



MAXIMUM CHELATION THERAPY RATE AFTER APPLICATION OF DIMERCAPTO-SUCCINIC ACID (DMSA) COMBINED WITH MAGNETIC TREATED WATER (MTW) AS DRINKING WATER

BASSEM M. RAAFAT*

*Assistant Professor of Biophysics Genetic Engineering and Biotechnology Division,
National Research Center, Al-Tahrir Street, Dokki, Cairo, EGYPT College of Applied Medical Science,
Taif University, Ring Road Street, Taif, KSA*

ABSTRACT

Water and life are closely linked. This has been recognized throughout history by civilizations and religions and is still the case with scientists today. Water properties are found to be very effected by magnetic and electric field. The aim of this work was to study to what extend magnetic treated water can enhance the chelation rate in cases of heavy metal ions intoxications. Thirty New Zealand albino rabbits weighing between 2.5 and 3 kg were conducted to the study. Study was approved from the (The National Research Center) (NRC) ethical committee. Rabbit were subdivided into four groups. Groups I; the Control groups: Rabbits Animals received neither lead acetate nor DMSA. Groups II : Rabbits received lead acetate in the drinking water with no treatment. Group III: Rabbits Animals received lead acetate in drinking water and then treated with DMSA as a chemical chelator with using tap water as water supply drinking water. Groups IV : Rabbits Animals received lead acetate in drinking water and then treated with DMSA as chemical chelator with using magnetic drinking water treated water (MTW) as drinking water. Results showed a dramatic reduction in all body compartments lead level after administration of DMSA chelation therapy. Rabbits Animals used Magnetic drinking water MTW as drinking water recorded the lowest lead ions concentration, antioxidants activity level and hemoglobin auto-oxidation rate as compared to those received lead with no treatment. It may be preliminary concluded that, magnetic treated water usage as drinking water reduced the free radicals formation rate that in role enhance the chelation therapy process when chemical chelator is administered.

Keywords : Magnetic drinking treated Water – Lead poisoning – Free radicals - DMSA



BASSEM M. RAAFAT

Assistant Professor of Biophysics Genetic Engineering and Biotechnology Division, National Research Center, Al-Tahrir Street, Dokki, Cairo, EGYPT College of Applied Medical Science, Taif University, Ring Road Street, Taif, KSA

*Corresponding author

INTRODUCTION

Water covers 71% of the Earth's surface and is vital for all known forms of life On Earth ¹., 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air), and precipitation . Only 2.5% of the Earth's water is fresh water, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products ². Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. There is a clear correlation between access to safe water and Gross Domestic Product GDP per capita ³. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability⁴. A recent report suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50% ⁵. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of the fresh water used by humans goes to agriculture⁶. Water fit for human consumption is called drinking water or potable water. Water that is not potable may be made potable by filtration or distillation, or by a range of other methods. Water that is not fit for drinking but is not harmful for humans when used for swimming or bathing is called by various names other than potable or drinking water, and is sometimes called safe water, or "safe for bathing". Chlorine is a skin and mucous membrane irritant that is used to make water safe for bathing or drinking. Its use is highly technical and is usually monitored by government regulations (typically 1 part per million (ppm) for drinking water, and 1–2

ppm of chlorine not yet reacted with impurities for bathing water). Water for bathing may be maintained in satisfactory microbiological condition using chemical disinfectants such as chlorine or ozone or by the use of ultraviolet light ⁷. Water is the blood of life, it is needed to transport compounds via the blood, maintain cellular structural integrity, regular temperature, etc⁸. Water is a very simple molecule, consisting of two hydrogen atoms attached to an oxygen atom. Although the water molecule as a whole has no charge, the parts of it, the hydrogen wings and the oxygen body, so exhibit individual opposite charges. Since opposite electrical charges attract, water molecules tend to attract each other⁹. Water in living systems naturally gathers into structures of 14, 17, 21, 196, 280 or more molecules¹⁰. There is a long history of the promotion of magnets to improve the quality and health benefits of water. Researchers found when a permanent magnet is kept in contact with water for a considerable period of time; the water gets magnetically charged and acquires magnetic properties. Such magnetically treated water has its effect even on the human body when taken internally and regularly for a considerable period of time ¹¹. Physics shows that water change weight under the influence of magnetic fields. More hydroxyl (OH-) ions are created to form alkaline molecules, and reduce acidity. Normal water has a pH level of about 7, whereas magnetized water can reach pH of 9.2 following the exposure to a 7000 gauss (G) strength magnet for a long period of time ¹¹.

