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Effect of Using Magnetic Water on Milk Yield and Its Composition of Zaraibi Goats

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Abstract

The aim of this study was to investigate the effects of using magnetic water on Zaraibi goat's milk yield and its composition. Thirty Zaraibi goats in the last third of pregnancy average live body weight of 32.33 kg and aged 3-4 years old were assigned into three groups (each of ten animals).The animals were divided into three groups as follow: first group was drinking tap water (control).Second group was drinking magnetic water (T_1, 2000 gauss).Third group was drinking magnetic water (T_2, 4000 gauss). Milk yield was recorded monthly during 6 months of lactation season and milk samples were analyzed every month; for milk components milk fat, protein, lactose, and solids not fat using Milko-Scan 133B. Results showed that there were significant differences between groups in daily and total goats milk yield. Second treatment (T_2, 4000 gauss) had a higher daily and total milk yield than the first treatment (T_1, 2000 gauss) and the control group. Similar findings were recorded for goat's milk composition (fat, protein, total solids and solids not fat %) while, there had no significant differences on lactose percentage due to using magnetic water. Second treatment (T_2, 4000 gauss) had a higher milk composition than the first treatment (T_1, 2000 gauss) and the control group except lactose %. It can be concluded that drinking magnetic water (T_1, 2000 gauss and T_2, 4000 gauss) can be increases effectively the daily, total Zaraibi goat's milk yield and its composition except lactose percentage without negative effects.

Keywords: Magnetic water, Milk yield, Milk composition, Zaraibi goats.

Introduction

Small ruminants contribute to the economy of many farmers in developing countries, including Egypt **Al-Tamimi (2007).** One of the most promising goat breeds in Egypt is the Zaraibi goat, which is mainly found in the northeastern Nile Delta. The Zaraibi goat is characterized by its large head, Roman nose, lower jaw, and long, drooping ears. Horns are often absent in both sexes. It is also characterized by a very variable body color, from cream to red, brown, or black or a mixture of them, sometimes with white spots. The body is also covered with short hair (**Shaat *et al.*, 2007 and Galal *et al.*, 2005**). Water is the basic and main element of all living organisms, as it represents 98% of all molecules in the animal body. Water is the element of life because of the important roles it plays within the living organism. It is an essential component in the circulatory system. It also regulates body temperature, transports oxygen, hormones, antibodies, and dissolves enzymes, in addition to a role in the digestion and absorption of feed and disposal of waste, so it was important to pay attention to water and its quality and find ways to improve it. There are many studies that confirm the ability of magnetic water to enhance the ability of cells to transport water. This is due to increasing the permeability of the cell membrane. This process increases the speed of cells getting rid of toxic metabolic substances. This may occur due to the regulation and management of osmotic balance and concentration ions between outside and inside cells. In addition to the positive effect of magnetized water on cell hydration, which may reach 20%, which is a very good indicator of the body's general health (**Mahdi, 2016; El-Sabrout and El-Hanoun 2019; Lee *et al.*, 2019 and Al-Bayar *et al.*,2020**). Scientists have used the magnetic field in many fields, including the medical field, to treat some diseases (**Bodrova *et al.*, 2020**), including the industrial and agricultural fields. The magnetic field is used in its various branches of irrigation water and plant cultivation (**Abdulraheem and Jameel, 2021; Fayed *et al.*, 2021**); in animal and poultry (**Radha and AL-Sardary, 2021**) and in fish production (**Abdelkhalek *et al.*, 2021**). Among these branches, we are interested in animal production, and one of its uses in this field is to treat the water that the animal drinks with a magnetic field to improve water quality by passing water through a magnetic field, which works to change many of the chemical and physical

properties of water and thus improves the quality of water (**Ali *et al.*, 2014**). Studies have shown the important role that the magnetic field plays in improving water by changing its various properties, as is more evident in unconventional water such as salt water and acidic water, which makes the use of magnetized water one of the solutions to water shortage in arid and semi-arid regions (**Dokhani, 2020**). The use of the magnetic field to treat water improves the quality and properties of water, which positively affects the improvement of the animal's immune system and increases its weight. It also increases the yield of milk production and its components in Zaraibi goats, Awassi sheep, and dairy cattle. It also improves the blood picture, biochemical parameters, and antioxidant status in humans and animals. It also reduces the environmental impact in livestock (**Ebrahim and Azab, 2017; Lindinger, 2021).**The aim of this study is to investigate the effect of drinking magnetic water on Zaraibi goat's milk production and its composition.

