Application of magnetic technology in local quail house and hatchery on performance, reproductive and physiological traits under heat stress

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Abstract

Using magnetic technology has shown major potentials in different fields especially agriculture. Two experiments were conducted to investigate the using of magnetic technology application in local quail house and hatchery on productive and physiological traits under heat stress condition. Results revealed that quail when served 0.2 T magnetically treated water (MTW) were significantly ($P\leq0.05$) better in most productive, reproductive characteristics in the 1st experiment: eggs production, water consumption, egg weight, shell strength, estrogen conc., also improved FCR in females, all semen quality and testosterone conc. in males. Also, total RBCs count, thrombocyte, blood pH, blood viscosity, plasma viscosity, blood iron (Fe), copper (Cu), calcium (Ca), thyroxin hormone and total count of *Lactobacillus spp.* in small intestine. However, reduction in dead sperm, abnormal acrosome, corticosterone conc., body temperature, blood clotting time, *E. coli* and fungi counts in both sexes. In the 2nd experiment using of magnetic technology on embryonic development traits of local quails incubating eggs that collected from experiment 1 were significantly ($P\leq0.05$) higher in the most characteristics at the group of 0.2 T MTW as fertility, hatchability, chicks weight, immune status of hatched chicks. While reduction in dead embryo and heterophil-to- lymphocyte (H/L) ratio. Finally, the results of 0.2 T MTW achieved superiorly gains compared with the other groups.

***Keyword*:** Magnetic technology, Quail, Hatchery, Reproductive, Physiological traits.
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استخدام التقنية المغناطيسية في حقل ومفقس السمان المحلي على الصفات التناسلية والفسيولوجية في ظروف الإجهاد الحراري

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الخلاصة

أن استخدام التقنية المغناطيسية أظهرت كفاءة عالية في مختلف المجالات وخاصة الزراعة. أجريت تجربتان للتحقق من استخدام تطبيق التكنولوجيا المغناطيسية في حقل السمان المحلي والمفقس في الصفات الإنتاجية والفسيولوجية تحت ظروف الإجهاد الحراري. أظهرت النتائج في التجربة الأولى عند تقديم ماء معالج مغناطيسيا بقوة ٠,٢ تسلا ارتفاعا معنويا ($P\leq0.05$) في معظم الصفات الإنتاجية والتناسلية والتي شملت إنتاج البيض واستهلاك الماء وزن البيض وقوة القشرة وهرمون الأستروجين وأيضا تحسن في معامل التحويل الغذائي في الإناث، وتحسن جميع الصفات النوعية للسائل المنوي وتركيز التستوستيرون في الذكور، أيضا ارتفاع معنوي في العدد الكلي لخلايا الدم الحمر والصفيحات الدموية ودرجة حموضة الدم ولزوجة الدم ولزوجة البلازما والعناصر المعدنية في الدم مثل الحديد والنحاس والكالسيوم وتركيز هرمون الغدة الدرقية والعد الكلي للبكتريا اللبنية *Lactobacillus* في الأمعاء الدقيقة. بينما انخفضت نسبة الحيوانات المنوية الميتة والأكروسوم غير الطبيعي وتركيز الكورتيكوستيرون ودرجة حرارة الجسم ووقت تخثر الدم وأعداد *E. coli* والفطريات في كلا الجنسين. وفي التجربة الثانية: أن استخدام التقنية المغناطيسية في المفقس لحضن البيض الذي جمع من التجربة الأولى عند استخدام

ماء معالج مغناطيسياً بقوة ٠,٢ تسلا كان له تأثير عالي المعنوية (P≤0.05) في معظم مجموعة من الصفات التي شملت الخصوبة والفقس ووزن الكتاكيت والحالة المناعية للأفراخ الفاقسة. بينما انخفضت نسبة الأجنة الميتة ونسبة الخلايا المتغايرة الى اللمفاوية (H/L). حققت نتائج الماء المعالج مغناطيسيا بقوة ٠,٢ تسلا نتائج متفوقة مقارنة بالمجموعات الأخرى.