According to many researchers that the equilibrium of living cells can be restored-with the help of magnets. A wide variety of magnetic water devices is available¹². These devices consist of one or more permanent magnets affixed either inside or to the exterior surface of the incoming water pipe. The water is exposed to the magnetic field as it flows through the pipe between the magnets to structure water. However, less seems to be known about the effects of magnetic field on the physical and chemical properties of water ¹¹. Magnetic water treatment (also known as anti-scale magnetic

treatment or AMT) is a controversial method of supposedly reducing the effects of hard water by passing it through a magnetic field, as a non-chemical alternative to water softening. Scientific studies into the efficacy the treatment have had mixed results, though several studies have produced significant effects and proposed possible mechanisms for the observed decrease in water scale.^{13,14,15,16} Some commentators regard the treatment as unproven and unscientific¹⁷. Vendors of magnetic water treatment devices frequently use pictures and testimonials to support their claims, but omit quantitative detail and well-controlled studies¹⁷. Advertisements and promotions generally omit such system variables as corrosion coupon results or system mass balance analyticals, as well as measurements of post-treatment water such as concentration of hardness ions or the distribution, structure, and morphology of suspended particles^{18,19,20}. Duration of exposure and field strength, gradient, rate of change, and orientation along or perpendicular to flow are variously cited as important to the results¹⁶. Magnetic water treatment proponent Klaus Kronenberg proposed that the shapes of solute lime molecules are modified by strong magnetic fields, leading them to precipitate as spherical or round crystals rather than deposit as sheets or platelets of hard crystals²¹. John Donaldson, professor of chemistry at Brunel University, proposed that the crucial step is the interruption of agglomeration of particles carrying a surface charge after dissolved contaminants have nucleated as a colloidal suspension. Simon Parsons of the School of Water Sciences at Cranfield University proposed that the magnetic field reduces the surface charge on small particles, increasing the tendency to coagulate as large particles that stay with the flow rather than depositing as scale. Some proponents propose that formation of the polymorph aragonite over the more common calcite is favored in the presence of a magnetic field. However, an internal study in 1996 at Lawrence Livermore National Laboratory found no difference in preferred crystal structure of scale deposited in magnetic water treatment systems²². In 2000 and 2010, Liu et al., Coey and Caps demonstrated that magnetic treatment causes water containing minerals to favor formation of a more soluble form of calcium carbonate (aragonite rather

than calcite), and the resulting removal of calcium carbonate deposits from a steel substrate. Furthermore, in their 2010 publication, Liu et al. (2010) concluded that "The magnetic treatment of scaling waters was proved to be efficient. The efficiency obtained with this very simple magnetic device can be very much improved if the geometry is better devised". Kozic and Lipus (2003) concluded in their 2003 paper that the effects of magnetic treatment on water indeed results in reduced formation of lime scale and that this effect lasts approximately 200 hours²³. The free-radical theory of aging (FRTA) states that organisms age because cells accumulate free radical damage over time. A free radical is any atom or molecule that has a single unpaired electron in an outer shell. While a few free radicals such as melanin are not chemically reactive, most biologically-relevant free radicals are highly reactive. For most biological structures, free radical damage is closely associated with oxidative damage. Antioxidants are reducing agents, and limit oxidative damage to biological structures by passivating free radicals²⁴. In some model organisms, such as yeast and *Drosophila*, there is evidence that reducing oxidative damage can extend lifespan. In mice, interventions that enhance oxidative damage generally shorten lifespan. However, in roundworms (*Caenorhabditis elegans*), blocking the production of the naturally occurring antioxidant superoxide dismutase has recently been shown to increase lifespan. Whether reducing oxidative damage below normal levels is sufficient to extend lifespan remains an open and controversial question²⁵. Lead poisoning is a medical condition caused by increased levels of the heavy metal lead in the body. Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, reproductive system and nervous cells and fibers. It interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behavior disorders. Symptoms include abdominal pain, confusion, headache, anemia, irritability, and in severe cases seizures, coma, and death²⁶.