Materials and Methods

This study was done during the period from January 2021 to August 2021 at Animal Production Research Station, Sakha, Kafer El-Sheikh Governorate, belongs to Animal Production Research Institute (APRI), Agriculture Research Center (ARC), Ministry of Agriculture in cooperation with the Department of Animal Production, Faculty of Agriculture, Benha University, Egypt.

Experimental animals and management:

Thirty Zaraibi goats in the last third of pregnancy average live body weight of 32.33 kg and aged 3-4 years old were assigned into three groups (each of ten animals). The animals were divided into three groups as follow: first group was drinking tap water (control), second group was drinking magnetic water (T_1, 2000 gauss) and third group was drinking magnetic water (T_2, 4000 gauss). The experiment continued from the last third of pregnancy until the end of the milking season during 6 months of lactation. Feeding has been adjusted according to body weight and different production stages according to **NRC (2007)**. Samples from Egyptian clover (EC), Egyptian clover hay (ECH) and concentrate feed mixture (CFM) were analyzed according to **AOAC (1995)** for ether extract (EE), crude protein (CP) and ash percentages while, crude fiber (CF) was measured using the method of **Van Soest *et al.* (1991).** Chemical composition of experimental diet illustrated in table 1.

Table 1. Chemical composition of experimental diet (% on DM basis).

Items	Concentrate feed mixture (CFM)*	Egyptian clover (EC)	Egyptian clover hay (ECH)
DM	92.2	18	**89.84**
OM	95.43	89.10	**89.34**
CP	14.45	13.16	**12.72**
CF	12.95	26.85	**27.44**
EE	2.50	2.84	**2.80**
NFE	65.53	46.25	**46.38**
Ash	**4.57**	**10.90**	**10.66**

***** Concentrate feed mixture (CFM) was consisted of: 40% wheat bran, 30% ground yellow corn, 24% undecorticated cotton seed meal, 3% cane molasses, 2% lime stone and 1% common salt.

Preparation of magnetized water:

A sample of water was taken from each group for analysis to see the effect of the magnetic field on it and the analysis was done through the National Water Research Center.Two permanent magnets were borrowed from (Nefertari Biomagnetic Comp., Egypt) 2000 Gauss and 4000 Gauss, .The intensities of its magnetic field was confirmed by checking it with a Gauss meter. , The magnet was installed before the animal drinking basin tap of the experimental animals the water was constantly available to the animal and the water was changed every 12 hours.

Milk sampling and analysis:

Milk production was recorded biweekly from the second week of birth (after colostrum milk) until the end of the milking season during 6 months of lactation, individually in the morning and evening for each group, by blocking half of the udder each time in an interchangeability manner. Then the entire udder was recorded from the second week of birth (after colostrum milk) until the end of the milking season (182 day). Milk samples were taken for analysis every month; all samples were analyzed for milk components milk fat, protein, lactose, total solids and solids not fat using Milko-Scan 133B.

