Journal of Water Resource and Protection, 2022, 14, 318-333
https://www.scirp.org/journal/jwarp
ISSN Online: 1945-3108
ISSN Print: 1945-3094

A Novel Method to Improve Quality of Drinking Water, Based on the Eye's Biology

Arturo Solís Herrera, María del Carmen Arias Esparza, Martha Patricia Solís Arias

Human Photosynthesis™ Research Centre, Aguascalientes, México
Email: comagua2000@yahoo.com

How to cite this paper: Herrera, A.S., del Carmen Arias Esparza, M. and Arias, M.P.S. (2022) A Novel Method to Improve Quality of Drinking Water, Based on the Eye's Biology. *Journal of Water Resource and Protection*, **14**, 318-333.
https://doi.org/10.4236/jwarp.2022.144016

Received: March 1, 2022
Accepted: April 8, 2022
Published: April 11, 2022

Abstract

Water represents a critical nutrient, the absence of which will be lethal within days. Water's importance for the prevention of nutrition-related noncommunicable diseases has received more attention recently. There are major gaps in knowledge related to the measurement of total fluid intake and hydration status at the population level. It is poorly understood the effects of chronic mild dehydration and fluid consumption on specific health outcomes including obesity. Urolithiasis is the only disorder that has been consistently associated with chronic low daily water intake. Water is an essential nutrient required for life, but until now, it was considered mainly as a universal solvent, which served to prepare the broth of life inside the cells, but the function of water now takes unusual importance with our discovery of the unsuspected ability of the human body to transform the power of light into chemical energy by dissociating the molecule from water, as it happens in plants. The process that we replicated in the laboratory for the first time in 2007, represents a light at the end of the tunnel, in the growing and serious problem of contamination of the mysterious and vital liquid that we call water.

Keywords

Drinking Water, Hydrogen, Oxygen, Dissolved Oxygen, Pollution, Human Eye

1. Introduction

Water is a finite resource, so we must preserve the water that we have. Environmental factors may affect body fluids, electrolytes, and acid-base balance [1] when drinking water quality is impoverished through pollution of the surroundings [2].

The main focus of researchers, doctors and the public is towards how much water we really need depending on water functions and the mechanisms of daily water balance regulation [3]. However, water has numerous roles in the human body. In accordance with the prevalent dogma, water acts as a building material; as a solvent, reaction medium and reactant; as a carrier for nutrients and waste products; in body thermoregulation; and as a lubricant and shock absorber, but to this day, we had not realized its fundamental role as a source of energy [4], which implies rethinking and rewriting biology.

Water is an essential but overlooked nutrient [5]. The regulation of water balance is very precise, as a loss of 1% of the body, water is usually compensated within 24 h. Both water intakes and water losses are controlled to reach water balance [6]. Minute changes in plasma osmolality are the main factors that trigger these homeostatic mechanisms. Healthy adults regulate water balance with precision, but young infants and elderly people are at greater risk of dehydration [7]. Dehydration of as little as 2% loss of body weight results in impaired physiological and performance responses. Dehydration can affect consciousness and can induce speech incoherence, extremity weakness, hypotonia of ocular globes, orthostatic hypotension, and tachycardia [8]. Human water requirements are not based on a minimal intake because it might lead to a water deficit due to numerous factors that modify water needs (climate, physical activity, diet and so on). Inadequate water consumption both in quality and quantity, can influence the risk of urinary stone disease, also cancer of the breast, colon, and urinary tract, besides, can favor childhood and adolescent obesity, mitral valve prolapses, salivary gland function, and affect overall health in the elderly [9].

The regulation of water balance is essential for the maintenance of health and life. On average, a sedentary adult should drink between 1.5 L to 2.9 L of water per day, as water is the only liquid nutrient that is essential for body hydration.

What matters is not only the volume of water we ingest, but also the quality of water, especially in two parameters: the dissolved oxygen content and the degree of acidity or alkalinity.

2. Dissolved Oxygen Levels in Drinking Water

The numerous clinical studies that are carried out and that are published continuously, tend to ignore the quality of the drinking water that is supplied to the population. As much, the researchers put a major interest only in the water and quality content of drinks that are ingested [10], but they forget the water with which we bathe, with which we cook, with we wash dishes, with we wash clothes, with which we clean house, with we water the garden, with which we irrigate the crops, etc.