Introduction

Water is the most crucial nutrient for poultry, also it softens food and carries it through the body, assists in digestion and absorption, cools the body as it evaporates through the bird's lungs and air sacs. Water assist lubricate joints, is a major component of blood, remove wastes and a necessary medium for many chemical reactions that help form meat and eggs production (1). Water is needed to transport compounds via the blood, maintain cellular structural integrity, regulate temperature (2). Magnetic water (anti-scale magnetic) treatment define as a method of supposedly reduction the effects of hard water by passing it through a magnetic device, magnetized water is hexagonal, can activate and ionize water molecules to change its structure, it is effective in several chronic diseases including diabetes that caused by oxidative stress (3). In a magnetic field, magnetic force can break large water clusters into single molecules or smaller ones and increasing polarization effects of water molecules (4), also reduces the hydrogen-oxygen bond angle within the water molecule from 104 to 103 degrees, leading to better water absorption across cell membranes (5). Magnetic fields change osmotic processes in muscles, affect the permeability of the cellular membrane and disturb the hydration ability of animal tissues. The possible health effects of magnetic fields on reproduction and development including gametogenesis, fertilization, embryo-genesis and endocrine systems have been extensively studied (6). Treating water with magnetic fields simple regenerates the natural energy and balance that nature intended (7). Magnetic water reduces the water temperature, which regulates and turn down body temperature in hot climates due to excess the rate of digestion and absorption (8). Dramatically improvement of broiler breeder performance by producing more eggs, egg weight, hatchability, immunity, physiology and microbiological so survived longer when used magnetized water (9). Magnetized well water improved body weight and feed conversion rate of birds, besides renal and hepatic functions; it also increased production, quality and hatchability of eggs, levels of reproductive hormones (progesterone and estrogen), and the blood antioxidant status (10).

The aims of this paper lies in the following aspects: i) investigate the beneficial effect of magnetically treated water at levels 0.1 and 0.2 Tesla power field on the dramatically changes on physical and chemical characteristics of well water. ii) the importance of MTW uses in quail farm on productive and physiological traits under heat stress. iii) the benefit of using MTW during incubating eggs in hatchery by conducted MTW device on pipes that supplies water to humidity device inside incubator and hatchery and its effect on embryonic development, hatchability and maternal immunity statues. iv) calculated the economic profit of each bird to have knowledge the gross of this project.

Materials and methods

The two experiments were carried out in Grdarasha Poultry Houses and Hatchery of Animal Resources Department, College of Agriculture, Salahuddin University-Erbil/ Iraq.

Experiment 1: Using magnetic technology in local quail house on production performances and physiological traits: 405 local adult quails (*Coturnix coturnix*) with average weight 219±10 g for females and 198±10 g for males at age 22 wk. (270 females and 135 males) were distributed into three groups, each group contains nine replicates as following: group 1: Well water (WW) as Control, group 2: MTW 0.1 T (1000 gauss), group 3: MTW 0.2 Tesla (2000 gauss). The quail birds were reared in special cages 65cm×60cm×50cm length, width and height respectively. Three sets of cages used one for WW group, 2 cages one for 0.1 T MT and the other for 0.2 T MTW group, each set included 9 cages designed for quails. The farm temperature was controlled under 35-37°C afternoon and 28-30 C° at night and early morning. In addition, the hens were exposed to a 16-h photoperiod for a period of 70 days. Feed and water were available to permit *ad libitum* consumption.

The production ration of quail was formulated according to the NRC (11), the basal composition of the diet contains (55.36 wheat, 6.50 wheat bran, 7.00 wheat flour,18.50 soya bean meal, 2.50 Bred-mix, 2.50 soybean oil, 7.30 limestone, 0.05 salt, 0.03 methionine, 0.03 lysine, 0.03 anti-toxin, 0.05 multi-minerals, 0.10 multi-vitamins, 0.05 enzymes) %, the chemical analysis of these ingredients are (18.0% Crude protein, 4.45% fat, 2802 ME. Kcal/kg, 155.82 C/P ratio, 3.91 Crude fibers, 3.05% Ca, 0.38% available P, 0.81% lysine, 0.42% methionine).

Bipolar or dipole magnetically device or called magnetron about 0.1 and 0.2 Tesla in a diameter 1 inch, manufactured by the UAE magnetic technology company. The direction of the passage of water from the north pole towards the south pole. The magnet device connected by pipes that provide water to the cages of quails.

At end of the study females egg production (H.D %), feed intake, feed conversion ratio (FCR), water

consumption, egg weight, eggshell strength was calculated and plasma estrogen hormone concentration was measured by RIA.

