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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2019 16(S1-2): 42-52. **OPEN ACCESS**

Effect of magnetic treated water on some productive and behavioral performance of two breeds of rabbits at pre and post weaning stages

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Two breeds of newly born rabbits; Alexandria and V-line were used to examine the effect of magnetic treated water (MTW) (5000 gauss) on productive and behavioral performances during growing period until marketing. Eight bucks and thirty six does of V-line and Alexandria rabbits were used in the experiment. Mature bucks and does mated purely to produce purebred progeny. Pregnant does were divided randomly into four groups; G1 and G2 drank magnetic treated water while, G3 and G4 used ordinary tap water (OTW) until weaning. One hundred and sixty newly born kits were obtained and divided into four groups in the same pattern of their mothers(G1, G2, G3 and G4) with two replicates for each group (20 kits each replicate). Rabbits fed ad libitum at all other times of experiment. At 8 weeks of age, three rabbits from each group were slaughtered to study carcass quality. Results indicated that MTW adversely influenced on body weight and body weight gain of growing rabbits. No significant effect of MTW on litter size, litter weight and FCR. Alexandria breed had heavier weaning and marketing weights with faster body weight gain. Feeding and drinking behaviors decreased in MTW rabbit. There were significant interaction between water treatment and breed of rabbit on body weight and body weight gain but not for litter size or litter weight. It is concluded that the exposure of tab water to a magnetic field of approximately 5000 gauss does not significantly reduced the performance and carcass composition of growing rabbits.

Keywords: Magnetic treated water, Rabbit, Productive traits, Behavioral pattern

INTRODUCTION

The continuous global increase of meat demands is the main problem which has to be solved in the future researches. The expected world meat demands expected to be 73% higher specially in the developing countries (FAO 2011; OECD-FAO2014) due to fast population growth (Makkar et al., 2014). In Egypt, domestic rabbit's meat is one of the alternative sources of meat shortage problem (Hanaa et al., 2014). Rabbit meat is characterized over the other mammal's meat by its highly nutritious, low-fat, low-cholesterol content. Also, Rabbits are characterized by small size, short generation

interval, high reproductive potential, rapid growth (El-Basiony et al., 2005).

Water is the most essential nutrient for livestock production and is needed for a lot of biological processes; growth, digestion, reproduction, blood components, immune indices and semen quality. High quality water maximizes animal production performance (Chiba et al., 2009). Attia et al., 2013 reported that water is essential for transporting fluids and nutrients into the blood, maintaining integrity of cellular structure, regulating body temperature. Additionally, Correction of water quality is related to broiler and turkey productive performance as well as reduction in the response to vaccination (Barton, 1996).

Previous studies indicated that passing water through magnet change its physical properties; The PH value is increased up to 9.2 in water treated with 7000 Gauss strength (Lam, 2001). Increasing dissolved oxygen and soluble salts as well as decreasing organic matter content (Yacout et al., 2015). Verma, 2011 showed that magnet impacted on the homogeneity of water solution as it increases the calcium salts solubility, and decreases lime scale deposits in pipes and cleans pipes from deposited lime scale. Moreover, excessive sodium in MTW improved protein digestibility and energy utilization (Attia et al., 2013). Economically, using magnet for treatment of water has a significant interest more than its chemical interference (Yacout et al., 2015).

Recently, there are several techniques used to improve water quality, treatment of water by magnet is one of the current methods. Magnetization of water, changes its properties by increasing O2 content, velocity of dissolved salts and amino acids in water (Shaban and Azab, 2017).Water treated by magnet is widely applied in several animals; El-RateII.T and Sara F. Fouda, (2017), studied the effect of water treated by magnet on production and preservation of semen as well as Kamel F.H, et al., 2015, found magnetically treated water not only has no effect on hematological parameter but also has adverse effect on immune response to bacterial infection in rabbit. Also, Mitre, 2018 reported no significant improvements of FCR, body weight gain, feed intake and livability of male broiler chicken. This experiment was designed to examine the effect of drinking magnetically treated water on some growth parameters, feed efficiency and carcass traits as well as behavioral pattern of growing rabbits.

