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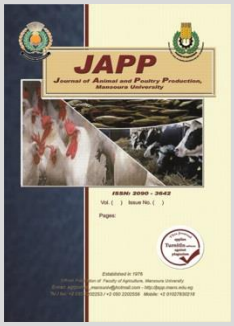
Effect of Magnetic Water on Reproductive Performance of Buffalo Bulls

Ghoneim, M. M.* ; M. A. Abo-Farw; M. M. Hegazy and S. M. Shamiah

Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza, Egypt.



ABSTRACT

A total of 10 stable Egyptian buffalo bulls with an average of 435.9±2.29 kg of live body weight and 18-24 months of age were used to research the effects of magnetic drinking on testicular proportions, physical semen characteristics and buffalo bull fertility. The bulls of Buffalo were classified into two related categories (5 bulls in each). Bulls in the first group were drinking natural water (NW) and acted as a monitoring group (G1). Bulls in the 2nd category had been drinking magnetic water (MW) for 60 days of pre-semen collection. During the semen collection era, ejaculate length, sperm cell concentration, sperm kinematics using a computer-assisted sperm analyzer and testicular measurements were registered. A total of 160 buffalo cows were used in a fertile survey (80 buffalo cows in each group). The findings revealed that testicular length, distance, and height, and scrotal diameter were substantially higher in MW than in NW bulls. Serum testosterone concentration was higher (P<0.05) in MW than in NW bulls (0.833 vs. 0.716 ng/ml). Most physical semen properties were higher (P<0.001) in MW than in NW bulls. The gaps in the ratios of non-progressive motility, straightness and chaos between the two classes were not important. The design rate on days 25 and 45 of post-insemination was higher (P<0.01) for buffalo co inseminate with MW semen (95.06 vs. 91.36) than for NW bulls (86.08 and 78.48 per cent respectively.

Keywords: Buffaloes, bulls, magnetic water, scrotal circumference, semen.

INTRODUCTION

Magnetic water involves passing the water from the magnetic tubing, placing the magnet in the water so that the properties of the water change into very fertile and productive, producing high oxygen ratio, dissolving salts and amino acids in the water (Batmanghelidj, 2005). Increased water penetration and versatility (Davis, 2004) and absorption of water from the body will minimize surface bonding of water (Szkatula et al., 2002). Drinking magnetic water has been used to maximize the effectiveness of feed transfer by reducing the surface tension and improving the permeability of the cells, allowing the widening of the intestines to take advantage of food and thereby enhance the body's proportions (Al-Nuemi et al., 2015). Moreover, magnetic water can increase ability of body for production general and sexual hormones, transport of food in blood, and improves semen characteristics and fertility rate (Morgan, 1988; Alfonso *et al.*, 2006; Al-Sabeea, 2008; Al-Nuemi *et al.*, 2015).

Attia *et al.* (2015) reported that rabbit bucks drank magnetized water showed a significant increase in fertility, sperm concentration, mass motility and total live sperm. These improvements were in association with significant increases in testosterone hormone, immunoglobulin A, antioxidant enzymes, and decreases in lipid peroxidation biomarker malondialdehyde and thiobarbituric acid-reactive substances. The increase in testosterone due to magnetized water may have led to increased sexual desire as demonstrated by the decrease in the reaction time and the increase in fertility and semen quality (Said *et al.*, 2005).

Al-Nuemi *et al.* (2015) reported that Holstein bulls treated with magnetic water showed a significant rise in testis dimensions and scrotal circumferences as compared with control bulls at age of 17-18 month. Also, a significant increase in testis dimension was also recorded in magnetic water treated bucks, and lambs (Atteyh, 2008; Yassin and AL-Dori, 2011). This benefit of magnetic water on testis dimension and scrotal circumferences may be this magnetic water enhances the digestion absorption of growth functions cell and circulating system (Hussen, 2002; Lebeau, 2001; Al-Nuemi *et al.*, 2015).

