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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Drinking Water Quality and its Effects on Productive Performance and Immune Response of Layers

Talha E.E. Abbas[1], Elfadil A. Elzubeir[2] and Omer H. Arabbi[3]
[1]Department of Poultry Production and Technology, Faculty of Agricultural Technology and Fish Science, University of Elneelain, Khartoum, P.O. Box: 12702, Sudan
[2]Department of Poultry Science, Faculty of Animal Production, University of Khartoum, Khartoum North, P.O. Box: 32, Sudan
[3]Department of Animal Health, Faculty of Animal Production, University of Gezira, Medani

Abstract: Samples of water were taken from two sources (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 water. Total bacterial count was higher in the Nile water than in the well water. Then an experiment was carried out to detect the effects of different sources of water on productive performance and immune response of immunized layers. The control (group A) was supplied with tap water that comes From Nile river. Group B was supplied with water from the same source and immunized with 0.2 ml of sheep red blood cells (SRBCs) at the end of the second week of the experiment. Group C was supplied with well water and immunized with SRBCs at the end of the second week of the experiment. After a 10 days interval group B and C were immunized with a second similar dose of SRBCs. different sources of water had no significant effect (P>0.05) on water and feed consumption, water/feed consumption ratio, egg production, egg weight, feed conversion ratio, change in body weight and on the total antibodies titres of layers when immunized with SRBCs.

Key words: Drinking water, quality, layers, immunity, production

Introduction

Al-Mufarrej *et al*. (2005) reported that, magnetically treated water did not influence antibody responses to sheep red blood cells (SRBC) antigens. Although, there is a long history of the promotion of magnets to improve the quality and health benefits of water.

Vodela *et al*. (1997a) noticed that, increasing levels of drinking water contaminants (arsenic, cadmium, lead, benzene and trichloroethylene) in the presence of low levels of vitamins and minerals in the diet resulted in a suppression of natural, humoral and cell – mediated immune response.

El-Hadri *et al*. (2004) studied the effects of feed restriction and glucose and electrolytes supplementation of drinking water on immune responses of poults with inanition. The authors observed that, feed restriction of poults to maintenance reduced the humoral immune responses. These responses significantly improved by drinking water containing electrolytes, glucose and citric acid. The response to electrolytes was significantly better than restricted feed only for the primary response. In general, supplementing water of these poults with electrolytes only (without glucose and citric acid) produced a modest effect on T - cell - dependent antibody production.

Materials and Methods

Experimental water: Water from different sources, river (Nile) and well 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.

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

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

house was an open sided poultry house. A total of 18 commercial layers (Hy-line) at the age of 22th week, were purchased from commercial farm. The history of layers before 22 weeks assured that birds were reared as well as recommended and fed a balanced diet.

Layers were assigned into 18 pens in groups of 1 bird in a pen. The same diet was fed to the all layers which were formulated to meet or exceed the (NRC, 1994) requirements of laying hens. Light was provided for 14 hours. In all five experiments each experimental water was supplied to 6 replicates. All groups of layers had approximately equal weights. Feed and water were provided ad -libitum throughout the experimental period. The control (group A) was supplied with tap water that comes From Nile river. Group B was supplied with water from the same source and immunized with 0.2 ml of sheep red blood cell SRBC at the end of the second week of the experiment. Group C was supplied with well water and immunized with SRBC at the end of the second week of the experiment. After a 10 days interval group B and C were immunized with a second similar dose of SRBC.

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 and egg weight. Feed consumption and feed conversion ratio recorded weekly.

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

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

Table 4: Chemical analysis of water obtained from different sources

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

Water consumption was recorded daily at 10:00 Am. Water/feed consumption ratio was calculated. Upper and lower temperature were measured daily. Mortality rate was recorded as it occurred.

Blood samples were collected from group B and C before the first dose of SRBC, then they were collected from all groups at days 5 and 10 post primary immunization and at similar intervals following secondary immunization to measure antibodies titre.

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.

Sheep red blood cell (SRBC) immunization method

Making SRBC batches: The blood was transferred into a plastic centrifuge tube (ca. 10 ml and was centrifuged for (10 minutes at 2000 rpm, lowest brake). The plasma was removed from the condensed cells at the bottom of the tube using a pipette. Phosphate buffered saline (PBS) was added to the cells (up to ca. 10 ml). Then cells were washed and dead and/or lysed cells were removed. The batch of SRBC was kept for one day in a fridge (4°C). To dilute the batch of SRBC, 49 ml of PBS were added to 1 ml washed SRBC.