MATERIALS AND METHODS

Experimental flock and management:

In the present study two lines of rabbits were used, Alexandria line which is a synthetic paternal rabbit line was established at the breeding rabbit unit of the Poultry Research Center, Faculty of Agriculture, Alexandria University, Egypt and V-line which is a synthetic maternal line originated at the Department of Animal Science of the Politecnica de Valencia University, Spain and imported to Egypt.

The study was carried out at private rabbit farm at Alexandria government, Egypt throughout the period from September, 2017 to April 2018. Four bucks and eighteen does of each rabbit line were used in the experiment. Mature bucks and does mated purely to produce purebred progeny. Growing rabbits vaccinated against pasteurellosis and rabbit viral hemorrhagic disease. Rabbits were housed in an open sided house in stainless steel cages supplied with feeders and nipples.

Diet preparation

The basal experimental diet was formulated and pelleted to cover the nutrient requirements of rabbits according to NRC (1977) recommendations. Ingredients needed for formulation of the experimental diets were finely ground by using hammer mill screen size 3.0 mm, then weighing of different ingredients at required amount for the experimental diets, thoroughly mixed and pelleted (3.5 mm size). Physical composition and chemical analysis of the basal diet are presented in table (1).

Experimental design:

The breeding rabbits were divided into four groups (G1, G2, G3 and G4), eight does and two bucks of rabbits each. The G1and G3contained eight V-line does and two V-line bucks and G2and G4 had eight Alexandria does and two Alexandria bucks, G1 and G2 received water treated with magnetic field (MTW) of approximately 5000 Gauss drinking water, while G3 and G4 drank ordinary tap water (OTW). These all groups mated one buck to each four does within its group. The pure progenies were kindled and left with their mothers for one month and then weaned. At weaning, the kits were divided into groups (G1, G2, G3 and G4) to drink water in the same strategy as their mothers. Two replicate for each group, twenty kits each group.

Table 1: Ingredient composition and chemical analysis of the basal diet

Ingredient composition		Chemical analysis	
Ingredients	%	Items	%
Yellow corn	9.5	Dry matter	87.8
Soybean meal 44%	15.0	Moisture	12.2
Wheat bran	17.0	Crude protein	17.9
Barley	21.7	Crude fiber	13.75
Barseem hay	34.5	Ether extract	3.6
Dicalcium phosphate*	1.2	Nitrogen-free extract[1]	42.75
Ground limestone**	0.25	Ash	9.8
DL-Methionine	0.05	DE (Kcal/kg)[2]	2677.97
Common salt	0.5		
Vitamin+Mineral premix***	0.3		
Total	100		

*Di-calcium phosphate: contain 20% Phosphorus and 25% calcium. ** Limestone: contain 34% calcium.***Premix: Muvco premix (Mineral and vitamin premix) each 3.0 Kg contain the following: Vitamin A (12000000 IU), Vitamin D3 (200000 g), Vitamin E (10 g), Vitamin K3 (2.5 g), Vitamin B1 (1.0 g), Vitamin B2 (5.0 g), Vitamin B6 (1.5 g), Vitamin B12 (10 g), Pantothenic acid (10 g), Niacin (30 g), Choline chloride (500 g), Folic acid (1.0 g), Biotin (50 mg), Iron (30 mg), Manganese (40 mg), Zinc(45 mg), Copper (3 g), Cobalt (100 mg), Iodine (300 mg), Selenium(100 mg). 1NFE was calculated by difference = 100 – (moisture % + CP% + E% + CF% + Ash %). 2DE was calculated according to values given in the feed composition tables of the NRC (1977).

Studied Traits

Pre-weaning traits

The litter size and litter weight at the day of kindling, weekly pre-weaning body weight (BW) in grams were recorded until four weeks (weaning weight) body weight gain (BWG) was calculated weekly during pre-weaning stage.

Post-weaning traits

Weekly body weight (BW) of fattening rabbits in grams was recorded after weaning until eight weeks (marketing age). Feed Conversion Ratio; consumed food/weight gain (FCR) of rabbits after weaning as well as weekly Body Weight Gain (BWG) were estimated. Also, Litter mortality rate in percentage for each group during 1-30 days and 30-60 days and 1-60 days.