Computer assisted semen analyzers (CASA) system yields accurate, objective assessment, repeatable, and reliable results on different semen parameters such as total motility, foreword progressive motility and different velocity parameters (Verstegen *et al.*, 2002) based on the measurement of individual sperm cells. The CASA does not only measure the proportion of motile spermatozoa but also measures other sperm motion parameters derived from individual sperm cells and it has more predictive power on fertility potential of semen ejaculates (Mortimer, 1994). No information are available on the effects of magnetic water on semen characteristics of buffalo bulls.

The purpose of this thesis was to investigate the effect of magnetic water on the semen characteristics and fertility of Egyptian buffalo bulls.

MATERIALS AND METHODS

The present analysis was carried out during 2019 at the Animal Production Research Station, Mehallet Moussa, Kafer El-Sheikh Governorate, Animal Production Research Institute, Agricultural Research Centre, Ministry of Agriculture.

* **Corresponding author.**
E-mail address: massoudghoneim@gmail.com
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In this experiment, 10 buffalo bulls aged 18-24 months with an average live body weight of 435.9±2.29 kg were split into two classes (n=5). Animals in the first group were drinking natural water (NW), and those in the second group were drinking magmatic water (MW) with a permanent magnet of 1200 Gauss (Nefertari Biomagnetic comp., Egypt)

Management and feeding system:

All animals were subjected to carful general clinical and anthological examination to determine that they are healthy and free from any disease. These animals were housed in semi-opened shade and provide with concentrate feed mixture (CFM), rice straw and corn silage in two time daily according to the recommendation of the APRI, 2002.

Preparation of magnetic water:

One permanent magnets (1200 Gauss) were used for conditioning of water was borrowed from Nefertari Bio. Magnetic Comp., Egypt) which were produced for pipe water conditioning. The water was change at morning and evening prior to consumption of concentrated food according to the information of the manufacture office. Physical and chemical properties of magnetic water in comparing ith natural water are hown in Table 1.

Table 1. Properties of magnetic and natural water using in drinking buffalo Bulls. (mean ±SE)

Items	Nature Water (G1)	Magnetic water (G2)	Sig. P-value
pH value	7.45±0.015	7.59±0.028	0.014*
T. dissolved solids (mg/l)	15.59±0.21	16.83±0.16	0.01**
Conductivity (µs/cm)	2273.5±3.69	2361.4±6.14	0.000***
Alkalinity (mg/l)	290.7±1.20	307.3±1.42	0.000***
Salinity (mg/l)	116.2±1.92	102.3±0.49	0.01**
Turbidity (ntu)	1.92±0.04	1.36±0.04	0.01**
T. hardness (ppm)	191.6±4.1	178.1±0.9	0.05*
Chloride (ppm)	458.8±1.13[a]	442.2±4.39[b]	0.05*
Calcium (ppm)	83.80±0.4	88.93±0.38	0.001***
Magnesium (ppm)	98.44±0.47	108.1±0.85	0.001***
Sodium (ppm)	6.14±0.02	6.55±0.06	0.01**
Potassium (ppm)	1.28±0.03	1.56±0.02	0.01**

*** Significant at P<0.05.* Significant at P<0.01.**
***** Significant at P<0.001.**

Testicular dimensions and scrotal circumference:

The length and width of the testes and scrotum circumferences were measured at the end of collection period according to Coulter, 1991.

Semen collection and evaluation:

Ten bulls aged 18-24 months were training for about two months before semen collection using artificial vagina. After that, total of 80 ejaculates were collected from all bulls (one ejaculate from each bull weekly) for 8 weeks.

Ejaculated volume was recorded by using the collection graduated centrifuge tube immediately after collection semen (Chemineau *et al.,* 1991), Sperm concentration ($x10^9$/ml) was estimated using heamocytometer according to Smith and Mayer (1955).

The total sperm-output per ejaculate was estimated by multiplying the ejaculate volume in ml by the sperm cell concentration per ml.