Studies on the importance of the minimum desirable physical and chemical characteristics of drinking water supplied to the population are rather scarce and some are only initiatives of international organizations [11], which are understandable because the problem of supplying safe drink water both in quality and quantity, is complex and its solution is not simple.

The WHO Guidelines for Drinking Water Quality in promoting safe drinking water for the world's population emphasize an integrated approach to water quality assessment and management from source to consumer, remarking the maintenance of microbial quality to prevent waterborne infectious disease as an essential goal [12], but there is no mention of the minimum levels of dissolved oxygen that drinking water must have to be considered safe, nor the degree of acidification of it.

And even more serious because the set of actions it advises, does not result in the improvement of dissolved oxygen levels, and much less in the acidification of drinking water.

Apparently, this omission is due to at least four factors: 1) the serious technical difficulties involved in raising the levels of dissolved oxygen in drinking water supplied to the population; 2) The non-existence (until today) of effective action in this regard; 3) Very expensive cost-benefit of current existing strategies (treatment plants, filters, etc.) that in the end produce less than mediocre benefits and; 4) Only the water that is ingested is considered important, without taking into account the water with which we bathe, cook, wash dishes, wash clothes, clean house and household goods, water the garden, irrigate the crops, etc.

But the minimum levels of dissolved oxygen that the human body requires to be able to dissociate it properly and therefore supply the energy that the body needs to carry out each one of its functions is in general terms, 6 mg/L or more.

Dissolved Oxygen (DO) refers to the concentration of oxygen gas incorporated in water. Water absorbs oxygen released by aquatic plants during photosynthesis. Sufficient DO is essential to growth and reproduction of aerobic aquatic life [13].

The sources and activities that impact negatively dissolved oxygen levels are impoundments, municipal waste treatment outfalls, industrial point sources, agricultural and urban runoff, removal of riparian vegetation, channel alteration, groundwater inflow.

The site evidence of low levels of dissolved oxygen water are high plant abundance (aquatic), slow-moving water, reduced water volume, weather conditions, season, time of day, high elevation, presence of organic waste, turbid water, foul smelling water, yellowish-green, brown, gray, or black water or dark sediments, embedded substrate, and absence of aquatic life.

The negative biological effects of hypoxic water are that kills of aquatic life, large fish die before small fish, species requiring greater concentrations of DO die first, characteristic body movements, fish gulping air, high Hilsenhoff Biotic Index (HBI) score, replacement of DO sensitive species with fly larvae and worms.

2.1. Contributing, Modifying and Related Factors as Possible Causes of Low Levels of Dissolved Oxygen

High temperatures reduce the solubility of oxygen in water (*i.e.*, warm water holds less DO than cold water). High nutrients can lead to excessive plant growth, resulting in DO declines due to respiration and decomposition. Embedded sediments can prevent DO from permeating interstitial areas. Oxygen is consumed as ammonia (NH_4) is oxidized (nitrification), and low oxygen levels increase ammonia levels by inhibiting nitrification.

Recall that high turbulence at the site creates consistent aeration but not oxygenation, because atmospheric air contains 78% of nitrogen and only 21% of oxygen, and nitrogen tends to displace oxygen.

The immediate paragraphs above are only to illustrate an overview of the complexity of the problem of the increasingly low levels of dissolved oxygen in the drinking water supplied to the population, as well as the huge difficulty to correct them.

The problem is enormous, it is serious, and it tends to be ignored because it seems to exceed our capabilities. At most, emphasis is placed on reducing water contaminants or neutralizing their sources.

But the challenge is formidable given the multiplicity of pollutants that the water comes to contain, because finally any type of pollution reaches the water; so strategies based on available technology that could be applied at any given time, they are very limited and to top it off, despite the high costs in human and material terms; the results are frustrating, as dissolved oxygen levels do not rise, or take decades to do so, or conversely, tend to decrease even more.

The problem is urgent, it is global, and it is getting worse and faster. And it doesn't seem to have a solution that would work anytime soon. But we have good news, because there is a new method developed based on the biology of the human eye, and given its recent development, it is relatively unknown; but it is efficient, we could say several times more efficient than any current methodology, in addition to that it does not require electricity, does not require added chemicals in most situations, and the formation of residual sludge decreases by more than 95%.

2.2. The Human Eye

The organ of vision in humans, and in all species in general, follows the same pattern of development [14], which speaks of the perfection that nature has attained in that aspect; but in the case of this article, I refer specifically to the 3 or 4 milliliters of water that the eye contains inside and that is the same all life, because it is not exchanged [15] (**Figure 1**).