At the end of the experiment period (8 weeks) three rabbits for each group were randomly selected to be slaughtered; carcass quality traits were performed. Rabbits were weighted just before slaughtering to obtain slaughter weight. After slaughtering, the carcasses were bled, skinned, and completely eviscerated before being weighted. The carcass, head, liver, kidneys, heart, spleen, abdominal fat, hindquarter and forequarter, were weighed 30 minutes after slaughter.

Water Analysis

Chemical analysis of MTW and OTW takes place in a private laboratory after 8 weeks of passing water on a magnet of 5000 gauss for the following parameters:

Hydrogen ion concentration (pH)

No direct relationship between human health and the pH of drinking water, as it depends mainly on water quality. The recommended guideline value for pH is (6.5- 8.5)

The electrical conductivity depends on the differential force among the negative molecules and the positive molecules. Conductivity increases in water rich in ionized mineral salts.

Calcium and magnesium

The concentration of calcium and magnesium salts can determine the water hardness.

Iron

The presence of iron in natural waters can be attributed to the disbanding of rocks and minerals, sewage or iron related industries. (WHO, 1984). The average daily requirement is considered to be 10 mg of iron. Iron high doses causes

haemochromatosis resulting in tissue damage due to simple dietary overloading.

Copper:
Copper occurs naturally in many waters and may also result from corrosion of pipes. The presence of copper in drinking water can give rise to staining or a stringent taste (WHO, 1988).

Behavior observation
The behavioral states of rabbits were recorded by using focal sample observation by using infra-red camera. The video was observed by naked eye day light periods according to the recommendation of Martin and Frs, 1996. The behavioral patterns observed in this study were

Ingestive behavior
*Feeding time (min/hr). The animal approximates and apparently contacts the hopper. It includes the time spend with head into the feeder, masticating or throwing.

*Drinking (Freq/hr). Drinking from the nipple in the cage.

Caecotrophy [Freq/hr] The rabbit touches the anus with the mouth and eat soft pellets.

B. Resting behavior (Min/hr). Sitting or lying.
C. Movement activities (Freq/hr). Slow or hurried movement.
D. Body care behavior (Freq/hr). Licking, scratching or nibbling the body or the hair.

Statistical analysis
Data were analyzed using SAS software (SAS, 2002). Data of the productive traits were analyzed using ANOVA GLM. However, statistical analysis, the analysis of data of the behavior patterns were analyzed by using SAS (2002} by using complete nested design. All results were expressed as means ± SE and $p \leq 0.05$ was considered to be significant.

RESULTS

Water Analysis
Analysis of pH of MTW and OTW has been done table (2) at the end of the experiment showing no effect of magnet treatment of water pH value (8.24 for MTW and 8.20 for OTW). However, Conductivity of the MTW increased. The elevation for conductivity was clear from 158 for OTW to 174 for MTW, with 9.2% the ratio of change. This is in contrary to oxygen % which increased in MTW than OTW table (1). Analysis of Manganese, Iron, Copper and Calcium recorded increase in their concentration in MTW in comparison to OTW table (3).

Table 2: Chemical analysis of MTW and OTW

Test	OTW	MTW
pH value at 20° C	8.20	8.24
Salinity ppt	1.3‰	1.2‰
Conductivity µ mhos/cm	158	174
Oxygen%	3.8	4.1

Table 3: Analysis of heavy metals of MTW and OTW

Test (ppm)	OTW	MTW
Manganese	0.04	0.09
Iron	0.11	0.44
Copper	0.25	0.88
Magnesium	12.6	11.25
Calcium	0.39	7.29

Effect of Breed on Growth parameters and mortality rate percentage
Table (4) weights of V-line rabbits go one better than Alexandria rabbits at 3 weeks of age and then decreased at weaning age, in opposite to body weight gain of V-line breed which increased significantly ($P>0.05$) than Alexandria breed at the same age. Mortality rate percentage from the day of kindling until weaning age of Alexandria and V-line rabbits are presented in table (2), showed significant reduction in mortality rate for Alexandria than V-line rabbits.

