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EFFECT OF DRINKING MAGNETIZED WATER ON SOME PRODUCTION CHARACTERISTICS OF RABBITS

A. Helal[1], Eman Shamardal [1], H.H.M Hassanein[1], M.Y Mohamed[2]

1- Animal and Poultry Production Department, Faculty of Agriculture, Beni-Suef University. 2- Animal Production Research Institute (APRI), Agricultural Research center (ARC)

SUMMARY

Twenty eight weaned V-line rabbit bucks were divided randomly into four groups:group 1 (tap water without magnetizationas control), group 2 (magnetized tap water), group3 (well waterwithout magnetization) and group 4 (well water with magnetization). The experiment lasted for 11 weeks. Well water Salinitywas 4000 ppm and the strength of the magnet was 10000 Gauss. In the magnetized water groups, average daily gain, growth rate and feed conversion ratiowere increased while feed intake was decreased compared to thenon-magnetized water groups. Salinity significantly decreasedthe plasma levels of total protein (TP), albumin (ALB), and glucose (GLU). Magnetization increased insignificantly both TP and GLU while, increased insignificantlyALB and globulin. In both tap water groups, magnetized water significantly decreased in alkaline phosphatase (ALP) and creatinine (CRT) in the plasma. Magnetization of well water tended to decrease the alanine aminotransferase (ALT), aspartate aminotransferase (AST), ALP, Gamma-glutamyltransferase (GGT), total bilirubin (T-Bill),CRT, and blood urea nitrogen (BUN) in rabbits by 10%, 25%, 24, 25%, 27%, 58%, and 31%,respectively.It could be concluded that using magnetization especially with salinity water decreases the adverse effect of salinity and improves water quality for growing rabbits.

Keywords: Magnetization, Salinity, Blood parameters, Rabbit

INTRODUCTION

As the world population increases the demand for animal proteins increases (Abd El-Moniem *et al*., 2016). Rabbit is considered as good potential source of protein (Daader *et al*., 2016). Comparing rabbits with other livestock animalsshowsome advantages like early sexual maturity, high prolificacy, short gestation interval, rapid growth, more efficient feed conversion and low rearing cost (Cheeke, 1987). Heba *et al*. (2016) reported that rabbit's meat is nearly white, mild flavored, low cholesterol content, finely grained, palatable, high-quality protein content and contains a high percentage of minerals. Hence rabbit production couldplay a considerable role in solving the problem of meat shortage in Egypt (Seleem *et al*., 2007).

Shaban and Azab, (2017) and Yacout *et al*. (2015) found that subjecting water to magnets improved water quality, and they attributed the improvement to considerable changes in the pH, salinity, total dissolved solids, conductivity, total hardness, dissolved oxygen, minerals, organic matter and total count of bacteria. Moreover, drinking magnetized water (MW) caused an increasein milk yield in dairy cows (Lin and Yotvat, 1990) and dairy ewes (Shamsaldain and Al-Rawee, 2012),improving fertility in buck (Attia *et al*., 2015), weight gain in geese (El-Hanoun *et al*., 2017) and egg production and hatchability in turkey (Shaban and Azab, 2017).

The aim of this study is to investigate the effect of drinking salinity water at (4000 ppm) and magnetization of water on some productive characteristics of growingV-line rabbitbucks.

MATERIALS AND METHODS

The present study was carried out at Sids Experimental Station belonging to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Beni-Suef governorate, Egypt. In the present experiment, 28 growing males V-line rabbits aged 60days with average body weight 656.07 ± 37.12 g were used. Rabbits were housed under monitoring for 10 days before starting the experiment to exclude any latent infections. Rabbits were randomly allotted into four equal groups (7 rabbits each): group 1 (tap water without magnetizationas control), group 2 (magnetized tap water), group3 (well water without magnetization) and group 4 (well water with magnetization). The experiment lasted for 11 weeks. Well water Salinity used was 4000 ppm and the strength of the magnet was 10000 Gauss. Rabbits were housed in galvanized metal rabbit battery cages (60 × 50 × 40 cm) supplied with individual feeders. All animals were kept under the same management and hygienic conditions. Pelleted diets were offered *ad-libitum* during experimental period and purchased from Uccma Factory (El Salam City, Cairo, Egypt), and water was available from automatic nipple drinkers. Both feed intake and body weight were recorded weekly. Body weight gain and feed conversion ratio were calculated**.**

The approximate chemical analysis of the basal diet and water analysis are presented in Tables (1) and (2), respectively.

