

Electrochemically reduced Water: A Crucial Nutrient for Life

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Abstract— Water is a transparent fluid which forms the world's streams, lakes, oceans and rain and it is the major constituent of the fluids of living things. It is the cradle of life which is a common heritage. Pure water is a clear, colourless and tasteless and odourless liquid with a boiling point of 100°C, a freezing point of 0°C, maximum density of 1g/cm³ at 4°C. Water is an important but often overlooked nutrient. The normal human body contains 40 liters of water. Water is not only vital for mere existence, but it is also essential for optimum health. An insufficient amount of water causes weakness, problematic skin, a weakened immune system—virtually every health issue under the sun requires water as part of the “healing squad.” Electrochemical system of water treatment has not received adequate attention. Electrochemistry, a link between chemistry and electronic science has been proven to be a clean, versatile and powerful tool for development of a new advanced method for water purification. Electrochemically reduced water is functional water which is capable of destroying microorganisms present in water and also can scavenge reactive oxygen species hence free radicals. The active agents in reduced water are hydrogen (atoms and molecules), minerals and nanoparticles.

Keywords—Water, Electrochemistry, Nutrient, Reduced, Life.

I. INTRODUCTION

Water is the most abundant compound on earth's surface, covering about 70% of the planet. In nature, water exists in liquid, solid and gaseous states. It is in dynamic equilibrium between the liquid and gas states at standard temperature and pressure. At room temperature, it is a tasteless and odourless liquid, nearly colourless with a hint of blue. Many substances dissolve in water and it is commonly referred to as the universal solvent. Water is the most abundant liquid on the earliest surface about 97% of earth's water is salty water and only 3% is fresh water. Although water is a renewable source, most of the world's fresh water supply is ground water. This precious element is needed for the basic survival of all living organisms^[2]. With the global population ever increasing, the need for water has become a global concern. Nowadays, the production of enough drinking water is a

major need. Many human diseases are related to lack of safe and hygienic water. Today, it is estimated that about 450 people in 29 countries suffer from water shortages^[5]. Water is a chemical substance with chemical formula H₂O. A water molecule contains one oxygen atom and two hydrogen atoms that are connected by covalent bonds. Plants and animals (including human) constitute mostly water inside and must drink water to live. Water is one of the six major nutrients required by the body for proper functioning. The normal human body contains 40 liters of water. Water is not only vital for mere existence, but it is also essential for optimum health. An insufficient amount of water causes weakness, problematic skin, a weakened immune system—virtually every health issue under the sun requires water as part of the “healing squad.” This is why humans can live for up to 40 days without solid food, but just up to five days without water and only live about 4 minutes without oxygen. With all of today's emphasis on food, the most basic of all body needs are water and oxygen^[1].

II. IMPORTANCE OF WATER

Water gives a medium for chemical reactions to take place and is the major component of blood. Water is essential to every bodily function. No other liquid can sustain your body like water, and the body needs a certain amount of water to function well. About 80% of the human brain is water; blood contains 83% water, the lungs contain 79% and the muscles contain 76%. All in all, the human body is comprised of about 75% water. Every function in the body is dependent on a steady supply and flow of water. Drinking water has physiological functions and health benefits^[12].

Water transports such things as hormones, chemicals and nutrients which are vital to efficient organ function. Without water we would not be able to digest or absorb minerals or nutrients and our kidneys would fail from toxic overload. Similarly, the blood circulation carries by-products of metabolism which are carbon dioxide and urea away from cells to the lungs and kidney for disposal. Transport of these nutrients depends on diffusion and water carriage within the body^[11]. To function properly the body requires between five to seven liters of water per day to avoid dehydration. The precise amount of water

depends on the level of activity, temperature, humidity and other factors.

III. HEALTH BENEFITS OF WATER

The health benefits of water are so much although we can go through some of these benefits.

Water relieves fatigue: When there is less water in the body, there is drop of blood volume which causes the heart to work harder to pump oxygenated blood out in the bloodstream, and other major organs also work less efficiently. Thus drinking adequate water can help your body function better. If one feels tired, there is a high chance that it could be due to inadequate consumption of water which makes the body function less efficiently.

Water improves mood: Research indicates that mild dehydration can negatively affect ones mood and ability to think. The colour of your urine is a good indicator of your level of hydration. Water is, in fact, a miracle elixir. Here is a summary of a few of the amazing things that water can do for your health:

Keep skin vibrant and supple, escort toxins from the body, support healthy metabolism, improve energy, remove body heat, lubricate joints, improve mental and physical performance and support digestion^[11].

IV. WATER TREATMENT

This is physical and chemical processes for making water suitable for human consumption and other purposes. Drinking water must be bacteriologically safe, free from toxic or harmful chemicals or substances. Researchers stated that water treatment entails the subjection of water to an agent or process with the objective of improving its source quality and specific criteria or standards. Water treatment is also the act or process of making water more potable or useful, by purifying, clarifying, softening or deodorizing it^[4]. According to Encyclopedia, water treatment is the treatment of water to make it safe and acceptable for human use. Water treatment should remove existing water contaminants so that the water becomes fit for its desired end use^[3].

