

Benefits of Long-Term Ingestion of Oxygen-Enriched Water

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I. INTRODUCTION

Homeostasis is the balanced internal environment of the body; the automatic tendency of an organism to maintain a steady state. Homeostasis describes the body's constant effort toward dynamic equilibrium.¹

The sheer complexity of human biochemistry is matched, paradoxically, by the simple but basic requirements for life: food, water and oxygen. We know that the adult human may go 60 days without food, but is seriously affected after just three days without water and is no longer functionally viable within minutes of oxygen deprivation.

The Big Pitcher, protected by US patent number 6,712,341, provides an energy-efficient, steady supply of water saturated with dissolved oxygen at 11-15 milligrams per liter (11-15 parts per million, or ppm), the maximum natural saturation. The Big Pitcher utilizes simple diffusion technology.

In The Big Pitcher, purification also occurs as fine bubbles remove particulates (organic and inorganic), physically "scrubbing" them out of solution, as well as oxidizing to some extent. In addition, the technical term for removing gases, both volatiles and semi-volatiles, is known as air sparging, and finally, an aerobic, or oxygenated, environment discourages and neutralizes the growth of pathogens in water, which are generally anaerobic. Bacteria, viruses and other pathogenic organisms will not flourish in an oxygenated environment.

Chronic Oxygen Debt Syndrome

There is enormous probability of impaired oxygen transfer and cellular oxygen uptake in the majority of today's adult population, hence the interest in oxygen therapies, and specifically in oxygen-enriched drinking water. Data presented in this abbreviated document generally point toward the wisdom of drinking oxygen-enriched water, but there is vital information which, when accompanied by the larger body of work, strongly supports the hypothesis.

Long-term ingestion of oxygen-enriched water should apply to the majority of the population, most of whom suffer from Chronic Oxygen Debt Syndrome.

II. OVERVIEW OF EXISTING STUDIES

- A. An unpublished study conducted by John J. Duncan, PhD, in 1997, concluded that of the 25 non-professional athletes who took part in a double-blind study to determine effects of drinking oxygenated water on performance, 83% of the half who drank bottled oxygenated water for two weeks achieved a personal best time in a 10K run. The age group of subjects was from 18-55, male and female. Dr. Duncan concedes that prior to conducting the study, he did not anticipate the "statistically significant" results. Dr. Duncan has served as Director of Research at the Cooper Institute in Dallas, Texas and has agreed to replicate the test above, and to conduct further testing. Dr. Duncan states "... the textbooks and

current understanding of physiology do not have an algorithm worked out to explain how enhanced oxygen in water would be absorbed and transported to organs which would presumably utilize the additional oxygen.”

The American Council on Exercise (ACE) and many others quote the following study as “proof” that drinking oxygenated water has no affect on the physiology of performance. The testing protocol, however, is flawed. We know that drinking only 16 ounces of oxygenated water prior to a series of exercises and physiological measurements is an inadequate intake of water and thus the study was destined to show no discernable effect on heart rate, blood pressure, or on most measurable criteria. In addition, the group is too small for this type of study.

- B. Led by John Porcari, Ph.D. at the University of Wisconsin, the study included 12 college-aged men and women who were randomly assigned to drink either 16 ounces of super oxygenated water or regular tap water. All participants performed a multi-stage treadmill test. At the end of each stage heart rate, blood pressure, ratings of perceived exertion and oxygen consumption were recorded. Researchers found that drinking super oxygenated water had no measurable effect on the subjects’ resting heart rate, blood pressure or blood lactate values. The results were not surprising to researchers. “There are only two possible ways to carry oxygen in the blood, either bound to hemoglobin or dissolved in the plasma,” said Porcari. “In normal healthy exercisers, hemoglobin is already 97 to 98 percent saturated with oxygen. Obviously, there is very little room to improve on this factor.”

This next section summarizes all other negative comments on the benefits of drinking oxygenated water. It is true that dissolving oxygen into water is physically difficult, both externally and internally, but 11- 15 mg/l is significant, considering plasma carries (or should carry) only 0.03 ml dissolved oxygen per 100 ml.