Table 4: Effect of rabbit breed on litter size and weight, body weight, body weight gain and mortality rate percentage at pre-weaning stage.

Item	Line	
	Alexandria	V-line
Body weight (BW) g		
BW1	104.20±1.08[a]	106.78±0.94[a]
BW2	296.39±1.81[a]	296.63±1.57[a]
BW3	457.67±2.47[b]	471.63±2.15[a]
BW4	598.06±4.30[a]	568.55±3.77[b]
Litter		
Size	6.69±0.50[a]	6.08±0.41[a]
Weight (g)	360.59±27.26[a]	372.13±22.62[a]
Body weight gain (BWG) g		
BWG1	192.14±1.70[a]	189.85±1.48[a]

BWG2	161.07±2.53[b]	175.00±2.19[a]
BWG3	140.01±4.44[a]	96.91±3.87[b]
BWG4	141.69±4.89[b]	192.31±4.28[a]
Mortality% 1st day~4 weeks	2.11+0.17[b]	2.64+0.30[a]

abc, means within the same raw carrying different superscripts differ significantly (P<0.05)

Weekly body weight, body weight gain and FCR after weaning was presented in **table 5**; Body weight showed significant increase (p<0-05) in V-line rabbits at fifth and sixth weeks however, at marketing age Alexandria line had higher body weight. Body weight gain at the seventh week as well as total weight gain increased in Alexandria than V- line rabbits. However, There is marked difference between Alexandria and V-line rabbits for mortality rate percentages from weaning (4 weeks) until marketing age (8 weeks) as well as overall mortality percentages (1st day~8weeks) table 5.

Table 5: Effect of rabbit breed on body weight and body weight gain at post-weaning stage.

Item	Line	
	Alexandria	**V-line**
Body weight (BW) g		
BW5	739.75±5.51[b]	760.85±4.83[a]
BW6	912.16±4.63[b]	924.69±4.05[a]
BW7	1038.09±3.98[a]	1041.59±3.49[a]
BW8	1350.98±6.81[a]	1303.72±5.97[b]
Body weight gain (BWG) g		
BWG5	172.41±4.96[a]	163.84±4.35[a]
BWG6	125.93±3.80[a]	116.90±3.32[a]
BWG7	312.89±5.65[a]	262.13±4.95[b]
TWG	1246.79±6.88[a]	1196.95±6.03[b]
1. FCR	3.49a	3.66a
Mortality% 4~8 weeks 1st day~8 weeks	1.98+0.20[b] 2.05+0.11[b]	2.92+0.19[a] 2.75+0.09[a]

abc, means within the same raw carrying different superscripts differ significantly (P<0.05)

Effect of magnetic treated water on growth parameters and mortality rate percentage

The effect of MTW on body weight, litter number, body weight gain and mortality rate from first week until weaning age (fourth week) were given in **table 6**. Body weights, litter size and body weight gain as well as mortality rate showed no significant effect (P<0.05) of MTW at pre-weaning stage. But, MTW reduced the body weight gain of the rabbit at weaning age.

Table 6: Effect of Magnetic treated water (MTW) on body weight (BW) litter, number, litter body weight gain (BWG) and mortality rate percentage of rabbits at pre-weaning stage.

Item	Treatment	
	MTW	**OTW**
Body weight (BW) g		
BW1	105.65±0.94[a]	105.33±1.08[a]
BW2	297.23±1.58[a]	295.79±1.80[a]
BW3	463.50±2.15[a]	465.80±2.47[a]
BW4	582.63±3.75[a]	583.97±4.32[a]
Litter		
Size	6.62±0.43[a]	6.15±0.49[a]
Weight (g)	359.91±23.46[a]	372.81±26.54[a]
Body weight gain (BWG) g		
BWG1	191.53±1.49[a]	190.47±1.69[a]
BWG2	166.06±2.22[a]	170.01±2.51[a]
BWG3	118.75±3.87[a]	118.17±4.44[a]
BWG4	143.70±4.26[b]	190.30±4.91[a]
Mortality% 1st day~4 weeks	2.59+0.09a	2.36+1.00a

ab, means within the same raw carrying different superscripts differ significantly (P<0.05)

