

## EFFECT OF USING MAGNETIC WATER ON PHYSIOLOGICAL STATE OF DROMEDARY CAMEL

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### Abstract

Experimental work of the present study was carried out in camel farm in North Coast in Matrouh, Egypt. There was an improvement in water quality when exposed to the magnetic field with considerable change in the pH, total dissolved solids, total hardness, conductivity, salinity, dissolved oxygen, evaporating temperature, minerals and organic matter. Magnetic process of water such drinking tap water by exposed to magnetic field. Thirty growing camels were randomly distributed into three similar groups of male and females (10 each) treatments of feeding trial included tap water without or with magnetic exposure (control, 1200, and 3600 Gauss) for C, T1, T2, treatments, respectively. Result showed that magnetic treatments induced greater effect on magnetic treated water. camels were consumed fed low-level magnetic water had higher insignificantly final body weight and weight gain at (12 weeks) than those in control (T1) and the higher level in magnetic water (T3). Feed intake as DM was higher in (T3). feed conversion was improved for camel drank magnetic water than treatments (T1) and significantly. Result showed that magnetic water treatments did not affect on concentration of blood metabolites which were similar in all groups, while concentration of glucose increased significantly due to both tested treatments. Count of red blood cells and white blood cells were nearly similar in all treatments. it could be concluded that magnetizing tap water by two levels (1200 and 3600 Gauss) led to an improvement respecting growth performance of dromedary camel.

**Keywords:** dromedary camel, magnetic drinking water, growth performance, blood constituent

### INTRODUCTION

the magnetic field (MF) could change the physicochemical properties of water since several decades, when water passing through a MF, it become magnetized water (MW) Magnetized water has been found effective in alleviating colds, coughs, bronchitis, all types of fever and more, arthritis pain, reducing blood pressure, recovering quickly from a stroke, and it helpful in the regularization of women's menses (11). Also, treatment with magnetic water was very effective in breaking up kidney and gall bladder stones into small particles. The water also prevented further formation of stones in the kidneys and gallbladder. Magnetic water may prevent aging and fatigue by increasing the cell membrane permeability (16). Effectiveness of magnetized water in the prevention and treatment of atherosclerosis has been shown in some animal and human studies (12). It has been reported that magnetic water helps unclog the arteries and veins of deposits of cholesterol and salts and normalize the circulatory system. Also, magnetized water can be helpful in weight control, as an adjutant to a correct diet because this water improves metabolic activity, it may be helpful in burning up excessive fatty tissue (14). Magnetized water has been found effective in alleviating colds, coughs, bronchitis, all types of fever and more, arthritis pain, reducing blood pressure, recovering quickly from a stroke, and it helpful in the regularization of women's menses. Also,

researcher found that (16) treatment with magnetic water was very effective in breaking up kidney and gall bladder stones into small particles. The water also prevented further formation of stones in the kidneys and gallbladder. Magnetic water may prevent aging and fatigue by increasing the cell membrane permeability (11). Scientist (10) studied the effect of MF on the hydrogen bonds of water, and discussed the mechanism of magnetization based on molecular dynamics simulation, experimental and theoretical models. researchers investigated the optical properties of water that between two strong magnets, they found that the infrared absorption property of MW changed. experimental and theoretical models, and (10) described MF could accelerate the degradation of organic substances of pulp and paper wastewater, and the PH values of wastewater first increased to the climax and then decreased when MFS ranges from 0 mT to 900 mT.

