

Lead Ions Chelation Process Optimization After Chelation with Ginkgo Biloba Combined with Usage of Magnetic Treated Water as Drinking Water

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ABSTRACT

Background: 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 the effect of a combination between Ginkgo Biloba and magnetic treated water (MTW) on the lead ions chelation rate.

Materials & Methods: Sixty New Zealand albino rabbits weighing between 2.5 and 3 kg were conducted to the study. Study was approved from the NRC, Ethical Committee. Animals were subdivided into four groups. Control groups I: animals received neither lead acetate nor Ginkgo biloba. Groups II: animals received lead acetate in the drinking water with no treatment. Group III: animals received lead acetate in drinking water and then treated with Ginkgo biloba as a chelator with using tap water as drinking water. Groups IV: animals received lead acetate in drinking water and then treated with Ginkgo biloba as chelator concomitant with usage of magnetic treated water (MTW) as drinking water.

Results: A dramatic reduction in all body compartments lead level after administration of Ginkgo biloba chelation therapy. Animals used 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.

Conclusion: Magnetic treated water usage as drinking water reduced the free radicals formation rate that in role enhance the chelation therapy process when chelator is administered.

Keywords: Magnetic Treated Water, Lead Poisoning, Free Radicals, Ginkgo Biloba.

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INTRODUCTION

Water covers 71% of the Earth's surface, and is vital for all known forms of life On Earth¹, 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 GDP per capita.³ However; some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability.⁴ 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 agriculture.⁶

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 etc.⁸ Water is a very simple molecule, consisting of two hydrogen atoms attached to an oxygen atom. Although the water molecule 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 other.⁹ Water in living systems naturally gathers into structures of 14, 17, 21, 196, 280 or more molecules.^{9,10}

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; 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.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 strength magnet for a long period of time.^{10,11}

According to many researchers that the equilibrium of living cell can be restored- with the help of magnets. A wide variety of magnetic water devices is available.¹² 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.¹³⁻¹⁶ Some commentators regard the treatment as unproven and unscientific.¹⁷

Vendors of magnetic water treatment devices frequently use pictures and testimonials to support their claims, but omit quantitative detail and well-controlled studies.¹⁷ 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.¹⁸⁻²⁰

Duration of exposure and field strength, gradient, rate of change, and orientation along or perpendicular to flow are variously cited as important to the results.¹⁶ 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 systems.²²

Liu et al. and Coey and Cass published research in 2010 and 2000 demonstrating 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. conclude 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 concluded in their 2003 paper that the effects of magnetic treatment on water indeed results in reduced formation of limescale and that this effect lasts approximately 200 hours.²³

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 radicals.²⁴

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 question.²⁵

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, and reproductive

and nervous systems. 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, headache, anemia, irritability, and in severe cases seizures, coma, and death.²⁶

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 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 body.²⁷ 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 therapy.²⁸

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. Ginkgo biloba 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 medicine.²⁹

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.¹⁶ 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 inducers.²¹

The aim of this work was to study to what extent a combination between chelation with Ginkgo biloba and usage of magnetic treated water (MTW) as a drinking water could enhance the chelation therapy process of lead ions.

MATERIALS AND METHODS

Sixty 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 hrs 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 *Ginkgo biloba*, 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 administrated to rabbits three times per week.

Magnetic treated water was prepared by passing water through a magnetic funnel (Magnetic Technologies LLC, No. 18262458) 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 animals cages each 10 hrs 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 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.

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 HNO_3 of specific gravity 1.3 plus one milliliter of 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 HNO_3 , 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 method.²⁹ The method involved a chelation and extraction technique in which lead was first complexed with fresh 2 % APDC and then extracted into MIBK. The MIBK layer was dried down and the sediment was digested/reconstituted into conc. nitric acid and injected into the atomic absorption spectrophotometer graphite furnace and will be measured at 283 nm.

Measurement of auto-oxidation rate was carried out spectrophotometrically³⁰ in air saturated 0.1 M phosphate buffer of pH 7.05 with 2 mg/ml HbO₂. The pH was checked before and

after each experiment and spectra of hemoglobin were recorded 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 125.³¹

Determination of glutathione peroxidase activity was carried out by a RANDOX kit package, cat. No. RS 504.³²

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.

