* 1998).

This experiment was conducted in the 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. Chicks were assigned into 18 pens in group of 4 birds in a pen, in a complete randomized design. Each experimental water was supplied to 6 replicates. All groups of chicks had approximately equal weights. Feed

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 (^{o}C)	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 obtained 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

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, 1994) requirements of broiler chicks. Routine and occasional management, vaccination and medication were carried out as and when due. 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 temperature 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 (1980). Tables 1 and 2 show 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 (1978).

Table 5: Effect of different sources of water on broiler chicks performance during the period (0 - 6 weeks)

	Sources of Water				LSD	
	Commercial (Crystal)	Nile	Well	±SE	5%	1 %
Water Consumption (ml/bird/week)	744.45^{b}	848.84^{a}	814.83^{ab}	34.180	103.000	142.460
Feed Consumption gm/bird/week)	618.92^{a}	568.50^{a}	633.31^{a}	26.770	80.680	111.570
Water/ Feed Consumption Ratio (ml/gm)	1.25^{b}	1.49^{a}	1.29^{b}	0.050	0.151**	0.209
Weight Gain (gm/bird/week)	221.53^{a}	234.09^{a}	236.03^{a}	6.570	19.800	27.380
Feed Conversion Ratio (kg feed/ kg weight)	2.79^{b}	2.43^{a}	2.68^{b}	0.076	0.23**	0.318
Final Live Body Weight (gm/bird/week 6)	1377.30^{a}	1393.80^{a}	1461.20^{a}	49.710	149.820	207.190
Mortality (%)	0	0	0			

Values are mean of six replicate groups of four birds each. SE: Standard error of the mean difference. $^{a-c}$ values in the same row with different superscripts are significantly different. **: Highly significantly different ($p < 0.01$).

Table 6: Effect of different sources of water on plasma minerals of broiler chicks during the period (0 - 6 weeks)

	Sources of Water				LSD	
	Commercial (Crystal)	Nile	Well	± SE	5%	1%
Sodium (meq/ l)	122.8^{a}	125.20^{a}	114.0^{b}	2.42	7.3**	10.09
Potassium(meq/ l)	1.59^{b}	1.78^{a}	1.79^{a}	0.062	0.19	0.26
Calcium (mg/100ml)	8.50^{a}	7.95^{a}	7.8^{a}	0.382	1.15	1.60
Magnesium (mg/100ml)	2.61^{a}	2.48^{a}	2.55^{a}	0.138	0.42	0.58
Inorganic phosphorus (mg/dl)	7.43^{a}	6.01^{b}	6.60^{ab}	0.37	1.11	1.54

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

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.

Reduced water consumption and water/feed consumption ratio of broiler chicks given commercial water (Table 5) may be due to higher level of chloride in the water. Similar findings were reported by Damron and Flunker (1993). The authors found that, water consumption of broiler chicks reduced as chloride concentration of the water increased. Improved feed conversion ratio of broiler chicks that consumed Nile water when compared to those consumed well or commercial water appears to be due to the increased Mg content of well water and sulphate content of commercial water. Barton (1996) and Zimmermann et al (1993) obtained similar results. The authors reported that, increased Mg (Barton, 1996) and sulphate (Zimmermann *et al.,* 1993) contents of drinking water of broiler chicks resulted in worse feed conversion ratio.

The lack of the effects of water sources on weight gain agreed with the results reported by Zimmermann (1998). The author found that, contents of the drinking water had no effect on body weight of broiler chicks when the author used analysis for single element relationship. Contrary to these results, when the author used analysis for relationship between multiple elements the author found body weight was increased as hardness, pH and dissolved oxygen increased. In addition, Barton (1996) reported that body weight of broiler chicks increased as hardness, Ca and Mg increased. Further more, Zimmermann *et al.* (1993) found that, mortality rate of broiler chicks decreased as K, Cl and Ca levels in the drinking water increased.

High level of plasma K of broiler chicks given Nile or well water (Table 6) may be due to higher concentration of K in well and Nile water. Ait-Boulahsen *et al.* (1995) obtained similar results, the authors found that addition of 0.6% KCl to the drinking water of male chickens increased plasma K concentration. Lower level of plasma Na of broiler chicks given well water in spite of higher concentration of Na in the water may be due to inverse relationship between Na+ and K+ excretion as explained by Houpt (1984) 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 the same time aldosterone increases reabsorption of Na which increases plasma Na concentration. Contradictory to these findings Ait-Boulahsen *et al.* (1995) reported that, addition of 0.9% KCl to the drinking water of male chickens resulted in a marked increase in plasma Na concentration.

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