Response of growth Performance, Some Blood Parameters and Intestinal Microbiology of Broiler Chickens to Magnetic Technology of Water

By

H.A. Ahmed[*], M.A. Soltan[**] and R.S. Shewita[**]

[*]Damanhour University, Faculty of Veterinary Medicine, Department of Nutrition and Vet., Clinical Nutrition.[**]Alexandria University, Faculty of Veterinary Medicine, Department of Nutrition and Vet.,Clinical Nutrition.

Egypt

Corresponding author: Hamada Ahmed E. mail: hamada_nutrition@vetmed.dmu.edu.eg

Abstract:

Forty eight one-day old Cobb broiler chicks were used to investigate the effect of magnetized water treatment on growth performance, immune response, some blood parameters, carcass traits and intestinal microbiology of broiler chicks.Chicks were randomly allotted into 2 groups (24 chicks per group and 3 replicate for each), first group drank normal tap water and considered as control, while the other drank magnetized water treatment for continuous 6 weeks.Magnetized water treatment significantly improved final body weight, daily gain, feed conversion ratio, protein efficiency ratio and performance index by about 7.3%, 7.4%, 11.7%, 23.3% and 20.6% respectively, while decreased total feed intake throughout the whole experimental period by about 4% when compared with the control.Moreover, magnetized water treatment improved total protein and globulin blood serum concentration and improved liver function through reduction of GPT, GOT and cholesterol serum concentrations when compared with the control.Magnetized water treatment improved antibody titer production and immune organs relative weights and significantly improved dressing percent, while had no significant effect on the other carcass traits. Magnetized water treatment significantly reduced total intestinal bacterial count and Coliforms bacteria by about 39.3% and 40% respectively, while significantly increased Lactic acid bacteria count by about 44.4% and non significantly increased Lactobacillus bacteria counts by about 14.6% when compared with control group.Magnetized water treatment for broiler chicken improve performance, improve immune response, protect liver and regulate intestinal microflora.

Key words: Magnetic water, Chickens, Growth, Blood, Immune response, Intestinal microbiology.

1- Introduction:

Water is the most important nutrient for life. It is useful in every action and reaction within the cell astransportation offluids and absorbed nutrientsthrough the blood, maintaining the cellular structural integrity, regulation of body temperatureas well as other processes**(Chiba 2009).**Water intakecontain pH, hardness and total dissolved solids that negatively affect animal health. Water characteristics have a close relation to its chemical structure and it can be affected by external processing such as magnetic field**(Pang and Deng, 2008).**There are several techniques used to improve water quality, and one of theminvolves the use of magnetic forces to magnetize the water. More studies reported that magnetic fields could have possible biological effects on animal's performance(**Al-mufarrej et al. 2005**). Magnetic water has been used forseveral decades in different fields. Researches showed that if water as

well as water-based solutions that pass through magnetic fields, it acquire finer compounds as various minerals and vitamins that are dissolved leading toincreasing fluidity and improving the biological activity of these solutions, which in turn improve the performance of animals (**Trachenko and Semyonova, 1995**).

Researchers reported that water can bechargedmagnetically, and so acquirethe magnetic properties, that become more active, energized, soft and high pH to slight alkaline and free of microorganism and have a positive effect even on the human body **(Lam, 2001).**

Several reports are available onthe application of magnets for improving the quality and health benefits ofwater as well as broiler performance(**Verma, 2011**).

It was reported that, using magnetic water could improve productive and reproductive performance of doe rabbits (**El-Hanoun *et al.*, 2013**), improve buck rabbit performance (**Attia *et al.*, 2015**),shortening of fattening period of broiler chickens, improve growth rate and meat quality flavor and tenderness **(Rona, 2004),** decrease in feed consumption andan improve in feed conversion ratio **(SagBaug, 2003).**Improve blood picture, decrease total cholesterol, LDL, VLDL, triglycerides, and glucose levels in Japanese quail (**Ali 2018**).Nonetheless**, (Alhassani and Amin, 2012)** showed that magnetic water did not significantly affect performance of broiler chickens, in addition, **Sargolzehi *et al.* (2009)**noticed that exposing water to a magnetic field produced no significant effect in performance, carcass composition, blood constituents or milk nutrient profile of lambs and goats.

The present study examined the hypothesis that the effect of magnetized drinking water by 500 gause and passed by magnetizer device with different speed flow upon some productive performance, immune status, some blood parameters and intestinal microbiology of broiler chickens.

