Original Research Article

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Evaluation of Superficial Well Water on the performance and Immune response of Broiler Chickens Against Avian Influenza and Newcastle disease Vaccination in New Valley Governorate

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Abstract

A total of 200 unsexed 1-day old broiler chickens (Masr poultry) were used in this study in El-Dakhla City in the New Valley Governorate. They were randomly allocated into two groups of 100 birds in each. Groups were classified according to water source, (G1) received superficial well water (S) and (G2) received filtered water (F), that have been physically and chemically analyzed. The two groups received balanced formulated diet free from any additives and vaccinated with AI (H9) and ND vaccines. Weekly, five chicks were randomly collected and weighted (FI, BWG and FCR were estimated), At (1, 7, 15, 25, 35 days) 5 serum samples were examined for the antibody titers of AI (H9) and ND vaccines using HI test. The results of physicochemical water analyses recorded higher numerical values in superficial well group than filtered group which exceeded the permissible limits. There are significant differences among groups at (p>0.05) for most of the performance and immune parameters. (G2) showed a significant higher response for body weight (BWT), BWT gain (BWG), feed conversion ratio and antibody response to ND and AI (H9) virus vaccine. Our study showed that concentration of heavy metals residues in different tissues of broilers received Superficial well as (Fe, Mn, Pb and CD) recorded higher result as compared with filter group. In conclusion, In El-Dakhla City the superficial well water affect negatively on performance and immune parameters of broiler chickens

Keywords: Broiler's performance, Broiler's immunity, Heavy metals, Superficial well water.

Introduction

Poultry production has experienced a remarkable growth within the last 35 years. Despite a lot of challenges that facing the industry in its bid to reach viable level of production; some of these problems involve disease, low quality raw materials and most recently feed contamination during feed processing. Deposition of heavy metals in birds is due to the feeding of contaminated feed and water as well as exposure to various manufacturing processes of factories and industries Gabol et al., (2003).

Broiler chickens should be provided with water of high quality to reduce the negative effects on broilers health, these quality criteria were set by many agencies, but many breeders failed to maintain these standards and thus cause negative influences on performance and broiler's health Jafari et al., (2006). Also suppling water of low quality might reduce the effectiveness of the medications and vaccination provided to the broiler chickens during the fattening cycle Scandurra, (2013). Many types of studies reported that the addition of water additives was recommended to induce water quality as ionized alkaline water Jassim and Aqeel, (2017), potassium chloride, Yosi et al., (2017), silicon Sgavioli et al., (2016), water soaking of sweet orange Orayaga et al., (2016) and amino acid-chelated trace mineral Baxter et al., (2020).

All birds consume water as a source of nutrition. Improving the quality of drinking water can aid in the health of chickens. To evaluate water sources and guarantee their level is within an acceptable range, factors such as physio-chemicals, heavy metals, and microbiological load should be evaluated Maharjan et al., (2017).

Water is an essential component of life. Water aids digestion, absorption, and excretion of toxic compounds and excess salts by the kidney in many types of poultry, as well as supporting the endocrine gland's function Barney and Van Horn, (2003). Birds used roughly 40% of the drinking water to maintain a steady body temperature of 42°C Allam, (1986). Carter and Sneed, (1996). IT was noted that water quality is highly important for poultry, as an increase in the salt content of well water above the optimum level causes severe, destructive, and pathological effects on birds, resulting in high mortality and elimination. Consuming heavy metal-contaminated poultry is extremely harmful due to the accumulation of heavy metal residues in chicken tissues and organs El-Sarha and Hussein, (1994). The increased levels of drinking water contaminants such as arsenic, cadmium, and lead, along with low levels of vitamins and minerals in the diet, resulted in a deterioration of natural, humoral, and cell- immunological responses, resulting in a loss of poultry health Vodela et al., (1997).

Heavy metals, sometimes known as hazardous metals, are trace metals with a density greater than five times that of water. As a result, they are bio accumulative and stable elements (meaning they cannot be digested by the body). Mercury, nickel, lead, arsenic, cadmium, aluminum, platinum, and copper are among the heavy metals (the metallic form versus the ionic form required by the body). Heavy metals have no biological role and can be extremely harmful Mohammad et al., (2010).

Drinking water is one of the most important routes for administering poultry vaccines because it is cost-effective and saves time and labor. However, in recent years, the main complaints of poultry producers have been that they vaccinated their flocks against Newcastle disease and still have problems with this disease; the reason could be water quality, which may have an adverse effect on the efficacy of poultry vaccines, particularly modified live virus vaccines Abu Zaid, (1988).

The main issue facing the commercial poultry sector is infectious diseases. The most two serious pathogens affecting flocks of chicken worldwide Newcastle disease (ND) and Avian influenza (AI) are often regarded as having devastated economic effects on the poultry industry Eterradossi and Saif, (2013). By using both live and inactivated viral vaccines, both of diseases can be controlled Gallili and Ben-Nathan, (1998), Swayneand and King, (2003).