In males: Feed and water were withheld from the males at least 6 h prior to semen collection, in order to minimize contamination of the semen with dropping then semen samples were collected according to (12). Semen was collected by stimulation of the male with a teaser female. The foam was removed from the cloacal gland by delicate squeezing of the gland by thumb. Semen was collected twice a week from each male by using a small glass collector fitted, with rubber tubing and a mouthpiece, into a small calibrated tube enabling measurement of ejaculate volume exact to 10 µl. The fresh collected semen was evaluated: immediately after collection in each ejaculate such as; semen ejaculates volume, sperm concentration, Live and normal morphology sperm, semen quality factor, dead sperm percentage, seminal plasma testosterone hormone conc. were measured by Radio immunoassay (RIA) using kits purchased from Biochem Immuno Systems.

At the end of study, blood samples were collected from the brachial vein of 15 birds of each group using EDTA tubes, the total RBC (10^6/ ml^{-1} blood) were determined by using Natt and Herrick diluting solution (13). Differential of heterophil and lymphocyte made on slides stained with Wright-Giemsa and observed in an optical microscope (100x) to determined H/L ratio. Blood and plasma viscosity were measured by Ostwald-viscom. Minerals Fe and Cu (µg/ml) and Ca (mg/ml) were measured by total reflection X- ray fluorescence spectrometer (TXRF) technique. Body temperature was measured in both sexes by inserting mercury thermometer in rectal. Plasma thyroxin and corticosterone concentration were measured by RIA. Jejunum contents were cautiously kept in sterile petri dishes at 20°C until analyses in the laboratory. One gram of each homogenized sample was collected and transferred into 10 ml sterile saline solution for dilution. The next step, each sample was spread on selective agar plates as follows. The Nutrient and McConkey agars were utilized for *E. coli* and fungi as medium cultures (14) and MRS agar medium was used for *Lactobacillus* bacteria. The number of fungi and bacterial colonies were computed after incubation at 37°C for 48 hours. After that, the result numbers were converted to log 10 per ml before statistical analysis.

Experiment 2: Using magnetic technology in hatching eggs on hatchability traits: A total of 1250 fertile eggs in average weight 11.85±0.3 g was collected from experiment 1 then incubated in the hatchery. Magnet device was connected by pipes that supply water to humidity device inside incubator and hatchery. The groups of this experiment included: i) Well water (WW) set 250 eggs. ii) 250 eggs collected from quail exposed to 0.1 T MTW and in the hatchery. iii) 250 eggs collected from quail exposed to 0.1 T MTW but not in the hatchery. iv) 250 eggs collected from quail treated with 0.2 Tesla MTW and in the hatchery. v) 250 eggs collected from quail treated with 0.2 Tesla MTW but not in the hatchery.

Eggs were set for 14 d in an incubator at 99.5 °F (37.5 °C) and 55% relative humidity, then transferred to the hatchery for 3d at 98.6 °F (37 °C) and 65% relative humidity until the end of d 17 of incubation. At the end of hatching all live and dead chicks were counted, the percentages of (fertility, hatching of fertile and total eggs, dead embryos, culled chicks) and chicks weight. 12 chicks in each group were sacrificed for determining H/L ratio its prepared smears stained by Wright-Giemsa. Serum was harvested after blood centrifuged from 1d old chicks to measure the antibody titer of Newcastle Disease (HI), Infectious Bursal Disease (IBD) or Gumboro and Infectious Bronchitis Viral (IBV) were measured by ELISA.

All data were analyzed by using CRD (Complete Randomize Design) by SAS (15), as per variance, significant differences among treatment means were determined by Duncan's multiple range tests at level 0.05 (16).

Results

Three samples of water which supplied to the quail groups were analyzed in laboratories of health directory in Erbil, The physic-chemical analysis of water observed 0.1 and 0.2 T MTW were significantly (P≤0.05) higher in pH value, consistency, dissolved oxygen and Ca^{+2}, also 0.2 T MTW achieved superiorly in electrical conductivity (EC) and solubility. Whereas, 0.1 and 0.2 T MTW were significantly (P≤0.05) lower or improved in turbidity, hardness, alkalinity, total dissolved solids (TDS), CO_2, soluble chloride concentration and NO_3^- also 0.2 T MTW decreased in evaporating temperature (ET), Surface tension (ST).