2- Material and methods

This study was conducted at Nutrition and Veterinary Clinical Nutrition Department, Faculty of Veterinary Medicine, Damanhour University, Egypt to investigate the possible comparative effect of magnetic technology of water on growth performance, immune response, some carcass characteristics and intestinal microbiology of broiler chickens.

Birds, housing and management: in this experiment, 48 one day old, non sexed *Arber Acres* chicks were individually weighed and wing-banded, randomly assigned into two equal groups (24 chicks per each and three replicate for each group). The chicks were housed in previously disinfected pen with formaldehyde gas; chicks were wormed up to 32ºC for the first three days then gradually lowered to 23ºC by the end of the period. Photoperiods were maintained at 24 h/day during the first week, and then decreased to 23 h/day up to the end of experiment. Feeds and water were supplied ad-libitum. Prophylactic measures against the most common infectious viral diseases (Newcastle disease, infectious bronchitis, and infectious bursal viral diseases) were carried out as presented in table, 1.

Design and dietsof the experiment: The chicks were randomly allocated into two groups (three replicate for each). All birds were fed conventional starter and finisher diets for 21 and 42 days old respectively during the experimental period (6 weeks experiment). The different proportions of ingredient to meet the requirements at different growth stage and the chemical analysis of the experimental diets **(according to AOAC, 1990)**are shown in Table, 2. Group

No. 1 received normal tap water (control group), whereas group No. 2 received magnetic drinking water which being passed by magnetizer by Magnetic power of bars by Teslameter 4060.50= 170 -204 ml tesla (mt).

Table (1) Vaccination program of broiler chicks:

Age of chicks (days)	Vaccine	Route of administration
7	Hitchner[1]	Eye drops
10	IBD(Intermediate)[2]	Eye drops
17	La Sota[3] + IBD[2]	Eye drops
27	La Sota[3] + IBD[2]	Eye drops

1-Hichner Fort Dodge Animal Health Batch NO: 1084264A, 2-IBD intermediate strain CEVA SanteAnimale Batch NO: 1609T2D2A . 3- La Sota, ISO S.P.A, batch NO: 0533D

Table (2): Chemical composition of the experimental diets

Items	Starter	Finisher
Moisture %	10.3	9.52
Crude protein%	22.4	20.67
Ether extract%	4.09	3.92
Ash%	7.25	9.39
Crude fiber%	3.65	6.10
NFE%*	52.31	57.12

*nitrogen free extract (calculated by difference).

The preparation of magnetic water (MW): Magnetized device was fixed inside the water container with a relatively low rotation for distribution. Chickens were provided with fresh MW every 12 hours following the recommendations of the magnetic manufacturer. According to the manufacturer that water retains the magnetic properties for up to 12 hours following the passing of water through the magnetic field. The strength of the magnets was between 85 – 102 tesla (mt).**Growth measurements:**initial body weight, weekly body weight development, body weightgain (BWG) andfeed intake (FI) of the chicks in experimental groups were recorded, whereas FCR, protein efficiency ratio (PER) and performance index (PI) were calculated.

Evaluation of immune response: Haemagglutination inhibition (HI) tests for *Newcastle* disease (ND)antibodies:Blood samples were taken at 42th day of the chicken age for Newcastle Disease antibodies determination.The samples were leftin room temperature without anticoagulant to clot. Separation of serum was done using centrifuge(adjusted at 3000 rpm for 10 minutes). Microtechnique of HI test was performed according to **Takatasy (1955)**. Geometric mean titer (GMT) was calculated according to **Brugh (1978).**

Blood samples: at 42thday of the chicken age, blood samples were taken from 2 chicks from each replicate of the two groups. The samples were left to drop on the side of the tube to prevent destruction of RBCs. Each blood sample was left to coagulate at roomtemperatureThe separation of serum was conducted by centrifugation at 3000 rpm for 10 minutes.Clear serum was used for determination of serum glucose, total serum protein, albumin and globulin according to**Trinder (1969),Doumas et al. (1981), Reinhold (1953) and Coles (1974)** respectively. Moreover, serum cholesterol, GOT, GPT and ALP (alkaline phosphatase) were analyzed according to**Reitman and Frankel (1957).**

Carcass characteristic: By the end of the experimental trial,two chickenfrom different groups were selected in a random manner from each replicate. The birds were fasted for 8 hours before weighingand they were then slaughtered for complete bleeding,scarified for calculating the carcass and dressing percentages, liver, heart, gizzard, spleen, bursa, thymus gland and total edible carcass were collected (TEC) and relative weight of each organ was calculated as follows: Relative weight = (organ weight/Live body weight) X 100.

