DOES MAGNETIZED DRINKING WATER AFFECT PRODUCTIVITY AND EGG QUALITY OF LAYERS?

RUNNING TITLE: MAGNETIZED WATER EFFECT ON EGG QUALITY

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SUMMARY

Water is a major component of cells in living organisms, and is important to poultry health and productivity. This study was conducted to evaluate production and quality of eggs from laying hens receiving magnetized drinking water. One hundred ninety-two Hy-Line W36 hens, 48-wk of age, were housed in a tunnel ventilated house. On d 1 of the trial, hens were randomly allotted to treatment groups of control (C; un-magnetized water line) or polyvinylchloride water line with 3000 Gauss magnet (MW) on the exterior surface. There were three replicates per treatment with 6 cages of 6 hens per cage (replicate 1) or 5 hens per cage (replicates 2 and 3). Standard laying diet and water were provided ad libitum. The trial was conducted for two consecutive months. The egg production was monitored daily while egg weight, shell weight and thickness, internal egg quality and egg yolk mineral content analyses were measured weekly. At the end of the experiment, eggs from each treatment from 3 consecutive days were used to determine breaking strength. Water pH of the MW group was lower (8.21, for the 1st month and 8.16, for the 2nd month) than those of C group (8.31 and 8.34, during the 1st and 2nd month, respectively). Egg production and egg weight were not affected by the treatment. Internal egg quality characteristics and shell mass of the eggs from hens in the MW group were improved (P = 0.04) compared to eggs from hens in the C group throughout the experimental period, and they had thicker (P = 0.03) shells during the second month of the study. In conclusion, magnetized drinking water can improve egg quality characteristics without affecting egg production or egg mass.

***Keywords**: Egg weight, eggshell quality, yolk index, albumen, yolk minerals, breaking strength*

INTRODUCTION

The poultry industry continues to grow worldwide in both meat and egg production. Improving internal and shell quality traits of egg is of great importance to the egg industry because quality traits consequently affect shipping durability, egg acceptability by consumers, and revenues for egg producers. Increasing and maintaining egg quality traits has been an area of interest for many researchers using different water or feed additives (Skřivan *et al*., 2010; Jiang *et al*., 2013and Świątkiewicz *et al*., 2013).

Water quality is an important factor to be considered because poultry performance is directly affected by quantity and composition of mineral and microorganisms in water (King, 1996). According to World Health Organization (WHO) (1996) drinking water quality guidelines, pH is one of the most important quality parameters for drinking water, and less than pH of eight is preferable. The changes in water pH (alkalinity and hardness) are a result of the amounts and types of minerals dissolved into the water from the surrounding environment. These minerals could negatively affect water characteristics such as taste, odor and appearance, and consequently, water consumption by the animal. Presence of bicarbonate, hardness, calcium, and magnesium in the drinking water adversely affect weight gain in broilers and turkeys (Barton, 1996).

Water is a major component of living cells, which contain charged molecules and particles. Magnetized water technology has shown great application potential for different fields, such as prevention of scale (precipitate deposition) on surfaces, plant irrigation, and wastewater management. Magnetic treatment of water re-arranges the water molecules into tiny and uniform structured clusters (Ali *et al*., 2014; and Alabi *et al*., 2015). This physical change eases water passage in plants and animals (Ali *et al*., 2014).

The few studies investigating the application of magnetic field treatment of water on productivity and physiology in animals have given mixed results. Conditioning of water with magnets does not affect blood metabolites, blood ions or milk composition in lactating dairy goats (Sargolzehi *et al*., 2009). Rabbits consuming magnetized water have elevated serum glutathione and total serum proteins, and suppressed total cholesterol, triacylglycerol, and low-density lipoprotein cholesterol in their serum (Khudiar and Ali, 2012).

In broiler chickens, water consumption was decreased while performance, carcass composition and immune system function were not affected by magnetized water treatment in the study of Al-Mufarrej *et al*. (2005). Gholizadeh *et al*. (2008) found that magnetized water increased meat-to-fat ratio, growth, and European production efficiency factor and decreased mortality, sickness and feed consumption. Alhassani and Amin (2012) reported that body weight, weight gain, feed intake, feed conversion ratio, mortality, viability and production index generally were not affected by different magnetic water treatments compared to untreated water. However, the differences in final body weight between water treated and untreated groups ranged between 108-110 g for birds given treated water, which is a large economic advantage. It was speculated that liver enzymes and gut physiology in broiler chickens were influenced by magnetized drinking water, but the weights and lengths of intestinal tract and femur and tibia bones of the magnetized water treated groups were similar to those of control birds (Gilani *et al*., 2014).

