BIOIMPEDANCE ANALYSIS TO DETERMINE THE EXTRACELLULAR/INTRACELLULAR WATER EXCHANGE OF MRET ACTIVATED WATER COMPARED TO CONTROL WATER

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Abstract

A double blind study was conducted using bio-impedance analysis (BIA) Evaluation to determine if there was any change to intracellular water (ICW) status caused by the ingestion of 0.5 litres of water when compared to the ingestion of 0.5 litres of the same source water that had been activated by the MRET polymer magnetic field configuration for thirty minutes. Cellular hydration is indicated by intracellular water content and is a vital factor for optimizing physiological function.[1] Decreased hydration occurs in aging and disease and diseased elderly persons display reduced ICW and expanded ECW.[2,3,4] The reduced ICW ratio has also been found to correlate to cell death, apoptosis and systemic tissue damage in a dehydrated aging population.[5] Recent evidence suggests that the cellular hydration state is an important determinant of cell function and effect hormones, oxidative stress, nutrition and metabolism.[6,7]

ICW can be accurately measured by a simple non-invasive form of testing called bio-impedance analysis. Devices using single and multi-frequency bio-impedance analysis (BIA) to evaluate body water compartments, body composition, and nutritional status have been developed.[8,9,10,11,12,13]

A Russian-American scientist has developed a patented system, Molecular Resonance Effect Technology (MRET), for the alteration of the molecular organization state of water and other liquid substances using a controlled magnetic field.[14,15] This finding is not uncommon since weak magnetic fields have demonstrated the ability to change the properties of water.[16] These structural alterations to the water molecule caused by the MRET activation, can be demonstrated to ameliorate physiological and biochemical processes and positively influence cellular bio-structures.[17] The process of activation alters the configuration of the water molecules into a linear

[1] Häussinger D. The role of cellular hydration in the regulation of cell function. *Biochem J.* 1996; 313:p.607-710. [2] Ritz P. Chronic Cellular Dehydration in the Aged Patient. *J Gerontol A Biol Sci Med Sci.* 2001; 56(6):p.M349-M352. [3] McManus M L, Churchwell K B, Strange K. Regulation of Cell Volume in Health and Disease. *N Engl J Med.* 1995;333(19):p.1260-1266. [4] McManus M L, Churchwell K B. Clinical significance of cellular osmoregulation. In: *Cellular and Molecular Physiology of Cell Volume Regulation*, Strange K editor. Boca Raton, FL: CRC. 1993;p.63-67. [5] Yong H J, Chung H N, Jong W C. Associations between body hydration status and serum markers for apoptosis in elderly persons. *Annals of Clinical & Laboratory Science.* 2008;p 38:88-91. [6] Häussinger D. The role of cellular hydration in the regulation of cell function. *Biochem J.* 1996; 313:p.607-710. [7] Häussinger D, Lang F Gerok W. Regulation of cell function by the cellular hydration state. *Am J Physiol.* 1994;Sep:267(3 Pt 1):pE343-355. [8] Chiu J S, Chong C F, Lin Y F, Wu C C, Wang Y F, Li Y C. Applying an artificial neural network to predict total body water in hemodialysis patients. *Am J Nephrol.* 2005; Sept-Oct:25(5):p507-513. [9] Donadio C, Consani C, Ardini M, Bernabini G, Caprio F, Grassi G, Lucchesi A, Nerucci B. Estimate of body water compartments and of body composition in maintenance hemodialysis patients: comparison of single and multifrequency bioimpedance analysis. *J Ren Nutr.* 2005; Jul:15(3):p.332-344. [10] Mohamed E I, Maiolo C, Linder R, Pöppl S J, De Lorenzo A. Predicting the intracellular water compartment using artificial neural network analysis. *Acta Diabetol.* 2003; Oct: 40: Suppl 1: S15-18. [11] Donadio C, Halim A B, Caprio F, Grassi G, Khedr B, Mazzantini M. Single- and multi-frequency bioelectrical impedance analyses to analyse body composition in maintenance haemodialysis patients: comparison with dual-energy x-ray absorptiometry. *Physiol Meas.* 2008; Jun:29(6):S517-524. [12] Powers J S, Choi L, Bitting R, Gupta N, Buchowski M. Rapid Measurement of Total Body Water to Facilitate Clinical Decision Making in Hospitalized Elderly Patients. *J Gerontol A Biol Sci Med Sci.* 2009; Jun;64(6):p.664-669. [13] Sun S S, Chumlea W C, Heymsfield S B, Lukaski H C, Schoeller D, Friedl K, Kuczmarski R J, Flegal K M, Johnson C L, Hubbard V S. Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys. *Am J Clin Nutr.* 2003; 77:p.331–340. [14] Fisher H W, Smirnov I V. Molecular Resonance Effect Technology: *The Dynamic Effects on Human Physiology.* Brittannia Press. Toronto. 2008;p.8. [15] Smirnov IV. The Anomalous Electrodynamic Characteristics and Polarized-Oriented Multilayer Molecular Structure of MRET-Activated Water. *Intl J Nanoscience.* 2008; Vol.7, (4 and 5): p.1-5. [16] Semikhina L P, Kiselev V F. Effect of weak magnetic fields on the properties of water and ice. *Russian Physics Journal.* 1988;(31)5:p.351-354. [17] Vysotskii V I, Smirnov I V, Komilova A A. *Introduction to the Biophysics of Activated Water.* Universal Publishers. Boca Raton, FLA. 2005.