Intestinal Microbiology: At the end of experiment, the same two chicken from every group used for carcass were used for separation of the cecum, aseptically handled, removing and weighting one gram of cecum contents of each birdfor determining the colony forming units (CFU). The cecum contents were addedto a tube containing 9 ml peptone water. The solution was properly shaken. Then, 1 ml of solution was added to another tube by a sampler containing 9 ml of sterile peptone water. This operation was done until tube number eight and a dilution series was prepared. Ten-fold dilutions (10^{-1} to 10^{-7}) of digesta were performed using buffered peptone water (BPW)according to **Mountzouris et al. (2007).**The samples were placed on a plate containing eosin methylene blue agar, McConkey agar, and Rogasa medium, for the growth of Escherichia coli, lactobacillus bacteria, and for the growth of lactic acid bacteria. Nutrient agar medium was prepared for the counting of total cultured bacteria. This process was repeated for each sample. Culture McConkey, eosin methylene blue and nutrient agar at 37°C for 24 h and Rogasa media. At the end, samples from 25 to 300 colonies, thatcan be counted was chosen as an appropriate dilution, after counting, multiplying by their inverse dilution and so the number of bacteria was obtained.

Statistical analysis: The obtained data were statistically analyzed using **Statistical Analysis System (SAS, 1996)**to estimate the significance between different treated groups, the means were significant at ($p<0.05$).

3-Resulta and Discussion:

Growth performance measurements:the effect of magnetized water treatment on body weight development of chickens is summarized in table 3. Statistical analysis of the obtained data revealed that no significant difference between the two experimental groups at the start of the experiment.

Table (3): Effect of magnetized water treatment on body weight development (g/bird) ofbroiler chicks.

Age/wk	Groups	
	Control group (CG)	Magnetic water treated group (MWTG)
Week 0 (Initial body weight)	40.08±2.75a	40.04±1.76a
Week 1	176.04±20.85a	183.48±21.87a
Week 2	455.00±43.19a	468.69±52.27a
Week 3	817.61±63.06a	749.57±119.13b
Week 4	1029.74±179.10a	1034.57±235.94a
Week 5	1749.09±191.73b	1894.13±198.74a
Week 6 (Final body weight)	2077.50±257.52b	2229.39±256.05a
FBW relative to control	**100**	**107.31**

Values are means ± standard error. Mean values with different letters at the same rowdiffer significantly at ($p \leq 0.05$).

It was observed that magnetized water had no positive effect on broiler chicken weight during the starter period while significantly increased broiler weight at finisher period. Magnetized water significantly (P≤0.05) increased final broiler chicken weight by about 7.31% when compared with the control group

Moreover, MWT improved total body gain, feed conversion ratio (FCR), protein efficiency ratio(PER) and performance index (PI) (table, 4) by about 7.4%, 11.7%, 23.3% and 20.6% respectively when compared with the control. However, MWT reduced feed intake by 4% when compared with the control.

Table (4): Effect of magnetized water treatment on growth performance and feedefficiency parameters of broiler chicks.

Items	Groups	
	Control group (CG)	Magnetic water treated group (MWTG)
Initial BW (g/bird)	40.08±2.75[a]	40.04±1.76[a]
Final BW (g/bird)	2077.50±257.52[b]	2229.39±256.05[a]
Total body gain (g/bird)	2037.14±255.06[b]	2187.22±254.56[a]
Daily body gain (DBG g/bird)	48.50	52.08
DBG relative to control	100	107.38
Total Feed Intake (g/bird)	3988.4	3824.5
Daily feed intake (g/bird/day)	94.9	91.1
DFI relative to control	100	95.99
Feed conversion ratio (FCR)*	1.96±0.25b	1.73±0.20[a]
FCR relative to control	100	88.27
Protein efficiency ratio (PER)**	2.40[b]	2.96[a]
PER relative to control	100	123.3
Performance index (PI)***	107.68±26.89[b]	129.87±30.78[a]
PI relative to control	100	120.61
Mortality %	8.2	4.1

Values are means ± standard error. Mean values with different letters at the same row differ significantly at ($p \leq 0.05$). *FCR = Feed intake/body gain. ** PER = body gain (g)/protein intake(g).***PI=Live body weight (Kg)/Feed conversion ratio X100.