Dr. Knuttgen, below, describing bottled oxygenated water, is also correct in saying that much of the “super-saturated oxygen” will equilibrate with ambient pressure upon opening the container. The fact that he agrees, “any additional oxygen would be absorbed into the cells of intestinal walls” is actually the good news. LeChatelier’s principle states, “A system at equilibrium, or changing toward equilibrium, responds in the way that tends to relieve or “undo” any stress placed upon it.”² In addition, part of LeChatelier’s principle is the Law of Mass Action, which states “when little intrinsic free energy difference exists between the reactants and the products, the overall direction of the reaction is determined mainly by their relative initial concentrations”.³

- C. “This is a case of pure fraud without a physiologic foundation, says Howard G. Knuttgen, Ph.D., newsletter editor-in-chief and professor emeritus of kinesiology at Penn State. “Very little oxygen can be forced

into water under pressure--less than that contained in a single breath. Most of the oxygen in the water would escape into the atmosphere when you open the container. Additional oxygen would be absorbed into the cells of intestinal walls. All of this would happen before any oxygen would reach the blood, much less the muscles.

The exchange of gases that allows the body to take in and utilize oxygen is a function of the respiratory, not the digestive system. Thus, any intake of so-called super-oxygenated water would be of no use in improving athletic prowess, he says.”

D. A Highly O₂-Supersaturated Infusate for Regional Correction of Hypoxemia and Production of Hyperoxemia

From the Cardiovascular Research Laboratory, Department of Medicine, Division of Cardiology, Harper Hospital/Wayne State University School of Medicine, Detroit, and the Department of Mechanical Engineering, Michigan State University, Lansing (G.J.B.), Mich.

Overview: The results of the present work support the hypothesis that an Aqueous Oxygen infusion can be used either to correct hypoxemia or to produce hyperoxemia on a regional basis. In the rabbit study, the mean arterial and venous oxygen tensions that were achieved during AO infusion on room air breathing are similar to those noted with oxygen breathing without the infusion. The mean arterial and venous oxygen tensions achieved during AO infusion on oxygen breathing approach values anticipated under hyperbaric conditions. (*Circulation*. 1997;96:4385-4391.© 1997 American Heart Association, Inc.

E. Peer-Reviewed Study Supports The Transport of Oxygen Via Oxygen-Enriched Water from the Stomach Into the Portal Vein. April, 25, 2002

Esam Z. Dajani, Ph.D., FACC, today commented on a study published by the European Journal of Medical Research, November, 1998, which examined the pharmacology of SuperOxygenated water. This peer-reviewed study was performed by Drs. Forth and Adam of the Walther-Straub Institute for Pharmacology and Toxicology, Munich, Germany. The study examined the intragastric absorption of oxygen following the consumption of oxygen-enriched water in anesthetized rabbits. The study clearly supports the systemic transport of oxygen, derived from oxygenated water, from the stomach into the portal vein.

III. OXYGEN AND CHEMICAL OXYGEN DEMAND

Oxygen ... is catabolic, meaning, it tears down, but more important, oxygen cleanses. Oxygen destroys the side products, or metabolites, of anabolism, the building-up process of the body.⁴

Chemical Oxygen Demand (COD) as defined by the U.S. Environmental Protection Agency is: A measure of the oxygen required to oxidize all compounds, both organic and inorganic, in water. Everything we eat, breathe, drink, smoke or generate internally, such as enzymes and hormones, has a relative COD value. It is no surprise that the National Academy of Sciences, in a 2000 study, continues to recommend fruits and vegetables, two food groups demanding little oxygen for digestion.

A general rule of thumb is that the longer period required for complete biodegradation, the greater the COD value. For instance, a thick, juicy steak will biodegrade (or be metabolized) much more slowly than an equal weight or volume of spinach. Cow's milk is more difficult for human digestion than apple juice. Prescription medications often have numerous and complex molecular bonds, requiring high levels of oxygen to break down, metabolize and absorb.

A compound that all of us are familiar with is nicotine. It is the essential ingredient of tobacco and is what makes tobacco tobacco and not just another weed... In pure form nicotine is a violent poison. One drop on a rabbit's skin throws the rabbit into instant shock.⁵ The COD of nicotine is therefore extremely great – the oxygen required to react with and metabolize nicotine appears to have caused severe disruption of the rabbit's oxygen cycle and circulatory system. The COD of nicotine in humans may contribute to the onset of abnormal cell division – a specific response of healthy cells to a non-dynamic equilibrium. The body's attempt to thwart chronic oxygen debt at the cellular level is to generate new cells to accommodate the burden of metabolizing the ongoing nicotine exposure.