Our study is designed to evaluate the effect of Superficial Wells Water on the performance and Immune response of Broiler Chickens Against Avian Influenza and Newcastle Diseases Vaccination in New Valley Governorate

Materials and Methods

Chickens and experimental design

A total of 200 unsexed one day old broilers chicks obtained from Masr poultry were raised from day one till 5 weeks of age on deep litter with stocking density of 10 birds / m2. Water and feed were provided ad libitum during the experimental period, and the chicks received balanced formulated diet free from any additives (El-magd company). Birds were weighed then randomly allocated into 2 groups (G1 and G2) with the same average initial body weight. The first group, depend on ground water (superficial wells), the second group was regularly supplied with filtered water as control group. The two groups received AI (H9) and ND vaccines. two ml blood (5 birds/ group) was collected from chicks (at 1 day by slaughtering) while at (7, 15, 25, 35 days from the wing vein). Blood was centrifuged and serum was analyzed for the antibody titers of Newcastle disease virus and AI H9 using HI test.

Physical analysis of water samples

Water samples were collected for physical analysis according to APHA., (2005) Physical analysis of water samples was carried out to determine color, odor, taste, temperature, pH, EC, total hardness, TDS, according to HACH Company, (2003).

Chemical analysis of water sample

determine the levels of Lead, Iron, Manganese and Cadmium by using standard methods of American Public Health Association APHA, (1998) by Atomic Absorptions Spectrophotometer (Perkin Elmer-403).

Evaluation of performance parameters

Birds at 1 day old were weighed then randomly allocated into 2 groups with the same average initial body weight (45-47gm). Five chickens were weighed individually each weak to determine: Weekly feed intake, Body weight, body weight gain (BWG) and feed conversion ratio (FCR) were calculated as per formula according to Hassan et al., (2012).

FCR=Feed intake / body weight

Immune parameters

Estimation of antibody titers of Newcastle disease virus and Avian Influenza H9 by Hemagglutination Inhibition (HI) test:

Collection of serum samples

Blood was collected from wing vein, Serum was separated from respective clotted blood samples by centrifugation at 3000 rpm for 10 minutes, then the sera were collected in the Eppendorf tubes and labeled then stored in deep freeze at - 20˚C for further studies until hemagglutination –inhibition (HI) test was performed.

Serology

Presence of NDV and AIV antibody was detected by hemagglutination inhibition test as described by OIE, (2000) A cut off titer of 1:4 was considered specific indicating that the birds had been previously exposed to the virus, while titers less that this value were considered nonspecific Numan et al., (2005). A serum that was used as a negative control during the test was used to evaluate the results' validity. All blood samples had measured by HI titers, and each group's geometric mean titer (GMT) was estimated.

Heavy metals residues in different tissues:

Three birds from each group received heavy metals in drinking water were randomly selected at 35th days old for detection of the heavy metal residues in their muscle, liver and kidney. Samples were prepared and digested according to Hseu., (2004) using an Atomic Absorption Spectrophotometer (Thermo Electron Corporation, type S4AA sys. USA).

Statistical analysis:

Data were edited in MS Excel (Microsoft Corporation, Redmond, WA, USA). The Levene and Shapiro–Wilk tests were conducted in order to check for normality and homogeneity of variance Razali et al., (2011) One sample T -test was used to compare the significant differences between the permissible limits and the means of heavy metal and trace elements in different tissue as well as water quality. (Proc ttest; SAS., 2012 version 9, Cary, NC, USA) SAS Institute Inc. SAS/STAT Statistics user's guide, (2012). The significant effects of the sources were examined according to the One-way anova (PROC ANOVA) with the level of significance set at α = 0.05. Results were expressed as means ±SE. Tukeys' test was used to perform pairwise comparisons between means in case of a significant effect was detected. Figures were fitted by the GraphPad Prism software 5.0 (GraphPad, USA). Statistical significance was set at p-value less than 0.05.

Results

Table 1. Illustrate the physicochemical parameters of superficial wells

Well name	Physicochemical parameters							
	Turbidity	Taste	Odor	Temperature	PH	EC	TDS	Total Hardness
Said Ghames	7.11	Palatable	Inoffensive	29	6.47	692.19	443	190.1
EL-Hasan	8.23	Palatable	Inoffensive	28	7.25	587.81	503	306.3
Dashy	6.93	Palatable	Inoffensive	28	5.87	427.05	498	235.32
Mahran	4.05	Palatable	Inoffensive	30.5	6.68	623.36	589	495.06
Abd-Elaaziz	2.74	Palatable	Inoffensive	31.5	6.31	641.64	412	164.5
MIN	2.74	---	---	28	5.87	427.05	412	164.5
MAX	8.23	---	---	31.5	7.25	692.19	589	495.06
Mean ±SE	5.81±1.03	---	---	29.4±0.69	6.52±0.22	594.4±45.10	489±30.27	278.25±59.30
Standard WHO (2011)	0-4 NTU	---	---	---	6.8-8.5	≤500 mg/L	≤500 mg/L	180.0-200.0 mg/L