Results in table 2 revealed that quail females when drank magnetically treated water (0.1 and 0.2 T MTW) were significantly (P≤0.05) higher in egg Production (HD) %, shell strength and estrogen concentration, also egg weight and water consumption were higher in 0.2 T MTW only compared with the quails in control group. Also, feed conversion ratio (FCR) improved in 0.2 T MTW. However, no significant differences among the quails of groups in feed intake.

Table 3 exposed that quail males served drinking 0.2 T MTW were significantly (P≤0.05) higher in ejaculate volume, sperm concentration, mass motility %, live and normal morphology sperm % and semen quality factors. Also increased in quantity of foam, individual motility % and testosterone hormone concentration in both 0.1 and 0.2 T MTW. While, dead sperm% significantly (P≤0.05) lower

in 0.1 and 0.2 T MTW and abnormal acrosome % in 0.2 T MTW compared with WW group.

Table 4 showed that quails when served drinking MTW were significantly (P≤0.05) higher in Total RBC, plasma viscosity, blood iron (Fe) and thyroxin hormone concentration in group 0.2 T MTW male and female, thrombocytes in groups 0.1 and 0.2 T MTW male and 0.2 T MTW female, blood viscosity, pH and Cu in groups presented 0.1 and 0.2 T MTW of both sexes, blood calcium (Ca^{+2}) in groups 0.1 and 0.2 T MTW in females only. However, MTW recorded significantly (P≤0.05) lower or improvement in corticosterone hormone concentration and body temperature in group 0.2 T MTW, also noticed reduction in blood clotting time in group 0.2 T MTW of males and in the groups 0.1 and 0.2 T MTW of female compared with control groups in both sexes.

Table 5 the using of magnetically treated water in quail house in both groups 0.1 and 0.2 T were significantly (P≤0.05) increase-ed the total count of *Lactobacillus* in small intestine, while *E. Coli* and fungi counts were significantly (P≤0.05) lower in 0.1 and 0.2 T MTW compared with the WW group in both males and females.

Table 1: Effect of magnetic technology on physical and chemical analysis of water

Physical analysis	WW	MTW	
		0.1 T	0.2 T
pH value	7.34 [b]	8.03 [a]	8.15 [a]
EC (µs/cm)	489 [a]	503 [ab]	512 [a]
Turbidity (NTU)*	528 [a]	405 [b]	347 [c]
Hardness (mg/L)	154 [a]	115 [b]	92 [c]
ET (g/hour)	0.688 [a]	0.629 [ab]	0.573 [b]
ST (Dyn/cm)	69.91 [a]	69.03 [a]	67.33 [b]
Consistency (g/ml)	0.9936[b]	1.0008[a]	1.0013[a]
Solubility (g/10 ml)	2.93 [b]	3.11 [ab]	3.28 [a]
Viscosity (centipoise)	0.726 [a]	0.704 [ab]	0.688 [b]
Salinity (%)	29.45 [a]	28.72 [ab]	28.31 [b]
Alkalinity (ppm)	130.1 [a]	119.6 [b]	113.6 [c]
Chemical analysis			
TDS (mg/L)	422 [a]	392 [b]	312 [c]
Dissolved oxygen %	36.18 [c]	40.11 [b]	46.39 [a]
CO_2 (ppm)	10.73 [a]	6.02 [b]	4.37 [c]
Soluble Chloride concentration (ppm)	57.84 [a]	47.59 [b]	40.69 [c]
Ca^{+2} (mg/L)	17.92 [c]	24.73 [b]	28.96 [a]
NO_3^- (mg/L)	3.59 [a]	2.06 [b]	1.55 [b]

WW: Well water (control), MTW: magnetically treated water, NTU: nephelometric turbidity units, the same superscripts within rows means non-significant, [a – c] Means within rows with different superscripts differ significantly at (P≤ 0.05).