In the 1800s, Dr. Percival Pott, 1714-1788, stated his conviction that scrotal cancer among chimney sweeps was the result of a highly specific response to soot.⁶ Young boys, typically orphaned and malnourished, were hired to enter chimneys unclothed and chronically unwashed. The constant exposure to tars from wood fires caused an epidemic with what the boys called "soot-wart", almost always fatal. What appears to have occurred at the tar-scrotal tissue interface was failure of cellular respiration to detoxify the very high COD components of the tars of burned lignin, itself "the most refractory biological polymer known: even bacteria cannot easily break it down for energy".⁷

Another tragic example in human physiology responding to extreme reactivity (high COD value) is what befell young women who painted glow-in-the-dark numbers on clock faces in factories early in the 20th century. To point the tips of their paintbrushes, the girls were taught to moisten the bristles with their lips. They would sometimes paint their nails, lips and teeth for the glow effect. Within a year, their teeth began to fall out and their jawbones disintegrated. When they began to sicken and die in large numbers, doctors found that their bodies, even their bones, contained large amounts of radioactivity.⁸ Normal respiration was unable to maintain homeostasis.

Air pollution can contribute to a wide variety of effects on humans and the environment depending on the particular type of pollutant. Increased susceptibility to cough, chest discomfort, headaches, respiratory illness, increased asthma attacks, bronchitis, pulmonary emphysema and reduced lung functions are believed to be due to air

pollution. The Fiji Ministry of Health data reveals that based on hospital admissions the number suffering from respiratory infections was 5,686 per 100,000 people in 1999 alone.⁹ These infections are the result of the body's inability to metabolize the guilty particulates, with their documented extremely high COD, outside the human body and presumably within it as well. The ensuing Chronic Oxygen Debt Syndrome is the result of the body's continuing efforts toward homeostasis, with the resulting shortfall of oxygen for proper cell function and detoxification causing various disease states and possibly a shortened life span.

IV. OVERVIEW OF CELL RESPIRATION

Ambient air is made up of 20.9% oxygen and several inert gases. Only a quarter (ideally) of that oxygen we breathe is transferred to blood, through the alveoli in the lungs. About three quarters of the oxygen in inspired (breathed) air is still present as it is expired.¹⁰ Therefore, if we inspire 500 CCs of air each time we breathe, 104.5 CCs is oxygen. We expire, or breathe out 78.3 CCs of oxygen, retaining 26.1 CCs of oxygen per breath, to do the work of respiration.

In health, an individual will have a respiratory system that will saturate 94-96% of the hemoglobin as it passes by the lungs. When a person is at rest, is elderly, loses fitness, or develops any number of circulatory or respiratory illnesses, the efficiency of the lungs decreases, lowering the oxygen saturation of the blood. Human blood should carry a dissolved oxygen level of about 4 ppm.¹¹

The total body water (TBW) content of adult men varies from 55% of body weight in the obese to 65% in thin individuals. Values for adult women are about 10% less. About two thirds of TBW is intracellular fluid (ICF) and one third extracellular (ECF). TBW content is normally regulated by a combination of factors, including the thirst mechanism...¹²

The mention of adenosine triphosphate (ATP) is necessary to the topic of aerobic and anaerobic respiration. ATP is the molecular net product of a sequence of processes collectively termed respiration.¹³ In *aerobic* cell respiration, ambient air, normally entrained with 20.9% oxygen, is inhaled and gas exchange occurs in the alveoli of the lungs. The lung is a diffusion organ, as is the placenta. (in the case of mother and fetus, there typically is no commingling of blood; nutrients and oxygen, are delivered from the mother's blood but diffused through the placenta for utilization by the fetus). "Because the lungs consist largely of air tubes and elastic tissue, it is a spongy, elastic organ with a very large internal surface area for gas exchange. In normal adults this surface area is estimated to be approximately the size of a tennis court."¹⁴