Sperm kinematics using computer assisted sperm analyzer:

Fresh semen of each group was pooled to avoid individual variation among bulls (five replicates per group) to analyze using CASA system (Microptic S.L., Barcelona, Spain) for estimation of sperm movement characteristics. Each assay was carried out in duplicate.

Fresh semen was diluted with Tris-buffer to get final concentration of 2-7 million spermatozoa per ml at 37ºC. Pre-warmed 8 chambered slide having depth 20 µm was loaded with 1µl diluted semen. The spermatozoa were counted in 5 optical fields around the central reticulum of the chamber.

In addition to the sperm motility, the kinematic parameters analyzed included the curvilinear velocity (VCL, µm/s), linear velocity (VSL, µm/s), average path velocity (VAP, µm/s), the percentage of linearity i.e the ratio between VSL and VCL (LIN, %), the straightness coefficient i.e the ratio between VSL and VAP (STR, %) and Wobble (WOB, %) the ratio between VAP and VCL.

Serum testosterone concentration

Blood samples were collected from all bulls of each group at the end of experimental period. Sera were obtained by centrifugation (3000 rpm) for 10 minutes and stored at -20C° until assessment of testosterone.

Serum testosterone concentrations were measured by using a commercial testosterone ELISA kit (Cat. No. EIA-1559, DRG Instrument GmbH, Germany).

Fertility trails:

A total of 160 buffalo cows in two groups (80 buffalo cows each group) were used in fertility trails**.** The genital tract for all buffalo cows which used in this trial were examined by ultrasonography for reproductive problems and ovarian activity so all buffalo cows in this trial were free from any reproductive problems and ovaries were cyclic. The cyclists of ovaries were determined by presence of functional corpus lutium or dominant follicle on the surface of ovaries. All Buffalo cow in both group were give two injection of PGF2α at11 day interval. Within 72 h after the 2nd PGF2α injection, estrous activity was detected every morning and evening by close observation for external signs in presence of a teaser buffalo bull all the times of observation. Buffalo cows which show estrus signs were naturally inseminated by bull from each experimental group base on 16 cows for each bull.

Pregnancy diagnosis:

Pregnancy was detected on day 25 and 45 days post-mating of each animal by ultrasound inspection (Digital ultrasound diagnostic imaging device, Model Dp-30 Vet. 50/60 HZ, SHENZHEN, MINDRAY BIO-MEDICAL.ELECTRONICS, CO. LTD) 7.5 MHz Linear array transducer and Depth 4.3.

Statistical analysis:

Measurement results, both semen characteristics and testicular measurements were statistically analyzed using a T-test to study the impact of water treatment. The data was analyzed by SAS (2000). The design rate was evaluated by the Chi-square test. All percentage values have been converted by arcsine values prior to the statistical analysis.

RESULTS AND DISCUSSION

Testicular dimensions and scrotal circumference:

Results in Table 2 show that all testicular measurements including length, width, size of testis as well

as scrotal circumference and ejaculate volumel increased significantly in MW bulls compared with control (NW bulls). These results concerning testis dimensions and scrotal circumferences are in agreement with Atteyh (2008), who establish significant increase in testis dimension for buck drinking magnetic water. Yassen and Al-Dori (2011) found similar results in lambs.

Table 2. Effect of magnetic water on testicular measurements, scrotal circumference and ejaculated volume in buffalo bulls. (mean±SE)

Items	Nature Water (G1)	Magnetic Water (G2)	Sig. (P-value)
Tests length (cm)	12.73±0.21^{b}	13.32±0.11^{a}	0.023*
Tests width (cm)	7.20±0.2^{b}	7.98±0.15^{a}	0.01**
Tests size (cm)2	369.3±2.12^{b}	378.6±1.54^{a}	0.01**
Circumference of scrotum (cm)	27.65±0.11^{b}	28.29±0.09^{a}	0.000***
Ejaculated volume (ml)	2.09±0.079^{b}	2.39±0.052^{a}	0.01**

a and b: Means in the same row with different superscripts are significantly different.
*** Significant at P<0.05.* Significant at P<0.01.**
***** Significant at P<0.001.**

This benefit of magnetic water on testis dimension and scrotal circumferences may be attribute to that magnetic water improves the digestion absorption of growth functions cell and circulating system (Lebeau, 2001), and increase the feed conversion efficiency by reducing the surface tension and increase the permeability of the cells, and this allows the expansion of the gut to take advantage of food and therefore, an improvement in the dimensions of the body (Hussen, 2002).