The knowledge that the water that the so-called vitreous body of the human eye is not replaced for a lifetime, is a knowledge that dates back about 70 years [16]. However, it had not been reflected that, for practical purposes, it is stagnant water. So, how is it that throughout the life of the individual the levels of dissolved oxygen it contains do not decrease and does it not tend to acidify, as happens in stagnant waters in nature?

We, circumstantially, found the mechanism involved, after an observational study that lasted twelve years (1990-2002) and included the data of six thousand patients. And five years later (2007), we were able to replicate it for the first time in the lab (**Figure 2**).

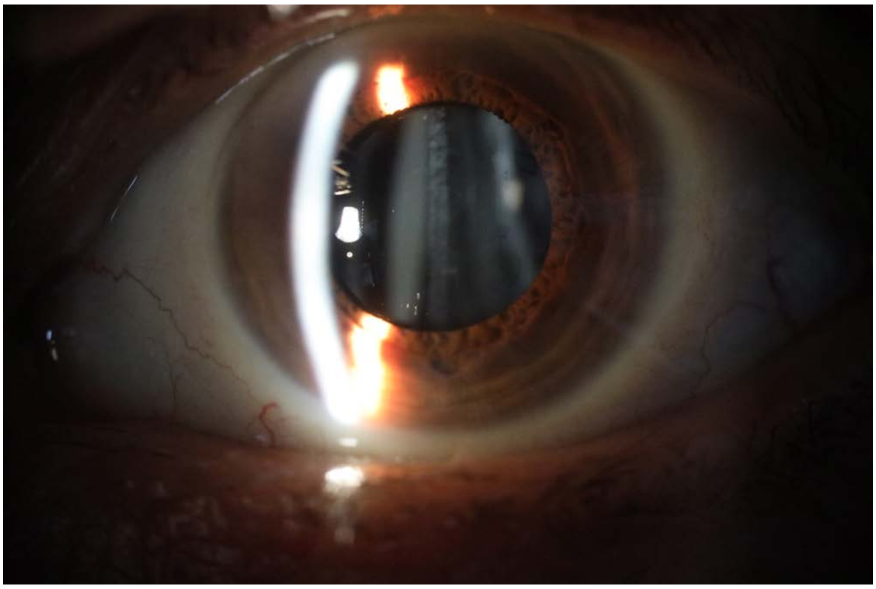

Figure 1. The photograph of the eye, of an aphakic patient, with an intraocular lens inserted, to replace the cataractous lens that was surgically removed, allows appreciating a small portion of the region where the "stagnant" water is normally located.

Figure 2. At the bottom of the flask, you can see the material developed in our laboratory (QBLOCK™), which, when immersed in any type of water (fresh, salt, gray water, black water, industrial waste, cold water, hot water, etc.) dissociates the molecule from the water, releasing oxygen constantly, as in the human eye, and for a similar period (minimum 25 years).

To date, we have studied and developed the process with the main purpose of applying it in industrial processes as well as improving water quality, because until now, water technology had focused on removing contaminants that the water could contain, which finally affect the notable decrease in dissolved oxygen, and then leave it to nature to raise these levels of dissolved oxygen; which would require years or rather decades, because in reality it is not well understood as it is, normally; nature raises and keeps dissolved oxygen levels high.

But throughout these two decades, we learned that first the levels of dissolved oxygen in the body of water must rise so that the toxics that it could contain begin to degrade or at least to become less toxic, as is the case of arsenic [17]. So, nature, by one or another mysterious process, to favor life; it first raises dissolved oxygen levels, rather than cleaning up water pollution (**Figure 3** and **Figure 4**).

This paradigm shift (first oxygen and then pollution) explains the failure of current methods of treating water, as they are based on the exact opposite: first pollutants and then oxygen (and for this that nature takes care of because we do not know how it achieves it).

Our results have been replicated in other laboratories, where tap water was used, and at the same time nitrogen was injected to displace and further decrease the levels of dissolved oxygen in the sample water (**Figure 5** and **Figure 6**).

The link to see the video of the upward and downward movement of the charcoal fragments is as follows.

https://drive.google.com/file/d/1ZYUkZ6Fhr33-0F2QsQCqI9ccMrLIOddI/view?usp=drive_web

3. Effects of Hypoxic Water on Human Health

We are all living with hundreds of anthropogenic chemicals in our bodies every day, a situation that threatens the reproductive health of present and future

Figure 3. QBLOCK™'s oxygen production is constant, day and night, just as it is in the human eye.