stratified pattern and strengthens the hydrogen-bonding patterns. As a result, the molecular organizational state of the water is changed.[18,19]

Two samples of water, marked Sample A and Sample B were tested. The actual content of the sample bottles were unknown to both the Lab Technician and the subject. Subjects were allowed to select either sample. Each subject ingested 0.5 litres of the water sample for each phase of the experiment. The Maltron BioScan 920-II Bio Impedance Device was used in real time mode to measure the speed of change between ECW and ICW. The Biomarkers for ICW were taken at the onset and evaluated every twenty (20) minutes. Sample A showed no change in the ICW after forty (40) minutes. Sample B (MRET activated water) showed a 3.1% increase in ICW after twenty (20) minutes and a 4.2% increase in ICW after forty (40) minutes based on the biomarker changes.

The MRET activated water demonstrated a significantly increased ability to enhance intracellular water (ICW) volume and hydrate cells when compared to non-activated water which showed a negligible ability to hydrate cells over a forty minute period.

Key Words: Bio-Impedance Analysis, Hydration, Intracellular water (ICW), Extracellular water (ECW), Molecular Resonance Effect Technology (MRET), Total body water, hydration

Introduction

Decreased hydration occurs in aging and disease and diseased elderly persons display reduced intracellular water (ICW) and increased extracellular water (ECW).[20] "In males a modest to large decrease in intracellular water was noted in elderly subjects, whereas extracellular water was either slightly smaller, or slightly larger. In females, intracellular water was found to be considerably smaller in elderly subjects whereas extracellular water did not differ. The results of these studies indicate that the changes in total body water with age are mostly due to changes in the volume of intracellular water."[21]

According to a number of sources, the total water content in the average male varies between fifty-seven and sixty percent (57-60%) of body weight, ranging from approximately seventy-five percent (75%) in a neonate)[22,23,24] and decreasing progressively through aging and disorders such as obesity.[25,26] Aging has been defined as the progressive decrease of intracellular water leading to the progressive decrease of cellular, tissue and organ functions. The maintenance of a constant volume (hydration status) in the face of ECW and ICW is a critical problem faced by all cells.[27,28] Although mechanisms are in place to buffer dramatic cellular hydration changes, the volume deviation acts to initiate modifications of cellular function.[29] Total body water (TBW), a basic component of body composition, is influenced by many physiological and patho-physiological states and is the combination of both ECW and ICW in the ratio of 20% to 40% of total body weight respectively.[30] Knowledge of a patient's TBW may be extremely important to proper disease diagnosis and therapeutic regimens.[31,32]