A few studies were found in the published literature on the influence of magnetized drinking water on layer hens, so this study was conducted to investigate the effects of magnetized drinking water on layer hens productivity and egg quality.

MATERIALS AND METHODS

This study was approved by the Institutional Animal Care and Use Committee, Louisiana State University Agricultural Center.

Experimental animals:

One hundred ninety-two Hy-Line W36 hens, 48 wk of age, were housed in a tunnel ventilated house for eight weeks. On day one of the trial, hens were randomly allotted to one of two treatment groups: control (C) (un-magnetized water line) or magnetized water line (MW). There were three replicates per treatment with 6 cages of 6 hens per cage (replicate 1) or 5 hens per cage (replicates 2 and 3). Feed and water were available *ad libitum*. The hens received a standard diet (Table 1) that was formulated on a total amino acid basis and with adequate levels of Ca and P. The diet contained 0.82% Lys, 4.80% Ca and 0.43% non-phytate P (NRC, 1994).

Table 1. Composition of the diet

Item	%
Yellow Corn	60.68
Soybean meal	22.92
Limestone	11.58
Soy oil	2.08
Monocalcium phosphate	1.57
Salt	0.41
Mineral premix[1]	0.10
Vitamin premix[2]	0.25
DL-Methionine	0.17
Choline chloride	0.14
Ethoxyquin	0.10
Calculated values	
Metabolize energy(kcal/kg)	2800
Non-phytate P, %	0.43
Total P, %	0.66
Ca, %	4.80
Lysine, %	0.82

[1] Provided per kilogram of diet: Cu (copper sulfate), 7 mg; I (calcium iodate), 1 mg; Fe (ferrous sulfate H_2O), 50 mg; manganese (manganese sulfate), 100 mg; Se (sodium selenite), 0.15 mg; Zn (zinc sulfate), 44 mg.
[2] Provided per kilogram of diet: vitamin A, 8,002.78 IU; vitamin D_3, 3003.8 IU; vitamin E, 25 IU; menadione, 1.5 mg; vitamin B_{12}, 0.02 mg; biotin, 0.1 mg; folic acid, 1 mg; niacin, 50 mg; pantothenic acid, 15 mg; pyridoxine, 4 mg; riboflavin, 10 mg; thiamin, 3 mg.

Treatment:

Two 3000 Guess magnets (K&J Magnetics, Inc., Pipersville, PA, US) were affixed parallel to the exterior surface of the incoming polyvinylchloride (PVC) water lines. This was determined to be the most effective orientation of the magnets and the required magnetic power to alter the water pH.

Measurements:

Live performance:

Eggs were counted daily throughout the experiment and expressed as= Σ daily egg production during the week /number of hens /7 days for each replicate.

Egg quality measurements:

During the experimental period, six eggs were randomly chosen every week from each replicate (18 eggs per treatment), and individually weighed using a 0.01 g digital balance (PM4600, Mettler; Columbus, OH). Then, eggs were broken out on a flat glass plate and albumen, yolk, and shell measurements were taken.

Albumen and yolk pH:

Albumen and yolk were separated into conical tubes and pH was immediately measured using a pH meter (Lab 870, SI Analytics; College Station, TX)

Egg yolk mineral analysis:

Two yolks per replicate were randomly selected, mixed and frozen at -10°C until analysis. Yolks were thawed and a 0.5 g sample was digested in 7 ml and 2 ml of nitric and perchloric acid by accelerated microwave digestion (MARS X, CEM Corporation; Matthews, NC). The resulting solution was diluted with deionized water and mineral concentration was determined (AOAC method 2011.14) by inductively coupled plasma optical emission spectrometry (AOAC, 1999).

Haugh Unit:

Albumen height was measured using a standard tripod micrometer (Baxlo Precision, Barcelona, Spain). Haugh unit (HU) for albumen quality was calculated as HU = 100 * Log10 (H - 1.7 * (W $^{0.37}$) + 7.6), where H: albumen height and W: whole egg weight (Romero *et al*., 2009).