## **MATERIAL AND METHODS**

### **1) Water samples magnetic field application**

Samples of three water from each treatment were collected at days 1, 15 and 30 of experiment to measure pH using pH meter (805 MP, FISHER, Germany) and electric conductivity (EC) using a conductivity meter (WTW LF315 Conductivity Meter, USA). At the end of the experiment (day 30), water samples were collected and negatively stained. All animals were subjected to tap and magnetic water as drinking water for 90 days before starting the experimental design. Magnetic treated water was prepared by passing water through a magnetic funnel 12 at relatively low speed. According to the product specification, water will keep its magnetic properties for the next 12 hour of exposure to the funnel. So, water was supplied to the animal's cages each 10 hours to ensure using magnetic treated drinking water. Each magnet had a circle shape with a diameter and thickness of 7.22 and 4.96 mm, respectively. Funnel's magnetic field consists of seven pairs of successive magnets. The strength of the magnet was between 1200 to 3600 Gauss as measured by a gauss meter (Mega Dev, Inc). Sample preparation attention was paid to avoid contamination, therefore every item from the moment of sampling until analysis was regarded as potential source of contamination and was checked not to contain or leach detectable amount of any contaminant. The samples were mixed together to form a homogenous sample which was subjected to magnetic fields with different intensity ( $\mu$ T) treatments. The treatments were (control, 1200, and 3600 Gauss) for C, T1, T2, treatments  $\mu$ T. These intensities were measured by Gauss meter. Experiments were done statically and dynamically in a shaker incubator of 200 rpm velocity.

### **2) Physical and chemical analysis of water samples**

The physical properties of the samples such as clearness, sedimentation, odor, pH and EC were measured, according to Chapman and Pratt by using pH meter WTW model 530 and conductivity meter ORION model 160. The results were recorded every week for 30 days. Some elements such as Ca, Mg, Na, K, Fe, P, Pb, Cu and Cl were measured in the laboratory of Water and Environment,

### 3) physiological state of dromedary camel

Camels drink 20-30 liters daily, and the camel can get an additional amount of water from the pasture plants on which it feeds, up to 3 liters in the dry season and 30 liters when the plants are young. In addition, there is a third source of water, which is produced inside the body during the metabolism of digested nutrients, and it is called metabolic water. Camels have the ability to preserve what is in their body of water and to be economical in its use, whether it is lost by getting rid of excess heat from the body or what is lost with dung and urine. The amount of water required for camels per day ranges between 20-50 liters, and this depends on all factors and conditions affecting the water needs of camels, including: Water, even if offered during the cold months, and camels get about 3-30 liters of water from pasture plants per day. When camels feed on saline plants, their drinking water needs increase. When feeding camels on dry rough feed materials or agricultural residues such as straw, hay and wood, their needs of water increase, due to the increase in the amount of saliva that the animal needs to moisten dry rough food, unlike what happens with green and green fodder.

#### Precautions to be observed when watering camels:

- 1) Water must be provided continuously in front of camels that are fed dry fodder materials, as well as in front of milking camels, as it has been observed that watering milking camels twice a day, they consume more water than they are allowed to drink once every day, and this increases their production of milk.
- 2) Camels should not be watered from stagnant water, such as from ponds and swamps, because this leads to serious and deadly diseases such as diphtheria, which leads to the death of animals. And when using water from wells, rivers and rainwater harvesting ponds, it must be taken into account that it is clean and not polluted.
- 3) Taking into account the cleanliness of drinking water, as well as the basins from which camels drink, and the water in them must be renewed at intervals, and they should be free of algae, fungi and the remains of decaying food.
- 4) It should be taken into account not to water the camels immediately after eating food, as this leads to:
  - \* Pushing the food mass from the stomach to the intestines before the digestion process is completed.
  - \* Reducing the effect of digestive juices and enzymes secreted from the digestive system, which leads to a lack of benefit from eaten food.

The occurrence of severe digestive disorders.

- 5) When watering camels after they are exposed to extreme thirst, it should be taken into account not to give them a large amount of water at once, but to give them small quantities and on successive times before feeding.

- 6) It should be taken into account that the camels should not work immediately after drinking the drinking water, and if the camels are equipped for hard work, they should be watered at least an hour before that.

#### **4) Feeding experiment**

Thirty growing camels were randomly distributed into three similar groups of male and females (10 each) treatments of feeding trial included tap water without or with magnetic exposure (control, 1200, and 3600 Gauss) for C, T1, T2, treatments, respectively (2). aging 2.5-3.5 years with 180-180.5 Kg in average body weights were randomly divided into three equal groups, (10 camels each) for experiment period of 90 days randomized (30), (19). Animals were offered roughage ad libitum twice a day at 8.00 and 16.00 plus restricted amount of CFM to cover 50% of protein requirements according to NRC 1. Dromedary camels were provided with fresh magnetic water treatment every 12 hours, water consumption was recorded.

