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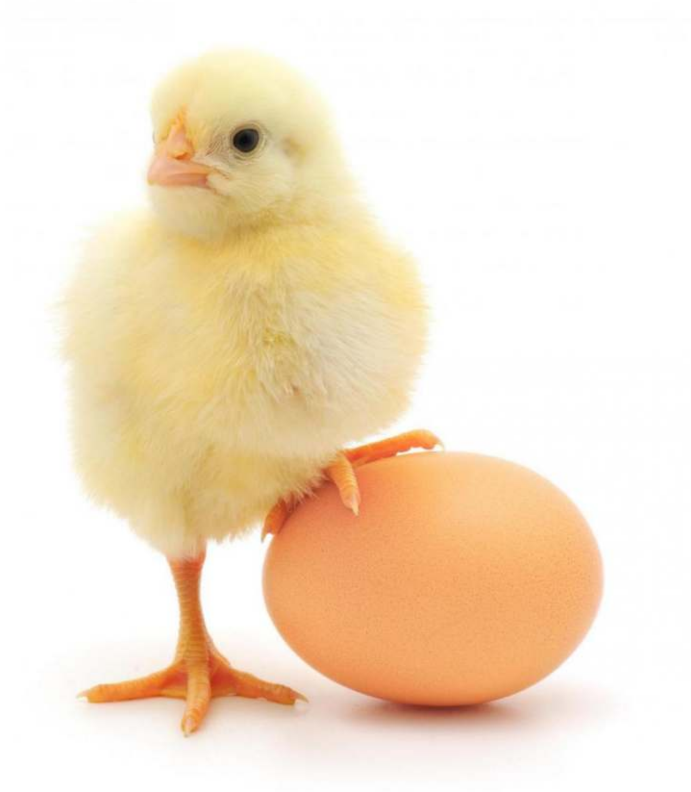

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Drinking Water Quality and its Effects on Productive Performance of Layers During Winter Season

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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 productive performance of layers during winter season. Layers consumed Nile and well water produced eggs with significantly increased ($P<0.01$) shell thickness than those consumed commercial water. Also it was observed that, layers given commercial water had significantly increased ($P<0.01$) levels of plasma sodium, potassium and calcium when compared to those hens given Nile or well water. A significant decreased ($P<0.05$) in magnesium concentration was observed in hens given commercial water than those given Nile or well water. Treatments had no significant effect ($P>0.05$) on egg production, feed conversion ratio, water and feed consumption, water/feed consumption ratio, egg weight, change in body weight and inorganic phosphorous concentration of the plasma.

Key words: Drinking water, layers, plasma, well water

Introduction

Mc Donald *et al.* (2002) mentioned that, water is vital to the life of the organism that the water content of the body be maintained, an animal will die more rapidly if deprived of water than if deprived of food. It also help to maintain homeostasis by participating in reactions and physiological changes which control pH, osmotic pressures, electrolyte concentrations and other functions necessary for life (Scott *et al.*, 1982). Several studies were performed to examine the effects of minerals contents of water on productive performance of layers. Pourreza *et al.* (1994) noticed that, NaCl given in the drinking water was more effective in reducing shell quality and increasing plasma calcium and phosphorus than NaCl given in the feed. Zhang *et al.* (1991) reported that, the incidence of eggs with defective shells doubled in hens receiving the saline drinking water. Damron and Flunker (1993) found that water consumption of older hens in cooler weather was adversely affected by 50 p.p.m. chloride, but egg production, egg weight or daily feed consumption were not reduced by 100 p.p.m. Fluoridated water increased the breaking strength of humeri and of tibia of caged layers. Also it increased the percentage of bone ash. Egg quality and rate of production were not reduced by the fluoride treatment (Merkley, 1981). Adams *et al.* (1975) noticed that, 4000 p.p.m. of total sulphate as Na_2SO_4 or $MgSO_4$ significantly decreased feed consumption and hen - day production. At that level, Na_2SO_4 significantly increased water consumption and faecal moisture content, while $MgSO_4$ significantly decreased water consumption. All hens on 11000 p.p.m. of either salt died during the experiment. No effect on egg quality was observed before the hen died. Damron and Flunker (1995) reported that, egg production and egg weight were not influenced by water borne calcium.

This experiment was performed to observe the effect of different sources of water with different contents on productive performance and plasma minerals concentration of layer hens 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 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.

Table 1: Calculated composition of experimental diets (%)

Ingredients	Layer hens
Sorghum	57
Groundnut meal	15
Wheat bran	12
Super-concentrate (Provimi)	5
Lime stone	10
Salt	1
Calculated nutrient composition of the diet:	
Metabolizable energy (MJ\kg)	11.92
Crude protein (%)	17.20
Lysine (%)	0.70
Methionine (%)	0.45
Calcium (%)	3.62
Available phosphorous (%)	0.50

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

	Layer hens
Dry matter (%)	93.69
Moisture (%)	6.31
Crude protein (%)	17.38
Ash (%)	8.33
Crude fibre (%)	8.80
Ether extract (%)	5.20
Nitrogen free extract (%)	53.98
Calculated metabolizable energy (MJ\kg)	12.44
Calcium (%)	3.70
Total phosphorous (%)	0.62

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 18 commercial laying hens (Hy-line) at the age of 22th week, were purchased from commercial farm. Birds were supplied with control water for week to adapt experimental water that provided after for six weeks. At the end of the week birds were assigned into 18 pens in group of 1 bird in a pen. Each experimental water was provided to 6 replicates. All groups of layers had approximately equal weight. Feed and water were provided *ad - libitum* throughout the experimental period. The same diet was fed to the all hens which were formulated to meet or exceed the (NRC, 1994) requirements of laying hens. Light was provided for 14 hours. Routine and occasional management, vaccination and medication were carried out as and when due. layers were weighed at the end of the adaptation period and before the beginning and after the end of the experiment to measure change in body weight. Eggs were collected two times a day at 9:00 Am and at 5:00 Pm, to measure daily egg production, egg weight and shell thickness. Feed consumption and feed conversion ratio recorded weekly. Water consumption was recorded daily at 10:00 Am. At day 7 water consumption was recorded three times, at 10:00 Am, 2:00 Pm and 5:00 Pm. Water/feed consumption ratio was calculated. Upper and lower temperature were measured daily. Mortality rate was recorded as it occurred. At the end of sixth week, blood samples were taken to determine plasma minerals concentration (sodium, potassium, calcium, magnesium and inorganic phosphorous).