Yolk index:

Yolk height was measured using a standard tripod micrometer and the yolk diameter was measured by digital caliper (General Tools & Instruments, NY, USA). Then, yolk index was calculated as = (yolk height / yolk width) * 100 (Wells, 1968).

Eggshell measures:

Eggshell weight was measured by digital balance and thickness was measured at three different points using the digital caliper.

Breaking strength:

At the end of the experiment (hens were 56 wk of age), eggs were collected for 3 days, 40 eggs/treatment/day, for determination of breaking strength using an egg support rig (TA-ESR) and probe (size, model) on a texture analyzer (Stable Micro System TA-Hdi; Godalming, Surrey, UK) with a 25 kg load cell and 10 mm per minute crosshead speed.

Statistical analysis:

Data were analyzed by ANOVA using the PROC MIXED Procedure of SAS software (SAS, 1999). Treatment was the fixed effect in a completely randomized design where time and the interaction of time*treatment was also accounted as random effects. With a similar model, non-continuous data (categorical) were analyzed by ANOVA using the GLIMMIX Procedure. The pens located within the same water line (n = 6) were considered the experimental units. The results are presented by month to account for the effect of the treatment and production cycle as affected by treatment. The PDIFF option with pre-planned comparisons was used to compare the effects of magnetized drinking water.

RESULTS AND DISCUSSION

Water pH:

The water pH of the magnetized water group (MW) was lower than untreated water (C) pH during the experimental period, being 8.21± 0.05 for MW group and 8.31 ±0.05 for C group during the first month (P = 0.02) and 8.16 ± 0.05 for MW group and 8.34 ±0.05 for C group during the second month (P = 0.003). In the present study, the water pH parameter was used as an inexpensive and rapid test to ensure the magnetization of the drinking water during the experiment. These results are in agreement with those of Ellingsen and Kristiansen (1979) and Parsons *et al*. (1997) who found that water pH was decreased up to 0.7 due to the exposure to a magnetic field, where the degree of the reduction was dependent on the strength of the magnetic treatment. Alabi *et al*. (2015) mentioned that water pH could be affected directly or indirectly by the exposure to a magnetic field. They suggested that Lorentz forces produce electric currents that may cause electrochemical reactions that increase the frequency of collisions between ions of opposite sides, which result in pH changes. It was also suggested that scale formation of re-crystallized soluble salt was decreased by magnetic field exposure. This may have an indirect effect on other water characteristics. This is in agreement with Dawson (1990) who suggested that a reduction in water scale may be attributed to decrease in pH of water from treated systems since small pH changes will cause shifts in the carbonate equilibrium.

Live performance:

Magnetized water treatment had no effect on egg production and egg mass (Table 2). Feed intake was 109.7 ±1.90 g for C group and 101.3 ± 1.90 g for MW group (P = 0.01). Since MW treatment reduced feed intake, the feed to egg conversion tended to be improved, with eggs/kg feed of 8.1 ± 0.35 for C group and 8.7 ± 0.35 for MW (P = 0.11). Al-Mufarrej *et al*. (2005) and Alhassani and Amin (2012) reported no significant differences in production index or carcass composition between MW treated and untreated broilers. It is noteworthy that both Al-Mufarrej *et al*. (2005) and Alhassani and Amin (2012) used a lower magnetic power of 500 Gauss in their studies. This may show the importance of the magnetic field power as a determining factor of the desired effect.

Table 2. Egg production with untreated water or magnetized drinking water for layers

Time	Month 1			Month 2		
Treatment / Item	C	MW	P-value	C	MW	P-value
Eggs/hen/d	0.89 ± 0.01	0.86 ± 0.01	0.15	0.87 ± 0.01	0.86 ± 0.01	0.77
Egg mass (g)	61.20 ± 0.46	61.82 ± 0.46	0.34	62.18 ± 0.82	62.03 ± 0.82	0.82

No significant differences were observed

C (Untreated water); MW (Magnetized water)

Magnetized water had no deleterious effect on mortality rate throughout the experimental period (N= 0). Gholizadeh *et al*. (2008) reported that the magnetized water reduced the mortality rate and sickness rate in broilers. Also, Alhassani and Amin (2012) did not find significant differences in broiler mortality rate between magnetized water treated groups and untreated ones.