Method of Water Treatment: There are different methods for improving the hygienic quality of water. These include:

- (i) Pressure-driven membrane based methods such as reverse osmosis, ultra filtration and micro filtration.
- (ii) Biological treatment, which includes treatment of water by means of chemical such as ozone, chlorine, etc
- (iii) Treatment with UV radiation.

Generally, microbial cell can be damaged as a consequence of adverse condition such as osmotic

pressure difference, electric field, desiccation, heating, chilling, chemicals, oxidants or ultraviolet radiations. Based on such mechanisms, many of drinking water treatment systems have been developed and tested, using osmosis, flocculation, UV light irradiation^[8]. However, recent research has shown that some treatment methods of water, such as chlorination and UV radiation with low pressure lamps are not fully efficient, as some pathogens are capable of "reactivation" or "recovery". It further revealed that most of the chemical treatment of water can only kill the pathogen but cannot be able to remove the heavy metals in water^[4]. They therefore suggested that since pathogens are able to change their prevalence hence electrochemical decomposition of all organic rather than chemical treatment and disinfection might be very effective. In their work they also stated that electrochemical systems for water treatment has been proven to be clean, versatile and powerful tool for water purification. It is an efficient method for the removal of pathogens and harmful metals^[6].

Electrochemistry is a branch of physical chemistry and plays an important role in most area of science and technology. Electrochemistry deals with the charge transfer at interface between an electrically conductive or semi-conductive material and an ionic conductor (example Lipids, melt or solid electrolytes) as well as with the reactions within the electrolytes and the resulting equilibrium. Further, it is increasingly acknowledged as a significant means for handling environmental and energy problem facing us today and in future^[14].

V. ELECTROCHEMICALLY REDUCED WATER:

Electrochemically reduced water is termed alkaline electrolyzed water, alkali-ionic water, alkaline cathodic water, and alkaline ionized water, based on its physicochemical and physiological aspects. Electrochemically reduced water exhibits an alkaline pH of 8-10, is hydrogen molecule-rich, has a negative oxidation-reduction potential (ORP) and reactive oxygen species (ROS)-scavenging activity^[13]. Studies on the functions of electrochemically reduced water were initiated in Japan in 1931. In 1960, it was applied to medical care as health-beneficial water and in 1966, the ministry of health in Japan admitted that electrochemically reduced water was effective for chronic diarrhoea, indigestion, abnormal gastrointestinal fermentation, ant-acid and hyperacidity. The government authorized the electrochemically reduced water producing device for home use^[13].

VI. MECHANISM OF

ELECTROCHEMICALLY REDUCED WATER

Electrolysis of water produces a strong reducing circumstances in the vicinity of a cathode because most voltage is applied in the very narrow water layer nearby the cathode forming very high electric field. Platinum-coated titanium electrodes are often used for electrolysis of water in the commercial electrochemically reduced water producing apparatus. On the cathodic platinum plate, hydrogen atoms and hydrogen molecules are generated. Mineral nanoparticles and mineral nanoparticles hydrides are formed^[14]. Electrochemically reduced water prepared from NaOH solution contains small amount of Pt nanoparticles. Synthesized Pt nanoparticles scavenged O₂, OH and H₂O₂. Pt nanoparticles exhibit superoxide anion radical scavenging activity. This is as strong as that of ascorbic acid which is one of the strongest scavengers. Pt nanoparticles activate hydrogen molecules to active hydrogen^[7].

VII. HEALTH BENEFITS OF

ELECTROCHEMICALLY REDUCED WATER

Electrochemical treatment of water is an efficient method for the removal of pathogens and heavy metals from water. Electrochemically reduced water treatment shows several benefits in terms of cost and safety. The various characteristics such as being hydrogen rich, having a negative oxidation-reduction potential (ORP) and reactive oxygen species scavenging activity make it good in improving oxygen stress related diseases^[6]. In another research work, it was found the patients who had chronic diarrhoea that drank alkali-ionized water showed higher improvement efficacy of 94.1% compared to those who drank purified water (64.7%)^[15].

Oxygen stress related diseases (free radical reactions) occur in most human. This is not to say that oxidative stress is the cause of most diseases. The increase in free radicals may be secondary to the disease process. Clinical conditions associated with free radical damage include the following diseases stated below: Alzheimer, Diabetes, Amyotrophic lateral sclerosis, Coronary artery diseases, Arthritis, Heart failure, Arteriosclerosis, Hypertension and many other diseases. In fact free radicals are believed to play a role in more than 60 different health conditions^[9]. Electrochemically reduced water has been found to suppress these free radical reactions^[10].

VIII. CONCLUSION

Electrochemically reduced water is said to be a functional water, alkaline water, alkaline reduced water, alkali-ionic water, alkali cathodic water and alkaline ionized water based on its physicochemical and physiological aspects. Water being an essential nutrient for the proper

functioning of the body will be of great importance to possess healing properties. Hence the new focus should be on the use of electrochemical method to produce functional water for the wellbeing of the human population.

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