Table 5: Effect of different sources of water on productive performance of layers during five weeks (23 - 28 week)

	Sources of Water				SSR (5%)	
	Nile (unimmunized)	Nile (immunized)	Well (immunized)	± SE	2 M	3 M
Egg Production(%)	77.61[a]	86.18[a]	85.23[a]	3. 82	11 .5	12.07
Water Consumption (ml/bird/day)	339.50[a]	333.66[a]	360.50[a]	18.56	55.87	58.65
Feed Consumption (gm/bird/day)	146.67[a]	150.89[a]	152.13[a]	6.84	20.59	21.61
Water/ Feed Consumption Ratio(ml/ gm)	2.35[a]	2.21[a]	2.39[a]	0.17	0.51	0.54
Egg Weight (gm)	51.70[a]	48.50[a]	52.10[a]	1.17	3.52	3.70
Feed Conversion Ratio (kg feed/kg egg)	3.67[a]	3.62[a]	3.43[a]	0.15	0.45	0.47
Change in Body Weight (gm)	43.33[a]	30.00[a]	26.66[a]	22.97	69.14	72.59
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. SSR: Shortest Significant Range. M: Mean

Table 6: Effect of different sources of water on the immune response of layers during five weeks (23 - 28 week)

	Sources of Water				SSR (5%)	
	Nile (unimmunized)	Nile (immunized)	Well (immunized)	± SE	2M	3M
Total Ab before immunization-	2.33	1.67	-	-	-	
Total Ab 5 days after first immunization	2.00[b]	8.00[a]	9.16[a]	1.00	3.01	3.16
Total Ab 10 days after first immunization	1.83[b]	8.33[a]	10.66[a]	0.99	2.98	3.13
Total Ab 5 days after second immunization	3.00[b]	9.17[a]	9.00[a]	0.64	1.93	2.02
Total Ab 10 days after second immunization	2.17[b]	6.33[ab]	9.83[a]	1.40	4.21	4.42

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. SSR: Shortest Significant Range. M: Mean. Total Ab: Total antibodies titre.

Separation of serum samples: 1 ml of blood was taken from each bird then put into marked Eppendorf aliquots. The blood samples was centrifuged for 10 minutes, 13000 rpm, brake 7(slow). The serum was transferred into a new marked aliquot using a pipette. The aliquots were stored at - 20ºC pending analysis.

Analysis of serum samples: The serum samples were taken from the freezer and placed in a polystyrene foam grid. The grid with the samples was placed in a 56°C waterbath for 30 minutes. Then the plates were prepared as follows: a plastic plate with 8 * 12 wells was used. The 12 rows were used to make a dilution series of 1:212. The 8 columns contained the serum samples. The columns were marked (sample no.). All 96 wells were filled with 50 µl PBS using a 12-fold pipette. The serum samples were diluted as follows: 50 µl serum were added to the 50 µl PBS in the first well of every 12 rows. First, mixed 3 – 5 times by sucking up with the pipette. Next, 50 µl were removed from this well and added to the next well (of the row) in the dilution series. Again, 50 µl were removed from this well, mixed and added to the next well. Then repeated for the remaining wells.

50 µl SRBC were added to all 96 wells. Then the grid with the serum samples was transferred to an incubator at 37°C for 1 hour. Then haemagglutination was checked. The (lowest) well number in the dilution series in which haemagglutination observed, was recorded. The number gives the titer of the antibody concentration (10 × cells per ml) (Hay and Hudson, 1989).

The data generated from the experiment was subjected to analysis of variance. Duncan's multiple range 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, chloride, calcium, magnesium, sodium and potassium in the well water were higher than those in the Nile water. Total bacterial count was higher in the Nile water than in the well water.

Table 5 shows that different sources of water had no significant effect (P>0.05) on water and feed consumption, water/feed consumption ratio, egg production, egg weight, feed conversion ratio and change in body weight of immunized layers. Mortality was not recorded related to water source.

The lack of the effects of well 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 addition, Chen and Balnave (2001) observed that, production of laying hens were not significantly affected by saline drinking water. Furthermore, Damron and Flunker (1995) assured that egg production and egg weight were not influenced by water borne calcium.

Table 6 shows that different sources of water had no significant effect (P>0.05) on the total antibodies titres at different intervals of layers when immunized with SRBC. This is similar to the findings of Khajali *et al.* (2006) who found that, withdrawal of trace minerals from a diet of broiler chicks did not influence the immuno - competence. Failure of higher levels of Ca and Mg in the well water to cause significant effect on the immune response of layers disagreed with results reported in the literature. Carpentieri *et al.* (1988) found that Ca and Mg were necessary for the growth of B-cells and T-cells of humans. In addition, Jaremin (1985) reported that, Mg takes part in the control of immunity processes. Furthermore, Miller (1985) reported that, the ability of animal to cope with infection may be influenced by mineral nutrition, in particular Mg and P.

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