Scrotal circumference is an important testicular parameter, easy to measure and most accurate indicator of semen quality (Pant et al., 2003). Testicular size is directly related to the total mass of sperm producing tissues in bulls (Ashwood, 2009).

Sperm cell concentration and total sperm output were significantly (P<0.01) higher in buffalo bulls drinking magnetic water as compared to control group (Fig. 1).

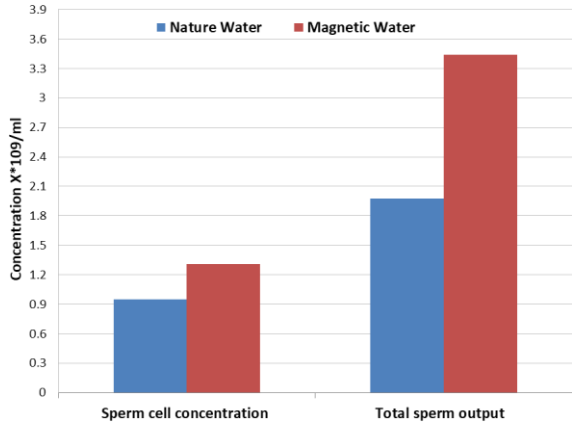

Fig. 1. Effect of magnetic water on sperm cell concentration (x10^{9}/ml) and total sperm output (x10^{9}/ejaculate) in buffalo bulls.

Testosterone concentration (ng/ml) in blood serum of buffalo bulls drinking magnetic water group (G2) (0.833 ng/ml) increased significantly (P<0.05) as compared to control group (G1, 0.716 ng/ml, Fig. 2). This trend is in paralleled with change in the scrotal circumference of bulls in each group. In this respect, Mahmoud *et al.* (2018) found that significant positive correlation (r = 0.4912) between scrotal circumference and plasma testosterone concentration in buffalo bulls. Consumption of magnetized water can increase the ability of the body to produce hormones like sexual hormones (Al-Nueimi *et al.*, 2015), that in turn improves semen characteristics (Alfonso *et al.*, 2006).

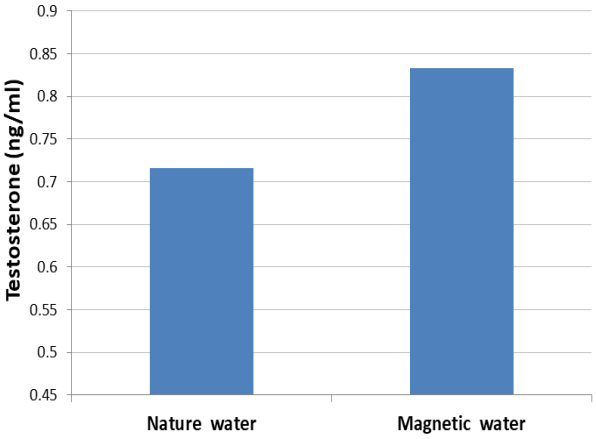

Fig. 2. Effect of magnetic water on testosterone concentration in buffalo bulls.

Motility an kinematics of spermatozoa

Buffalo bulls drinking magnetic water (G2) significantly improved most motility an kinematic characteristics, in terms of increasing progressive motile, total motil and viable sperm percentages, curvilinear (VCL), straight line (VSL), and average path (VAP) sperm velocities, percentage of linearity (LIN) ,and significant decreasing in immotile sperm percentage as compare to those in NW wobble percentage were not affected by drinking magnetic water (Table 3).