Most cells respond to dehydration by activating specific metabolic or membrane-transport processes to optimize the water ratio, processes that are essential for the normal function and survival of cells. Normal and disrupted cellular hydration underlies many disease states and their complications. ECW is consistently higher in aged patients than in healthy elderly participants. There are pathophysiological consequences that occur when cellular hydration levels cause aberrant changes to cellular function.[33,34]

Devices using single and multi-frequency bioimpedance analysis (BIA) to accurately predict body water compartments, body composition, and nutritional status have been developed.[35,36,37,38,39] The comparison between BIA and dual energy x-ray absorptiometry, the accepted

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standard in evaluating body composition, demonstrated no significant difference.[40]

Investigative evidence suggests that the cellular hydration state is an important determinant of cell function and effects hormones, oxidative stress, nutrition and metabolism.[41,42,43] Furthermore, protein and amino acid synthesis, fatty acid metabolism, and carbohydrate metabolism are all affected by cellular hydration levels.[44,45,46,47,48] Cell shrinkage (dehydration) generally inhibits overall protein synthesis however cell swelling (hydration) stimulates overall protein synthesis.[49] Decreased cellular hydration was found to increase viral protein synthesis by four to five times, while increased cellular hydration demonstrated a fifty percent (50%) reduction in viral protein synthesis.[50,51,52] Aberrant cell volume regulation significantly contributes to the physiological pathologies of several disorders such as liver insufficiency, diabetic ketoacidosis, hypercatabolism, fibrosing disease, sickle cell anemia, and infections and is evident in cases of heart failure, liver cirrhosis and chronic renal failure.[53]

A Russian-American scientist has developed a patented system, Molecular Resonance Effect Technology (MRET), for the alteration of the molecular organization state of water and other liquid substances using a controlled magnetic field.[54] This finding is not uncommon because weak magnetic fields have the ability to change the properties of water.[55] These structural alterations to the configuration of water molecules caused by the MRET activation, can be demonstrated to ameliorate physiological and biochemical processes and positively influence cellular bio-structures.[56,57]

The water-activating device used in Molecular Resonance Effect Technology (MRET) is made of a polar polymer compound mixed with certain amounts of pharmacologically active organic and inorganic substances. During the activation process, the MRET polymer compound is placed within an externally generated distinct electromagnetic field with a designed pro-biotic frequency. The activation of water occurs when the MRET polymerized epoxy is exposed to a homogenous magnetic field and oscillating optical light with a wavelength of 600-700 nanometres and a frequency of 7.8 Hertz.[58] The activating device itself consists of an arrangement of magnets that stimulate the MRET polymer into producing the required electromagnetic field. The process of activation alters the configuration of the water molecules and strengthens the hydrogen-bonding patterns. As a result, the water molecular organization state is changed and the physiological properties of the water are changed as well.[59]

One of these property changes relates to enhanced hydrating ability.[60] The process of activation alters the configuration of the water molecules into a linear stratified pattern and strengthens the hydrogen-bonding patterns. Agre (2006) has determined that there is another method for cellular hydration aside from diffusion: aquaporins.[61] Aquaporins are hydration channels through the cellular membrane designed for the rapid transport of water molecules in a single manner, while diffusion is a much slower process dependent primarily upon osmotic gradients.[62] In combination with the linear configuration alteration of the MRET activation of water, aquaporins should theoretically allow for a decreased transition time between ECW and ICW when water is ingested, increasing cellular hydration.[63,64]

Method

Subjects were placed in a supine position and two electrodes were placed on the hand and two electrodes on the foot. The Maltron BioScan 920 Multi-frequency Analyzer is a rapid, non-invasive, method for evaluating hydration and nutrition status. The advance circuitry and processing power of this bio-impedance device allows it to measure Extracellular (ECW) and Intracellular Water (ICW) volume without the need of complex clinical techniques like radioisotope dilution. The Maltron BioScan 920-II was used in real time mode to measure the change, if any, between ECW and ICW. All data is recorded and displayed immediately for analysis by the system.