Table 2: Effect of magnetically treated water on some productive parameters and estrogen concentration of local quail females

Characteristics	WW	MTW		SEM
		0.1 T	0.2 T	
Egg Production%	80.67 [c]	87.22 [b]	92.58 [a]	2.45
Feed Intake (g)	2433.5[a]	2441.2[a]	2330.7[a]	112
FCR (g feed/g egg)	2.55 [a]	2.27 [a]	1.90 [b]	0.18
Water consumption (ml/bird/d)	70.13 [b]	73.40 [ab]	79.22 [a]	3.19
Egg Weight (g)	11.83 [b]	12.33 [b]	13.25 [a]	0.47
Shell Strength (g/cm^2)	633 [b]	691 [a]	728 [a]	36.8
Estrogen (ng/ml)	0.533 [c]	0.810 [b]	0.903 [a]	0.104

WW: Well water (control), MTW: magnetically treated water, FCR: feed conversion ratio, the same superscripts within rows means non-significant, [a – c] Means within rows with different superscripts differ significantly at (P≤ 0.05).

Table 3: Effect of magnetically treated water on sperm quality of local quail males

Characteristics	WW	MTW		SEM
		0.1 T	0.2 T	
quantity of foam (mg)	4.11	104.9 [a]	89.5 [b]	72.0 [c]
Ejaculate volume (µL)	4.85	53.1[a]	37.9 [b]	34.3 [b]
Sperm concen. ($10^6/ml^{-1}$)	47.9	825.3 [a]	690.3 [b]	652.5 [b]
Mass Motility %	3.16	94.05 [a]	83.58 [b]	80.92 [b]
Individual Motility %	2.97	97.10 [a]	88.17 [b]	83.93 [c]
Live and normal sperm %	1.88	83.33 [a]	68.75 [b]	67.11 [b]
Semen quality factor	1.04	36.52 [a]	17.99 [b]	15.02 [b]
Dead sperm %	0.75	5.43 [c]	11.55 [b]	15.00 [a]
Abnormal sperm %	1.02	8.00 [b]	15.10 [a]	13.90 [a]
Abnormal acrosome %	0.306	3.24 [a]	4.60 [a]	3.99 [a]
Testosterone hormone (ng/ml)	0.218	5.29 [a]	4.33 [b]	3.67 [c]

WW: Well water (control), MTW: magnetically treated water, FCR: feed conversion ratio, [a – c] Means within rows with different superscripts differ significantly at (P≤ 0.05).

Experiment 2

Table 6 showed the results of magnetically treated water on hatchability. The eggs at the end of 17th day which treated and untreated groups with 0.2 T MTW in hatchery were significantly (P≤0.05) higher in fertility %,

hatchability of fertile and total egg % and hatched chicks weight, also treated group with 0.1 T MTW had increased in hatchability of fertile and total egg % compared with WW group. However significantly (P≤0.05) lower in total dead embryo and culled chicks percentage in 0.2 T MTW and 0.1 T MTW with the treated group compared with WW group.

The antibodies titer of hatched chicks by ELISA shows significantly (P≤0.05) higher of ND, IBD and IBV in 0.2 T MTW in treated and untreated and 0.1 T MTW in treated group compared with 0.1 T MTW in untreated and WW groups. While, H/L ratio were significantly (P≤0.05) lower or improved in all groups of MTW as compared with WW group (Table 7).

Table 4: Effect of magnetically treated water on blood and plasma characteristics of local quail males and females

Characteristics	WW		MTW				SEM	
			0.1 T		0.2 T			
Sex	M	F	M	F	M	F	M	F
Total RBC (10^6/ml^{-1} blood)	4.27 ^{b}	4.02 ^{b}	4.85 ^{ab}	4.39 ^{b}	5.09 ^{a}	4.88 ^{a}	0.612	0.417
Thrombocyte (10^3/ml^{-1} blood)	22.48 ^{c}	22.10 ^{b}	23.05 ^{b}	22,83 ^{b}	25.79 ^{a}	25.13 ^{a}	1.33	1.45
Blood viscosity (centipoise)	2.31 ^{b}	2.18 ^{b}	2.66 ^{a}	2.57 ^{a}	2.84 ^{a}	2.69 ^{a}	0.26	0.22
Plasma viscosity (centipoise)	0.94 ^{b}	1.16 ^{b}	1.08 ^{ab}	1.38 ^{ab}	1.39 ^{a}	1.53 ^{a}	0.11	0.15
Blood clotting time (sec)	110 ^{a}	117 ^{a}	102 ^{ab}	105 ^{b}	94 ^{b}	97 ^{b}	4.25	5.11
Blood pH	7.16 ^{b}	7.28 ^{b}	7.43 ^{a}	7.65 ^{a}	7.62 ^{a}	7.83 ^{a}	0.703	0.854
Blood Fe (µg/ml)	0.849 ^{b}	0.826 ^{b}	1.272 ^{ab}	1.035 ^{ab}	1.617 ^{a}	1.419 ^{a}	0.134	0.152
Blood Cu (µg/ml)	0.289 ^{b}	0.290 ^{b}	0.390 ^{a}	0.368 ^{a}	0.475 ^{a}	0.453 ^{a}	0.078	0.054
Blood Ca^{+2} (mg/ ml)	9.57 ^{a}	15.03 ^{b}	10.13 ^{a}	17.69 ^{a}	10.42 ^{a}	19.04 ^{a}	0.820	0.692
Corticosterone (ng/ml)	2.035 ^{a}	1.675 ^{a}	1.739 ^{ab}	1.245 ^{ab}	1.398 ^{b}	0.917 ^{b}	0.105	0.094
Thyroxin (T4) (ng/ml)	1.157 ^{b}	1.209 ^{b}	1.400 ^{ab}	1.715 ^{b}	1.606 ^{a}	1.925 ^{a}	0.128	0.203
Body Temperature (°C)	41.42 ^{a}	41.67 ^{a}	40.92 ^{ab}	41.08 ^{ab}	39.97 ^{b}	40.05 ^{b}	1.33	0.93