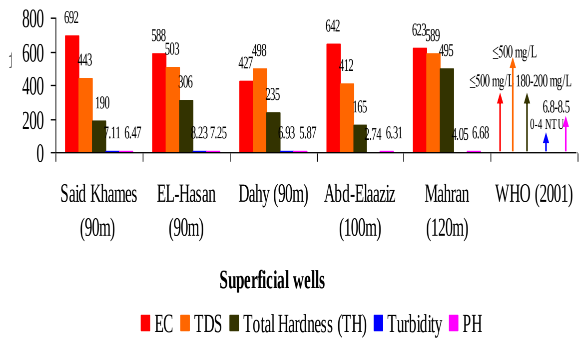

Figure 1. shows the Physicochemical examination of superficial wells.

Table 2. illustrate the of levels of some heavy metals (Fe, Mn, Pb and Cd) in superficial wells

Well name	Element (ppm)			
	Fe	Mn	Pb	Cd
Said Khames	10.7	0.5	0.26	0.16
EL-Hasan	12.62	1.31	0.15	0.12
Dahy	10.63	1.18	0.013	0.01
Mahran	7.04	0.33	0.014	0.12
Abd-Elaaziz	4.6	0.89	0.2	0.04
MIN	4.6	0.33	0.013	0.01
MAX	12.62	1.31	0.26	0.16
Mean ±SE	9.12±1.44	0.84±0.19	0.12±0.04	0.09±0.03
Standard WHO (2011)	0.3 mg/L	0.05 mg/L	0.01 mg/L	0.03 mg/L
Standard ECS (1994)	1.0 mg/L	---	0.05 mg/L	0.01 mg/L

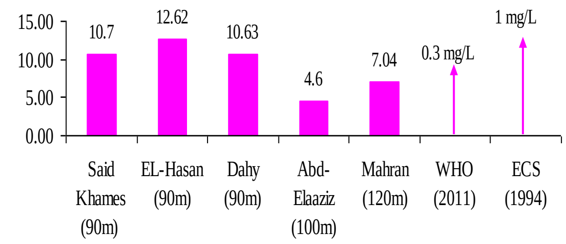

Figure 2. shows estimation of Fe levels in superficial wells.

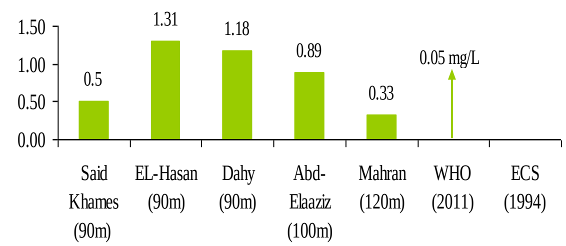

Figure 3. Shows estimation of Mn levels in superficial wells.

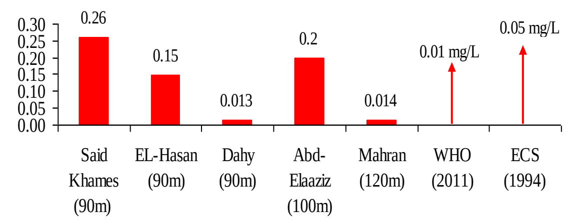

Figure 4. Shows estimation of Pb levels in superficial wells.

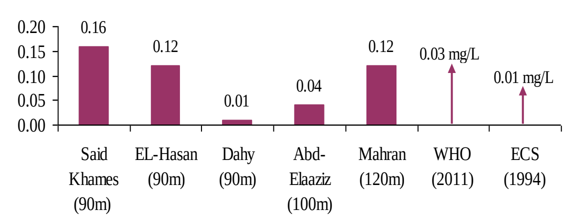

Figure 5. Shows estimation of Cd levels in superficial wells.

Table 3. Illustrate the physicochemical parameters of different water sources (superficial well and filtered water) used in the experiment.