#### **5) Blood Samples**

Blood was withdrawn from the jugular vein using of the camels in the morning before access to feed and water. Commercial kits were used for all blood measures Serum was obtained by centrifugation of blood and stored at  $-20^{\circ}\text{C}$  until used for analysis. Glucose concentration was determined by the method of (14), serum cholesterol by the colorimetric method of (2), serum total protein (TP) by the Biuret method according to (4), Albumin (A) concentration was determined according to (10) Liver function was assessed by measuring the activities of aspartate aminotransferase (AST) and alanine amino transferase (ALT) by the method of Reitman and Frankel. 50 Kidney function was evaluated by measuring blood urea using the colorimetric methods (12). Hematological measures applied on all whole blood samples immediately after collection according to (11). Enzymatic antioxidants activity in red blood cells was determined for glutathione peroxidase according to (17). Catalase was determined according to (12). Superoxide dismutase was determined according to (15). For rhinometry, blood was carefully centrifuged to separate plasma from RBC concentrate. Portions of blood plasma as well as concentrated RBC samples with varying hematocrit were immediately tested.

#### **6) Statistical analysis:**

The data on water pH and EC were collected and analyzed using SAS (1999) and significant differences among means were separated using LSD test according to Duncan<sup>56</sup> and significance was declared at  $P < 0.05$ . Significance was declared at  $P < 0.05$

## **RESULTS and DISCUSSION**

### **1) Water quality**

The MW application is eco-friendly, zero energy consumption and costless when a permanent magnet is used. Magnetized water can be made by passing water through a magnetic field (33). There was an improvement in water quality when exposed to the

magnetic field with considerable change in the pH, total dissolved solids, total hardness, conductivity, salinity, dissolved oxygen, evaporating temperature, minerals, organic matter(18),(17). Physics shows that water changes weight under the influence of magnetic fields (20). Increasing both the electric conductivity and the dielectric constant of water was documented (18). The increase of salinity due to the magnetic exposure could be attributed to increasing soluble salts which concurred with the conductivity (29), while increasing dissolved oxygen could be due to the decrease in organic matter in magnetic water(30). Some researchers reported that magnetic treatment affect water properties such as light absorbance, pH, surface tension<sup>58</sup> and amount of oxygen dissolved in water.<sup>5</sup> It was reported that water passed through the magnetic field acquires finer and more homogeneous structure (35). Researcher (6) suggested that the atoms' nuclei in the water are polarized under the magnetic field and then those atoms act as tiny magnets. Moreover, he suggested that the increase in pH value is due to the polarization and the uniform order of atoms. Laycock DC (32) reported that magnetic water lead to an increase of blood flow and supply of oxygen and nutrients to the cells (59). It is also; possible that exposure to electromagnetic field can ameliorate the deleterious effect of free radicals by decreasing the chemical reactions that caused damage to DNA, proteins and lipids (190). Alternatively, applied magnetic fields to water through using magnetic pipe may increase their rates of degradation by reaction with protective enzymes such as catalase and superoxide dismutase. (63)

This increasing fluidity, dissolving capacity of various constituents like minerals and vitamins (71) and consequently improving the biological activity of solutions positively affecting the performance of human being, animal and plants. (73)

**Table (1): Physiological properties of ordinary and magnetically treated water used in the experiment**

Physical Properties	Unit	Treatments		
		Control	1200 Gauss	3600 Gauss
<b>Conductivity (EC)</b>	Ms/cm	696	731	749
<b>Total Hardness</b>	mg/L	432	445	459
<b>pH</b>	-	6.76	7.39	7.44
<b>Salinity</b>	mg/L	370	385	395
<b>Dissolved Oxygen</b>	ppm	6.40	7.10	7.30
<b>Total Dissolved Solids (TDS)</b>	mg/L	658	673	697