At the cellular level, *anaerobic* respiration occurs in a deficiency of oxygen in tissues of higher species and produces much less energy than the aerobic process: about 0.25 attojoules per glucose molecule versus 0.06 attojoules in *aerobic* respiration. In addition, anaerobic respiration results in incomplete breakdown of glucose, producing ethyl alcohol, toxic to most living tissue. If the oxygen supply in an aerobic system becomes seriously depleted, the process is arrested at an intermediate stage, and anaerobic glycolysis takes over, giving the lactate that appears in overworked muscles.¹⁵

The normal value of pH in the human body is 7.35 to 7.45.¹⁶ , slightly alkaline. Remember that the range of pH is zero to 14, with a pH value of 7 considered neutral; lower numbers indicate acidity and higher numbers indicate alkalinity. *Aerobic* energy is caused by oxygen + nutrients = energy. With inadequate oxygen, *anaerobic* energy production occurs, ultimately creating a byproduct, lactic acid, hence reducing pH, toward the acidic. The lower the acidity of the plasma, the less oxygen will be taken up by the hemoglobin or the more will be lost by it. This is called the Bohr effect. The main factor governing pH of the plasma is the amount of carbon dioxide in the bloodstream (writer's note: carbon dioxide and oxygen are the yin/yang of respiration); CO₂ reacts with water to form carbonic acid, which then dissociates hydrogen ions to cause a fall in pH.¹⁷

V. OXYGEN AS A THERAPEUTIC TOOL

One of the most interesting aspects of high altitude exposure is that it provides a model to examine the nature of adaptive processes which are evoked by chronic oxygen debt in otherwise normal subjects. Adaptations to chronic oxygen debt can be analyzed in three categories:

- I. Improved O₂ Transport/Supply
 1. Increased alveolar ventilation
 2. Increased cardiac output
 3. Increased erythrocyte mass (*more red blood cells*)
 4. Altered hemoglobin affinity
 5. Increased myoglobin
 6. O₂ conservation by arterial constriction
- II. Improved Substrate Supply (*glucose, amino acids, fatty acids plus a variety of hormonal, neural and humoral mechanisms operate in various forms of O₂ depletion to improve substrate provision*)
 1. Increased substrate delivery
 2. Glucose conservation by arterial constriction (*fat*)
 3. Substrate conservation by endocrine or paracrine regulation
- III. Direct adaptations of cell metabolism to hypoxi(a)...¹⁸

How can one man of many survive a mining disaster, where “bad air” containing a mixture of deadly gases displaces oxygen? How is the survivor’s body able to utilize the small amount of available oxygen necessary to keep that spark of life? Was his muscle tissue greater, requiring less oxygen? Did he have low COD meal(s) prior to the disaster? Did he have NO meal prior to the disaster, thus relieving the digestive tract of its oxygen-consuming work? Was his Vitamin E level adequate to decrease muscular and cellular oxygen requirements? Was he able to slow his bodily processes, thereby using less oxygen? Was he more adequately hydrated, easing the transport system for delivering oxygen to the brain and heart, the two largest users of oxygen in the body and the two organs minimally necessary for survival? Was he a happy and calm man? What was his Body Mass Index? Were his parents long-lived? Did he avoid cigarettes, alcohol, drugs, prescription medications? Did he avoid sugary beverages?

Were his sleep patterns regular and did he enjoy peaceful slumber? Was he less stressed or less concerned about the dangers of his occupation? Was his breathing optimal? Did he close his eyes during the ordeal (the eyes are the third largest demander of oxygen)? The list is endless, really, but illustrates how much of organic bodily function, and survival of the organism itself, is dependent upon oxygen and its efficient utilization. The difference between health and disease, in fact, life and death -- is measured in nano-increments of available oxygen.

Overweight/Obesity

“A billion hours ago, human life appeared on earth”, a 1996 Coca-Cola Company annual report reads. “A billion minutes ago, Christianity emerged. A billion Coca-Colas ago was yesterday morning.” Overweight/Obesity is a pandemic. The numbers are staggering to comprehend, and the health of America is at stake. Hippocrates said he sees old patients and he sees fat patients, but never old, fat patients. Things have changed little since 400 BC.