Parameter	Water sources	MIN		MAX	Water quality standard	
Physicochemical Examination	G1(S)	G2(F)			WHO (2011)	ECS (1994)
Turbidity (NTU)	7.11	0.20	0.13	7.11	0-4 NTU	---
Odor	Inoffensive	Inoffensive	---	---	---	---
Temperature	29	20.5	20.4	45	---	---
Taste	Palatable	Palatable	----	---	---	---
PH	6.47	7.13	6.47	7.15	6.8-8.5	7
EC	692.19	25	25	692.19	≤500 mg/L	---
TDS (ppm)	443	16	16	443	≤500 mg/L	---
Total Hardness	190.1	11.6	11.6	190.1	180.0-200.0 mg/L	500
Fe	10.7	0.08	0.08	10.7	0.3 mg/L	1.0 mg/L
Mn	0.50	0.01	0.01	0.50	0.05 mg/L	---
Pb	0.26	0.01	0.002	0.28	0.01 mg/L	0.05
Cd	0.16	0.004	0.0001	0.16	0.03 mg/L	0.01

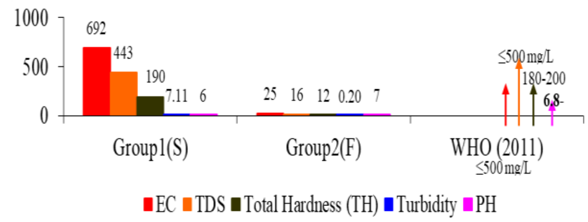

Figure 6. Shows the physicochemical parameters of different water sources (superficial well and filtered water) used in the experiment.

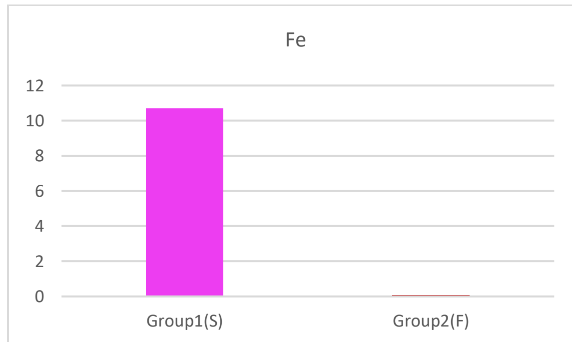

Figure 7. Shows the level of Fe in (G1) and (G2)

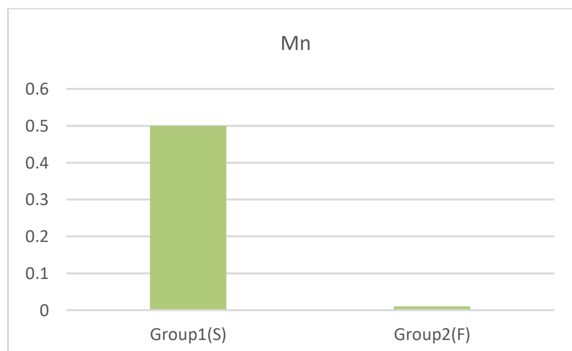

Figure 8. Shows the level of Mn in (G1) and (G2)

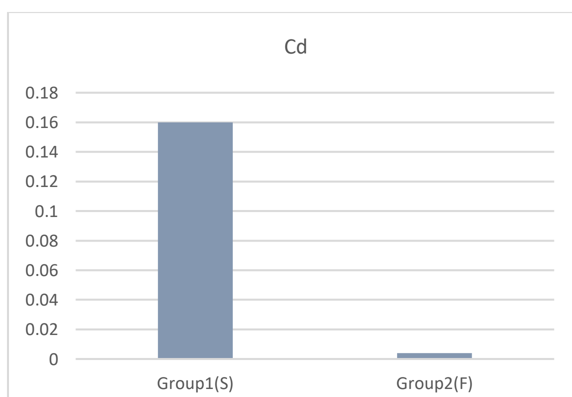

Figure 9. Shows the level of Cd in (G1) and (G2)

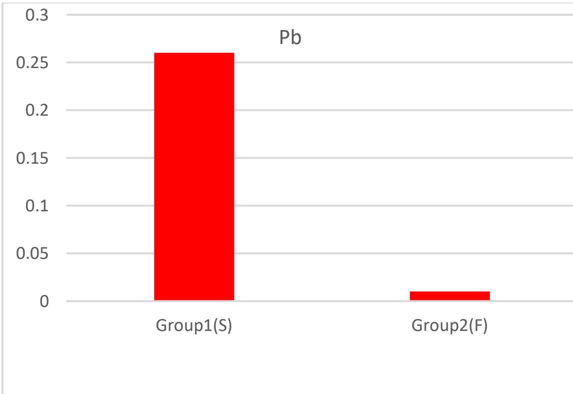

Figure 10. Shows the level of Pb in (G1) and (G2)

Table 4. Illustrate the effect of water source diversity on BWT of broilers at different weeks (g) of the experiment.

Parameters	Weekly body weight (g/bird)		*p*-value
	Group1(S)	Group2(F)	
1st week	196.2±9.21^{d}	236±1.00^{a}	0.0013
2nd week	552±27.86^{b}	730±10.95^{a}	0.0001
3rd week	976±68.29^{c}	1526±11.33^{a}	0.0001
4th week	1670±56.12^{b}	2120±46.36^{a}	0.0001
5th week	1980±174.35^{b}	2640±60.00^{a}	0.0001

* p-value was calculated according to one sample t test; a, b Means with different superscripts in the same row are significantly different (p<0.05, Tukey HSD test).