It is worth pointing out that the test condition in our study is from room temperature to boiling point while other studies are room temperature (5), and the degree of increase is more obvious in our study(3). This can be explained by the evaporation become faster during the heating process. Moreover, this study explores the effect of MF on specific heat and boiling point of water (8), and the decrease of specific heat and boiling point have been observed (33). This is an important result, which can provide a new way to change the two properties of water (75), and then apply to the relevant industries to save energy the optimal magnetizing condition was determined as the MFS of 300 mT

**Table (2): Chemical analysis of ordinary and magnetically treated water used in the experiment**

Parameters	Unit	Treatments		
		Control	1200Gauss	3600 Gauss
Sodium (Na+)	ppm	6.4	6.6	7.1
Organic Matter	ppm	55	49	41
Potassium (K+)	ppm	1.5	1.7	1.8
Ammonia (NH <sub>4</sub> <sup>+</sup> )	ppm	3.1	2.9	2.8
Calcium (Ca <sup>2+</sup> )	ppm	112.9	118.3	120.5
Magnesium (Mg <sup>2+</sup> )	ppm	112.7	114.7	117.3
Chloride (Cl <sup>-</sup> )	ppm	2.9	3.1	3.3
Carbonate (Co <sub>3</sub> <sup>2-</sup> )	ppm	3.9	4.1	4.3
Bicarbonate (HCo <sub>3</sub> <sup>-</sup> )	ppm	25.2	25.9	26.8

Researcher (21) found that magnetic drinking water tended to have adverse effects on feed intake (167), nutrients utilization and lamb performance

## 2) Proximate analysis and fiber fraction of diet

Table (3) showed the chemical composition of experimental concentrate feed mixture (CFM) and roughages on DM basis used in the experiment (25). CFM consists of 35% yellow corn, 10% soybean meal, 18% wheat bran, 8% rice bran, 20% undecorticated cotton seed meal, 5% molasses, 2.5% limestone, 1% salt, 0.5% mineral mixtures.

**Table (3): Chemical analysis and fiber fraction of CFM and RS (% on DM basis)**

Items	CFM	RS
<b>Chemical analysis</b>		
OM	90.21	84.88
CP	15.56	3.83
CF	11.83	36.79
EE	2.88	1.61
Ash	9.79	15.12
<b>Fiber fraction</b>		
NFE	59.94	42.65
NDF	50.11	66.84
ADF	33.06	47.25
ADL	4.21	11.34
Hemi-Cellulose	17.05	19.59
Cellulose	28.85	35.91



### 3) Average body weight

Growing camels data exposed to magnetic treated water are presented in table (3) . average final live body weight (33) and average daily body weight gain increased insignificantly in T1 than those received T0 and T2 Higher feed intake was recorded for T2, while insignificantly different ( $P > 0.05$ ) between the control and T1(34).weight gain during 6-12 weeks of age. When the daily water consumption was related to DM intake (ml/g DM intake) it kept the same trend above where it ranged from 2.61 (C) to 2.75 (T2) (44). The result indicates a direct relationship between voluntary water consumed and weight gain (36) ,these finding are in accordance with those obtained by (38) attributed the save in water intake and the high benefit of the consumed magnetic water to the changes in water properties such as surface tension, fluidity, absorbency, pH level and dissolving capabilities( 19).

An achievement in the growth for sheep and calves and a reduction in carcass fat in sheep were demonstrated due to magnetizing of water (21)

In paradox to this elucidation, scientist (32) emphasized that water magnetization affects (31) some of the mineral's utilization such as calcium and magnesium which in turn may converts water to be unpalatable.