A can of regular soda contains the equivalent of about 24 teaspoons of sugar. The oxygen demand of sugar is extremely high – to metabolize sugar requires a high level of oxygen. Jelly and jam made from fruit does not require refrigeration – why? The sugars entrained in the jelly are unable to biodegrade with available oxygen in room air. These sugars require more than is available in room air and therefore will not deteriorate on the shelf.

Fats are made up of the same elements as those that form carbohydrates, but in fats these elements are combined in different proportions, being especially poor in oxygen. The chief fat of olive oil is olein which has the formula $C_{57}H_{104}O_6$. This formula shows that this fat contains an enormous number of hydrogen atoms, a small number of oxygen atoms and a large number of carbon atoms. Fats are spoken of as “concentrated food.” They are readily oxidized, thus liberating heat.¹⁹ Given Le Chatelier’s principle, the chemical makeup of fat demands excessive oxygen – far more than muscle tissue – and may explain why overweight/obese patients experience high blood pressure, among other diseases, as the body strives toward dynamic equilibrium.

Endocrine System

Researchers have known for decades that stress causes the body to secrete hormones that can harm the immune system. Joseph A. Boscarino, a senior scientist at the New York Academy of Medicine used health data on Vietnam veterans collected by the Centers for Disease Control and Prevention 20 years after the men were discharged from military service. The veterans who suffered from post-traumatic stress disorder were three times more likely to have an autoimmune illness than veterans not experiencing post-traumatic stress disorder.

According to renowned endocrinologist, Hans Sale, 1907-1982, M.D., Ph.D., formerly head of the University of Montreal’s Institute of Experimental Medicine and Surgery, “reaction to stress is governed mainly by three tiny glands: the pituitary, which nestles

under the brain, and the two adrenals, which sit on either side of the kidneys. Together they weigh only about a third of an ounce, yet the hormones they secrete have a huge influence on vital body functions.”²⁰

“The apparent cause of illness,” says Dr. Selye, “is often an infection, an intoxication, nervous exhaustion or merely old age. But actually a breakdown of the hormonal-adaptation mechanism appears to be the most common ultimate cause of death.”

Vietnam veterans who suffer post-traumatic stress disorder are more likely to have autoimmune diseases such as arthritis, psoriasis and hypothyroidism, the CDC study has found.

The extremely potent hormones released by the pituitary and the adrenals have exceedingly high COD. The adaptation to and metabolism of these hormones require oxygen and a lot of it. The glands eventually wear out, test animals sicken and die. Oxygen is depleted throughout the entire system. Stress can kill.

Digestion

The implementation of ... digestive system functions is accomplished by highly specialized mucosal cells located at the surface of the intestinal wall. These mucosal cells require a significant input of energy in the form of oxygen and nutrients in order for the digestive system to function at peak performance levels. The life span of these mucosal cells is very short and must be replaced rapidly by the first cell layer of the intestine. To accomplish this, the GI system is highly vascularized (writer's note: supplied with super-adequate blood supply) which provides the energy (oxygen and nutrients) needed to accomplish the task. The GI system must also produce mucus, digestive enzymes, transport proteins, protons and ions which are necessary for the proper and complete absorption of nutrients. This adds to the total energy requirements needed by the GI system. The smooth muscle of the intestine is in continuous motion to insure proper mixing and propulsion of the digesting food. This adds to the total energy requirements needed by the GI system. Yet another energy demand is the reaction of the mucosal cells to toxins and xenobiotics, most commonly introduced by ingestion. These toxic responses in the mucosal cells create yet another demand for energy.

All of this is to say that there is a high demand for energy in order for the digestive system to function at peak performance levels. The essential functions of the digestive system often does not have sufficient energy to function at peak performance levels. This will reduce the efficiency with which the digestive system absorbs energy (oxygen and nutrients). Eventually, the body's natural immune mechanisms will be adversely affected due to the continued high demand for energy with increasingly less energy being available. This scenario becomes even more critical to those whose immune systems are already at risk... Indeed, oxygen is rapidly consumed by the mucosal epithelial cells, and in the absence of oxygen, pathogens and toxins readily invade the intestinal tissues.