Elevated lead in the body can be detected by the presence of changes in blood cells visible with a microscope and dense lines in the bones of children seen on X-ray. However, the main tool for diagnosis is the measurement of the blood lead level or a urine test. When blood lead levels are recorded, the results indicate how much lead is circulating within the blood stream, not the amount being stored in the body²⁷. There are two units for reporting blood lead level, either micrograms per deciliter ($\mu\text{g}/\text{dl}$), or micrograms per 100 grams ($\mu\text{g}/100\text{ g}$) of whole blood, which are both numerically equivalent. The Centers for Disease Control has set the standard elevated blood lead level for adults to be 25 ($\mu\text{g}/\text{dl}$) of the whole blood. For children however, the number is set much lower at 5 ($\mu\text{g}/\text{dl}$) of blood as of 2012 down from a previous 10 ($\mu\text{g}/\text{dl}$). Children are especially prone to the health effects of lead and as a result, blood lead levels must be set lower and closely monitored if contamination is possible. The major treatments are removal of the source of lead and chelation therapy²⁸. Chelation therapy is the administration of chelating agents to remove heavy metals from the body. Chelation therapy has a long history of use in clinical toxicology. Poison centers around the world are using this form of metal detoxification. For the most common forms of heavy metal intoxication—those involving lead, arsenic or mercury—the standard of care a number of chelating agents are available. Dimercaptosuccinic acid (DMSA) has been recommended for the treatment of lead poisoning in children by poison centers around the world. Other chelating agents, such as 2,3-dimercapto-1-propanesulfonic acid (DMPS) and alpha lipoic acid (ALA), are used in conventional and alternative medicine²⁹. Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are well-established molecules responsible for the deleterious effects of oxidative stress. Accumulation of free radicals coupled with an increase in oxidative stress has been implicated in the pathogenesis of several disease states. The role of oxidative stress in vascular diseases, diabetes, renal ischemia, atherosclerosis, pulmonary pathological states,

inflammatory diseases, cancer, as well as ageing has been well established. Free radicals and other reactive species are constantly generated *in vivo* and cause oxidative damage to biomolecules, a process held in check by the existence of multiple antioxidant and repair systems as well as the replacement of damaged nucleic acids, proteins and lipids. Measuring the effect of antioxidant therapies and ROS/RNS activity is crucial to suppressing or treating oxidative stress inducers²⁹. The aim of this work was testing the role of magnetically treated water as a helping tool in chelation therapy of lead poisoning to enhance getting out of lead ions from the body, as well as, controlling the free radical side effect resulted from elevated lead levels.

MATERIALS AND METHODS

Thirty New Zealand albino rabbits weighing between 2.5 and 3 kg, aged two months, of both sexes were used for this study. All animals were subjected to distilled water as drinking water for 30 days before starting the experimental design. All through the experiment duration, rabbits were housed in separate cages, fed standard laboratory food and allowed free access to water in room lightening with a 12 hour light-dark cycle in animal house of National Research Center (NRC). Experimental animals design was priority approved from the National Research Center ethical committee. Animals were divided into four groups each contains 15 rabbits: Group I: Negative control group which represents animals received neither lead acetate in water nor any other chemical administration, Group II : Positive control group which represents animals received lead acetate ($\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$ El-Nasr Pharmaceutical Chemicals CO.; 1000 ppm) through drinking water for 30 day. Group III: animals received 1000 ppm lead acetate in water for 30 day and then received DMSA, as a chemical chelator, three times per week for 30 day with using tap water as drinking water. Group IV: 15 rabbits received 1000 ppm lead acetate in drinking water for 30 day and then

DMSA, three times per week orally for another 30 day with replacing the tap drinking water with MTW. Lead acetate was given to animals in drinking water with concentration 1000 ppm. Acidification of water is essential for dissolving lead acetate so 1 ml of conc. hydrochloric acid was added per liter of deionized water. This concentration (1000 ppm lead acetate) is known to induce the desired level of toxicity in blood and other soft tissues. DMSA (50 mg/kg body weight) was orally administered to rabbits three times per week.