The weekly average weights of post weaned rabbits for treated and controlled groups showed that weights for treated group statistically lower than control weights **table 7.** At seventh week, body weight gain of Rabbits treated with magnet decreased significantly than non treated kits. The overall body weight gain decreased significantly for rabbits used MTW. Additionally, FCR and post weaning mortality rate percentages as well as overall mortality percentage had no improvement by drinking rabbits of MTW (**table 5**).

Effect of interaction between breed and magnetic treated water on litter number, litter weight, FCR and mortality rate percentage

As illustrated in table (6), drinking magnetic water during pregnancy period for both Alexandria and V- line rabbits had no significant effect on litter size or litter weight. Also, FCR and mortality rates at different age stages didn't alter significantly (p<0.05) by drinking the growing rabbits of MTW**.**

Effect of interaction between breed and magnetic treated water on Body weight and Body weight gain

The results in the table (9) revealed that V- line

rabbits drank OTW were the highest body weight gain while Alexandria rabbits had the lowest gains at second and fourth weeks of age. After weaning, both Alexandria and V-line rabbits treated with OTW kept the highest body weight from six weeks of age until marketing age, while the lowest weights were reported with Alexandria rabbits drank MTW.

Table (10) shows that the average body weights of Alexandria and V- line rabbits treated with MTW significantly decreased ($p<0.05$) in comparison to that drank OTW. Alexandria rabbit got MTW had the lowest body weight at all weeks after weaning until marketing. While the slowest body weight gain was estimated in V- line rabbits treated with MTW.

Table (11) showed that either the rabbit breed or the type of drinking water didn't effect on the carcass cuts and giblets percentages except increase the percentages of Abdominal fat and head percentages for MTW group. However, liver weight (gm) affected significantly by breed and magnetism of water. As, liver weight of V-line rabbits excellence on Alexandria rabbits reduced by MTW. In addition of liver weight, hind quarter and forequarter weights affected negatively by MTW.

Data in table (12) represents the effect of the interaction between the breed (Alexandria and V-line) and treatment (MTW and OTW) on the carcass traits. Abdominal fat was significantly increased in both breeds for the MTW group in addition to a higher response was observed in Alexandria than the v-line rabbits.

Table 7: Effect of Magnetic treated water (MTW) on body weight gain (BWG), litter number and litter body weight (BW) of rabbits at post-weaning stage.

Item	Treatment	
	MTW	**OTW**
Body weight (BW) g		
BW5	726.33±4.80^{b}	774.28±5.54^{a}
BW6	898.97±4.03^{b}	937.89±4.65^{a}
BW7	1025.30±3.47^{b}	1054.38±4.00^{a}
BW8	1304.41±5.93^{b}	1350.30±6.84^{a}
Body weight gain (BWG) g		
BWG5	172.64±4.32^{a}	163.61±4.98^{a}
BWG6	126.34±3.30^{a}	116.49±3.81^{a}
BWG7	279.10±4.92^{b}	295.93±5.68^{a}
TWG	1198.76±5.99^{b}	1244.98±6.91^{a}
FCR	3.71^{a}	3.57^{a}
Mortality% 4~8 weeks	1.99+0.09^{a}	2.03+0.20^{a}
1st day~8weeks	2.16+0.12^{a}	2.21+0.18^{a}

ab, means within the same raw carrying different superscripts differ significantly ($P<0.05$)

Table 8: Effect of breed and Magnetic treated water (MTW) on litter number and litter weight of rabbits