Oxygen is extremely important in digestion for the following reasons:

- Energy metabolism requires oxygen;
- Cell restitution and regeneration requires oxygen;
- Biotransformation of toxins requires oxygen;
- The control of pathogen overgrowth requires oxygen;
- Maintaining the mucosal barrier against xenobiotics requires oxygen;
- The health of the mucosa requires oxygen;
- Efficient glucose absorption requires oxygen; and
- Preventing the absorption of bacterial endotoxins requires oxygen.

The overriding principle that ties all of this together is that when the tissues of the GI tract are well oxygenated and the integrity of the mucosa is intact, normal physiology performs quite well... and also defends against pathogen and toxin invasion.²¹

Cancer

For his discovery of the nature and mode of action of the respiratory enzyme, the 1931 Nobel Prize in Medicine was awarded to Otto Heinrich Warburg, M.D., 1883-1970. This discovery opened up new studies in cellular metabolism and cellular respiration. He has shown, among other things, that cancerous cells can live and develop even in the absence of oxygen.²³ Dr. Warburg's name is often used to support the promotion of oxygen therapies and of drinking oxygenated water.

Unhealthy lifestyle choices account for up to half of all cancer deaths²⁴ and smoking alone accounts for over 30 percent of these²⁵. Seventh-Day Adventists, who do not smoke, who drink minimal alcohol, who use caffeine moderately, and who favor vegetarianism, have notably lower rates of both lung and digestive tract cancers.²⁶

Consider colon cancer: In a study conducted at the Fred Hutchinson Cancer Research Center in Seattle, researchers conclude that women who drank more than four glasses of water per day (writer's note: not oxygen-enriched) had nearly half the odds of getting the disease as women who drank two glasses or less. That risk reduction was almost comparable to the cancer-fighting benefits of eating five servings of fruits and vegetables a day.

A similar effect may keep cancer from taking hold in the urinary tract – home to your bladder, kidney, ureter and ancillary tissue. One study at the Cancer Research Center of Hawaii found that women who reported drinking the most tap water every day were a whopping 80% less likely to develop bladder cancer than those who drank the least. A few earlier studies have not reported such a dramatic result perhaps because they were conducted in areas where tap water is chlorinated more than Hawaiian municipal tap water.

VI. CONCLUSION

If one were to name the universal factor in all death, whether cellular or planetary, it would certainly be loss of oxygen. Dr. Milton Helpert, who was for twenty years the Chief Medical Examiner of New York City, is said to have stated it quite clearly in a single sentence: Death may be due to a wide variety of diseases and disorders, but in every case the underlying physiological cause is a breakdown in the body's oxygen cycle.²⁸

We know that the amount of oxygen in the water fraction of blood (plasma) should be about 0.3 ml/100 ml blood. The amount of oxygen held by hemoglobin should be about 20 ml/100 ml of blood. The oxygen in air, in water of blood, and hemoglobin is in dynamic equilibrium – or should be. But what if it isn't? “Man is an obligate aerobe.”²⁹ Does this mean perhaps that man absorbs oxygen in extraordinary ways to ensure survival of the organism?

Findings resulting from a 5,200 clinical study group observed over a 30-year span showed that pulmonary function measurement is an indicator of general health and vigor and literally the primary measure of potential life span. Vital Capacity falls with age – 9 percent to 27 percent each decade depending on sex and age at the time the test is given. The decline is clear both in cross-sectional data, comparing persons of different ages, and in cohort data, following a group of people as they grow older. The long-term predictive power of Vital Capacity is what makes it a good candidate as a marker of aging.³⁰ Can Vital Capacity be more than a passive benchmark? Can improvement of Vital Capacity become an expected outcome for all who drink oxygenated water?

Homeostasis and its required dynamic equilibrium is the result of the basic formula: **oxygen + nutrition = energy**. This three-part equation is easily knocked down by deficits in oxygen or nutrition. Inadequate nutrition has been the health industry's scope of interest for decades but as consumer interest in drinking oxygen-enriched water continues its meteoric rise, medical and clinical research are destined to keep the pace. Drinking oxygenated water is as benign a “therapy” as ever there has been.

Indeed, disease and aging are destined to be -- and the national health crisis makes it imperative that they be -- observed through the prism of the oxygen cycle. Oxygen: truly, the big picture.

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