Table 1. Chemical composition and calculated analysis of the experimental diet for growing rabbits

Ingredients	%	Calculated analysis: [l]	%
		Crude protein %	17.02
		Digestible energy (Kcal/Kg)	2500
*Clover hay (12%CP)	30.00	C/P ratio	147
Barely	29.00	Ether extract %	2.72
Yellow corn	10.00	Crude fiber %	13.25
Soybean meal (44%CP)	18.00	NDF% [m]	37.63
Wheat bran	8.00	ADF% [n]	21.52
Molasses	3.00	Hemicellulose %[o]	16.11
DL-Methionine	0.10	Calcium %	1.10
Vit..& Min. mix.*	0.40	Total Phosphorus %	0.80
Salt	0.50	Methionine %	0.36
Limestone	1.00	TSAA	0.61
		Lysine %	0.75
Total	100		

* Each 1.5Kg. of Vita. mix contained : 50,000,000 IU Vit. A; 1,000,000 IU D3; 10,000 mg Vit. E; 1170 mg Vit. K3;735 mg Vit.B1; 15000 mg Vit. B6;15 mg Vit. B12; 500 mg Vit. B5 Pantothenic acid; 30,000 g Nicotinic acid; 84 mg Biotin; 500 g Folic acid; 300g choline chloride. Each 1.5 Kg Min. mix contained 25g Zn (oxide); 33.4g Mn; 26.7g Fe; 2.67g Cu; 67mg cobalt; 1mg Se and 0.334 gI;

[l] According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001) ,

% NDF= 28.924 +0.657 (%CF); % ADF= 9.432 +0.912 (%CF); Hemicellulose= %NDF - % ADF

Table 2. Analysis of water types used in the experiment

Parameters	Tap water		Well water	
	(–)	(+)	(–)	(+)
TDS (mg/l)	272	278	3975	4440
Salinity (mg/l)	0	0	4.2	4.3
Na (mg/l)	59.86	64.36	1422	1271
K (mg/l)	4.55	5.12	70.93	60.44
pH (mg/l)	7.47	8.08	8.03	8.06
Conductivity (µS/cm)	576	583	7950	8880
Alkalinity (HCO_3 , mg/l)	180.6	186.2	127	131.8
Chloride (mg/l)	67.5	70.3	2053.5	2464.29
Total Hardness	204.49	220.40	2464.29	2659.00
CO_3 (mg/l)	0	0	0	0
Ca (mg/l)	42.24	46.88	782.4	763.64
Mg (mg/l)	23.73	29.72	121.97	179.90

Blood samples were collected at the end of the experiment using 5ml-syrings. Oneml of the blood was put into a bottle containing ethylene diaminetetracetic acid (EDTA) as an anticoagulant for plasma haematological assay. The remaining 4 ml of the blood sample was put into a sterile vacutainer tube without an anticoagulant and then centrifuged for 10 minutes at 3,000 rpm for serum. The clear non-haemolysed supernatant serum was quickly removed and kept at -20 °Cuntil used for analysis.

The hematological assay was determined by using automatic method (automatic cell counter) Vet hematology analyzer was used (Abacus junior, Radim, Italy) after putting the samples on electric mixer. Each sample had been estimated in duplicate manner (mean of each duplicate was introduced to the statistical analysis).

Total protein, albumin, and globulin were determined according to Domas *et al*. (1971), respectively.Lipid metabolites were determined using an enzymatic colorimetric method using commercial kits (Vitro Scient, Germany) according to manufacturer's instructions. Levels of total cholesterol (TC) and triglycerides (TGs) were quantified after enzymatic hydrolysis and oxidation of the sample. The high-density lipoprotein cholesterol (HDLc) assay was determined using cholesterol E-Test Kit (Wako, Osaka, Japan) according to Lopes-Virella *et al*. (1977). The amount of low-density lipoprotein cholesterol (LDLc) level was calculated by using Friedewald equation: LDLc = TC - HDLc - (TG/5), where (TG/5) = very low-density lipoprotein cholesterol (VLDLc).