Figure 4. The comparison between two containers containing distilled water, one without QBLOCKS™ and the other with QBLOCKS™, allows us to appreciate the substantial difference in the content of oxygen bubbles.

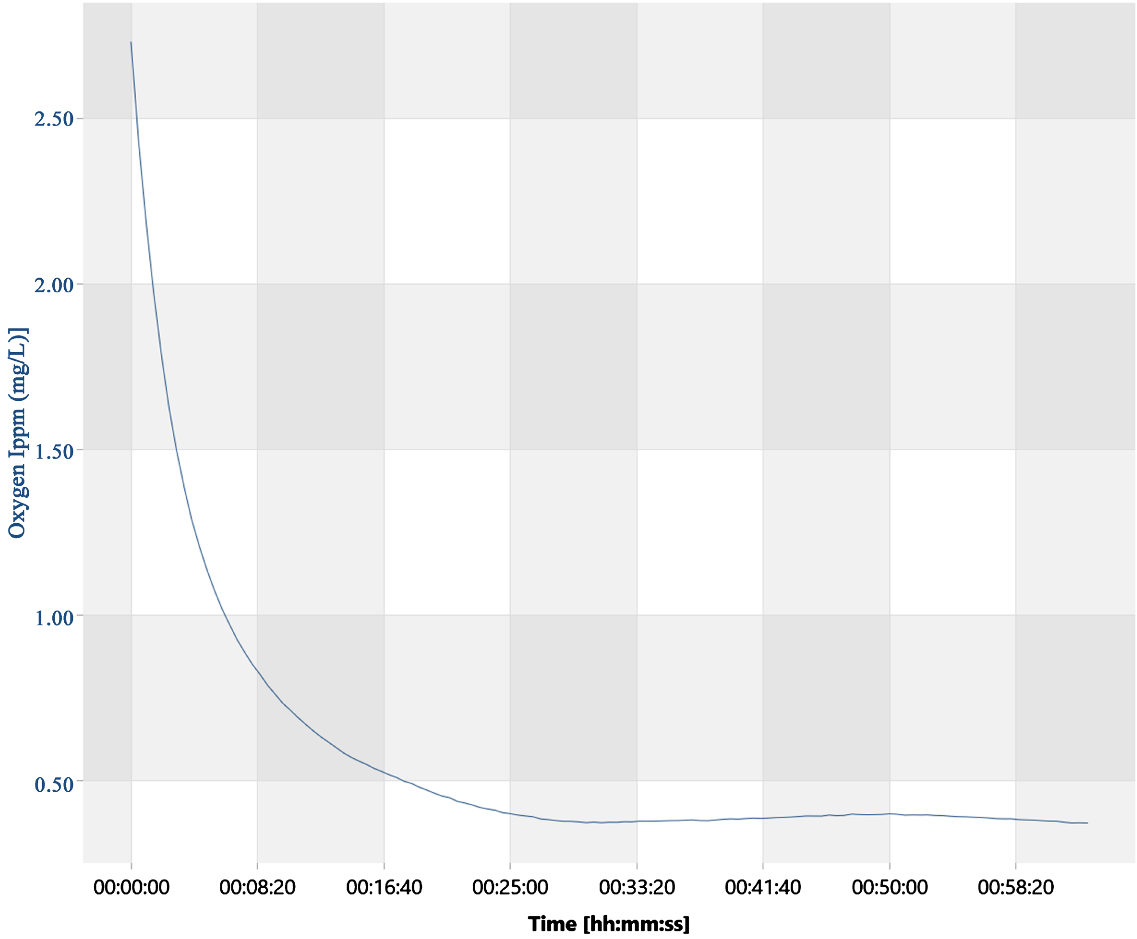

Figure 5. In a simple system, just tap water, and nitrogen first to decrease the oxygen levels to less than 2 mg/L; without QBLOCK™ (Courtesy Dr. Esther de Kroon-HVHL, Netherlands; Dr. Agostino Luewton-Wetsus, Netherlands).