WW: Well water (control), MTW: magnetically treated water. The same superscripts within rows means non-significant, $^{a-c}$ Means within rows with different superscripts differ significantly at (P≤ 0.05).

Table 5: Effect of magnetically treated water on bacterial and fungi count (cfu×10^5/g) content of small intestine of local quail

Characteristics	WW		MTW				SEM	
			0.1 T		0.2 T			
Sex	M	F	M	F	M	F	M	F
Lactobacillus	5.52 ^{b}	5.13 ^{b}	7.75 ^{a}	7.12 ^{a}	8.47 ^{a}	8.25 ^{a}	0.906	0.762
E. coli	8.22 ^{a}	8,46 ^{a}	5.94 ^{b}	6.35 ^{b}	5.65 ^{b}	5.21 ^{b}	0.495	0.602
Fungi	7.39 ^{a}	7.63 ^{a}	3.86 ^{b}	4,25 ^{b}	4.74 ^{b}	5.03 ^{b}	0.477	0.510

WW: Well water (control), MTW: magnetically treated water, cfu: colony forming unit, $^{a-c}$ Means within rows with different superscripts differ significantly at (P≤ 0.05).

Table 6: Effect of magnetically treated water on hatchability characteristics of local quail incubated eggs

Characteristics	WW	MTW (0.1 T)		MTW (0.2 T)		SEM
		treated	non	treated	non	
Fertility %	80.77 ^{b}	83.25 ^{b}	83.45 ^{b}	93.70 ^{a}	90.51 ^{a}	1.83
Hatchability of fertile egg %	77.09 ^{bc}	81.05 ^{b}	74.16 ^{c}	89.62 ^{a}	85.36 ^{ab}	1.08
Hatchability of total egg %	70.76 ^{c}	78.30 ^{b}	71.31 ^{c}	88.62 ^{a}	83.81 ^{ab}	1.22
Total dead embryos (1-17) d %	14.56 ^{a}	13.00 ^{b}	13.70 ^{ab}	5.30 ^{c}	7.99 ^{c}	0.031
Culled chicks %	4.67 ^{a}	2.85 ^{b}	3.75 ^{ab}	1.00 ^{c}	1.50 ^{c}	0.130
Hatched chicks weight (g)	8.15 ^{b}	8.23 ^{b}	8.04 ^{b}	9.05 ^{a}	8.90 ^{a}	0.55

The same superscripts within rows means non-significant. $^{a-c}$ Means within rows with different superscripts differ significantly at (P≤ 0.05).

Table 7: Effect of magnetically treated water on immunological ELISA titer (ng/ml) against some diseases of hatched quail chicks

Characteristics	WW	MTW (0.1 T)		MTW (0,2 T)		SEM
		treated	non	treated	non	
ND	5280 ^{c}	6709 ^{b}	5437 ^{c}	8011 ^{a}	7183 ^{ab}	132
IBD	2785 ^{c}	3780 ^{ab}	3167 ^{bc}	4307 ^{a}	4121 ^{a}	122
IBV	1780 ^{c}	1966 ^{b}	1839 ^{bc}	2417 ^{a}	2295 ^{a}	98.6
H/L ratio	0.711 ^{a}	0.503 ^{b}	0.579 ^{b}	0.391 ^{c}	0.422 ^{bc}	0.103

$^{a–c}$ Means within rows with different superscripts differ significantly at (P≤0.05). ND**:** Newcastle disease; IBD: Gumboro disease, IBV: Infectious bronchitis viral disease.