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.	Liver lead conc.	Kidney lead conc.
	µg/dL	(µg/100 g wet wt)	(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 G1.

c Highly significant difference compared to G1.

Table 2: Super Oxide Dismutase (SOD) and Glutathione peroxidase activity of animals treated with DMSA after exposure to lead poisoning with tap water and MTW as compared to control^a

	SOD activity	Glutathione peroxidase
	U/m	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 G1.

c Highly significant difference compared to G1.

RESULTS

Table 1 shows lead ions concentration in blood, liver and kidneys of animals exposed to lead acetate in drinking water and then treated with Ginkgo biloba 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 demonstrates antioxidants activity of animals exposed to lead acetate in drinking water for 21 days and then treated with Ginkgo biloba either with tap water or

magnetic treated water. Significant decrease was recorded in animals treated with Ginkgo biloba with using MTW as drinking water in both antioxidants activity. Both antioxidants activities in animals received Ginkgo biloba showed significant reduction as compared to control. In figure 1, peak at 630 that is characteristic with Met-Hb hemoglobin derivative was shown. It is 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 Ginkgo biloba with using of MTW as drinking water.

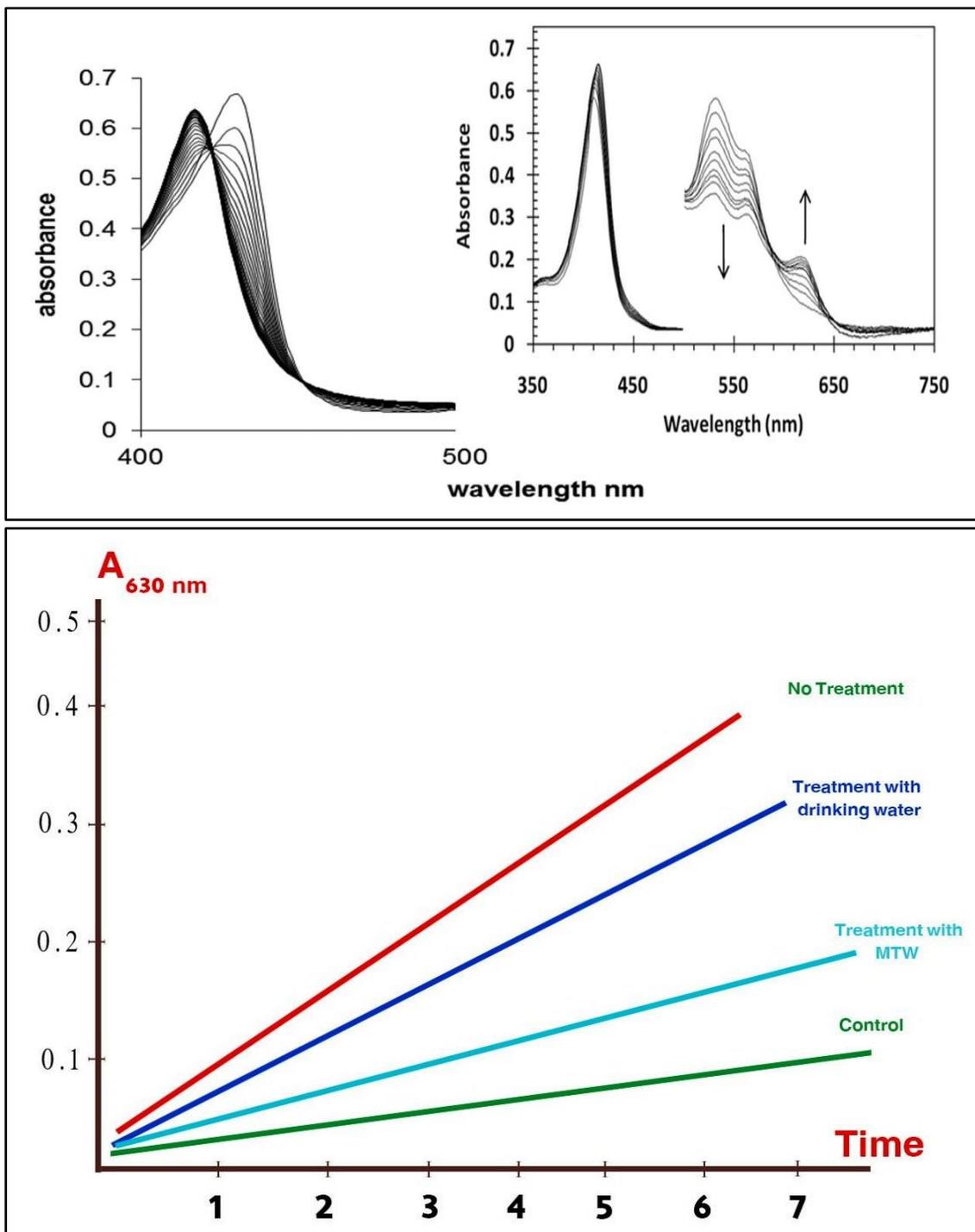


Fig. 1: (A): Characteristic curves of hemoglobin spectrum at absorption band 630 nm that is defined as met0hemoglobin peak. (B): Hemoglobin Auto-oxidation rate of animals treated with Ginkgo biloba after exposure to lead poisoning with tap water and MTW as compared to control.

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 group.³³ 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 pregnancy.³⁴

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 removed.³⁵

Ginkgo biloba, commonly known as ginkgo or gingko (both pronounced /'gɪŋkɔʊ/), also known as the ginkgo tree or the maidenhair tree,³⁶ is the only living species in the division

Ginkgophyta, all others being extinct. It is found in fossils dating back 270 million years. Native to China³⁷, the tree is widely cultivated and was introduced early to human history. It has various uses in traditional medicine and as a source of food.

Ginkgos are large trees, normally reaching a height of 20–35 m (66–115 ft), with some specimens in China being over 50 m (160 ft). The tree has an angular crown and long, somewhat erratic branches, and is usually deep rooted and resistant to wind and snow damage. Young trees are often tall and slender, and sparsely branched.³⁸ The crown becomes broader as the tree ages. During autumn, the leaves turn a bright yellow, then fall, sometimes within a short space of time (one to 15 days). A combination of resistance to disease, insect-resistant wood and the ability to form aerial roots and sprouts makes ginkgos long-lived, with some specimens claimed to be more than 2,500 years old.³⁹