Magnetic treated water was prepared by passing water through a magnetic funnel¹² 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. Funnel's magnetic field consists of seven pairs of successive magnets. Each magnet had a circle shape with a diameter and thickness of 7.22 and 4.96 mm, respectively. The strength of the magnet was between 450 to 500 G 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. Determination of blood lead level was carried out according to the method described in the Pye-unicum instruction manual (1980) using a Pye-unicum SP 90 series Atomic absorption spectrophotometer. Ashing technique was done by taking 2 ml blood added to 2 ml of Nitric acid HNO₃ of specific gravity 1.3 plus one milliliter of Hydrogen chloride HCl in a 100 ml beaker to be placed on hot plate till dryness. When the contents become almost dry, the side of the beaker was flushed with few drops of water, then 3 ml of HNO₃, was added and the contents will be digested again to dryness. The deproteinized blood was dissolved, centrifuged

and transferred quantitatively to the original volume of the sample is 2 ml. Then the sample was introduced into the apparatus for reading, the point of intersection between the sample reading and the standard curve indicates the contents of lead in the blood sample expressed in mg/dl. Lead content in tissues was investigated, where dried bone was crushed with acid wash glass/glass motor and pestle. The lead concentration of the various tissues was determined by atomic absorption with a graphite furnace utilizing modified methods of Yeager et al., (1971). The method involved a chelation and extraction technique in which lead was first complexed with fresh 2 % Ammonium Pyrroly Dinedithio Carbamate APDC and then extracted into Methyl isobutyl Ketone MIBK. The MIBK layer was dried down and the sediment was digestive/reconstituted into conc. HNO₃ and injected into the atomic absorption spectrophotometer graphite furnace and will be measured at 283 nm. Measurement of auto-oxidation rate was carried out spectrophotometrically as described by³⁰ and³¹ in air saturated 0.1 M phosphate buffer of pH 7.05 with 2 mg/ml Oxoborinic acid HbO₂. The pH was checked before and after each experiment and spectra of hemoglobin were recorded in order to confirm the absence of hemichrome during auto-oxidation rate measurements. Determination of superoxide dismutase (SOD) activity was carried out by a RANDOX kit package, cat. No. SD 125 according to³². Determination of glutathione peroxidase (GPx) activity was carried out by a RANDOX kit package, cat. No. RS 504 according to³³.

Statistical analysis

The data was expressed as mean + standard deviation. All analyses were made using the SPSS statistical software package. A one-way ANOVA test was applied to data to detect significant differences between different groups. Differences were considered significant at $p < 0.05$.

RESULTS

Table 1

Lead ions concentration in blood, liver and kidney of animals treated with DMSA after exposure to lead poisoning with tap water and MTW as compared to control ^a

	Blood lead Conc. µg/dL	Liver lead conc. (µg/100 g wet wt)	Kidney lead conc. (µg/100 g wet wt)
G _I (n=15)	4.25 ± 0.214	14.58 ± 1.214	7.41 ± 5.478
G _{II} (n=15)	44.72 ± 3.147 ^c	125.47 ± 6.457 ^c	85.58 ± 6.457 ^c
G _{III} (n=15)	15.05 ± 1.154 ^b	42.05 ± 2.478 ^b	33.47 ± 2.547 ^b
G _{IV} (n=15)	8.75 ± 0.588 ^b	31.47 ± 1.478 ^b	11.47 ± 0.874 ^b

a Mean + SD.

b Significant difference compared to G_I.

c Highly significant difference compared to G_I.