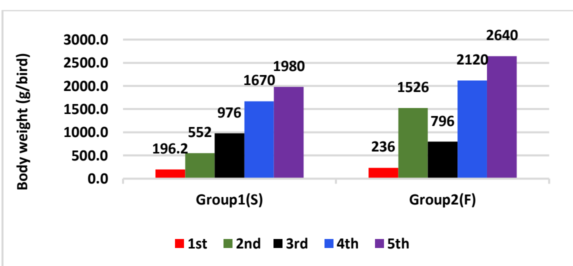

Figure 11. Shows BWT of (G1) and (G2) at different weeks of the experiment.

Table 5. Illustrate the effect of water source diversity on BWG/week of broilers at different weeks of the experiment.

Parameters	Weekly body weight gain (g/bird)		*p*-value
	Group1(W)	Group2(F)	
1st week	150.6±7.07^{b}	190.4±0.80^{a}	0.0021
2nd week	355.8±17.96^{b}	494±7.41^{a}	0.0001
3rd week	424±29.66^{c}	796±5.91^{a}	0.0001
4th week	694±23.32^{a}	594±12.99^{b}	0.0001
5th week	310±27.29^{b}	520±11.81^{a}	0.0001

(p<0.05, Tukey HSD test).

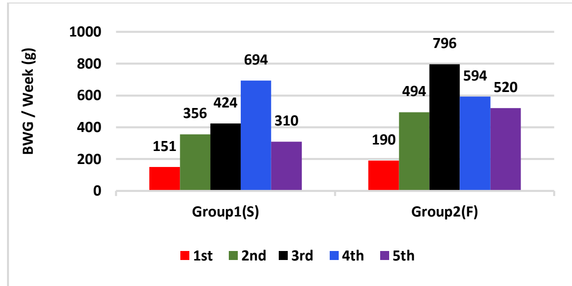

Figure 12. Shows BWG of (G1) and (G2) at different weeks of the experiment.

Table 6. Illustrate the effect of water source diversity on FI/(g/bird/day) of broilers at different weeks (g).

Parameters	FI (g/bird/day/)		p-value
	Group1(S)	Group2(F)	
1st week	17.5±0.82	15±0.10	0.1262
2nd week	88.57±4.47	78.57±1.17	0.0963
3rd week	125±8.75	125±0.93	0.3624
4th week	142.82±4.80	140±3.06	0.4421
5th week	167.85±14.78	171.42±3.89	0.1142

a, b Means with different superscripts in the same row are significantly different (p<0.05, Tukey HSD test).

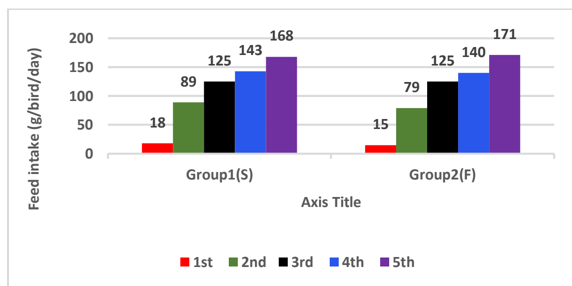

Figure 13. Shows FI of (G1) and (G2) at different weeks (g/bird/day) of the experiment

Table 7. Illustrate the effect of water source diversity on FCR of broilers at different weeks of the experiment.

Parameters	FCR		*p*-value
	Group1(S)	Group2(F)	
1st week	0.81±0.03^{a}	0.55±0.00^{c}	0.0110
2nd week	1.74±0.08^{a}	1.11±0.01^{b}	0.0002
3rd week	2.06±0.14^{b}	1.09±0.01^{d}	0.0001
4th week	1.44±0.04$^{a, b}$	1.64±0.03^{a}	0.0001
5th week	3.79±0.33^{a}	2.3±0.05^{c}	0.0001

a, b Means with different superscripts in the same row are significantly different (p<0.05, Tukey HSD test).

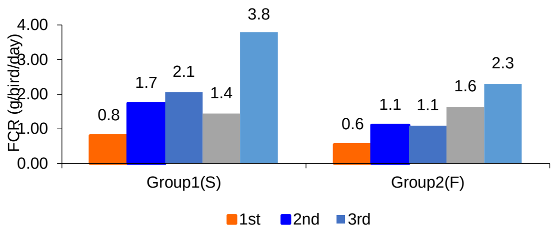

Figure 14. Shows the FCR of (G1) and (G2) at different weeks (g/bird/day) of the experiment.