An extract of Ginkgo biloba leaf (GBE) is marketed in dietary supplement form with claims it can enhance cognitive function in people without known cognitive problems. Studies have failed to find such effects on memory or attention in healthy people.⁴⁰

A standardized medicinal extract of Ginkgo biloba leaf originally called EGb 761 has been studied as a possible treatment for dementia and Alzheimer's disease⁴¹ with mixed results. Some reviews have concluded there is no good evidence supporting the use of Ginkgo in dementia⁴² whereas others have concluded that the EGB761 extract may help people with dementia.⁴³

There is a good evidence supporting the use of Ginkgo for treating high blood pressure, menopause-related cognitive decline, tinnitus, post-stroke recovery, peripheral arterial disease, macular degeneration, or altitude sickness.⁴⁴

Water and life are closely linked. This has been recognized throughout history by civilizations and religions and is still the case with scientists today.⁴⁵ 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 systems.⁴¹ More recently, various theories have been propounded but without a consensus except for the key involvement of liquid water.⁴⁶ Water possesses 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 evident in liquid water.⁴⁷

The hydrogen bond in liquid water is highly affected by electrical and magnetic fields.⁴⁸ 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 disorders.⁴⁹ 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."⁵⁰ He states (page 82) that he has seen over 100 successful cases. Because this water improves metabolic activity, it may be helpful in burning up excessive fatty tissue.⁵¹

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. Dr. H. L. Bansal found it helpful in the regularization of women's menses.⁵²

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 minutes.⁵³

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.¹⁶ 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.⁴⁴ 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 beings.⁵⁴

"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 energy⁵⁵, it burrows deep into the ground, collecting the stored and transformed energies.⁵⁶

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."⁵⁷

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 Ginkgo biloba 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 (GII). After application of Ginkgo biloba treatment, significant reduction of all these compartments was recorded in both groups (GIII and GIV). 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 (GI) or with those received chelation with tap water (GII).

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, SOD and glutathione peroxidase (76 ± 6.147 and 5847.82 ± 458.81), respectively as compared to those received lead acetate in water with no treatment. This dramatically reduced level directly reflects 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 the rate by which functional hemoglobin may oxidized 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 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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