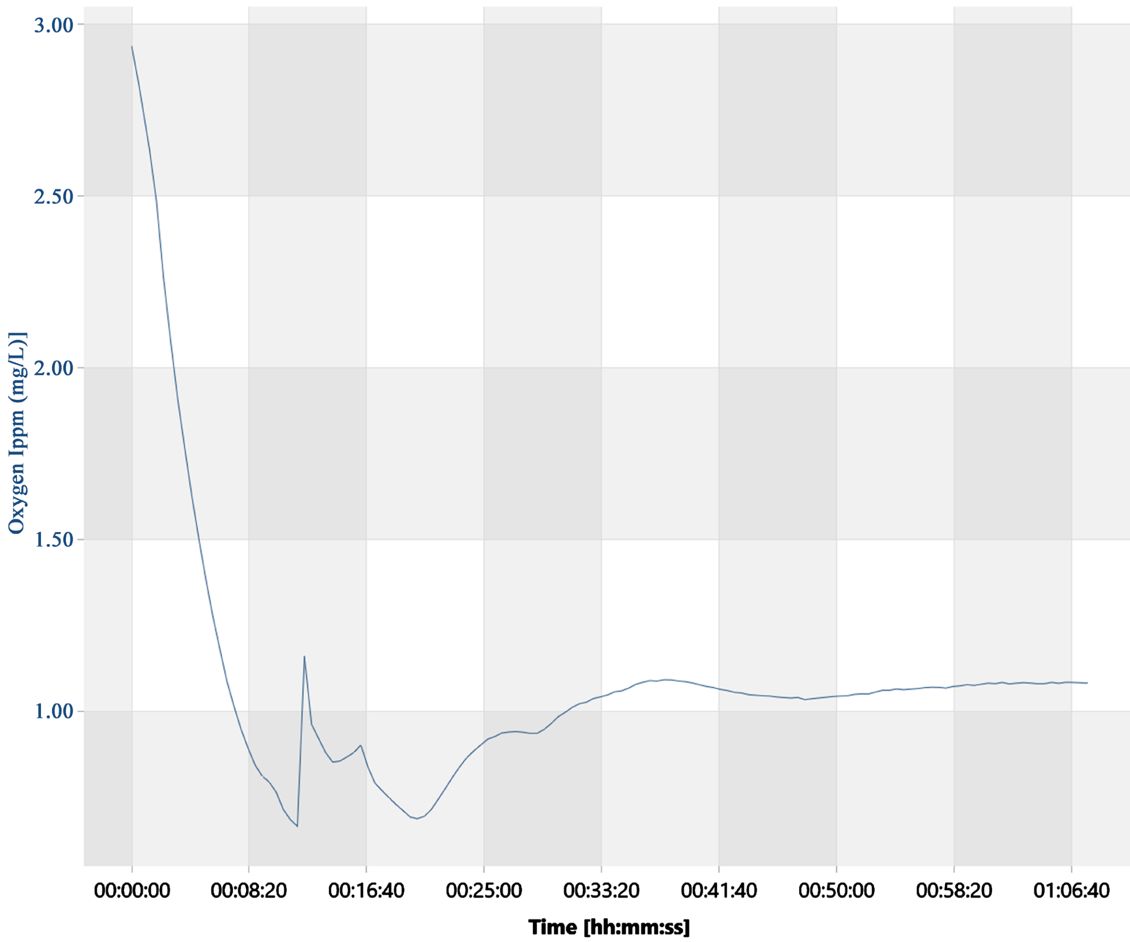

Figure 6. Similar system, this is: tap water, nitrogen, and this time with our QBLOCK™ (Courtesy Dr. Esther de Kroon-HVHL, Netherlands; Dr. Agostino Luewton-Wetsus, Netherlands).

generations. This review focuses on Endocrine-Disrupting Compounds (EDCs), both naturally occurring and man-made, and summarizes how they interfere with the neuroendocrine system to adversely impact pregnancy outcomes, semen quality, age at puberty, and other aspects of human reproductive health [18]. The neuroendocrine system is highly sexually dimorphic and essential for maintaining homeostasis and appropriately responding to the environment. Comprising both neural and endocrine components, the neuroendocrine system is hormone sensitive throughout life and touches every organ system in the body. The integrative nature of the neuroendocrine system means that EDCs can have multi-system effects. Additionally, because gonadal hormones are essential for the sex-specific organization of numerous neuroendocrine pathways, endocrine disruption of this programming can lead to permanent deficits [19].