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 (°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

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).

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

Table 5: Effect of different sources of water on productive performance of layers during six weeks (23 – 29 week)

	Sources of Water				LSD	
	Commercial (Crystal)	Nile	Well	±SE	5%	1%
Egg Production(%)	86.100^{a}	94.800^{a}	96.800^{a}	4.520	13.630	18.830
Water Consumption (ml/bird/day)	433.320^{a}	412.700^{a}	428.020^{a}	34.560	104.170	144.050
Feed Consumption (gm/bird/day)	159.450^{a}	155.250^{a}	148.080^{a}	7.520	22.660	31.330
Water/ Feed Consumption Ratio(ml/ gm)	2.715^{a}	2.671^{a}	2.889^{a}	0.176	0.531	0.734
Egg Weight (gm)	50.000^{a}	53.300^{a}	52.800^{a}	1.490	4.490	6.220
Feed Conversion Ratio (kg feed/kg egg)	3.780^{a}	3.075^{a}	2.902^{a}	0.299	0.900	1.244
Shell Thickness (mm)	0.530^{b}	0.570^{a}	0.590^{a}	0.010	0.03**	0.041
Change in Body Weight (gm)	+55.830^{a}	-20.830^{a}	+21.670^{a}	29.510	88.950	123.010
Mortality (%)	0	0	0			

Values are mean of six replicate groups of one bird 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 layers during six weeks (23 – 29 week)

	Sources of Water				LSD	
	Commercial (Crystal)	Nile	Well	±SE	5%	1%
Sodium (meq/ l)	130.83^{a}	121.50^{b}	121.00^{b}	1.46	4.41**	6.10
Potassium(meq/ l)	3.93^{a}	2.25^{b}	2.70^{b}	0.39	1.17**	1.62
Calcium (mg/100ml)	8.78^{a}	7.67^{b}	7.35^{b}	0.24	0.73**	1.00
Magnesium (mg/100ml)	2.32^{b}	2.97^{a}	3.02^{a}	0.18	0.55	0.77
Inorganic phosphorus (mg/dl)	3.55^{a}	3.78^{a}	4.32^{a}	0.39	1.19	1.65

Values are mean of six replicate groups of one bird 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.

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.

As observed from table 5 layers consumed Nile and well water produced eggs with significantly increased (P<0.01) shell thickness than those consumed commercial water. Treatments had no significant (P>0.05) effects on egg production, water and feed consumption, water/feed consumption ratio, egg weight, feed conversion ratio and change in body weight of layers. Mortality was not recorded related to water source.

The lack of the effects of commercial water chloride on the egg production, egg weight and daily feed consumption is in agreement with the findings obtained by Damron and Flunker (1993) who reported that, 100 p.p.m. Cl in the drinking water of layers in cooler weather had no effect on egg production, egg weight and daily feed consumption. In contrast to the recent research, Damron and Flunker (1993) found that water consumption of older hens was adversely affected by 50 p.p.m. chloride. Also higher levels of sulphate in the commercial water failed to produce adverse effects on feed and water consumption and egg production and this disagreed with the findings obtained by Adams *et al.*(1975) who reported that, 4000 p.p.m. of total sulphate as Na_2SO_4 or $MgSO_4$ significantly decreased feed consumption and hen – day production. At that level, Na_2SO_4 significantly increased water consumption and faecal moisture content, while $MgSO_4$ significantly decreased water consumption. The reduction in the eggshell thickness of layers given commercial water seems to be due to the higher level of Cl in the commercial water and higher levels of Ca in the well and Nile water. Pourreza *et al.* (1994) reported similar findings. The authors demonstrated that, increased NaCl intake through drinking water reduced eggshell thickness of layer hens. Damron and Flunker (1995) noticed that, eggshell quality was significantly improved when layers had low dietary Ca (2.25%) was supplemented with 0.2% Ca in the drinking water, but egg production and egg weight were not influenced by water borne calcium.

As shown in Table 6 layers given commercial water had significantly higher (P<0.01) levels of plasma sodium, potassium and calcium when compared to those hens given Nile or well water. A significant decreased (P<0.05) in magnesium concentration was observed in hens given commercial water than those given Nile or well water. The source of water had no significant effects (P>0.05) on plasma inorganic phosphorous concentration of layers.

Higher level of plasma Ca in layers given commercial water may be due to the higher level of Cl in the water.

Similar results were observed by Pourreza *et al.* (1994) who found that increased consumption of NaCl through drinking water increased plasma Ca concentration of layers. Different results obtained by Balnave *et al.* (1989) who pointed out that, supplementation of NaCl in the drinking water (600 and 2000 mg NaCl/L) to the layers had little effect on blood acid – base balance and electrolytes. In addition to these opposite results, Deyhim and Teeter (1995) found that addition of NaCl (0.067 mol/L) to the drinking water of broilers had no effect on the plasma concentrations of Na^+, K^+ and aldosterone.

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