Blood serum units: Effect of MWT on some blood serum parameters of broiler chickens are presented in table, 5. Magnetized water treatment significantly increased blood serum total protein and globulin concentrations by about 5.7% and 12.2% respectively when compared with the control group, while had no effect on blood serum albumin concentration. Moreover, MWT significantly reduced GOT and Alkaline phosphatase blood serum concentrations by about 4.4% and 8.5% respectively, while had non significantly reduced GPT blood serum concentration by about 2% compared with control group.

Immune response: Effect of MWT on immune response of broiler chickens are presented in table 6. The analysis of variance of the obtained data revealed that magnetized water treatment significantly improved antibody titer production against New castle disease vaccine by about 12.6% when compared with control group.

Table (5): Effect of magnetized water treatment on some blood serum parameters of broiler chicks.

Items	Groups	
	CG	MWTG
Total protein (g/dl)	4.24±0.19[b]	4.48±0.08[a]
Albumin (g/dl)	2.27±0.08[a]	2.27±0.08[a]
Globulin (g/dl)	1.97±0.19[b]	2.21±0.11[a]
GOT (U/100 ml)	68.0±1.58[a]	65.0±2.23[b]
GPT (U/100 ml)	69.8±0.84[a]	68.4±1.14[a]
Alkaline phosphatase (mg/dl)	11.8±0.81[a]	10.8±0.45[b]
Glucose (mg/dl)	180.4±1.67[a]	176.4±2.51[b]
Cholesterol (mg/dl)	201.4±3.36[a]	196.6±2.30[b]

Values are means ± standard error. Mean values with different letters at the same row differ significantly at ($p \leq 0.05$).

On the other hand, magnetized water treatment significantly (P≤0.05) increased spleen weight, while non significantly (P≥.05) improved both bursa and thymus gland weight when compared with the control group. However, magnetized water non significantly improved spleen and bursa relative weights, while had no effect on thymus gland relative weight when compared with the control group.

Table (6): Effect of magnetized water treatment on antibody titer against Newcastle disease vaccine (HI) and some immune organs weights and relative weightsofbroiler chicks.

Items	Groups	
	CG	MWTG
Antibody titer at 42th day old of chickens	4.28±0.22[b]	4.82±0.49[a]
Spleen weight (g)	1.73±0.24[b]	2.10±0.28[a]
Spleen relative weight (% to live weight)	0.09±0.02[a]	0.10±0.01[a]
Bursa weight (g)	1.04±0.44[a]	1.13±0.14[a]
Bursa relative weight (% to live weight)	0.05±0.03[a]	0.06±0.01[a]
Thymus gland weight (g)	5.82±1.62[a]	6.15±1.39[a]
Thymus gland relative weight (% to live weight)	0.30±0.09[a]	0.26±0.05[a]

Values are means ± standard error. Mean values with different letters at the same rowdiffer significantly at ($p \leq 0.05$).

Carcass quality: Effect of MWT on some carcass traits of broiler chickens are presented in table 7. It was observed that magnetized water treatment significantly (P≤0.05) improved dressing percent of broiler chicks by about 5% when compared with control group. Moreover, magnetized water non significantly (P≥0.05) increased heart, liver, gizzard and proventriculus weights by about 29.9%, 25.3%, 18.8% and 42.4% respectively compared with the control group. Otherwise, magnetized water treatment had no effect on body organs relative weights compared with the control group.

Table (7): Effect of magnetized water treatment on some carcass traits ofbroiler chicks.

Items	Groups	
	CG	MWTG
Dressing %	74.62±0.97[b]	78.32±2.81[a]
Heart weight (g)	9.08±0.92[a]	11.80±2.39[a]
Heart relative weight (% to live weight)	0.47±0.02[a]	0.48±0.08[a]
Liver weight (g)	39.73±0.76[a]	49.80±7.90[a]
Liver relative weight (% to live weight)	2.05±0.16[a]	2.13±0.21[a]
Gizzard weight (g)	27.50±4.67[a]	32.68±3.18[a]
Gizzard relative weight (% to live weight)	1.41±0.16[a]	1.39±0.10[a]
Proventiculus weight (g)	5.85±0.98[a]	8.33±1.49[a]
Proventiculus relative weight (% to live weight)	0.30±0.03[a]	0.34±0.04[a]

Values are means ± standard error. Mean values with different letters at the same rowdiffer significantly at ($p \leq 0.05$).