Estrogen/androgen pathways are of utmost importance in gonadal development, determination of secondary sex characteristics and gametogenesis. Most of the EDCs mediate their action through respective receptors and/or downstream signaling [20]. Bisphenol A., dichlorodiphenyltrichloroethane, dichlorodiphenyldichloroethylene, polychlorinated biphenyls and phthalates are major toxicants that interfere with the normal estrogen/androgen pathways leading to infertility in both sexes through many ways, including DNA damage in spermatozoids, altered methylation pattern, histone modifications and miRNA expression. It has become clear that a wide variety of environmental contaminants have specific effects on neuroendocrine systems in fish, amphibians, birds, and mammals. Organochlorine pesticides bioaccumulate in neuroendocrine areas of the brain that directly regulate GnRH neurons, thereby altering the expression of genes downstream of GnRH signaling. Organochlorine pesticides can also agonize or antagonize hormone receptors, adversely affecting crosstalk between neurotransmitter systems.

These effects impact sexual differentiation of the hypothalamic-pituitary-gonadal axis, and other neuroendocrine systems regulating the thyroid, metabolic, and stress axes and their physiological responses. Weakly estrogenic and anti-androgenic pollutants such as bisphenol A, phthalates, phytochemicals, and the fungicide vinclozolin can lead to severe and widespread neuroendocrine disruptions in discrete brain regions, including the hippocampus, amygdala, and hypothalamus, resulting in behavioral changes in a wide range of species. Behavioral features that have been shown to be affected by one or more these chemicals include cognitive deficits, heightened anxiety or anxiety-like, sociosexual, locomotor, and appetitive behaviors [21]. Fluoxetine is a selective serotonin reuptake inhibitor that can affect multiple neuroendocrine pathways and behavioral circuits, including disruptive effects on reproduction and feeding in fish. There is growing evidence for the association between environmental contaminant exposures and diseases with strong neuroendocrine components, for example decreased fecundity, neurodegeneration, and cardiac disease.

Wildlife studies have revealed that exposure to Endocrine Disrupting Compounds (EDCs), either naturally occurring or man-made, can profoundly alter reproductive physiology and ultimately impact entire populations. Laboratory studies in rodents and other species have elucidated some of the mechanisms by which this occurs and strongly indicate that humans are also vulnerable to disruption. Use of hormonally active compounds in human medicine has also unfortunately revealed that the developing fetus can be exposed to and affected by endocrine disruptors, and that it might take decades for adverse effects to manifest [22].

Many EDCs are resistant to biodegradation, due to their structural stability, and persist in the environment. Considerable evidence links exposure to estrogenic environmental EDCs with neuroendocrine reproductive deficits in wildlife and in humans. The effects of an EDC are variable across the life cycle of an animal and are particularly potent when exposure occurs during fetal and early postnatal development. Consequently, abnormal sexual differentiation, disrupted reproductive function, or inappropriate sexual behavior may be detected later in life [23].

3.1. Contamination of Drinking Water Is More Complex than Previously Thought

Dissolved oxygen levels are a very sensitive marker of water pollution, as almost any contaminant decreases it. For decades it began to detect that the levels of dissolved oxygen began to fall, then it was understood that it was caused by pollution; so, currently, there has been an unsuccessful attempt to reverse the process. The prevailing logic regarding water pollution is as follows: if dissolved oxygen levels began to drop as soon as pollution began to occur, then if we clean the water of contaminants (which is almost impossible), then, once the water has as few contaminants as possible, the levels of dissolved oxygen, they will tend to rise naturally (or magically), but this has not happened anywhere in the world; despite the best efforts in every way, on the contrary, the levels of dissolved oxygen that the water must contain, not only have not decreased, but have not even stopped its descent, and worse, because the levels of dissolved oxygen continue to fall (**Figures 7-12**).