Table 8. Illustrate the level of heavy metals (Fe, Pb, Cd and Mn) residues in liver(µg/g)

Parameters	Wells	Min.	Max.	Mean ± SE	Standard limits	*p*-value*
Iron	Group1(S)	33.1	34	34.03±0.54^{a}	30-150 µg/g WHO (2001)	ND
	Group2(F)	9	11	10.00±0.57^{c}		0.001
Lead	Group1(S)	6.5	7.5	6.96±0.29^{a}	0.5 µg/g WHO (2001)	0.001
	Group2(F)	0.32	0.40	0.35±0.02^{d}		0.066
Cadmium	Group1(S)	2.1	3.2	2.63±0.31^{a}	0.5 µg/g WHO (2001)	0.001
	Group2(F)	0.2	0.4	0.30±0.01^{b}		0.046
Manganese	Group1(S)	0.92	1.2	1.02±0.08^{a}	0.5 µg/g WHO (2001)	0.001
	Group2(F)	0.12	0.31	0.21±0.05^{c}		0.026

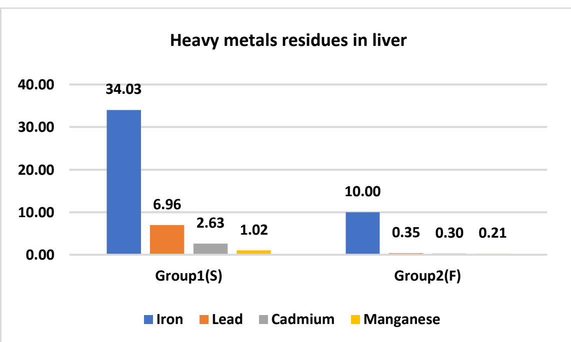

Figure 15. shows the level of Heavy metals residues (Fe, Pb, Cd and Mn) in liver.

Table 9. Illustrate the level of heavy metals (Fe, Pb, Cd and Mn) residues in kidney(µg/g)

Parameters	Wells	Min.	Max.	Mean ± SE	Standard limits	*p*-value*
Iron	Group1(S)	33.5	34.1	33.83±0.18^{a}	30-150 µg/g WHO (2001)	ND
	Group2(F)	12.2	13.2	12.83±0.32^{c}		0.001
Lead	Group1(S)	7.9	8.2	8.1±0.01^{a}	0.5 µg/g FAO (2012)	0.001
	Group2(F)	0.33	0.65	0.47±0.09^{d}		0.001
Cadmium	Group1(S)	3.2	3.5	3.36±0.08^{a}	0.5 µg/g FAO (2012)	0.001
	Group2(F)	0.22	0.49	0.33±0.08^{d}		0.050
Manganese	Group1(S)	0.89	1.2	1.06±0.09^{a}	0.5 µg/g WHO (2001)	0.001
	Group2(F)	0.11	0.31	0.19±0.06^{c}		0.001

* p-value was calculated according to one sample t test; a,b Means with different superscripts in the same row are significantly different (p<0.05, Tukey HSD test). ND, non-determined.

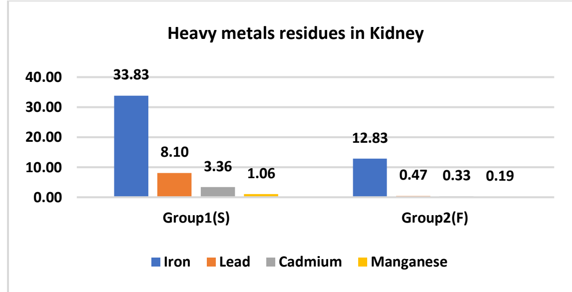

Figure 16. Shows the level of Heavy metals residues (Fe, Pb, Cd and Mn) in kidney

Table 10. Illustrate the level of heavy metals Fe, Pb, Cd and Mn) residues in muscle (µg/g)

Parameters	Wells	Min.	Max.	Mean ± SE	Standard limits	*p*-value*
Iron	Group1(S)	17.3	18.1	17.6±0.25^{a}	30-150 µg/g WHO (2001)	0.001
	Group2(F)	6.3	7.2	6.86±0.28^{c}		0.001
Lead	Group1(S)	0.8	1.5	1.06±0.21^{b}	0.1 µg/g WHO (2001)	0.001
	Group2(F)	0.10	0.15	0.12±0.01^{c}		0.143
Cadmium	Group1(S)	0.3	0.5	0.4±0.05$^{a, b}$	0.1 µg/g WHO (2001)	0.001
	Group2(F)	0.06	1.00	0.07±0.01^{c}		0.164
Manganese	Group1(S)	0.12	0.33	0.20±0.06^{a}	0.5 µg/g WHO (2001)	0.001
	Group2(F)	0.00	0.12	0.04±0.00^{b}		0.001

* p-value was calculated according to one sample t test; a, b Means with different superscripts in the same row are significantly different (p<0.05, Tukey HSD test).