Table 1 shows lead ions concentration in blood, liver and kidneys of animals exposed to lead acetate in drinking water and then treated with DMSA by using tap water and magnetic treated water as drinking water. Results showed highly significance elevation of all

body lead content after 21 days of exposure. Both groups treated with DMSA showed chelation effect as compared with control. Animals received magnetic treated water as drinking water showed better chelation potency than those used tap water.

Table 2

Super Oxide Dismutase (SOD) and Glutathione peroxidase (GPx) activity of animals treated with DMSA after exposure to lead poisoning with tap water and MTW as compared to control

	SOD activity U/mL	Glutathione peroxidase U/mL
G _I (n=15)	153.25 ± 11.125	5147.14 ± 398.47
G _{II} (n=15)	215.47 ± 16.47 ^c	8741.28 ± 654.14 ^c
G _{III} (n=15)	122.25 ± 11.174 ^a	6874.58 ± 514.47 ^b
G _{IV} (n=15)	76.47 ± 6.147 ^b	5847.82 ± 458.81 ^a

a Mean + SD.

b Significant difference compared to G_I.

c Highly significant difference compared to G_I.

Table 2 demonstrates antioxidants activity of animals exposed to lead acetate in drinking water for 21 days and then treated with DMSA either with tap water or magnetic treated water. Significant decrease was recorded in animals treated with DMSA with using MTW as drinking water in both antioxidants activity. Both antioxidants activities in animals received DMSA showed significant reduction as compared to control.

In figure 1, peak at 630 nm that is characteristic to Met-Hb hemoglobin derivative was shown. It is very obvious that the lowest peak was recorded in control while the highest one was for animals received lead poisoning with any treatment application. Both groups treated with chelator showed value reduction but the highest reduction was recorded in animals treated with DMSA with using of MTW as drinking water.

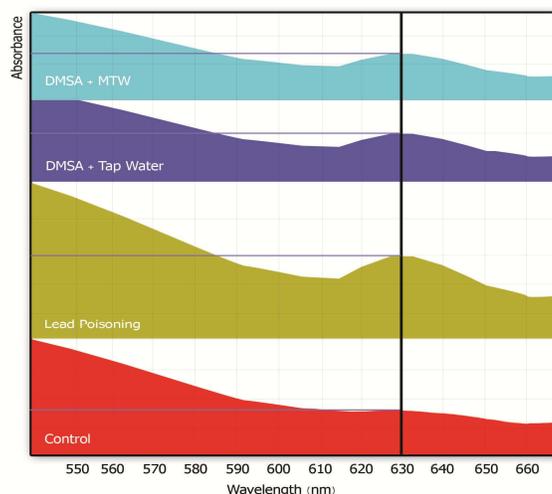


Figure 1

Hemoglobin Auto-oxidation rate of animals treated with DMSA after exposure to lead poisoning with tap water and MTW as compared to control.

DISCUSSION

Lead poisoning is caused by swallowing or breathing in lead. Lead is a metal that can harm children and adults when it gets into their bodies. There are many sources of lead. Lead can be found in dust, air, water, soil, and in some products used in and around our homes. Lead can harm a young child's growth, behavior, and ability to learn. Children under six years old are more likely to get lead poisoning than any other age group³⁴. Most often, children get lead poisoning from breathing in or swallowing dust from old lead paint that gets on floors and windowsills, hands and toys. Lead can also be passed from mother to baby during pregnancy³⁵. Although lead poisoning is preventable, lead continues to be a major cause of poisoning among children. Thousands of children are still at risk. Chelation therapy is the use of specific substances, either synthesized chemicals or natural ones, to remove some toxic metals from a person's body. It is widely used by some holistic doctors and naturopaths. The word, to chelate, means to grab onto something. Thus, chelating agents are substances that have a strong ability to grab onto toxic metals and dislodge them from the

tissues so they can be removed³⁶. Di-Mercapto-Succinic acid (DMSA), is the organo-sulfur compound with the formula $\text{HO}_2\text{CCH}(\text{SH})\text{CH}(\text{SH})\text{CO}_2\text{H}$. This colorless solid contains two carboxylic acid and two thiol groups, the latter being responsible for its mildly unpleasant odor. It occurs in two diastereomers, meso and the chiral *d/l* forms. The meso isomer is used as a chelating agent³⁷.