Line	Treatment	Litter size± SE	Litter weight± SE	FCR	Mortality%			
					1	1st day~4 weeks	4~8 weeks	1st day~8weeks
Alexandria	MTW	6.57±0.64[a]	350.19±35.19[a]	3.76[a]	2.53+0.15 [a]	2.11+0.18 [a]		2.33+0.32 [a]
	OTW	6.80±0.76[a]	371.00±41.64[a]	3.29[a]	2.44+0.17 [a]	1.96+0.22 [a]		2.24+0.27 [a]
V-line	MTW	6.67±0.57[a]	369.63±31.04[a]	3.80[a]	2.63+0.19[a]	2.45+0.32 [a]		2.45+0.26[a]
	OTW	5.50±0.60[a]	374.63±32.92[a]	3.52[a]	2.50+0.22 [a]	2.48+0.20 [a]		2.48+0.11[a]

a, means within the same column carrying different superscripts differ significantly (P<0.05)

Table 9: Effect of breed and Magnetic treated water (MTW) on Body weight and Body weight gain (BWG) of rabbits at pre-weaning stage

Item		BW					BWG		
Line	Treatment	BW1±SE	BW2±SE	BW3±SE	BW4±SE	BWG1±SE	BWG2±SE	BWG3±SE	BWG4±SE
Alexandria	MTW	103.09±1.42[b]	295.78±2.41[a]	458.14±3.27[b]	600.85±5.66[a]	192.58±2.27[a]	160.19±3.39[c]	141.96±5.87[a]	110.82±6.43[c]
	OTW	105.31±1.62[ab]	297.01±2.7[a]	457.2±3.71[b]	595.26±6.48[a]	191.7±2.54[a]	161. 91±3.76[bc]	138.07±6.66[a]	172.57±7.37[b]
V-line	MTW	108.21±1.23[a]	298.69±2.05[a]	468.86±2.81[a]	564.41±4.91[b]	190.48±1.92[a]	170.17±2.85[b]	95.55±5.05[b]	176.58±5.58[b]
	OTW	105.34±1.43[ab]	294.57±2.38[a]	474.41±3.27[a]	572.68±5.72[b]	189.23±2.24[a]	179.84±3.32[a]	98.28±5.87[b]	208.04±6.5[a]

ab, means within the same raw per each item carrying different superscripts differ significantly (P<0.05)

Table (10) Effect of breed and Magnetic treated water (MTW) on Body weight gain (BWG) and Body weight of rabbits at post-weaning stage

		BW				BWG			
Line	Treatment	BW5±SE	BW6±SE	BW7±SE	BW8±SE	BWG5±SE	BWG6±SE	BWG7±SE	TWG±SE
Alexandria	MTW	711.67±7.24[c]	884.16±6.08[c]	1015.73±5.23[c]	1272.12±8.95[b]	172.49±6.52[ab]	131.57±4.99[ab]	296.39±7.43[b]	1209.03±9.04[b]
	OTW	767.83±8.31[a]	940.17±6.97[a]	1060.45±6.0[a]	1389.85±10.27[a]	172.34±7.48[ab]	120.28±5.72[b]	329.4±8.51[a]	1284.54±10.37[a]
V-line	MTW	740.99±6.29[b]	913.77±5.28[b]	1034.88±4.54[b]	1296.69±7.78[b]	172.79±5.66[ab]	121.1±4.33[b]	262.82±6.45[c]	1188.48±7.85[b]
	OTW	780.72±7.32[a]	935.61±6.15[a]	1048.3±5.29[ab]	1310.75±9.05[b]	154.89±6.59[b]	112.69±5.04[c]	261.45±7.51[c]	1205.41±9.14[b]

abc, means within the same raw carrying different superscripts differ significantly (P<0.05)

Table 11: Effect of breed and treatment (MTW and OTW) on carcass traits of rabbits

	Breed		Treatment	
	Alexandria	V- line	Control	Magnetic
Liver%	4.62±0.16	4.78±0.16	4.75±0.16	4.65±0.16
Kidney%	2.02±0.09	1.94±0.09	2.06±0.09	1.89±0.09
Heart%	0.42±0.05	0.47±0.05	0.46±0.05	0.42±0.05
Spleen%	0.22±0.01	0.21±0.01	0.20±0.01	0.23±0.01
Abdominal Fat%	0.57±0.02	0.51±0.02	0.45 ± 0.02^{b}	0.63 ± 0.02^{a}
Carcass%	53.27±1.05	52.90±1.05	53.76±1.05	52.42±1.05
Head%	1.29±0.02	1.24±0.02	1.23±0.02	1.29±0.02
Hind Quarter%	57.23±1.25	54.44±1.25	55.28±1.25	56.39±1.25
Forequarter%	50.18±1.44	47.13±1.44	47.86±1.44	49.45±1.44

abc, means within the same raw carrying different superscripts differ significantly (P<0.05)