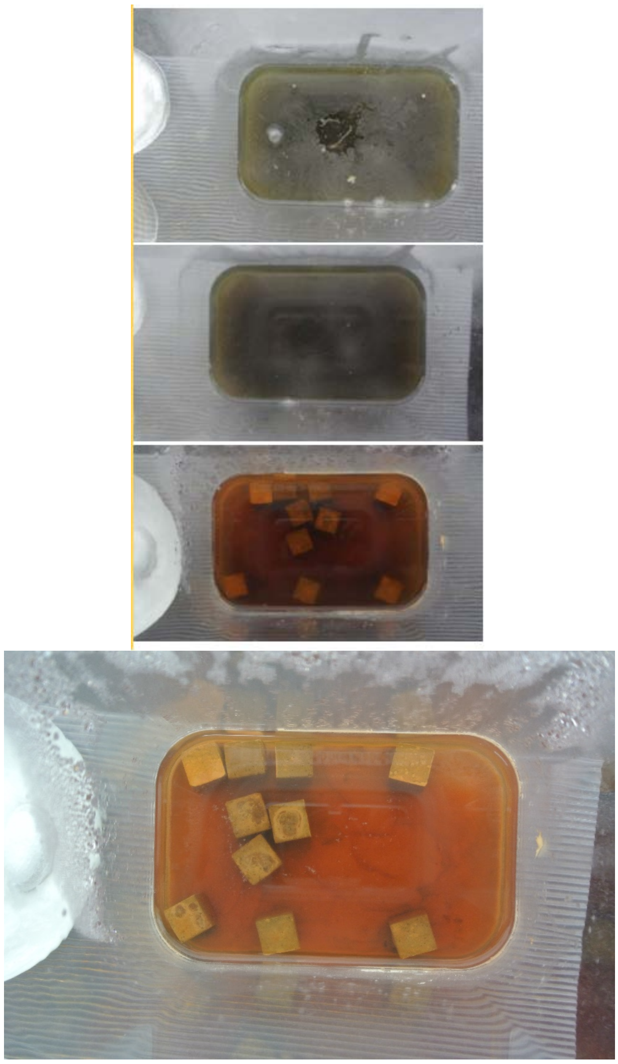

Figure 7. Our QBLOCK™ raises the levels of dissolved oxygen in fresh water, salt water, gray water, residual water, and industrial waste, as in the case of the serial photographs shown in the photo. The initial photograph is top left, of industrial waste from a brewery, the middle photograph, on the right, at 2 weeks, the bottom right photograph, at 6 weeks. The photograph at bottom was taken 12 weeks after the experiment began.

Figure 8. In this experiment, in which we studied the effects of water carbonization, using fragments of charcoal, it was surprising that, 4 months after adding the QBLOCKS™, larvae appeared.

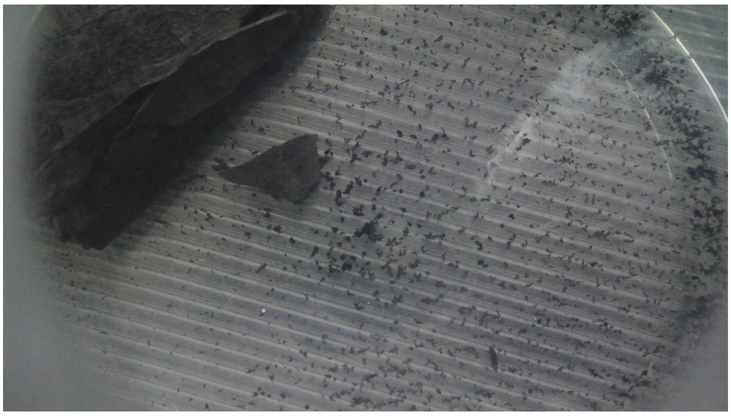

Figure 9. Photograph corresponding to the control of the experiment shown in photograph 6. In this case, distilled water was placed in a flask, also one liter; but only fragments of charcoal were placed, without QBLOCK™. 7 months later, the presence of larvae is not appreciated.

Figure 10. In the case of industrial waste, there are also multiple bubbles that form once the QBLOCK™ are added.

Figure 11. The constant dissociation of water is the beginning of all life. In one of many experiments, the formation of algae at the top of the QBLOCK™ is appreciated, which confirms that its activity favors life.

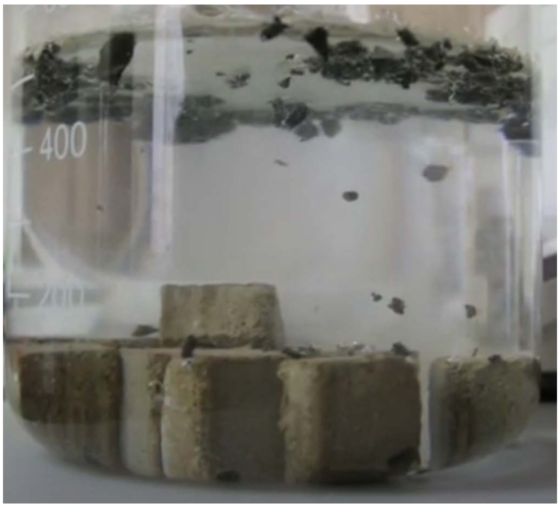

Figure 12. In this experiment, distilled water, QBLOCK™, and small fragments of vegetable carbon were placed, and we observed that the fragments rose and fell in a similar way to when the water was boiled, but in this case, it was due that the fragments of vegetable carbon rose driven by the oxygen bubbles that constantly form inside the QBLOCK™, and then descend attracted by the force of gravity.