Plasma aldosterone concentrations were measured using a RIA kit produced by Abbott laboratories (Diagnostics Division, North Chicago, Illinois 60064, USA) (Ekins *et al*., 1972). Serum sodium (Na), potassium (K), phosphorus (P), calcium (Ca), and magnesium (Mg) concentrations were determined using the specific kits of enzymatic colorimetric measuring (Biodiagnostic Company), and chloride (CL) was determined using Thiocyanate method (QCA Company). Concentrations of triiodothyronine (T3), and testesterone hormones were determined by Radioimmunoassay (RIA) technique using ready made kits.

All data were subjected to analysis of variance using factorial design (2 types of water × 2 magnetic treatments) of the general linear model using SAS software program (SAS, 2004) according to the following model: $Y_{ijk} = \mu + W_i + M_j + WM_{ij} + e_{ijk}$
where: Y_{ijk} = any observation of type of water effect (W_i), magnetic effect (M_j) and their interaction (WM_{ij}) for ijk rabbit; μ= general mean.

RESULTS AND DISCUSSION

Table (3) showed that in both magnetized (tap / well) water, feed intake (FI) wasdecreased. El-Hanoun *et al*. (2013) showed that magnetic treatment of water tended to reduce feed intake, However, Yacout *et al*. (2015) and Rodriguez *et al*. (2003) showed a positive impact of magnetized water on feed utilization of rabbit bucks. While, Mahmoud, *et al*. (2015) did not findany significant differences in average feed intake among groups (magnetized treatment at 1200 and 3600 gauss and non-magnetized group). In the present study, a significant increase was found in the average daily gain (ADG) for tap water group compared with well water which could be related to the salinity stress. These results were similar to those obtained by Ayyat *et al*.(1991) and Gad (1995) who found a decrease in body weight gain of animals that given saline water than those receiving tap water. A slight increase in ADG was found in magnetized water groups as well as feed conversion improved compared tonon-magnetized water groups (Table 3). Growth rate (GR) takes the same trend of ADG among groups. As a result of increasing FI in well water group, the feed conversion ratio (FCR) was significantlyincreased. Also, El-Hanoun *et al*. (2013) reported that rabbits drank magnetized tap or well water at 4000 Gauss had a significant increasein thebody weight gain for growing rabbits and a significantimprovementin the feed conversion ratio. Greater amount of water was consumed by both groups used tap water compared with well groups. Groups with magnetic treatment consumed a significant higher amount of water compared to thenon-magnetized water groups.

Table 3. Growth performance, feed efficiency and water consumption of male V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	Growth performance				FI	FCR	WC
		IW (g)	FW (g)	ADG (g)	GR (%)	(g/h/d)	(g FI/ g BG)	(ml/d)
Interaction effect:								
Tap water	(–)	652.88	2132.88^{ab}	21.57^{a}	238.72^{a}	75.54^{ab}	3.58^{b}	357.15^{b}
	(+)	657.88	2211.38^{a}	22.19^{a}	240.03^{a}	71.05^{b}	3.23^{b}	386.90^{a}
Well water	(–)	654.25	1926.38^{c}	18.17^{b}	202.29^{b}	83.59^{a}	4.67^{a}	326.43^{c}
	(+)	659.25	1995.75^{bc}	19.09^{b}	210.42^{b}	79.84^{ab}	4.22^{a}	356.37^{b}
±SME of interaction effect		37.60	61.52	0.85	16.96	3.09	0.22	0.29
Main effect of water type:								
Tap		655.38	2187.13^{a}	21.88^{a}	239.37^{a}	73.29^{b}	3.40^{b}	372.03^{a}
Well		656.75	1961.06^{b}	18.63^{b}	206.36^{b}	81.71^{a}	4.45^{b}	341.40^{b}
Main effect of magnetic treatment:								
(–)		653.56	2044.63	19.87	220.51	79.56	4.13	341.79^{b}
(+)		658.56	2103.56	20.64	225.22	75.44	3.72	371.64^{a}
±MSE of main effect		26.59	43.50	0.60	11.99	2.18	0.15	
P value:								
Interaction		0.9993	0.0079	0.0059	0.0430	0.0436	0.0003	0.0001
Type of water		0.9711	0.0010	0.0007	0.0416	0.0109	0.0001	0.0001
Magnetic treatment		0.8952	0.3463	0.3741	0.7828	0.1928	0.0776	0.0001

a, b and c: Means within each column with different superscripts are significantly different (P <0.05).
TR= Treatments (+= with magnetization, – = without; IW= Initial weight; FW= Final weight; ADG= Average daily gain; GR= Growth rate; FI= Feed intake; FCR= Feed conversion ratio; WC= Waterconsumption.