The beneficial effects of magnetic water on semen content have been reported in Holstein bulls (Al-Nueimi and Al-Badry, 2014), humans (Shaban and Azab, 2017), rabbit bucks (Attia et al., 2015; El-Ratel and Fouda, 2017) and male geese (El-Hanoun et al., 2017).

Table 3. Effect of magnetic water on motility and velocity parameters in buffalo bulls spermatozoa. (mean ±SE)

Items	Nature Water (G1)	Magnetic Water (G2)	Sig. (P-value)
Progressive motility (%)	48.17±0.62^{b}	65.17±1.26^{a}	0.000***
Non progressive motility(%)	12.1±0.55	7.71±1.61	0.062^{NS}
Total motility (%)	60.24±0.59^{b}	72.88±0.84^{a}	0.000***
Immotile sperms (%)	39.76±0.59^{a}	27.12±0.84^{b}	0.000***
Viability (%)	65.7±0.91^{b}	75.65±0.76^{a}	0.001***
Curvilinear velocity(μm/sec)	142.6±.1.2^{b}	152.7±o.69^{a}	0.002**
Straight line velocity(μm/sec)	60.71±0.61^{b}	71.36±0.64^{a}	0.000***
Average path velocity (μm/sec)	77.12±1.41^{b}	84.02±1.58^{a}	0.031*
Linearity (LIN) (%)	42.57±0.71^{b}	46.74±0.62^{a}	0.011*
Straightness (STR) (%)	78.77±1.57	85.02±2.32	0.089
Wobble (WOB) (%)	54.1±1.38	55.02±0.87	0.599

a and b: Means in the same row with different superscripts are significantly different.
*** Significant at P<0.05.* Significant at P<0.01.**
***** Significant at P<0.001.**

Increased testosterone levels attributable to magnetic water have been shown to boost semen consistency (Said et al., 2005). It is important to note that

changes in the physical features of buffalo bull drinker magnetic water are related to a remarkable rise in testosterone levels.

The release of testosterone is responsible for regulating and performing spermatogenesis activity (Syamyono, et al., 2014; Rajak, et al., 2014). Some studies reported a strong correlation between serum testosterone concentration, sperms quality and fertility of bulls (Javed, et al., 2000; Hastomo and Arifin, 2004; Hastomo et al., 2010), but other could not find any relation (Rajak, et al., 2014).

Sperm abnormality:

Buffalo bulls drinking magnetic water (G2) significantly decreased the percentages of abnormal head, abnormal tail and total abnormality of spermatozoa in comparing with bulls drinking nature water. However, no significant difference was detected between two groups in percentage of sperm with abnormal neck (Table 4).

Table 4. Effect of magnetic water on sperm abnormalities in semen of buffalo bulls. (mean ±SE)

Semen Abnormality (%)	Nature Water (G1)	Magnetic Water (G2)	Sig. (P-value)
Abnormal head (%)	16.68±0.55^{a}	8.04±0.48^{b}	0.000***
Abnormal neck (%)	8.71±3.62	6.06±0.193	0.505
Abnormal tail (%)	5.74±0.24^{a}	4.35±0.39^{b}	0.038*
Total abnormal (%)	31.133±3.56^{a}	18.45±0.971^{b}	0.026*

a and b: Means in the same row with different superscripts are significantly different.
*** Significant at P<0.05.* Significant at P<0.01.**
***** Significant at P<0.001.**

Conception rate:

Pregnancy diagnosis on days 25 and 45 using ultrasound indicated significantly higher conception rate for buffalo cows inseminated with bulls drinking magnetic water group (95.06 and 91.36%) than cows inseminated with bulls drinking nature water (86.08 and 78.48%), respectively (Table 5).

Table 5. Conception rate of buffalo cows inseminated with bulls in natural an magnetic water groups. (mean ±SE)

post-service day	Nature Water (G1, n=80)		Magnetic Water (G2, n=80)	
	Conceived cows	Conception rate	Conceived cows	Conception rate
Day 25	68	85^{b}	76	95^{a}
Day 45	62	77.5^{b}	73	91.25^{a}

a and b: Means in the same row with different superscripts are significantly different.