Albumen and yolk pH:

Albumen pH is considered one of the most important parameters to determine egg quality (Copur *et al*., 2008). The pH of fresh eggs ranges between 7.6 and 8.5 for albumen, and close to 6 for yolk (Silversides and Scott, 2001; The Poultry Site, 2007 and Copur *et al*., 2008). In the current study, eggs of MW group had slightly lower albumen pH (≈0.11- 0.16) compared to albumen pH of eggs of C group, while yolk pH values ($P > 0.10$) of treated and untreated groups were similar (Table 3). The albumen pH of eggs from the MW treatment might be influenced by the lower pH of the magnetized drinking water. Lower egg pH might extend egg shelf life since pH increases with storage time as CO_2 is lost through shell pores (Caner and Cansiz, 2008).

Table 3. The pH of egg albumen and yolk with untreated water or magnetized water for layers

Time	Month 1			Month 2		
Item \ Treatment	C	MW	P-value	C	MW	P-value
Albumen pH	8.26 ± 0.05	8.15 ± 0.05	0.13	8.55 ± 0.08	8.39 ± 0.08	0.17
Yolk pH	6.27 ± 0.03	6.23 ± 0.03	0.35	6.40 ± 0.01	6.37 ± 0.01	0.06

No significant differences were observed
C (Untreated water); MW (Magnetized water)

Mineral profile of egg yolk:

Magnetized water had a variable effect on the amounts of most minerals in the yolk. The boron content of yolk in the C group was significantly greater than boron amount in the yolk of MW group during the first and second months of the experiment (Table 4). Boron has an important role in a broad range of life processes such as metabolism, bone and mineralization enzymatic reactions (Dinca and Scorei, 2013 and Bozkurt and Küçükyilmaz, 2015). For humans, a medical study showed that the need for boron is very limited (Scorei and Rotaru, 2011). The daily intake of boron ranges between 1-3 mg or lower for safe intake for unlimited duration. This daily intake of boron varies depending on food constituents and water boron contents (Becking and Chen, 1998; Nielsen, 2002). These results suggest that magnetic treatment could reduce the boron content in the animal products, especially, in those areas that have boron-rich water sources. The yolks of MW group had higher amounts of sulfur ($P = 0.10$) compared to yolks of C group (Table 4). These results may be somewhat explained by Alabi *et al*. (2015) who concluded that the period of exposure to magnetic fields and the power of the magnetic fields influenced the charge of ions and homogeneous precipitation of crystals.

Table 4. Egg yolk mineral content with untreated water or magnetized water for layers

Time	Month 1			Month 2		
Element \ Treatment	C	MW	P-value	C	MW	P-value
B (mg/kg)	30.57 ± 5.3 [a]	16.83 ± 5.3 [b]	0.04	43.94 ± 7.2[a]	17.53 ± 7.2[b]	0.02
S (mg/kg)	24.0 ± 31.47	109.6 ± 31.47	0.10	265.00 ± 29.5	336.66 ± 29.5	0.11
Ca (%)	1.43 ± 0.05	1.59 ± 05	0.07	1.44 ± 0.06	1.41 ± 0.06	0.44
Cu (mg/kg)	2.14 ± 0.26	2.10 ± 0.26	0.91	2.42 ± 0.16 [a]	1.80 ± 0.16 [b]	0.03
Fe (mg/kg)	51.15 ± 3.1	58.11 ± 3.1	0.16	61.08 ± 2.6	54.08 ± 2.6	0.10
Mg (mg/kg)	109.9 ± 5.2[b]	134.6 ± 5.2 [a]	0.005	124.3 ± 3.5	125.1 ± 3.5	0.86
Mn (mg/kg)	1.12 ± 0.09	1.31± 0.09	0.17	1.71 ± 0.08 [a]	1.20 ± 0.08 [b]	0.002
P (%)	4.77 ± 0.02	5.09 ± 0.02	0.18	5.00 ± 0.01	4.83 ± 0.01	0.22
K (%)	0.90 ±0.04	0.98 ± 0.04	0.08	0.97 ± 0.02 [a]	0.91 ± 0.02 [b]	0.04
Na (%)	0.45 ± 0.03	0.45 ± 0.03	0.87	0.50 ± 0.02	0.48 ± 0.02	0.44
Zn (mg/kg)	44.07 ± 3.5	47.98 ± 3.5	0.45	44.97 ± 1.5	43.21 ± 1.5	0.11

[a,b] Means ± (SEM) followed by different superscripts, between treatments, within element and month, are significantly different.