Statistical analysis:

The obtained data in this study were statistically analyzed using general linear models (GLM) procedure of **SAS (2000).**

$$\mathbf{Y_{ij} = \mu + T_i + e_{ij}}$$

Where: Y_{ij}= the observation of milk yield and its composition for the ij Zaraibi goats; μ= general mean, common element to all observations;
T_i= the fixed effect due to the i^{th} treatment with magnetic water (i=1, 2, 3 while, 1= control, 2= 2000

Gauss, 3= 4000 Gauss); e_{ij}= random error associated with the individual observation and assumed to be (N,IND) and (0, Ϭ2e).Tests of significance for differences between means were carried out according to **Duncan (1955).**

Results and Discussions

Goat's milk yield:

Table 2 shows milk yield and its composition in the lactation season of Zaraibi goats and a significant increase (P<0.01) in the second (T2, 4000 gauss) and first (T1, 2000 gauss) treatments over the control group in daily milk yield (881.64, 870.9 and 778.79 grams/day, respectively) and in total milk yield (160.46, 158.50 and 141.74 kg, respectively) during the lactation season.

Table 2. Milk yield and its composition of Zaraibi goats during the lactation season.

Parameter	Control	T_1 (2000 Gauss)	T_2 (4000 Gauss)		Significant
	Mean	Mean	Mean	SEM*	
Daily milk yield, grams/day	778.79[b]	870.9[a]	881.64[a]	20.85	**
Total milk yield, kg	141.74[b]	158.50 [a]	160.46 [a]	3.79	**
Milk composition (%):					
Fat	3.40[b]	3.98[a]	4.08[a]	0.11	***
Protein	2.83[b]	3.14 [a]	3.26 [a]	0.06	***
Lactose	4.38	4.39	4.44	0.04	NS
Total solids	11.33[b]	12.24[a]	12.51[a]	0.15	***
Solids not fat	7.93[b]	8.26[a]	8.43[a]	0.07	***

[a,b] Within rows means bearing different superscripts differ significantly at P<0.05. *SEM= Standard error of mean. NS= non-significant, **= P<0.01, *** = P<0.001.

These results agree with **Yacout *et al.* (2015)** indicated that treating water with a magnetic field (1200-3600 Gauss) in Zaraibi goats at ages 2.5-3.5 years led to a significant (P<0.05) increase in the amount of milk produced, as T_2 (3600 Gauss) was significantly higher compared to T_1 (1200 Gauss)(1.049 vs. 1.011 kg/day), and T_1 was significantly (P<0.05) higher compared to the control (1.011 vs. 0.902 kg/day).On other species, **Mustafa and Muhammed (2023)** indicated that a study they conducted on the use of magnetic water using Awassi ewes aged 2 years old that treatment with the magnetic field of water, showed an improvement in the milk yield in T_3 (6000 Gauss), followed by the T_2 (4000 Gauss), then T_1 (2000 Gauss), the least being T_0 (well water) (0.735, 0.640, 0.533 and 0.429) respectively, where the increase in milk post-partum was significant for T_3 compared to T_1 and T_0. The increase was also significant in T_1 compared to T_0, while it was not significant between T_1 and T_2 and between T_2 and T_3. Also, **Ghoneim *et al.* (2020)** found that milk production and its composition was increased when they drink magnetic water intensity (1200 gauss) compared to tap water on Egyptian buffaloes. Where the results showed a significant (P<0.01) increase in milk production from magnetic drinking water of buffaloes starting from 6 to 14 weeks of lactation compared to the tap water. The results also showed a significantly higher (P<0.05) in protein, fat, lactose, total solids (TS), and solids not fat (SNF) in magnetic drinking water compared to the tap water of buffaloes.

Goat's milk composition:

Furthermore results indicated that there was a significant increase in goat's milk fat percentage in the second and first group versus the control during the lactation season (4.08, 3.98 vs. 3.4%, respectively) as showed in Figure1. These results agree with **Yacout *et al.* (2015)** indicated that treating water with a magnetic field (1200-3600 Gauss) in Zaraibi goats led to an increase in milk composition in treated water(1200-3600 Gauss) compared to the control, where the milk fat percentage in T_2 (3600 Gauss) was significantly higher compared to T_1 (1200 Gauss) (3.94 vs. 3.78%) and T_1 was significantly higher compared to the control (3.78 vs. 3.19%).On other species, **Ghoneim *et al.* (2020)** found that milk production and composition increased when drinking magnetized water intensity (1200 Gauss) compared to tap water on Egyptian buffalo cows within 4-5 valences as the percentage of fat was significantly higher (P<0.05) in the magnetized drinking water compared to tap water (7.53% vs. 7.06%).On contrary, **Sargolzehi *et al.* (2009)** showed that treatment with magnetized water (1200-3600 gauss) had no significant effect on milk composition of Saanen goats.