Salinity water significantly decreased the total protein (TP), albumin (ALB), and glucose (GLU), while it insignificantly decreasedboth globulin (GLO) and albumin/globulin ratio (A/G) (Table 4). These results were similar to those obtained by Huda and Abdel-Monem (2014),Marai *et al*.(2001), Pond *et al*. (1995), Abdel-Samee and El-Masry, (1992) and Ellefson and Garaway, (1982). Magnetization significantly increased both TP and GLU. An increase was also observed in both of ALB and GLO by magnetization, however, the differences were not significant. These results are similar to those obtained by Khalisa and Ali (2012) and Araibi and Dagher, (2014) who showed that concentration of total protein was significantly higher in magnetized water comparedto the control group. Also, Yacout *et al*. (2015) and Mahmoud, *et al*. (2015) found that using magnetic water caused a significant increase in the blood glucose, while Sargolzehi *et al*. (2009) showed that consuming magnetic water did not affect blood glucose concentrationin lactating Saanen goats. It couldbe concluded that magnetization is considered as a good applicationfor rabbits drinking well water because magnetized well water group almost gives the same blood measurements of the control group that drinking the normal tap water.

Table 4. Serum protein profile and glucose level of V-line rabbits asaffected by type of water and/or magnetic exposure

Water type	TR	Serum protein profile TP (g/dl)	ALB (g/dl)	GLO (g/dl)	A/G ratio	GLU (mg/dl)
Interaction effect:						
Tap water	(–)	5.63^{b}	3.90^{a}	1.73^{b}	2.25	107.33^{b}
	(+)	6.67^{a}	4.03^{a}	2.64^{a}	1.53	123.69^{a}
Well water	(–)	4.67^{c}	3.04^{c}	1.63^{b}	1.87	96.92^{b}
	(+)	5.27^{bc}	3.48^{b}	1.79^{b}	1.94	103.96^{b}
±MSE of interaction effect		0.22	0.13	0.24	0.38	3.69
Main effect of water type:						
Tap		6.15^{a}	3.96^{a}	2.19	1.81	115.51^{a}
Well		4.97^{b}	3.26^{b}	1.71	1.91	100.44^{b}
Main effect of magnetic treatment:						
(–)		5.15^{b}	3.47	1.68	2.07	102.12^{b}
(+)		5.97^{a}	3.75	2.22	1.69	113.82^{a}
±SME of main effect		0.15	0.09	0.17	0.27	1.65
P value:						
Interaction		0.0012	0.0021	0.0570	0.4359	0.0053
Type of water		0.0006	0.0005	0.0807	0.9931	0.0035
Magnetic treatment		0.0053	0.0536	0.0546	0.3458	0.0132

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05). Total protein (TP), Albumin (ALB), Globulin (GLO), Albumin /Globulin ratio (A/G), Glucose (GLU).

As shown in Table (5), well water group had the highest values among all groups in theliver and renal function measurements, which express the suffering of this group from salinity. Well water group had higher values 3.4, 2.8, 1.9, 2.0, and 4.5 times for alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), Gamma-Glutamyltransferase (GGT), and total bilirubin (T-Bill), respectively, as indicators for liver function, and 5.9 and 2.1, respectively for creatinine (CRT) and blood urea nitrogen (BUN) as indicators for kidney function. The same results were found by Morsy *et al*. (2016),Attia *et al*. (2015), Huda and Abdel-Monem (2014), Marai *et al*. (2010) and Abdel Rahman *et al*. (2000).

Tap water and magnetized water groups had a significant decrease in the ALP and CRT, while other parameters were not significantlydifferent. Magnetization ofwell water led toa decrease in both liver and kidney function significantly asshownin Table (5). Magnetization of well water tended to decrease the ALT, AST, ALP, GGT, T-Bill, CRT and BUN by 10%, 25%, 24, 25%, 27%, 58% and 31%, respectively. These results arein agreement with those obtained by Yacout *et al*. (2015) who showed that magnetic water significantly decreasedtheALT than non-magnetized water. Also, Araibi and Dagher (2014) found that using magnetic water for broiler chickens at 1500 Gauss caused a significant decrease in GPT compared with those drank non-magnetized water. In the same context, El-Hanoun *et al*. (2013) mentioned that magnetized tap and well water at 4000 Gauss significantly decreased ALT compared to non-magnetized water.