In this study, increasing in semen characteristics and sperm fertility of bulls drinking magnetic water may be results from the positive impact of magnetic water on antioxidant enzymes, lipid peroxidation biomarkers and immunity which improve body tolerance to pollutants and harmful effects of free radicals (Rommerts, 1990).

In this respect, several researchers reported that magnetic water can increase ability of body for production general and sexual hormones, transport of food in blood, and improved semen characteristics and fertility rate (Al-Nuemi *et al.,* 2015, Al-Sabeea (2008), Morgan (1988) and Alfonso *et al.*, 2006).

CONCLUSION

under the experimental conditions, drinking buffalo bulls magnetic water in comparing with the natural water is better to improve semen characteristic and fertility rate of buffalo bulls.

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تأثير الماء الممغنط على الأداء التناسلي في طلائق الجاموس

مسعود محمد غنيم ، محمد عبدالفتاح أبوفرو ، محمد محمود حجازى و شريف مغاورى شامية

معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية

تم إستخدام عشرة طلائق من الجاموس المصري السليم صحيا بمتوسط وزن2.29 ±435 كجم من الوزن الحي وتتراوح أعمارهم ما بين 18 و 24 شهرًا وذلك لدراسة تأثير شرب الماء الممغنط والماء الطبيعى على قياسات الخصية وبعض الخصائص الفزيائية للسائل المنوي وخصوبة طلائق الجاموس. قسمت حيوانات التجربة إلى مجموعتين متماثلتين (5 طلائق لكل مجموعة). كانت الطلائق في المجموعة الأولى (الكنترول) تشرب المياه العادية غير الممغنطه (G1)، بينما المجموعة الثانية تشرب الماء الممغنط (مجموعة المعاملة) (G2). كانت الفترة التجريبية أربعة أشهر ، تم تقسيم هذه المدة إلى فترتين (فترة شهرين معامله قبل جمع السائل المنوى وشهرين تم فيها أخذ القياسات وجمع عينات السائل المنوى . أثناء الفترة الأخيرة من التجربة تم تقدير قياسات الخصية ، حجم السائل المنوي ، تركيز خلايا الحيوانات المنوية ، الناتج الإجمالي للحيوانات المنوية وكذلك حركة الحيوانات المنوية باستخدام جهاز تحليل الحيوانات المنوية بواسطة الكمبيوتر. أظهرت النتائج زيادة معنوية في طول وعرض وحجم الخصية ومحيط كيس الصفن لمجموعة طلائق الجاموس المعامل بالماء الممغنط مقارنة مع مجموعة الكنترول. أيضا زاد تركيز هرمون التستوستيرون (نانوجرام / مل) لمجموعة طلائق الجاموس المعامل بالماء الممغنط معنويا مقارنة بمجموعة الكنترول. عند شرب طلائق الجاموس للماء الممغنطأظهرت النتائج تحسن معنوى في معظم خصائص السائل المنوي الخواص الفزيائية مقارنة بمجموعة الكنترول. لم يلاحظ فروق معنوبه بين المجموعتين (المعامل أو الكنترول) في الحركة غير التقدمية (٪) ، والاستقامة (STR) (٪) والتمايل (WOB) (٪). النسبة المئوية لمعدل الأخصاب عند اليوم 25 باستخدام الموجات فوق الصوتية وعند اليوم 45 باستخدام الفحص الشرجى كانت أعلى معنويًة لمجموعة طلائق الجاموس المعاملة بالماء الممغنط مقارنة بمجموعة الطلائق الغير معاملة. الإستنتاج : في ظل الظروف التجريبية للدراسه المقدمة أظهرت النتائج ان خصائص السائل المنوي ومعدل الخصوبة تحسن في طلائق الجاموس المعامل بالماء الممغنط مقارنة بطلائق الجاموس التي شربت الماء الطبيعى.