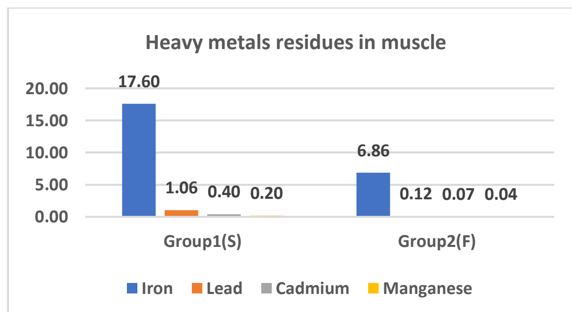

Figure 17. Shows the Level of Heavy metals residues (Fe, Pb, Cd and Mn) in muscle.

Table 11. Illustrate the antibody titers (zero day) of Newcastle disease virus and Avian Influenza H9 by Hemagglutination Inhibition (HI) test.

Disease	HI titer at zero day										Mean titer log 2
	1	2	3	4	5	6	7	8	9	10	
ND	--	--	--	--	--	--	--	--	2	3	9.6
AI(H9)	--	--	--	--	--	--	--	--	3	2	7.4

Table 12. Illustrate the antibody titers of Newcastle by Hemagglutination Inhibition (HI) test:

ND. V												
Age	**Group**	**HI Titer**										**Mean**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
7D	**G1(S)**							7	1			7.1
	G2(F)							7	1			7.4
15D	**G1(S)**				3	5						4.6
	G2(F)				4		3	1				5.1
25D	**G1(S)**			2	4	2						4
	G2(F)				2	3	3					5.1
35D	**G1(S)**			2			5	1				5.4
	G2(F)				1	1	2		3		1	7.4

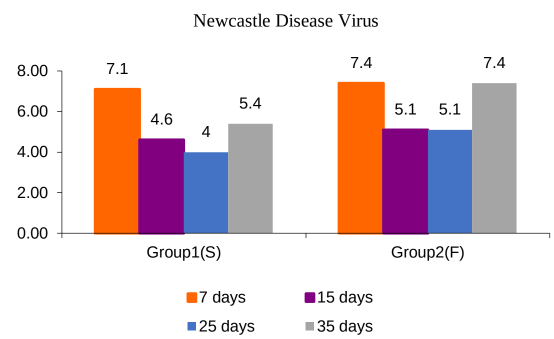

Figure 18. Shows the mean titer of ND vaccine in different age.

Table 13. Illustrate the antibody titers of AI H9 by Hemagglutination Inhibition (HI) test.

AI H9												
Age	**Group**	**HI Titer**										**Mean**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
7D	**G1(S)**						7	1				6.1
	G2(F)					1		4	3			7.1
15D	**G1(S)**			4	4							3.5
	G2(F)			4		3	1					4.1
25D	**G1(S)**			3	1	1	3					4.5
	G2(F)		2	1	3	1	1					3.8
35D	**G1(S)**			2	2	1	2	1				4.8
	G2(F)		1	1	2		2	1	1			5

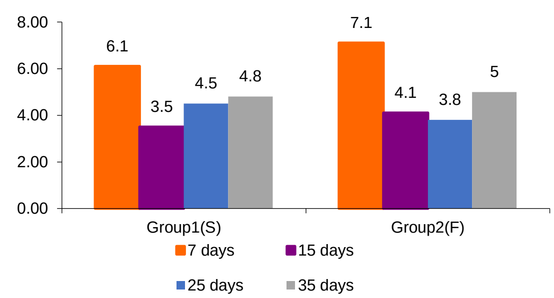

Figure 18. Shows the mean titer of AI(H9) vaccine in different age.

Discussion

The results in table (1) showed the physicochemical examination of most superficial wells were above the permissible limits WHO, (2011). the mean value of turbidity was 5.81±1.03. This value is higher than the result indicated by Talha et al., (2008). and Khalil and Khalafalla, (2011). While Osei et al., (2019). detected value above this current study. Taste and odor were palatable and inoffensive as the result reported by EL-Saidy et al., (2015). Temperature with mean value 29.4±0.69 which like Talha et al., (2008). The mean value of PH was 6.52±0.22 which is lower than the values of Sonousi, (2002), Abdel Wahab, (2008), Talha et al (2008). and Khalil and Khalafalla, (2011). while the closest result reported by SOLTAN, (1997). and Ibitoye et al., (2013). The mean value of TDS was 489±30.27, El-Ghazaly et al., (2008). revealed significant increase in TDS analysis, on the other hand Talha et al., (2008). reported lower value. Hardness with mean value was 278.25±59.30 mg/L. this value was low when parallel to Sonousi, (2002). but considered the nearest result to El-Ghazaly et al., (2008). [38] and Talha et al., (2008).