The effects of water magnetization were very remarkable with lipid profile measurements. It significantly affected all parameters and increased the good cholesterol (HDL) and decreased the bad one (LDL). Magnetization process in tap water decreased the total cholesterol (TC) and low density lipoproteins (LDL) significantly, while it decreased the triglycerides (TGs) and very low density lipoprotein (VLDL) insignificantly (Table, 6). On the other hand, it increased the high density lipoprotein (HDL) significantly. Magnetization of well water tended to decrease both TG and VLDL significantly and LDL insignificantly compared to the well water group. Mahmoud *et al*. (2015) revealed that cholesterol and LDL concentrations were not influenced by magnetization process of water. Also, Khalisa and Ali (2012) reported that there were no significant differences of adult male rabbits dinking magnetized water respecting serums TC and LDL concentrations compared tocontrol group. In contrast, Khalisa and Ali (2012) reported that the values of serum TG concentrations tended to decrease significantly and serum high HDL concentration tended to increase significantly following exposure to magnetic water.

Well water negatively affected the lipid profile by increasing TC, TG, LDL and VLDL. Also, total lipids and cholesterol in rabbits drinking sea water were significantly lower than the animals drinking fresh water. These results are similar to those obtained by Huda and Abdel-Monem (2014), Marai *et al*. (2001), Pond *et al*. (1995), AbdelSamee and El-Masry, (1992) and Ellefson and Garaway, (1982).

Table 5. Liver function enzymes and renal function of V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	Liver function enzymes					Renal function	
		ALT (IU/L)	AST (IU/L)	ALP (IU/L)	GGT (IU/L)	T-Bill (mg/dl)	CRT (mg/dl)	BUN (mg/dl)
Interaction effect:								
Tap water	(–)	30.33[c]	47.00[a]	247.33[c]	6.41[c]	0.61[c]	0.59[c]	85.00[c]
	(+)	35.67[c]	53.44[a]	196.67[d]	4.42[c]	0.41[c]	0.39[d]	92.33[c]
Well water	(–)	102.90[a]	130.67[b]	474.00[a]	13.05[a]	2.77[a]	3.49[a]	177.48[a]
	(+)	93.00[b]	97.67[c]	359.61[b]	9.83[b]	2.03[b]	1.47[b]	123.33[b]
±SME of interaction effect		2.87	11.38	14.28	0.99	0.11	0.06	7.31
Main effect of water type:								
Tap		33.00[b]	50.22[b]	222.00[b]	5.41[b]	0.51[b]	0.49[b]	88.67[b]
Well		97.95[a]	114.17[a]	416.80[a]	11.44[a]	2.40[a]	2.48[a]	150.41[a]
Main effect of magnetic treatment:								
(–)		66.62	88.83	360.67[a]	9.73[a]	1.71[a]	2.04[a]	131.24[a]
(+)		64.33	75.56	278.14[b]	7.13[b]	1.22[b]	0.93[b]	107.83[b]
±SME of main effect		2.03	8.05	10.10	0.70	0.08	0.04	5.17
P value:								
Interaction		0.0001	0.0025	0.0001	0.0012	0.0001	0.0001	0.0001
Type of water		0.0001	0.0005	0.0001	0.0003	0.0001	0.0001	0.0001
Magnetic treatment		0.4494	0.2775	0.0004	0.0299	0.0029	0.0001	0.0126

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05).Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Alkaline phosphatase (ALP), Gamma-glutamyltransferase (GGT), Total Bilirubin (T-Bill), Creatinine(CRT) and blood urea nitrogen (BUN).

Table 6. Lipid profile of V-line rabbits as affected by type of water and/or magnetic exposure.