Two samples of water, marked Sample A and Sample B were tested. Actual content of the sample bottles were

[40] Ibid. [41] Häussinger D. The role of cellular hydration in the regulation of cell function. *Biochem J.* 1996; 313:p.607-710. [42] Häussinger D, Lang F Gerok W. Regulation of cell function by the cellular hydration state. *Am J Physiol.* 1994;Sep:267(3 Pt 1):pE343-355. [43] Häussinger D. The role of cellular hydration in the regulation of cell function. *Biochem J.* 1996; 313:p.607-710. [44] Häussinger D, Lang F Gerok W. Regulation of cell function by the cellular hydration state. *Am J Physiol.* 1994;Sep:267(3 Pt 1):pE343-355. [45] Grant A, Tosh D, Burchell A. Liver perfusion with hyper-osmotic media stimulates microsomal glucose-6-phosphatase activity. *Biochem. Soc. Trans.* 1993;21:p39S. [46] Peak M, Al-Habori M, Agius L. Regulation of glycogen synthesis and glycolysis by insulin, pH and cell volume. Interactions between swelling and alkalinization in mediating the effects of insulin. *Biochem J.* 1992; 282:p.797-805. [47] Al-Habori M., Peak M, Thomas T H, Agius L. The role of cell swelling in the stimulation of glycogen synthesis by insulin. *Biochem J.* 1992; 282:p.789-796. [48] Waldegger S, Busch G L, Kaba N K, Zempel G, Ling H, Heidland A, Häussinger D, Lang F. Effect of cellular hydration on protein metabolism. *Miner Electrolyte Metab.* 1997;23:p.302-205. [49] Stoll B, Gerok W, Lang F, Häussinger D. Liver cell volume and protein synthesis. *Biochem J.* 1992; October 1; 287(Pt 1): p.217–222. [50] Offensperger W B, Offensperger S, Stoll B, Gerok W, Häussinger D. Effects of anisotonic exposure on duck hepatitis B virus replication. *Hepatology.* 1994; 20:p1-7. [51] Agol V I, Lipskaya G Y, Tolskaya E A, Voroshilova M K, Romanova L I. Defect in poliovirus maturation under hypotonic conditions. *Virology.* 1970;41:p.533-540. [52] Waite M R F, Pfefferkorn E R. Effect of altered osmotic pressure on the growth of Sindbis virus. *J. Virol.* 1968;2:p.759-760. [53] Lang F. Mechanisms and Significance of Cell Volume Regulation. *J Am Coll Nutr.* 2007; 26:p.613S-623S. [54] Fisher H W, Smirnov I V. Molecular Resonance Effect Technology: *The Dynamic Effects on Human Physiology.* Brittannia Press. Toronto. 2008:p.8. [55] Semikhina L P, Kiselev V F. Effect of weak magnetic fields on the properties of water and ice. *Russian Physics Journal.* 1988;(31)5:p.351-354. [56] Vysotskii V I, Smirnov I V, Komilova A A. *Introduction to the Biophysics of Activated Water.* Universal Publishers. Boca Raton, FLA. 2005. [57] Fisher H W, Smirnov I V. *Molecular Resonance Effect Technology: The Dynamic Effects on Human Physiology.* Brittannia Press. Toronto. 2008 [58] Vysotskii V I, Smirnov I V, Komilova A A. *Introduction to the Biophysics of Activated Water.* Universal Publishers. Boca Raton, FLA. 2005;p.134. [59] Vysotskii V I, Smirnov I V, Komilova A A. *Introduction to the Biophysics of Activated Water.* Universal Publishers. Boca Raton, FLA. 2005. [60] Smirnov I V. Activated Water. *Explore Magazine.* 2002;11:2. [61] Agre P. (Johns Hopkins University School of Medicine), The Aquaporin Water Channels. *The Proceedings of the American Thoracic Society* 3:5-13. 2006. [62] Ibid [63] Nielsen S, King L S, Christensen B M, Agre P. Aquaporins in complex tissues II Subcellular distribution in respiratory and glandular tissues of rat. *Am J Physiol Cell Physiol.* 1997;273:C1549-1561. [64] Agre P. (Johns Hopkins University School of Medicine), The Aquaporin Water Channels. *The Proceedings of the American Thoracic Society* 3:5-13. 2006.

unknown to both the Lab Technician and the subject. Each subject was used in both tests to eliminate subject variation. The subject was not allowed meals six hours before the testing.