Moreover, Alabi *et al*. (2015) mentioned that scale formation by re-crystallized soluble salts of barium sulphate, strontium sulphate and iron sulphide was decreased by magnetic field exposure. Sulfur is the most abundant mineral element found in the human body (Nimni *et al*., 2007). It is derived exclusively from dietary proteins and yet only methionine and cysteine amino acids normally present in proteins contain sulfur (Nimni *et al*., 2007). Although Soetan *et al*. (2010) indicated that diets adequate in protein will meet the daily requirements for sulfur, the current study suggests that increased sulfur in eggs due to use of magnetized water would provide benefit in areas where quantities of animal source proteins are limited.

The content of egg from magnesium, copper, manganese, and potassium did not show clear patterns during the 1st and 2nd months of experimental period (Table 4). For instance, the amount magnesium was greater (P= 0.005) in eggs from layers of MW group than this of eggs from layers of C group in the 1st month, while no significant difference was found between the eggs from layers of both MW and C groups.

Internal egg quality:

All measures of the internal egg quality (albumen height and yolk height) were greater (P≤0.01) in the eggs obtained from MW group than controls, but the eggs of C group had wider yolks (P<0.03) compared to the eggs of MW group (Table 5). Both of HU and yolk index are considered important determination parameters for the internal egg quality.

Table 5. Internal egg quality and eggshell characteristics with untreated water or magnetized water for layers

Time	Month 1			Month 2		
Item \ Treatment	C	MW	P-value	C	MW	P-value
Albumen						
Height (mm)	9.73 ± 0.1 [b]	10.40 ± 0.1[a]	0.0003	8.91 ±0.2 [b]	9.81 ±0.20[a]	<0.0001
Haugh (unit)	97.69 ± 0.6 [b]	100.55 ± 0.6[a]	0.0006	93.35 ±1.1 [b]	97.88 ±1.1[a]	<0.0001
Yolk						
Width (mm)	44.09 ± 0.1 [a]	43.62 ± 0.1 [b]	0.01	43.96 ±0.1 [a]	43.49 ±0.1 [b]	0.03
Height (mm)	18.88 ± 0.1 [b]	19.39 ± 0.1 [a]	0.008	18.83±0.1 [b]	19.21± 0.1 [a]	0.01
Yolk index (%)	42.87 ± 0.3 [b]	44.53 ± 0.3 [a]	<0.0001	42.88 ±0.3 [b]	44.20 ±0.3[a]	0.0003
Shell						
Mass (g)	8.15 ± 0.09[b]	8.41 ±0.09[a]	0.04	8.05 ±0.1 [b]	8.45 ±0.1 [a]	0.01
Thickness (mm)	0.329 ± 0.00	0.330 ± 0.00	0.89	0.307 ±0.003 [b]	0.318 ±0.003 [a]	0.03

[a,b] Means±(SEM) followed by different superscripts, between treatments, within item and month, are significantly different.
C (Untreated water); MW (Magnetized water)

Copur *et al*. (2008) mentioned that the yolk index percentage of a good quality fresh egg should be around 44-45%. According to HU score, the quality of the egg would be categorized as: perfect (AA) > 79, good (A) between 55 and 78 and bad (B) between 31 and 54 (Sarica and Erensayin, 2004). In the current investigation, both HU and yolk index of eggs from MW group were greater (P ≤ 0.0006 and <0.0001) than those of C group throughout the experimental period.

The high HU and yolk index % of the eggs of MW group may be due to the changes in the egg mineral content. Sulfur might play a role in changing the nature of the albumen proteins. Moreover, the internal quality characteristics of eggs of MW group may be further maintained by thicker and stronger eggshells of the eggs of MW group compared to the eggs of C group. Similar explanations were presented in previous studies about the importance of eggshell quality in protecting the egg albumen and yolk against losses and environmental aggression (Swanson and Johnson, 1973; Pizzolante *et al*., 2009).

Eggshell quality:

Eggs with acceptable shell quality contain about 2.2 g calcium, 0.3 % phosphorous, 0.3% magnesium, and traces of other elements (Butcher and Miles, 2015). The authors also stated that about 25 mg of calcium must be deposited on the shell every 15 minutes during shell formation. This required amount presents the normal calcium amount in a hen's circulatory system. The heavier shell in both months (P ≤ 0.04) and thicker shell in the second month (P = 0.03) with MW treatment compared to the C group may be due to the changes in the minerals deposited in the shell.