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Table 12: Effect of the interaction between breed and treatment on carcass traits of rabbits

	Alexandria		V line	
	Control	Magnetic	Control	Magnetic
Liver%	4.67±0.23	4.57±0.23	4.84±0.23	4.73±0.23
Kidney%	2.16±0.13	1.88±0.13	1.97±0.13	1.91±0.13
Heart%	0.48±0.07	0.35±0.07	0.45±0.07	0.49±0.07
Spleen%	0.21±0.02	0.23±0.02	0.19±0.02	0.22±0.02
Abdominal Fat%	0.44 ± 0.03^{c}	0.70 ± 0.03^{a}	0.45 ± 0.03^{c}	0.57 ± 0.03^{b}
Carcass%	53.46±1.49	53.08±1.49	54.05±1.49	51.76±1.49
Head%	1.25±0.03	1.32±0.03	1.20±0.03	1.28±0.03
Hind Quarter%	56.45±1.77	58.02±1.77	54.11±1.77	54.76±1.77
Forequarter%	49.40±2.04	50.96±2.04	46.32±2.04	47.93±2.04

abc, means within the same raw carrying different superscripts differ significantly (P<0.05)

Behavior observation

The breed of rabbit affected significantly behavior of rabbit as the V-line rabbits drinking magnetic water showed a higher feeding time, drinking frequency than Alexandria rabbit groups receive the same water source. The higher resting time was recorded for V-line rabbits sitting and stretching time than Alexandria rabbit breed. On the other hand, the body care and movement activities was higher in Alexandria breed than V-Line breed however the result was not significant.

The purpose of rest and sleep is restorative, allowing metabolic recoveries and conservation of energy. Resting is governed by timing controls, more obviously than the cyclic activity. Rabbit drinking magnetic water showed a higher significant difference in sitting and stretching time (34.66+1.42 and 14.50+1.30 respectively} than those receive normal tape water (27.74+1.34 and 12.50+1.32 respectively}. While the body care behavior showed a higher significant difference in rabbit receive normal tape water for both licking and scratching frequency than those receive magnetic however the movement activities showed no significant difference between the two groups.

Table 13: Effect of breed and treatment (MTW and OTW) on Ingestive and resting behavior of rabbits.

Item	Ingestive behavior			Resting behavior	
	Feeding Min/hr	Drinking freq/hr	Caecotrophy Freq/hr	Sitting Min/hr	Stretching Min/hr
MTW	12.76±1.04[b]	0.43±0.07[b]	0.25±0.03[b]	34.66±1.42[b]	14.50±1.30[a]
OTW	17.68±1.24[a]	0.97±0.06[a]	0.44±0.05[a]	27.74±1.37[b]	12.50±1.32[b]
MTW/V.Line	13.32±0.99[b]	0.40±0.66[b]	0.28±0.01[b]	40.13±2.87[a]	16.77±1.13[a]
MTW/Alex	11.92±0.92[b]	0.33±0.12[b]	0.22±0.09[b]	28.54±1.62[b]	10.60±1.10
OTW\V-Line	18.32±0.86[a]	0.55±0.8[b]	0.45±0.07[a]	29.72±1.31[b]	12.13±1.20
OTW\Alex	16.45±0.77[a]	0.52±0.6[b]	0.45±0.03[a]	23.44±1.42[b]	11.98±0.98

Table 14: Effect of breed and treatment (MTW and OTW) on body care and movement activities of rabbits.