In the first trial the subjects ingested 0.5 litres of Sample A water. Immediately after ingestion BioMarkers readings for Intracellular water (ICW) were taken using the Maltron BioScan 920 device. Biomarker values were recorded immediately after ingestion and at three minutes, ten minutes, twenty minutes and forty minutes.

In the second trial subjects ingested 0.5 litres of Sample B water. Immediately after ingestion BioMarkers readings for Intracellular water (ICW) were taken using the Maltron BioScan 920 device. Biomarker values were recorded immediately after ingestion and at three minutes, ten minutes, twenty minutes and forty minutes.

Results

Time	Biomarker Sample A Average Values	Biomarker Sample B Average Values
Base-line	9.4	9.5
3 minutes	9.5	9.5
10 minutes	9.5	9.6
20 minutes	9.5	9.8
40 minutes	9.5	9.9

- Sample A Total change from base line (initial) = +0.1 Biomarker
- Immediate change after water consumed over 40 minutes = 0% (0.1) Biomarker
- Sample B Total change from base line (initial) = +0.4 Biomarker
- Immediate change after water consumed over 40 minutes = 4.2% (0.4) Biomarker

Discussion

There are several issues that merit discussion in this investigation since the experimental design intended to examine the effect of MRET activated water on cellular hydration when compared to the cellular hydration of water that had not undergone these molecular structural changes. Another issue to consider is the derived benefits of increasing cellular hydration levels when related to physiological function, disease, and aging.

The BioScan 920-II bio-impedance analysis device measures the time delay between the transmitted and received signals by electrodes placed on then hands and feet. Both Extracellular water (ECW) and Intracellular water (ICW) contain different ions which conduct electricity with measurable time delay in the measured voltage when a current is applied. Current passing through ICW has delay and current passing through ECW has no delay. The ratio of delayed vs. no delayed signal is therefore an indication of the ratio of ICW compared to ECW. ECW and ICW exist in the ratio of 20% to 40% of total body weight respectively, and therefore the average 75 kg. male is composed of 45 litres of total body water (TBW) with approximately thirty litres being ICW.[65,66]

Water, when first ingested, is absorbed as ECW and the subsequent effect is an increase in the direct or non-delayed signal reducing the indicated biomarker value. An increase in Biomarker is a clear indication of increase in ICW, thus Sample B results clearly showed the change and increase in ICW. From the results, the indication of a transition or lack of transition of the ingested water from ECW to ICW demonstrated a clear difference between the two water samples. When the untreated water was ingested (SAMPLE A), there was little or no movement into the ICW compartments and therefore caused no change to the time delay and no change to the Biomarker. When the MRET activated water was ingested, the water moved rapidly into the ICW compartments, causing a greater time delay which increased the biomarker value. In the test for water Sample A, it was determined that the change in the biomarker was unremarkable at an average value of 0.1. In the test for water Sample B (MRET activated water) the biomarker measurement increased markedly with an average value of 0.4 indicating a 4.2% increase in intracellular water. This finding is consistent with a previous preliminary non-blinded study of twenty patients in which the average intracellular water shift was a 6.4% increase in ICW in sixty minutes post ingestion of MRET activated water.

The biomarker change is not a fixed value in all subjects. The physiological parameters of the individual (height, weight gender and age), in conjunction with the biomarker index which is part of the algorithm built into the processor of the BioScan device, will dictate the increased or decreased percentage of ICW or ECW. The range of biomarker values and the relationship of the BioScan algorithm to hydration is categorized as below 3.7 very low hydration, 3.7 to 4.7 below average hydration, 4.7 to 6.5 average hydration, 6.5 to 7.5 above average hydration and 7.5 to 12.0 indicates a high level of hydration.