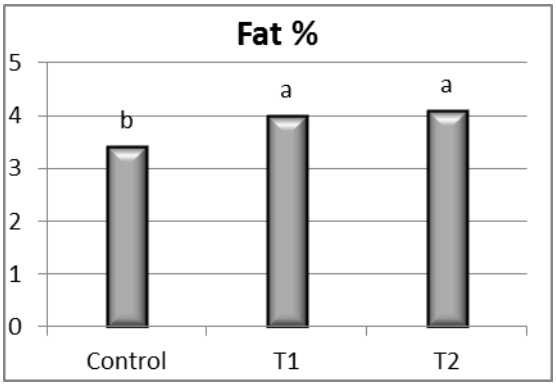

Figure 1. Effect of drinking magnetic water on milk fat percentage of Zaraibi goat

Results showed that there was a significant increase in the protein percentage in the second and first group versus the control during the lactation season (3.26, 3.14, 2.83 %, respectively) as observed in Figure 2. Similar results recorded by **Ghoneim *et al.* (2020)** who found that milk protein percentage was significant increase ($P < 0.05$) when drinking magnetized water intensity (1200 Gauss) compared to tap water (4.47% vs. 4.37%) in Egyptian buffalo cows within 4th and 5th parity. Also, **Yacout *et al.* (2015)** indicated that treating water with a magnetic field (1200-3600 Gauss) led to an increase in milk composition in treated water(1200-3600 Gauss) compared to the control, the milk protein percentage was 3.23,3.19 and 3.03%, for T_2 (3600 Gauss), T_1 (1200 Gauss) and control group, respectively.

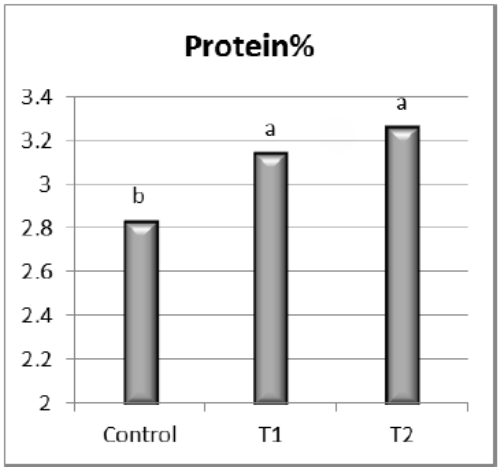

Figure 2. Effect of drinking magnetic water on milk protein percentage of Zaraibi goat

Results showed that there was no significant increase in the lactose percentage in the second and first groups and the control during the lactation season (4.44, 4.39, 4.38 %, respectively) as obtained in Figure 3. These results agree with those reported by **Shamsaldain and Al Rawee (2012)** who showed that magnetic water (1000 Gauss) had not significant effect in level of lactose (4.32 vs. 4.17%) of Awassi sheep at ages 3- 4 years. On contrary, **Yacout *et al.* (2015)** indicated that treating water with a magnetic field (1200-3600 Gauss) led to an increase in milk composition in treated water(1200-3600 Gauss) compared to the control, the milk lactose percentage was (4.98, 4.97and 4.56%, for T_2 (3600 Gauss), T_1 (1200 Gauss) and control group, respectively.