DMSA was first synthesized by V. Nirenburg in the Urals Polytechnic Institute, commissioned by one of the electrical enterprises of Sverdlovsk, which consumed many tons of mercury and was looking for a medicine to prevent poisoning of personnel. In 1957, it was found by Chinese scientists that DMSA can effectively treat antimony poisoning due to overdose of tartar emetic³⁸. Pronounced protective effect in animal poisoning with arsenic and mercury was first shown by I. Okonishnikova in 1961³⁹. DMSA (CHEMET) is indicated for the treatment of lead poisoning in children with blood level measured above 45 $\mu\text{g}/\text{dL}$. The use of DMSA is not approved for prophylactic/prevention of lead poisoning in anticipation of exposure in known lead

contaminated environments. Its elimination half-life is 2.5-3.5 h. DMSA can cross the blood-brain barrier of mice (Aasath, 1995), but not that of humans, limiting its use to extracting heavy metals from parts of the body other than the central nervous system^{39,40}. Water and life are closely linked. This has been recognized throughout history by civilizations and religions and is still the case with scientists today⁴¹. Liquid water is required for life to continue. No enzymes work in the absence of water molecules. No other liquid can replace water. The development of life required this water. How exactly this was achieved, is a question that has interested many since well before the early experiments producing amino acids from simpler molecules by electric discharge in aqueous systems⁴². More recently, various theories have been propounded but without a consensus except for the key involvement of liquid water⁴³. Water possesses particular properties that cannot be found in other materials and that are required for life-giving processes. These properties are brought about by the hydrogen-bonded environment particular evident in liquid water⁴⁴. The hydrogen bond in liquid water is highly affected by electrical and magnetic fields⁴⁵. It is found that some physical and chemical properties changed when water pass through magnetic field. Therefore, the so called magnetic treated water (MTW) has different chemical and physical properties and action than ordinary water.

Magnetized water was first used in Russia by three specialists: Drs. G. Gerbenshchikow, I. Shetsov and K. Tovstoles, all three specialists in urology at the Kirov Military Medical Academy in Leningrad. They had their patients drink bi-polar magnetized water. This simple treatment was very effective in breaking up kidney and gall bladder stones into small enough particles to be passed through urine without any pain or danger to the patient. The water also prevented further formation of stones in the kidneys and gallbladder. Soviet physicians have been giving internally magnetized water to patients for over 30 years for digestive, urinary and

nervous problems, ailments like mastitis, pains and swellings, painful urination and many other disorders⁴⁶. Because magnetized water is wetter and therefore more penetrating, it furthers better assimilation of the various nutrients and vitamins in the cells. The Soviet biologist Kumarov had experimentally doubled the life span of flies by feeding them magnetized sugar. In his book "Magnets for Your Health" Dr. Louis Donnet, M.D., wrote, "magnetized water can be helpful in weight control, as an adjunct to a correct diet." He states that he has seen over 100 successful cases. Because this water improves metabolic activity, it may be helpful in burning up excessive fatty tissue⁴⁷. Similarly to the way magnetized water dissolves the settled salts on the wall of boilers and radiators, so it has been reported to help unclog the arteries and veins of deposits of cholesterol and salts and normalize the circulatory system. Magnetized water has been found effective in alleviating colds, coughs, bronchitis, all types of fever and more. H. L. Bansal found it helpful in the regularization of women's menses⁴⁸.