The results of the breaking strength test of eggs at the end of the second month were directly related to shell mass and thickness with breaking strength of the shell of eggs from MW group was higher (P = 0.015) (4076 ± 82 g / cm^2 force) than shells of eggs from C group (3784 ± 86 g / cm^2 force).

There was no literature found on the influence of magnetized drinking water on eggshell and internal egg quality parameters, which are very important for the market. Stronger shells in eggs from MW group may be due to thicker shells because of the strong relation between the shell thickness and breaking strength. Bennett *et al*. (1988) suggested that breaking strength and shell thickness information together improve the evaluations of shells.

An explanation could be derived from the fact that magnetization is able to reduce the precipitation of calcium carbonate and magnesium carbonate in the water lines by changing the movement orientation in magnetically treated water compared to those formed in unmagnetized water (Kronenberg, 1985; Liburkin *et al*., 1986; and Alabi *et al*., 2015). Hence, the treatment might provide more calcium and magnesium in better forms to be utilized by laying hens during the experimental period, especially since laying hens cannot extract 100 % of the calcium of the available source in the diet (Butcher and Miles, 2015).

CONCLUSIONS

1. Changes in water pH are a cost-effective and efficient means to measure the effects of magnets on drinking water.
2. Magnetized water improved the internal egg quality parameters and egg: feed efficiency without any influence on egg numbers and egg mass.
3. Eggshell quality is an important economic parameter that could be positively enhanced by using magnetized water for laying hens.

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هل لماء الشرب الممغنط تأثير على انتاجية و جودة بيض الدجاج البياض؟

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المياه من المكونات الرئيسية لخلايا الكائن الحي، كما انها ضرورية لصحة الدواجن و انتاجيتها. اجريت هذه التجربة لتقييم انتاج و جودة البيض الناتج من دجاج يقدم له ماء شرب ممغنط. استخدم في هذه التجربة ١٩٢ دجاجة بياض (هاي لاين) عمر ٤٨ أسبوع، تم تسكينها في عنبر مغلق مجهز بتقنية انفاق التهوية. في اليوم الأول من التجربة ، تم توزيع الدجاجات عشوائياً على مجموعتين الأولى (مجموعة مقارنة، كنترول) و فيها تحصل الدجاجات على ماء غير ممغنط، و الثانية مجموعة المعاملة و فيها تم مغنطة ماء الشرب باستخدام مغناطيس بقوة ٣٠٠٠ (جاوس) مثبت على خط الماء من الخارج. احتوت كل مجموعة على ٣ مكررات كل منها عبارة عن ٦ اقفاص في المكرر الأول احتوى كل قفص على ٦ دجاجات، بينما المكررين الثاني و الثالث احتوى كل قفص على ٥ دجاجات. قدمت العليقة المناسبة و المياه حتى الشبع. استمرت هذه التجربة لمدة شهرين متتالين. و تمت فيها متابعة الإنتاج اليومي للبيض، بينما وزن البيض، وزن و سمك القشرة، و مواصفات جودة البيض الداخلية، و محتويات الصفار من الأملاح تم قياسها أسبوعياً. في نهاية التجربة و لمدة ٣ أيام متتابعة تم جمع بيض من المجموعتين لقياس قوة الكسر لقشرة البيض. و قد أوضحت النتائج التالي: درجة حموضة الماء في مجموعة الماء الممغنط (٨,٢١ خلال الشهر الأول، ٨,١٦ خلال الشهر الثاني) كانت اقل مقارنة بدرجة حموضة المياه غير المعاملة (٨,٣١ خلال الشهر الأول، ٨,٣٤ خلال الشهر الثاني). لم يتأثر كلا من انتاج و وزن البيض بشرب الدجاج للماء الممغنط. بينما كان للماء الممغنط أثراً معنوياً ايجابياً على كل من مواصفات جودة البيضة الداخلية و زيادة وزن القشرة (معنوية = ٠,٠٤) مقارنة بالبيض الناتج عن دجاجات مجموعة الكونترول خلال فترة التجربة. أيضاً كان البيض الناتج من مجموعة الماء الممغنط ذو قشرة اسمك منه في المجموعة المقارنة (معنوية = ٠,٠٣) خلال الشهر الثاني من الدراسة. الخلاصة ان الماء الممغنط يمكن أن يحسن من مواصفات جودة البيض دون التأثير على انتاج أو وزن البيض.