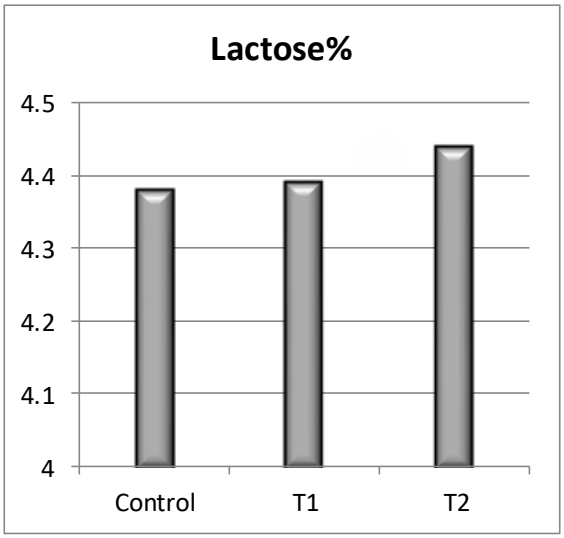

Figure 3. Effect of drinking magnetic water on milk lactose percentage of Zaraibi goat

Results showed that there was a significant increase (P<0.001) in the total solids percentage in the second and first group compared to the control during the lactation season (12.51, 12.24, 11.33 %, respectively) as showed in Figure 4. The present results are in good agreement with the findings of **Yacout *et al.* (2015)** who indicated that treating water with a magnetic field (1200-3600 Gauss) in led to an increase in milk composition in treated water (1200-3600 Gauss) compared to the control, the milk total solids percentage was 12.88, 12.66 and 11.51%, for T_2 (3600 Gauss), T_1 (1200 Gauss) and control group, respectively. On other species, **Ghoneim *et al.* (2020)** who found that the total solids had a significant increase (P<0.05) when drinking magnetized water intensity (1200 Gauss) compared to tap water (17.63 vs. 17.04) in Egyptian buffalo cows within 4th -5th parity.

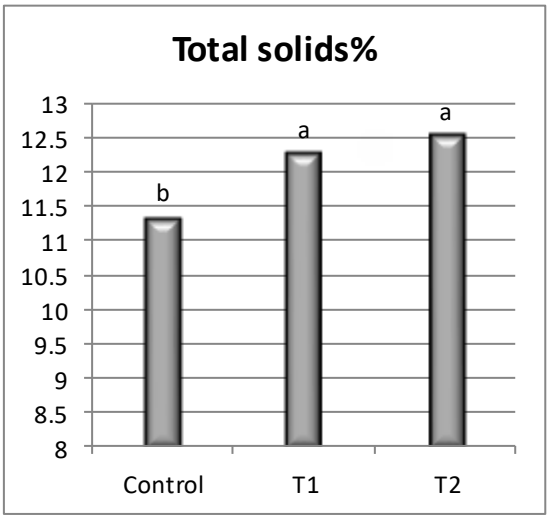

Figure 4. Effect of drinking magnetic water on milk total solids percentage of Zaraibi goat

The results of the lactation season showed a significant increase (P<0.001) in solids not fat for the second and first treatments compared to the control (8.43, 8.26, 7.93 %, respectively) as observed in Figure 5. Results partially agree with, **Yacout*et al.* (2015)** indicated that treating water with a magnetic field (1200-3600 Gauss) in Zaraibi goats led to an increase in milk composition in treated water (1200-3600 Gauss) compared to the control, the milk solids not fat percentage was 8.88, 8.94 and 8.32 %, for T_2 (3600 Gauss), T_1 (1200 Gauss) and control group, respectively. On other species, **Shamsaldain and Al Rawee (2012)** showed that drinking Awassi sheep at ages 3- 4 years magnetic water (1000 gauss) comparing with tap water had significantly (P<0.05) increased total milk yield (117.19 vs. 83.65 kg). It also caused a significant (P<0.05) increase in milk fat % (6.90 vs. 5.77%), milk protein% (8.08 vs. 4.31%), and milk total solids % (17.23 vs. 14.86%), while not significant effect was found in level of lactose% (4.32 vs. 4.17%).