There were two significant results determined by this experiment. The first is that the results demonstrated a meaningful difference between the two water samples in terms of the water's ability to hydrate the cells. The control water (not activated and therefore no change to the linear molecular configuration) did not change the intracellular water (ICW) content or cellular hydration levels. The activated water caused a marked 4.2% increase in ICW, increasing the hydration level of the cells. Another aspect of this finding is that the subjects were well

[65] Bedogni G, Borghi A, Battistini N. Body water distribution and disease. *Acta Diabetologica.* 2003;40(S1):s200-s202. [66] Guyton, A C. *Textbook of Medical Physiology* (8th ed.). Philadelphia: W.B. Saunders. 1991;p. 274.

hydrated initially and hydration values moved toward a more ideal value.

The second significant finding is that the amount of increase in ICW is much greater than the volume of water consumed. The test was considered to be extremely revealing considering the amount of water that was consumed (0.5 litres) was only 1.1% of Total Body Water (TBW), and yet it caused a 4.2% increase of ICW, in this case causing an increase of 1.2 litres in ICW volume or the movement of 3.75% of TBW. Similar findings have occurred in other testing and those findings are consistent with these results. The ability of the MRET activated water to move directly into the cells and cause a subsequent increase in ICW and hydrate the cell while decreasing ECW has beneficial implications: a super-hydrating effect and an anti-inflammatory effect since extraneous ECW has been reduced. These hydration benefits merit further investigation.

Professor Neeser, who has conducted comprehensive research into BIA assessments, states, "Water is the underlying element in all body fluids, serving as the primary medium of transport for the body's complex biochemical exchanges. Ideally, healthy women should have approximately 55 to 60 percent total body water content, while healthy men have 60 to 65 percent total body water content (athletes sometimes up to 70%). The ideal ratio ICW to ECW is approximately 3 to 2 for both sexes. Obese people with excessive storage of fat (body fat > 30%) have a reduced body water content of approximately 40 to 50 percent or less, and ICW levels are in most cases lower than ECW levels. There is a strong correlation between ICW and fat metabolism activity as my many studies of obese people have shown...ICW is for me the most significant biomarker of aging."

Conclusion

The MRET activated water has demonstrated the ability to transition from ECW to ICW quickly and efficiently when compared to non-activated water. Hydration has health benefits by influencing cell function and the synthesis and homeostasis of many necessary physiological functions and countermands the effects of dehydration. [67,68,69,70,71,72,73]

[67] Häussinger D. The role of cellular hydration in the regulation of cell function. *Biochem J.* 1996; 313:p.607-710. [68] McManus M L, Churchwell K B. Clinical significance of cellular osmoregulation. In: *Cellular and Molecular Physiology of Cell Volume Regulation*, Strange K editor. Boca Raton, FL: CRC, 1994; p.63–77. [69] Häussinger D, Lang F Gerok W. Regulation of cell function by the cellular hydration state. *Am J Physiol.* 1994;Sep:267(3 Pt 1):pE343-355. [70] Grant A, Tosh D, Burchell A. Liver perfusion with hyper-osmotic media stimulates microsomal glucose-6-phosphatase activity. *Biochem. Soc. Trans.* 1993;21:p39S. [71] Peak M, Al-Habori M, Agius L. Regulation of glycogen synthesis and glycolysis by insulin, pH and cell volume. Interactions between swelling and alkalinization in mediating the effects of insulin. *Biochem J.* 1992; 282:p.797-805. [72] Al-Habori M., Peak M, Thomas T H, Agius L. The role of cell swelling in the stimulation of glycogen synthesis by insulin. *Biochem J.* 1992; 282:p.789-796. [73] Stoll B, Gerok W, Lang F, Häussinger D. Liver cell volume and protein synthesis. *Biochem J.* 1992; October 1; 287(Pt 1): p.217–222.

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Being widely recognized for his ability to easily assimilate what many view as daunting scientific and clinical information, Dr. Fisher transforms essential knowledge that would otherwise remain inaccessible to the public into readily available life-altering information. He has written scores of articles for trade publications and is a featured guest on many radio and television broadcasts. In addition to authoring thirteen health oriented books, his research has also been published in peer-reviewed journals. His books and lectures have been translated into seven languages and are sold in North America, Europe and Asia.