Intestinal microbiology: Effect of MWT on the intestinal microbiology is presented in table 8. It was observed that magnetized water treatment (group, 2) significantly reduced total intestinal bacterial count and Coliforms bacteria by 39.3% and 40% respectively compared with the control one. On the other hand magnetized water significantly increased Lactic acid bacteria count by about 44.4% while, non-significantly increased Lactobacillus bacteria counts by about 14.6% when compared with control group.

Table (8): Effect of magnetized water treatment on intestinal microbiology of broiler chicks.

Items	Groups	
	CG	MWTG
Total bacteria [cfu/gr]	$9.05X10^8$±0.24[a]	$5.49X10^8$±0.68[b]
Coliforms bacteria [cfu/gr]	$6.65x10^7$±0.83[a]	$3.99X10^7$±0.57[b]
Lactobacillus bacteria [cfu/gr]	$1.37X10^8$±0.17[a]	$1.57X10^8$±0.43[a]
Lactic acid bacteria [cfu/gr]	$2.43X10^8$±0.50[b]	$3.51X10^8$±0.24[a]

Values are means ± standard error. Mean values with different letters at the same row differ significantly at ($p \leq 0.05$).

Improvement of final body weight of broiler chicken with Magnetized water when compared with the control group, which agreed with **Alhassani and Amin (2012),**who stated thatmagnetized water with longer period had superior body weight of broiler chicken compared with the control group. In addition, the present data agree with that obtained by **Rona (2004)** who stated that using magnetic drinking water for chickens resulted in shortening of fattening period of broiler chickens, an increase in growth rate by 5-7% compared with control group. **AlFadul (2007)** observed improved FCR of birds provided magnetic water comparedwith those in the control group.Otherwise, the result is in contrast with **Al-Mufarrej et al. (2005)** who reported that magnetized water had no significant effect on the broiler growth performance. The difference may be related to the period which passed the water through magnetized device.

Improvement of FCR, PER and PI by MWT may be related to higher weight gain and lower feed intake. The present data are in contrast with those obtained by **Al-Mufarrej et al. (2005)** who concluded that MWT had no effect on feed intake or FCR of broiler chickens compared with untreated water group.

The differences results among studies in this field may be attributed to the variety of broiler strain, the magnetizer device type, the power of magnetization, the speed of device. The obtained results may be related that Magnetic water is able to increase the solubility of minerals thus facilitating the better absorption of the nutrients to all parts of the body of chicks**(Gholizadeh et al., 2008)**. The same authors suggested that, the magnetic device never affect the properties of the water, its properties and qualities unchanged. Thus, the poultry can take benefit some of the following advantages when it is being magnetized.Varieties of explanations are offered to explain the difference between different magnetic water treatment results, the most of them,show little scientific substance. Some of the researchers reported that magnetic water treatments have a role in affecting hydrogen bonds between the water molecules. They noticed that there were changes in the properties of water such as light absorbency, surface tension, and pH **(Bruns *et al.*, 1966; Joshi and Kamat, 1966; Klassen, 1981).** Otherwise, other researchers **(Mirumyants *et al.*, 1972)** showed thatthese effects have not always been observed.

To counteract that transit effect the magnetic device remain more than 12 hours inside the water tank and during introducing the water to the chicken which it is differ from other treatment of the published research.

Higher globulin concentration in blood serum of broiler chicks indicated that MWT had immune stimulation effect. Moreover, reduction of liver enzyme concentration indicate that MWT had hepatic cell protection and improve general broiler chicken health and reflected on the blood serum concentration of MWT group as it is reduced by about 2.4% compared with the control one.

The analysis of variance of the obtained data revealed that magnetized water treatment significantly improved antibody titer production against New castle disease vaccine by about 12.6% when compared with control group. The present data are in contrast with those obtained by **Al-Mufarrej et al. (2005)** who reported that water treatment and sex of broiler chickens did not influence antibody responses to SRBC antigens.