**Table (4): Effect of magnetic water on dry matter intake and water consumption of growing camels**

Items	Treatments				
	C	T1	T2	SEM	Sig.
Number of camels	10	10	10	-	-
Body weight, kg	180.43	180.39	180.22	-	-
<b>DM Intake, g/d</b>					
CFM	2536.39b	2540.90b	2549.92a	3.19	*
Corn silage	380.32b	388.63b	417.08a	2.23	*
Rice straw	4080.73b	4805.26b	4941.99a	2.12	*
<b>Water Consumption, ml</b>					
ml/d	15335b	14352ab	132710a	55.97	*

(means $\pm$ SE) \* $P < 0.05$  a and b: means in the same row with different superscripts are significantly ( $P < 0.05$ ) different. c= group fed the Basel diet (control),

**Table (5): Effect of magnetic water on camel growth performance**

item	C	T1	T2
Initial live weight (kg)	176.0	175.5	175.75
Final live weight (kg)	221.56	287.28	296.58
Average daily gain (kg) (12 week)	0.542	1.3307	1.4381

(means±SE) \*P< 0.05 a and b: means in the same row with different superscripts are significantly (P<0.05) different.

Feed conversion ratio data of growing dromedary camels of control and two drank magnetic treated water levels are presented in table (5). Significant differences among treatments in average feed intake as DM (22). These results are agreement with those obtained by(27), who illustrated that higher ( $p < 0.05$ ) between the control and 1200 Gauss. Feed conversion of T1 was improved ( $p < 0.05$ ) significantly compared with control one (T0). (32) Showed that magnetic treatment of water tended to reduce feed intake. However, showed positive impact of magnetic exposure on weight gain and feed utilization of rabbit bucks.

#### 4) Blood biochemical constituents:

**Table (6): Effects of magnetic water on and blood biochemical constituents of dromedary camels (means±SE)**

Items	Treatments				
	C	T1	T2	SEM	Sig.
<b>Total Protein, g/dl</b>	7.21c	7.88b	8.53a	0.12	**
<b>Albumin, g/dl</b>	3.88c	4.15b	4.46a	0.07	**
<b>Globulin, g/dl</b>	3.33b	3.73ab	4.07a	0.06	*
<b>A/G ratio</b>	1.165	1.116	1.090	0.03	NS
<b>Urea-N, mg/dl</b>	15.33a	11.81b	11.14b	0.59	*
<b>AST, u /L</b>	38.93a	31.74b	30.17b	1.13	*
<b>ALT, u /L</b>	15.25a	11.52b	11.23b	0.41	*
<b>Glucose, mg/dl</b>	64.13c	70.26b	76.93a	1.06	**
<b>Cholesterol, mg/dl</b>	86.18a	74.22b	71.82b	2.30	*

Blood biochemical constituents could be used as an indicator for nutritional and physiological status of experimental dietary treatments with normal or magnetic tap water as shown by data which are presented in table (5). Using magnetic water at the levels of 1200 and 3600gauss caused a significant ( $P < 0.05$ ) increase in glucose, total protein, albumin and globulin compared with camels that drank un-magnetic water. On the other hand, significantly ( $P < 0.05$ ) decreased in cholesterol concentration with treatments groups than control group.



Furthermore, water treatments did not influence albumin/globulin ratio. This finding agrees with those reported by (39).

Increasing the concentration of total protein level may play positive role in an increase in growth and the consumption of protein to build somatic cells.91Effect of drinking treated water on the kidney function parameters, showed that treatments at the levels of 1200 and 3600gauss caused a significant ( $P<0.05$ ) decreased in urea than control one. Data of AST and ALT showed that magnetic water had a significant ( $P<0.05$ ) decrease in AST and ALT than un-magnetic water (155). So, these parameters showing improved renal and liver function due to magnetic treatment (156). Luo et al. (92) reported that single exposure to electromagnetic field (EMF) decrease the serum values of total cholesterol concentration and triglyceride level (162). The mechanism of EMF action in biological systems can be examined by its interaction with moving charges and enzymes activities rates in cell-free systems increasing transcript levels for specific genes.

## CONCLUSION

In conclusion, magnetic treatment resulted in improved water quality which consequently improves performance state, nutrient digestibility, saves water consumption, and contributing to mitigate environmental impact in livestock, positive animal health, which is reflected in the increase in improves blood picture. This treatment may be useful management practice in the area where camels depends on well water as a source of drinking water. A reappraisal of magnetizing treatment of water containing differ powerful magnetic field and longer time on various aspects of dromedary camels is suggested for future studies.

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## Conflict of interest

Author declares that there is no conflict of interest.

## Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential.

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