Magnetized water has been reported helpful for tiredness in daily activities. Biophysicist Albert R. Davis, a pioneer in magnet therapy research, wrote in his book "The Magnetic Effect" that he and his co-workers found they could overcome the early afternoon letdown by drinking a glass of magnetized water while relaxing for a few minutes⁴⁹. Independent research into magnetized water began in both Eastern and Western European countries. One grass roots researcher was a self-taught scientist by the name of Johann Grander. He claimed his knowledge came from studying nature in his native Austria. "In normal conditions," Grander wrote, "water flows either on the surface of the earth or deep underground, always seeking a natural course". In our water supply system, however, the water is collected and forced through pipelines under pressure. At this stage, the water suffers a serious aggression for the first time. The high pressures are highly detrimental to the liquid. The water is then further contaminated by the addition of

powerful chemicals, such as chlorine. However, we use it; the water eventually finds its way back to nature through the drains. We collect clean water from nature and return it soiled and sick." Grander said: water has a double function. It supplies life-giving energy. It also acts as a waste disposal agent for all living beings⁵⁰. "Water picks up energy from the sun and collects the energies that are stored in the earth. In summer, with strong solar energy, the water pushes itself to the surface. In winter, with weaker solar energy, it burrows deep into the ground, collecting the stored and transformed energies. "It is an eternal circle in which water plays the main role. The water is also a living organism and therefore capable of transforming energies and refuse through its own microorganisms. Live water seeks by itself its sources of energy. Healthy water can be distinguished from sick water even by its murmurs."

Many success reports specify that magnetized water maintains its property of scale deposit prevention up to two days. Kronenberg says some critics make this fact look absurd by calling it "water's ability to remember its magnetizing experience."⁵⁰. Our work can be considered as another prove of the healthy benefits of magnetic treated water. The study design was based on testing to what extend magnetic treated water may enhance a well known biological process in which heavy metal ions may be excluded from the body. Animals were firstly intoxicated with lead acetate in drinking water to reach a convenient level of lead poisoning and then treatment started by using of well known chemical chelator DMSA by using tap water and magnetic treated water. Results demonstrated in table (1) obviously showed that all body compartment lead content were elevated after exposure to lead acetate in the drinking water (G_{II}). After application of DMSA treatment, significant reduction of all these compartments was recorded in both groups (G_{III} and G_{IV}). Attention should be drawn to the lead ions concentration in animals those received chelation therapy with MTW. These animals

recorded the lowest blood, liver and kidney lead ions concentration, (8.75 ± 0.588 , 31.47 ± 1.478 and 11.47 ± 0.874) respectively, when compared with those did not receive any treatment (G_I) or with those received chelation with tap water (G_{II}).

As a try to understand the mode of action of this enhancement recorded in all body compartment lead ions concentrations, antioxidant activity was studied. Reduction of the lead content in animals treated with MTW showed the lowest activity of the antioxidants enzymes, super oxide dismutase and glutathione peroxidase (76 ± 6.147 and 5847.82 ± 458.81), respectively as compared to those received lead acetate in water with no treatment. These dramatically reduced levels directly reflect lower levels of free radicals formation as it is well established that antioxidants activity increased with elevated free radicals formation. Another evidence of reducing the oxidative stress with application of chelation therapy is to study the hemoglobin auto-oxidation rate. This is the rate by which functional hemoglobin may be oxidize to non-function hemoglobin forms that is called Met-hemoglobin. This is the form of hemoglobin derivatives in which iron atom is oxidized and continuous in the ferric state. In this case, hemoglobin will be not able to bind with further oxygen and carbon dioxide that is the main role of hemoglobin. Hemoglobin auto-oxidation spectrum is plotted in figure (1), the characteristic peak of Met-Hb is at the position of 630 nm. It is very clear that the lowest peak value was recorded in control group while the highest one was to animals received lead acetate in drinking water with no treatment administration. Enhancement was recorded in both groups treated with DMSA either with or without MTW but the best was recorded in animals received the chelation therapy with using MTW as drinking water. It may be preliminary concluded that, magnetic treated water usage as drinking water reduced the free radicals formation rate that in role enhance the chelation therapy process when chemical chelator is administered.

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Conflict of Interest:

Conflict of interest declared none.

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