Table 8 declare the using of 0.1 and 0.2 T MTW in quail house during the laying period and in humidity of the hatchery significantly (P≤0.05) raise the economical profit compared with the WW the control group.

Table 8: Effect of magnetically treated water on economical profit (outcome) ($/ bird)

Characteristics	WW	MTW		SEM
		0.1 T	0.2 T	
EP-laying period	1.628^{b}	1.818^{ab}	2.175^{a}	0.176
EP-hatching period	0.433 ^{c}	0.545 ^{b}	0.671 ^{a}	0.1.33
Total EP	2.061 ^{c}	2.363 ^{b}	2.846 ^{a}	0.210

$^{a–c}$ Means within rows with different superscripts differ significantly at (P≤0.05). EP: Economic profit.

Discussions

Using application of magnetic technology in local quail exposed to heat stress, improved water quality by passing water through a magnetic device. Data in table 1 exist to considerate changes in water physical characteristics: pH value (7.34, 8.03, 8.15), electrical conductivity (489, 503,5012 µs/cm), turbidity (528, 405, 347 NTU), hardness (154, 115, 92 mg/L), evaporating temperature (0.688, 0.629, 0.573 g/h), surface tension (69.91, 69.03. 67.33 Dyn/cm), consistency (0.9936, 1.0008, 1.0013 g/ml), solubility (2.93, 3.11, 3.28 g/10 ml), viscosity (0.726, 0.704, 0.688 centipoise), salinity (29.45, 28.72, 28.31 %), refractive Index (1.315, 1.332, 1.337, alkalinity (130.1, 119.6, 113,6 ppm) and chemical characteristics: the total dissolved solids (422, 392,312 mg/L), dissolved oxygen (36.18, 40.11, 46.39 %), CO_2 (10.73, 6.02, 4.37 ppm), soluble chloride (57.84, 47.59, 40.69 ppm), Ca^{+2} (17.92, 24.73, 28.96 mg/L), NO_3^- (3.59, 2.06, 1.55 mg/L) of WW and 0.1 T MTW, 0.2 T MTW respectively.

The recovery of water physic-chemical quality by water passing through a magnetic field acquires a finer and more homogeneous structure (17), reduces the hydrogen-oxygen bond angle within the water molecule (5), due increase in water consumption 79.22 ml/bird in the group 0.2 T MTW that led up to improvement in overall quail hens reproductive performance: egg production up to 92.58%, egg weight 13.25 g, and estrogen hormone concentration which increases water fluidity and ability to dissolve various constituents such as minerals and vitamins (18), leading to better water absorption across cell membranes. The recent results with the results of El-Hanoun *et al.* (10) exalted magnetic treatment of tap and well water improved water consumption, productive performance, such as number, weight and mass of eggs, feed conversion ratio of geese compared with groups without magnetically treated. For the same reasons above the male performance presented of ejaculate volume, sperm concentration, individual and mass motility, live and normal morphology sperm percentages, semen quality factor, quantity of foam and testosterone hormone concentration increased. While, decreased dead sperm and abnormal acrosome percentages. Consumption of MTW raised iron and copper concentrations in blood plasma led to increase in total number of erythrocyte and thrombocytes give rise to high blood and plasma viscosity which had a role in accelerating the process of blood clotting, which could be due to contain adequate of thromboplastin. In addition, MTW positively effect on thyroid gland by increasing the activity of the pituitary gland in the liberation thyrotrophic stimulation hormone for rise thyroxin hormone T_4 concentration which enhanced metabolic rate. These results of blood ameliorate in agreement with Mustafa (9) when used MTW in drinking water in broiler.

Magnetic water causing increased production and transferred large amount of RBC (19) or perhaps causes increase in attract iron from the blood and then connect the blood in large quantities and thus increase number of RBCs (20), this is due to the possibility of magnetically treated water to increase the solubility of metal salts and nutrients, especially iron, which have been more willing to penetrate cells' membrane especially blood cells.