Figure 5. Effect of drinking magnetic water on milk solids not fat percentage of Zaraibi goat.

The improvement in milk production and its composition may be due to the improvement in water quality, which subsequently improved food digestion, assimilation and absorption **(Yacout *et al.*, 2015)**.These results agree with **Ghoneim *et al.* (2020)** found that milk production and its composition was increased when they drink magnetic water intensity (1200 gauss) compared to tap water on Egyptian buffaloes. Where the results showed a significant ($P < 0.01$) increase in milk production from magnetic drinking water of buffaloes starting from 6 to 14 weeks of lactation compared to the tap water on Egyptian buffaloes. The results also showed a significantly higher percentage ($P<0.05$) in protein, fat, lactose, total solids (TS), and solids not fat (SNF) in magnetic drinking water compared to the tap water of Egyptian buffaloes. Furthermore **Ebrahim and Azab, (2017)** reported that animals consumed magnetized water showed an increase in the amount of milk produced, such as Zaraibi goats, ewes, Awassi sheep, and dairy cattle, as well as an increase in milk protein and fat %

Conclusion

It can be concluded in the present study that drinking magnetic water (T1, 2000 gauss and T2, 4000 gauss) can be improving effectively the growth performance, carcass traits, blood metabolites and immunity than drinking tap water without negative effects on Zaraibi kids.

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تأثير إستخدام الماء الممغنط على محصول اللبن ومكوناته فى الماعز الزرايبى

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هدفت هذه الدراسة إلى معرفة تأثير استخدام الماء الممغنط على محصول اللبن ومكوناته في الماعز الزرايبي. تم تقسيم ثلاثين من الماعز الزرايبي في الثلث الأخير من الحمل بمتوسط وزن حي 32.33 كجم وعمر 3–4 سنوات إلى ثلاث مجموعات (كل منها عشرة حيوانات). تم تقسيم الحيوانات حسب الوزن إلى ثلاث مجموعات على النحو التالي: المجموعة الأولى الكنترول كانت تشرب الماء العادى. المجموعة الثانية كانت تشرب الماء الممغنط (T_1، 2000 جاوس). المجموعة الثالثة كانت تشرب الماء الممغنط (T_2،4000 جاوس). تم تعديل التغذية وفقًا لوزن الجسم ومراحل الإنتاج المختلفة وفقًا NRC (2007). تم تسجيل محصول اللبن شهريًا خلال 6 أشهر من موسم الحليب وتم أخذ عينات اللبن للتحليل كل شهر ؛ تم تحليل جميع العينات لمكونات اللبن الدهن والبروتين واللاكتوز والمواد الصلبة الكلية والمواد الصلبة غير الدهنية باستخدام Milko–Scan 133B. أظهرت النتائج وجود فروق ذات دلالة إحصائية بين المجموعات في محصول لبن الماعز اليومي والإجمالي. أظهرت المعاملة الثانية (T_2, 4000 جاوس) أعلى محصول يومي وإجمالي للبن الماعز من المعاملة الأولى (T_1, 2000 جاوس) ومجموعة الكنترول . كما سجلت نتائج مماثلة لتركيب لبن الماعز (نسبة الدهون والبروتين والمواد الصلبة الكلية والمواد الصلبة غير الدهنية) بينما لم تكن هناك فروق معنوية في نسبة اللاكتوز بسبب استخدام الماء الممغنط. أظهرت المعاملة الثانية (T_2, 4000 جاوس) أعلى تركيب للبن الماعز من المعاملة الأولى (T_1, 2000 جاوس) ومجموعة الكنترول باستثناء نسبة اللاكتوز.

ويمكننا أن نستنتج أن شرب الماء الممغنط (2000 جاوس و 4000 جاوس) يمكن أن يزيد بشكل فعال من محصول لبن الماعز الزرايبي اليومي والإجمالي وتركيب اللبن باستثناء نسبة اللاكتوز بدون تأثير سلبى.