Improvement of immune organs weight and relative weights indicated that magnetized water improved immune system of the broiler chickens. This finding was in contrast with **Battocletti *et al.* (1981); Bellossi and Toujas (1982); Tenforde and Shifrine (1984); Osbakken *et al.* (1986)** who reported no effect for static magnetic field of 130- 20,000 gauss on the immune system of animals. On the other hand, **(Lam, 2001, magnetic technologies LLS, 2000-2003),** suggested that magnetic water treatment has been claimed to help the body ward off microbial invaders and so have a role in improvingthe immune system of chicks.The obtained data indicated that magnetized water had beneficial effect on the intestinal microbiology through liberated active oxygen molecule. This theory supported by those obtained by **Kronenberg (1993)** who indicated that magnetized water reduced the amount of chlorine needed to kill bacteria in a pool by 30 percent by clamping magnets on the water supply line.

Lowering pathogenic bacteria and improved lactic acid bacteria counts of the intestinal microflora by magnetized water treatment group may be related to reduction of mortality (4.1% vs 8.2% of control group) and disease condition compared with control group. This finding are in harmony with those obtained by (**Wasef, 1996)** who reported that magnetized water reduce mortality and disease of broiler chicken. There is no any published data concerning the effect of MWT on the intestinal microbiology. Moreover, other important factors can affect the outcome of MWT application and should be taken in consideration before any final investigation regarding such treatment. These include poultry strain, quantity of water, space between the water and magnetic field the magnetizer device type, the power of magnetization, the speed of device, the number and shape of magnets, and finally way (s) to evaluate the MWT. So that further investigation required to proof the results.

4-Conclusion: From the obtained data can be concluded that magnetized water treatment improve growth performance, immune response, of broiler chickens. Moreover magnetized water treatment reduce total bacterial and Coliform bacteria counts, while increases lactic acid producing bacteria. Generally, magnetized water can improve broiler chicken health, and further investigationsare required to proof these results.

5- References:

A.O.A.C. (1990): Association of Official Analytical Chemistry .Official Methods of Analysis 15ED published by AOAC Washington,

Al-Fadul, M. F. M. (2006): The effect of magnetic treated water and diet on the performance of the broiler chicks. M.Sc. Thesis, Dept. Poult. Prod., Fac. Anim. Prod., Univ. Khartoum, Sudan.

ALHASSANI, D.H.and AMIN, G.S. (2012): Response of Some Productive Traits of Broiler Chickens to Magnetic Water. Int. J. of Poult. Sci. 11 (2): 158-160.

Ali, H. A. (2018): Effect of Magnetically Treated Water on Physiological and Biochemical Blood Parameters of Japanese Quail. International Journal of Poultry Science ,Volume 17 (2): 78-84.

AL-MUFARREJ,S.; AL-BATSHAN, H.A.; SHALABY, M.I. and SHAFEY, T. M. (2005): The Effects of Magnetically Treated Water on the Performance and Immune System of Broiler Chickens. Int. National J. of Poult. Sci., 4 (2): 96-102.

ATTIA, Y.A., EL-HANOUN, A.M, ABD EL-HAMID, A.E and ABDELLA, M.M.(2015): Responses of the fertility, semen quality, blood constituents, immunity, and antioxidant status of rabbit bucks to type and magnetizing of water. Annals AnimSci 2015; 2:387-407.

BATTOCLETTI, J.H., SALLES-CUNHA, S., HALBACH, NELSON, R.E.; J. and SANCES, Jr., A. (1981): Exposure of rhesus monkeys to 20,000 G steady magnetic field: Effect on blood parameters. Med. Phys., 8: 115-118.

BELLOSSI, A. and TOUJAS, L. (1982): The effect of a static uniform magnetic field on mice: A study of a Lewis tumor graft. Radiation and Environmental Biophysics, 20: 153-157.

BRUGH, M.J. (1978): A simple method for recording and analyzing serological data. J. Avian disease, 22:362-365.

BRUNS, S.A., KLASSEN, V.I. and KONSHINA, A. K. (1966): Change in the extinction of light by water after treatment in a magnetic field. KolloidnyiZhurnal, 28: 153-155.

CHIBA L.I. (2009): Animal Nutrition handbook. Second revision. p. 1–552.

COLES, E. H. (1974): Veterinary Clinical Pathology: 211-213, W. B. Saunders Company Philadephia London Toronto.

DOUMAS, B. T.; WATSON, W. A. and BIGGS, H. G. (1971): Albumin standards and the measurement of serum albumin with bromocresol green. Clin. Chim. Acta, 31: 87-96.