Item	Body care behavior		Movement activities behavior	
	Licking Req/hr	Scratching freq/hr	Walking Freq/hr	Running Freq/hr
MTW	1.20+0.11[a]	0.18+0.03	1.20+0.20[a]	0.20+0.020
OTW	0.98+0.09[b]	0.25+0.03	1.22+0.20[a]	0.30+0.02
MTW/V.Line	1.30+0.90[a]	0.13+0.01	0.80+0.20[a]	0.14+0.01
MTW/Alex	1.02+0.70[a]	0.20+0.70	1.80+0.30[a]	0.20+0.01
OTW\V-Line	0.88+0.50[b]	0.22+0.02	1.02+0.20[a]	0.25+0.01
OTW\Alex	1.03+0.02[b]	0.28+0.04	1.40+0.20[a]	0.40+0.01

DISCUSSION

This study is the first research discusses the effect of magnetic treated water (MTW) on growth performance of rabbits from the first day after kindling until marketing at eight weeks of age and carcass traits. Results from this study showed that magnetic treated water (MTW) had no significant effect on litter size, litter weight of both Alexandria and V-line rabbits. Also, feed conversion ratio from weaning until marketing age was not affected by magnetic treated water in this trial. This result agree with Al-Mufarrej et al. (2005) and Mitre, 2018 who reported no difference of feed conversion ratio of broiler chicken treated with water passed over magnetic field compared to control birds. This in contrast to Al-Fadul (2007) who observed that magnetic treated water improved feed conversion of broiler birds; however Alhassani and Amin (2012) concluded that magnetized treated water negatively affect feed conversion ratio of birds.

The mortality rate remained similar between the treated and control group during preweaning, postweaning and the entire trial periods, and the statistical analysis showed no significant result. These results agreed with Mitre, 2018 for broiler chicken at 0-7, 0-14, 0-21, 0-28, 0-35 and 0-42 days. But, differs with Gholizadeh et al., (2008) who reported positive effect of magnetic treated water on mortality rate of broiler chicken.

Treatment of rabbit by magnetic treated water (MTW) increased their sitting and stretching time while decreased feeding and drinking behavior which may be linked to decrease body weight and body weight gain. This productivity decline may be attributable to the shift of the gut microbiota, which can lead to poor growth performance as Wang et al., 2019 confirmed that physiological changes of drinking water by increasing temperature of post weaned rabbits optimize gut micribiota and consequently improves their growth performance. These findings were not agree with Al-Mufarrej et al. 2005 and Mitre, 2018 that recorded no significant effect of MTW on body weight gain of broiler chickens. Further studies are needed to clarify the mechanism of MTW on growth parameters of growing rabbits.

The MTW did not influence the carcass trait percentages of slaughtered rabbits at eight weeks of age. But, it was only an increase in the abdominal fat percentage in both breeds of rabbits comparable to rabbits consumed OTW. The null effect of MTW comes to an agreement with Al-Mufarrej et al. 2005 for broiler chicken at 32 days but in contrast to Gholizadeh et al., 2008.

The analysis of MTW and OTW come to an agreement of Munzer, 2002 and Ochkov, 2006 who reported that water subjected to magnetic field change the physic-chemical characters of water and affects the structure of water and hydrated ions. The decrease of heavy metals (Manganese, Iron, Copper and Calcium) in MTW approved with Elshima, 2007.This may have a role in the adverse effect of MTW on productive performance of rabbits.

CONCLUSION

The results from this research concluded that magnetic treated water with a magnet 5000 gauss power does not influence litter size, litter weight, post weaning feed conversion ratio (FCR), mortality rate and carcass cuts percentages at Alexandria and V-line rabbits. However, magnetic treated water has adverse effect on body weight and body weight gain but it resulted in an increasing of abdominal fat percentage in rabbits. Little scientific researches were done in the effect of MTW on productive performance of growing rabbits, so it is very important to extend the studies about the effect of MTW on different breeds of rabbits with different power of magnetic field with joining the results by the physic-chemical changes of water treated by magnet.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

All listed authors have made substantial contributions to the research design, the acquisition, analysis, or interpretation of data; and to drafting the manuscript or revising it critically; and that all authors have approved the submitted version.

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