Water type	TR	Lipid profile				
		TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
Interaction effect:						
Tap water	(–)	91.00[c]	40.82[bc]	31.14[b]	51.70[b]	8.16[bc]
	(+)	79.50[d]	37.82[c]	39.25[a]	32.69[c]	7.56[c]
Well water	(–)	117.67[a]	52.64[a]	41.64[a]	65.50[a]	10.53[a]
	(+)	110.00[b]	42.64[b]	41.14[a]	60.33[a]	8.53[b]
±SME of interaction effect		0.98	1.12	1.25	1.90	0.22
Main effect of water type:						
Tap		85.25[b]	39.32[b]	35.20[b]	42.19[b]	7.86[b]
Well		113.83[a]	47.64[a]	41.39[a]	62.91[a]	9.53[a]
Main effect of magnetic treatment:						
(–)		104.33[a]	46.73[a]	36.39[b]	58.60[a]	9.35[a]
(+)		94.75[b]	40.23[b]	40.20[a]	46.50[b]	8.05[b]
±SME of main effect		0.69	0.79	0.89	1.34	0.16
P value:						
Interaction		0.0001	0.0001	0.0012	0.0001	0.0001
Type of water		0.0001	0.0001	0.0011	0.0001	0.0001
Magnetic treatment		0.0001	0.0004	0.0162	0.0002	0.0004

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05).Total Cholesterol (TC), Triglycerides (TG), High Density Lipoprotein (HDL), low density lipoproteins (LDL), and very low density lipoprotein (VLDL)

Morsy *et al*. (2016) and Attia *et al*. (2015) reported that rabbits drinking well water hada significant decrease inhemoglobin (Hgb), red blood cell count (RBCs), and hematocrit (HCT) compared to those drinking tap water. Results in Table (7) showed that there were significant increases in Hgb, RBCs, and HCT in the group drinking tap water compared towell water group. Also, magnetized water groups significantlyhad a higher Hgb compared tonon-magnetized water groups. Meanwhile, magnetized saline water showed significantly increased RBCs, WBCs, Hgb and Hct (Attia *et al*., 2015). Table(7) showed that mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and Red cell distribution (RDW) were notsignificantly affected by magnetization, or by salinity of water. Araibi and Dagher (2014) showed that there are significant increases in blood physiological traits (RBC, WBC, Hgb, Hct) for broilers which consumed magnetic treated water with 1500 Gauss compared tothose consumednon-magnetized water. While these results are opposite to those recorded by Mahmoud *et al*. (2015) whodid not findany significant differences (P>0.05) due to themagnetization of water in the concentrations of RBCs, Hgb, HCT, packed cell volume (PCV) and white blood cells count (WBCs). These findings are in agreement with those reported by (Aziz *et al*., 2013).

Table 7. Red blood cell characteristics of V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	RBCs traits						
		Hgb (g/dl)	RBCs ($\times10^6$/mm^3)	HCT (g/dl)	MCV (fl)	MCH (pg)	MCHC (%)	RDW (%)
Interaction effect:								
Tap water	(–)	11.05^a	4.95^a	36.10^a	72.35	22.20	30.90	44.20
	(+)	12.15^a	5.30^a	40.45^a	73.10	22.20	30.15	43.45
Well water	(–)	7.75^b	3.55^b	24.35^b	68.55	21.80	31.80	44.50
	(+)	8.33^b	3.83^b	25.83^b	67.57	21.77	32.33	44.70
±SME		0.39	0.20	1.78	3.46	0.58	0.83	1.49
Main effect of water type:								
Tap		11.6^a	5.13^a	38.28^a	72.73	22.20	30.52	43.83
Well		8.04^b	3.69^b	25.09^b	68.06	21.78	32.07	44.60
Main effect of magnetic treatment:								
(–)		9.40^b	4.25	30.23	70.45	22.00	31.35	44.35
(+)		10.24^a	4.57	33.14	70.33	21.98	31.24	44.08
±SME		0.28	0.14	1.24	2.45	0.41	0.59	1.06
P value:								
Interaction		0.0001	0.0006	0.0004	0.6178	0.9110	0.3257	0.93664
Type of water		0.0001	0.0001	0.0001	0.2147	0.4912	0.1011	0.6176
Magnetic treatment		0.0450	0.1476	0.1346	0.9740	0.9777	08982	0.8584

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05).Hemoglobin (Hb), Red Blood Cell Count (RBCs), Hematocrit (HCT), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC) and Red cell distribution (RDW)

White blood cell count in rabbits islocated between 5.1-11.0×10^3/mm^3 (Nemi, 1986). Water type and the interaction between water type and magnetization had no significant effects on the leucocyte measurements (Table, 8). While, magnetization process significantly decreased both of the eosinophil and basophil leukocytes. Mahmoud *et al*. (2015) reported that rabbits drinking magnetized water (1200 gauss) significantly increased neutrophilscompared to thecontrol group (tap water), while rabbits drinking magnetized water (3600 gauss) did notdiffer significantly with the control group.Also, lymphocyte value was significantly (P<0.05) lower with 1200 gauss than control.In the same context,Aziz *et al*. (2013) observed that heterophil to lymphocyte ratio was decreased significantly in group received magnetic water. Hussen (2002) reported that magnetic water led to an increase of blood flow and supply of oxygen and nutrients to the cells.