The obtained result in table (2) showed that the mean value of (Fe) was 9.12±1.44 mg/L. This result was higher than the permissible limit of World Health Organization WHO (2011). The results indicated by Sonousi, (2002). and Alshikh, (2011) were lower than this study. the maximum value of Fe that estimated by Omar, (2015) was nearly the same result of the current study. The recorded mean value of Mn was 0.84±0.19 mg/L, which is higher than that of WHO, (2011), SOLTAN, (1997) and Mandour and Azab, (2010). The mean value of Pb was 0.12±0.04 mg/L that exceeded the standard limit of WHO, (2011) and Omar, (2015) who mentioned higher result, while lower result reported by Mandour and Azab, (2010), Sonousi, (2002) but Abd-El-Kader et al., (2009) reported nearly similar result. Our study revealed 0.09±0.03 as mean value of Cd which is higher than that of WHO, (2011), Mandour and Azab, (2010), Alshikh, ((2010) and SOLTAN, (1997), while Sonousi, (2002) reported higher result.

In table (3) showed the data of noticeable difference between the two groups by the analysis of water samples, all results of (G1) either physical examination or measurement of heavy metal that exceeded the permissible limit were higher compared to (G2), on the contrary the filter group was less than the permissible limit of WHO, (2011).

The results at Table (4) and table (5) showed that (G2) had the highest values for most of the performance parameters as it reported the highest mean values BWT (body weight), BWG (body weight gain) in the 1st, 2nd, 3rd, 4th and 5th week of the experiment. On the other hand, (G1) group which supplied by superficial well water showed a significant decrease ($p<0.05$) in BWT and BWG.

Table (6) illustrate that (G1) recorded higher results of feed intake in the 1^{st}, 2^{nd}, and 4^{th} of the experiment while in the 5^{th} week (G2) reported higher result with no significant difference in the 3rd week among two groups.

The mean values of FCR in table (7) (G1) group which drink superficial well recorded a significant increase ($p<0.05$) in FCR throughout the experiment at the day 7 (1st week), 14(2nd w), 28(4th w), and 35(5thw). On the other hand, the results of (G2) showed the significant decrease ($p<0.05$). The same results were obtained by Bao et al., (2007) and EL-Saidy et al., (2015), while El-Ghazaly et al., (2008) didn't find difference in performance parameters with different water sources.

Table (8) showed the concentration of heavy metals (Fe, Pb, Cd and Mn) in liver of broilers in both (G1) and (G2), which referred that the Mean ± SE (34.03±0.54a , 6.96±0.29a , 2.63±0.31a and 1.02±0.08a µg/g) of Group1(S) reported higher value than Mean ± SE(10.00±0.57c , 0.35±0.02d , 0.30±0.01b and 0.21±0.05c µg/g) of (G2) respectively as well higher than permissible limit of WHO, ((2001).

The results in table (9) showed the Mean ± SE concentration residues (33.83±0.18a, 8.1±0.01a, 0.33±0.08d and 0.19±0.06c µg/g) of (Fe, Pb, Cd and Mn) in kidney of broilers that recorded rates higher than permissible limit of WHO, (2001) and FAO, (2010) in Group1(S). while (G2) recorded Mean ± SE (12.83±0.32c, 0.47±0.09d, 0.33±0.08d and 0.19±0.06c µg/g) which were less than the permissible limit of WHO, (2001) and FAO, (2010) respectively.

Table (10) illustrated that broilers received filtered water showed Mean ± SE (6.86±0.28, 0.12±0.01, 0.07±0.01 and 0.04±0.00b µg/g) of Heavy metals residues (Fe, Pb, Cd and Mn) in muscle which is lower than the permissible limit of WHO, (2001) such as results reported of Fe residues in (G1) which was (17.6±0.25), otherwise the Mean ± SE of Pb and Cd were (1.06±0.21b and 0.4±0.05a,b µg/g) respectively ,which recorded results higher than WHO (2001).

The current study showed that iron and manganese were accumulated with large quantity in liver, kidney, and muscle respectively, GHIMPEŢEANU et al., (2012) and Khalil et al., (2012), while lead and cadmium residue were the highest in the kidney then liver, and the lowest in the muscle, this results as that reported by Blagojevic et al., (2012). On the other hand, Okoye et al. (2015) recorded that the order of accumulation of heavy metals (Pb and Cd) in the internal organs of the chickens were liver > kidney > muscle.

Our study in table (11) stated that the mean titer of antibody of ND and AI (H9) vaccine at zero day was (9.6 and 7.4) respectively.

Table (12) showed that the mean titer of antibody of ND vaccine at day 7, 15, 25 and 35 of age in filter water group were higher than mean titer recorded in (G2).

The mean titer of AI vaccine of broilers supplied with well water (superficial) recorded titer lower than group received filtered water at 7, 15 and 35 days of age while 25 day reported highest mean titer.

Conclusion

In conclusion, the superficial well water has an adverse effect on body performance and immune parameters of broiler chickens against ND and AI (H9) disease virus vaccines.

Conflict of interest

The authors haven't conflict of interest to declare.

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