Magnetic field animated blood more flow than increases it, and distribute nutrients to the tissues much more effectively and quickly (21), so tissue and get more nourishment. The uplift of blood Ca^{+2} procures deposition

of adequate calcium on egg shell which strengthens it in groups MTW in the female. The mostly studied ionic second messenger in cell magneto sensitivity is the cellular Ca^{+2}. Respectively, many experiments have been performed on the effects of magnetic fields on the processes, involving calcium. Many of them can be affected by oscillating magnetic fields (22).

Using 0.2 T MTW in quail drinking act remarkable reduction in body temperature, it means regulating body temperature during heat stress from 41.42 to 39.97 ℃ in the male and from 41.67 to 40.o5 ℃ in the female, which depressed corticosterone hormone concentration from 2.035 to 1.398 ng/ml in male and from 1.675 to 0.917 ng/ml in female. Adams (8) elucidated MTW turn down body temperature in hot climates due excess the rate of digestion and absorption, Gross and Siegel (23) observed a significant positive correlation between the level of corticosterone and H/L. Passing water through magnetizer device pH become more alkaline 8.03 and 8.15 in water treated with 0.1 and 0.2 T respectively, which led to increase in blood pH from 7.16 (MTW) to 7.43 and 7.62 (0.1 and 0.2 T MTW) in male and from 7.28 (MTW) to 7.65 and 7.83 (0.1 and 0.2 T MTW) in female.

More alkalinity of MTW fulfilled increase of total count of *Lactobacillus* in small intestine, otherwise *E. coli* and fungi counts in both males and females. Exposure of water to the magnetic field caused marked changes in pH value, total dissolved O_2 and solids, total hardness, electric conductivity, salinity, temperature of evaporation, mineral contents, organic matter and bacteria count (24), caused to destruct bacteria in water and it consequently reduces diseases by more than three times (25**)**, other studies found exposing water to magnetic field increased the permeability of a cell membrane (26,27). Which may lead to the loss of microbe viability (28). Also, magnetic field directly affected intracellular fluid and intracellular substances to activate enzymes inside the cells and to accelerate biochemical reactions in the body (29). Thus, it is possible that drinking magnetized water activates antioxidant enzymes in the body and reduces DNA damages. In biological systems there is a whole set of signaling mechanisms, based on various biochemical reactions (30). The increased of fertility and hatchability percentages, chicks weight and reduction in the dead embryo, also high development of maternal immunity (for ND, IBD and IBV diseases) of hatched chicks in the groups of quail drank MTW or received MTW in hatchery through humidity especially 0.2 T group. Embryogenesis is one of the most important developmental stages, and the biological value of adult organisms and breeding results are largely dependent on proper embryonic development. The embryo is especially sensitive to external factors that may have a detrimental effect on its development (31,32). El-Hanoun *et al.* (10) evaluated magnetic treatment of tap and well water improved egg fertility, and egg hatchability, health status and biological performance, reproductive hormone levels, total antioxidant capacity of geese compared with groups without magnetically treated these effects could be due to increased mineral solubility, facilitating nutrient transfer across cell membranes thus, uptake and utilization (33-35). Blood heterophil to lymphocyte ratio (H/L) improved (recorded lower value) in the groups of MTW compared with well water group which increased H/L ratio it is an indicator of stress, Gross and Siegel (23) observed a significant positive correlation between the level of corticosterone and H/L ratio.

Finally, using MTW in quail drinking water and humidity of the hatchery increased egg production with rate 6.55, 11.91 % and hatching with rate 7.54, 17.86 % in the groups 0.1 and 0.2 T MTW respectively compared with the control group (WW), which had positively affected on economic profit.

Conclusion

The application of magnetically treated water (MTW) especially 0.2 Tesla (2000 gauss) had improved the physical and chemical characteristics of water and regulate body temperature, which gain high yield of egg about 11.91%, improved feed conversion ratio, water consumption more eggshell strength in females and perfect semen quality in males. Besides promoting blood traits and better count of lactobacillus; it also increased embryonic development, fertility and hatchability of incubated eggs about 17.86% when used MTW in humidity device, levels of reproductive hormones (progesterone and estrogen), and the immunity status for neonatal hatched chicks, so resultant more benefit outcome of this study.

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