Table (9) showed that groups drank well water significantly had higher sodium (Na), chlorine (Cl), calcium (Ca) and magnesium (Mg), while tap water groups significantly had higher values of potassium (K) andphosphorus (P). The same results were obtained by Morsy (2016) who affirmed that drinking well water increased significantly concentrations of calcium and sodium in rabbits drinking saline water compared to rabbits drinking tap water. However, phosphorus and potassium concentrations were decreased in the rabbits drinking saline water. These results agreed with the results obtained by Amal (2003), Hussein and Azab (1999). In the same context magnetization of water significantly decreased Na, Ca and Mg, while significantly increase K.

Table (10) showed that testosterone (TES), aldosterone (ALD), Triiodothyronine (T_3) and Thyroxine (T_4) were significantly increased in the group that drank magnetized tap water than the group that drank non-magnetized tap water. The group that drank magnetized well water increased TES non-significantly than the group that drank non-magnetized well water. While ALD, T_3, T_4 increased in the group that drank magnetized well water than the group that drank non-magnetized well water.

Table 8. Leucocyte count and its fractions of V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	WBCs (× 10^3/mm^3)	Different white blood cell types (%)				
			Neutrophil	Lymphocyte	Monocyte	Eosinophil	Basophil
Interaction effect:							
Tap water	(–)	7.10	23.70	65.70	7.65	0.30	2.65
	(+)	6.25	24.55	67.20	5.85	0.15	2.25
Well water	(–)	5.80	26.95	62.20	8.05	0.35	2.45
	(+)	5.13	25.77	64.67	7.13	0.13	2.30
±SME of interaction effect		0.63	1.24	1.88	0.89	0.06	0.11
Main effect of water type:							
Tap		6.68	24.13	66.45	6.75	0.23	2.45
Well		5.47	26.36	63.43	7.59	0.24	2.38
Main effect of magnetic treatment:							
(–)		6.45	25.33	63.95	7.85	0.33[a]	2.55[a]
(+)		5.69	25.16	65.93	6.49	0.14[b]	2.28[b]
±SME of main effect		0.45	0.88	1.33	0.63	0.04	0.08
P value:							
Interaction		0.2442	0.3362	0.3552	0.3885	0.0634	0.1073
Type of water		0.0929	0.1093	0.1478	0.3745	0.7756	0.5034
Magnetic treatment		0.2655	0.8964	0.3230	0.1675	0.012	0.0332

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05).

Table 9. Minerals parameters of V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	Minerals parameters					
		Na (mmol/l)	K (mmol/l)	Cl (mmol/l)	P (mg/dl)	Ca (mg/dl)	Mg (mg/dl)
Interaction effect:							
Tap water	(–)	111.19[b]	5.46[a]	84.16[b]	5.83[a]	9.67[b]	1.57[c]
	(+)	98.87[b]	5.49[a]	81.57[b]	5.77[a]	9.33[b]	1.64[c]
Well water	(–)	157.93[a]	4.36[c]	92.23[a]	4.10[b]	12.17[a]	2.74[a]
	(+)	144.15[a]	4.97[b]	90.58[a]	3.97[b]	10.60[b]	2.03[b]
±SME of interaction effect		4.95	0.09	1.68	0.12	0.41	0.09
Main effect of water type:							
Tap		105.03[b]	5.47[a]	82.86[b]	5.80[a]	9.50[b]	1.61[b]
Well		151.04[a]	4.66[b]	91.40[a]	4.04[b]	11.38[a]	2.39[a]
Main effect of magnetic treatment:							
(–)		134.56[a]	4.90[b]	88.20	4.97	10.92[a]	2.16[a]
(+)		121.52[b]	5.23[a]	86.07	4.87	9.97[b]	1.83[b]
±SME of main effect		3.50	0.07	1.19	0.08	0.29	0.06
P value:							
Interaction		0.0001	0.0001	0.0058	0.0001	0.0048	0.0001
Type of water		0.0001	0.0001	0.0010	0.0001	0.0017	0.0001
Magnetic treatment		0.0300	0.0092	0.2422	0.4197	0.0475	0.0057