EL-HANOUN, A.M, ATTIA, Y.A, ABD EL-HAMID, A.E, GAD, H.A.M and ABDELLA, M.M. (2013): Response of rabbit does to water type and magnetic treatments. pp. 370-383 in 4th Scientific Conference of Animal Production Research Institute (APRI) proceeding; 12-13 Nov ; Giza, Egypt.

Gholizadeh, M.; Arabshahi,H.; Saeidi, M.R. and Mahdavi, B.(2008): The Effect of Magnetic Water on Growth and Quality Improvement of Poultry.Middle-East Journal of Scientific Research 3 (3): 140-144.

JOSHI, K.M. and KAMAT, P.V. (1966): Effect of magnetic field on the physical properties of water. J. Ind. Chem. Soc., 43: 620-622.

KLASSEN, V.I. (1981): Magnetic treatment of water in mineral processing. In Developments in Mineral Processing, Part B, Mineral Processing. Elsevier, N.Y., pp: 1077-1097.

KRONENBERG, K. J. (1993): Magnetized ll: More alluring facts about treating water with magnets. **Aqua Magazine,** September, 20-23.

LAM, M. (2001): Magnetized water. (www.DrLam.com).

MIRUMYANTS, S.O.; VANDYUKOV, E.A. and TUKVATULLIN, R.S. (1972): The effect of a constant magnetic field on the infrared absorption spectrum of liquid water. Rus. J. Phy. Chem., 46: 124.

MOUNTZOURIS, K.C., TSIRTSIKOS, P.,KALAMARA, E.,NITSCH, SCHATZMAYR, G.,FEGEROS, K. (2007): Evaluation of the efficacy of a probiotic containing Lactobacillus, Bifidobacterium, Enterococcus, and Pediococcus strains inpromoting broiler performance and modulating cecal microflora composition andmetabolic activities. Poult.Sci.86,309–317.

OSBAKEN, M., GRIFFITH, J. and TACZANOWSKY, P. (1986): A gross morphologic, histologic, hematologic, and blood chemistry study of adult and neonatal mice chronically exposed to high magnetic fields. Magnetic Resonance in Medicine, 3: 502-517.

PANG, X.F. and DENG, B. (2008): Investigation of changes inproperties of water under the action of a magneticfield. Science in China Series G: Physics, Mechanics& Astronomy, 51: 1621-1632

REINHOLD, R. R. (1953): Determination of serum albumin. Clin. Chem., 21: 1370 – 1372.

REITMAN, S. and FRANKEL, S. (1957): A colorimetric method for determination of serum glutamic oxaloacetic and glutamic pyruvic transaminase. Am. J. Path., 26: 1-13.

RONA, Z. (2004): Magnetized water is not mystery. Encyclopedia of Natural Healing, pp: 405 (internet).

SAGBAUG, M., 2003. Heavy-duty magnetic water condition. (http://www.space.age.com).

SARGOLZEHI, M.M, REZAEE ROKN-ABADI, M. and NASERIAN, A.A.(2009): The effects of magnetic water on milk and blood components of lactating Saanen goats. Int J of Nutr and Metab 2009; 1:20-24.

SAS (1987): Statistical Analysis System. Users Guide Statistics. As. Institute Cary, North Carolina.

TAKATASY, G. Y. (1955): The use of spiral 100 Min Serological and Virologicalmicromethods. Acta, Microbial, Acad. Sci. Hung., 3:191.

TENFORDE, T.S. and SHIFRINE, M. (1984): Assessment of the immune responsiveness of mice exposed to a 1.5- Tesla stationary magnetic field. Bioelectromagnetics, 5: 443-446.

TRACHENKO, Y. AND SEMYONOVA, N. (1995). Your Way to Health: Magnetic Water Plusseparate Nutrition. In: Mysteries of Magnetic Energies a Collection of Scientific Works on the Usage of Magnetic Energies in Medical Practice, Tkachenko, Y.P. (Ed.)., Part 6, Printing Emirates, Printing and Publishing, Sharjah, UAE. Moscow, Russia. Sochi, Russia. Dubai, UAE, pp: 225-244.

TRINDER, P. (1969): Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. Annals of Clinical Biochemistry 6: 24–27.

Verma, S.S. (2011): Magnetic water treatment. Chem Business; 25:13-16.