[a, b and c]: Means within each column with different superscripts are significantly different (P <0.05).Sodium (Na), Potassium (K), chlorine (Cl), phosphorus (P), Calcium (Ca) and Magnesium (Mg)

Table 10. Hormones levels of V-line rabbits as affected by type of water and/or magnetic exposure

Water type	TR	Hormones			
		TES (ng/dl)	ALD (Pg/ml)	T_3 (nmol/L)	T_4 (nmol/L)
Interaction effect:					
Tap water	(–)	4.69[b]	41.15[b]	2.32[a]	33.04[b]
	(+)	5.23[a]	48.48[a]	2.63[a]	35.97[a]
Well water	(–)	3.62[c]	22.59[d]	1.37[c]	26.11[d]
	(+)	4.02[c]	31.16[c]	1.94[b]	28.81[c]
±SME of interaction effect		0.16	1.19	0.10	0.72
Main effect of water type:					
Tap		4.97[a]	44.82[a]	2.47[a]	34.51[a]
Well		3.83[b]	26.88[b]	1.65[b]	27.46[b]
Main effect of magnetic treatment:					
(–)		4.16[b]	31.87[b]	1.84[b]	29.58[b]
(+)		4.63[a]	39.82[a]	2.29[a]	32.39[a]
±SME of main effect		0.11	0.84	0.07	0.50
value:					
Interaction		0.0001	0.0001	0.0004	0.0001
Type of water		0.0001	0.0001	0.0001	0.0001
Magnetic treatment		0.0177	0.0002	0.0022	0.0046

Testosterone (TES), aldosterone (ALD), Triiodothyronine(T3), thyroxine(T4),

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تأثير شرب الماء الممغنط على بعض الصفات الإنتاجية فى الأرانب

أحمد هلال محمود[١]، إيمان سعد شمردل احمد[١]، حسام حسين محمد حسنين[١]، محمود يسين محمد[٢]

١ـقسم الإنتاج الحيوانى، كلية الزراعة، جامعة بنى سويف، ٢ـمعهد بحوث الانتاج الحيوانى، مركز البحوث الزراعيه

أستمرت التجربة احد عشر اسبوعا لدراسة تاثير المغنطة والملوحة على صفات الدم والصفات الانتاجية للارانب .استخدم في الدراسة ثمانية وعشرين ذكر من الارانب (V-line) عند عمر الفطام. قسمت الارانب عشوائيا الى أربع مجموعات: مجموعة المقارنة (ماء الصنبور بدون مغنطة) ، المجموعة ٢ (ماء الصنبور الممغنط) ، المجموعة ٣ (مياه الآبار بدون مغنطة) والمجموعة ٤ (مياه الآبار الممغنطة). كانت الملوحة المستخدمة ٤٠٠٠ جزء في المليون والقوة المغناطيسيه ١٠٠٠٠ جاوس. في مجموعات المياه الممغنطة زاد كل من معدل النمو و معدل الزيادة اليومية ومعامل التحويل الغذائى بينما انخفضت كمية العلف الماكول مقارنة بمجموعات المياه غير الممغنطة.أدت الملوحة بشكل معنوى الى تقليل كل من البروتين الكليوالألبيومينوالجلوكوز. زادت المغنطة بشكل معنوى كلا من البروتين الكليوالجلوكوز بينما زادت بشكل غير معنوى كل من الألبيومينوالجلوبيولين. في كلتا مجموعتي مياه الصنبور، كان للمياه الممغنطة تاثير معنوى فى انخفاض انزيمات الفوسفاتيز القلويوالكرياتينين.

أدت مغنطة مياه الآبار إلى إنخفاض ما يلى بنسب ١٠٪ ، ٢٥٪ ، ٢٤ ، ٢٥٪ ، ٢٧٪ ، ٥٨٪ و ٣١٪ فى انزيمات الألانين والأسبارتات الناقلة لمجموعة الأمين و الفوسفاتيز القلوي، جاما-غلوتاميل ترانسفيرازو إجمالي البيليروبينوالكرياتينين ونيتروجين اليوريا في الدمفى قياسات مياه الآبار على التوالي. استخدام المغنطة خاصة مع المياه المالحة يقلل من التأثير السيئ للملوحة ويحسن جودة المياه.