3.2. But We Have Good News, There Is a Light at the End of the Tunnel

Circumstantially, we find a new process developed based on the biology of the human eye. Under normal conditions, the human eyeball contains about 3 or 4 ml of water that is never changed, and this throughout the life of the individual. For practical purposes, it is stagnant water, but with the particularity that it never acidifies, and its dissolved oxygen levels are always above 6 mg/L. We were able to decipher the mechanism that nature uses to keep the stagnant water that the human eye contains in good condition.

The observational study, of a descriptive nature, began in 1990 and ended in 2002; and it includes ophthalmological studies of 6000 patients [24]. But in the end, we were able to conclude that several substances in our body have the unsuspected ability to transform solar energy into light energy, just as plants do dissociating the molecule from water. We were able to replicate the process in the laboratory in 2007, and we have studied its possible applications, which are multiple and varied. But the material we developed, which we commercially call QBLOCK™, allowed us to break a deep-rooted dogma: first we try to clean the water (**Figure 13**) and then, magically, the levels of dissolved oxygen will rise.

Figure 13. The novel material that makes up the QBLOCK™, which allows to constantly oxygenate the water, day and night, without requiring the use of electricity, without the need to add chemicals, without the formation of toxic sludge, and with a useful half-life of 25 years, opens a new era in the field of wastewater treatment plants, because they are often abandoned due to high energy expenditure, the need for tons of chemicals to precipitate the compounds and form tons of Tons of toxic sludge, which are eventually buried, or thrown into the open field, into riverbeds, or into the sea.

Figure 14. QBLOCK™, the technology of the future, at your fingertips.

But such an approach has failed around the world, as it has never happened that dissolved oxygen levels rise and instead continue to decline. So now we can address the problem from a totally opposite point of view: first we raise the levels of dissolved oxygen (**Figure 14**) and then, the contamination of the water, magically, will disappear. The word "magically" I use to exemplify that the complex mechanisms involved are not well understood to date.

Among the numerous advantages of this novel method, we have that it does not require electricity, does not require added chemicals, occurs day and night as in the human eye, and is also long-lasting, as in the human eye (minimum 25 years). Incidentally, the formation of toxic sludge is reduced by more than 95%.

3.3. Conclusions

The complex, serious and increasingly acute problem of dissolved oxygen levels in drinking water, suddenly has an ideal solution, which comes, unexpectedly, from the biology of the human eye. But fortunately, it was possible to bring the biological event to the test tube, and the multiple advantages of this material are due to we did not invent it, we simply copied it from the ocular tissues surrounding what we call the eye's stagnant water.

The technical difficulties that previously had to be able to inject oxygen continuously from the bottom of water, are now solved, and although the material is not cheap, this is compensated because it has no operating expenses, and its useful life is at least 25 years.

Acknowledgements

This work was supported by Human Photosynthesis™ Research Centre. Aguascalientes 20000.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Davidhizar, R., Dunn, C.L. and Hart, A.N. (2004) A Review of the Literature on How Important Water Is to the World's Elderly Population. *International Nursing Review*, **51**, 159-166. https://doi.org/10.1111/j.1466-7657.2004.00224.x

[2] Nyakundi, V., Munala, G., Makworo, M., Shikuku, J., Ali, M. and Song'oro, E. (2020) Assessment of Drinking Water Quality in Umoja Innercore Estate, Nairobi. *Journal of Water Resource and Protection*, **12**, 36-49. https://doi.org/10.4236/jwarp.2020.121002

[3] Jéquier, E. and Constant, F. (2010) Water as an Essential Nutrient: The Physiological Basis of Hydration. *European Journal of Clinical Nutrition*, **64**, 115-123. https://doi.org/10.1038/ejcn.2009.111

[4] Herrera, A.S., Md Ashraf, G., Esparza, A., del Carmen, M., Tarasov, V.V., Chubarev, V.N., Avila-Rodriguez, M.F., Makhmutova, A., Ganash, M., Mosa, O.F., Hafeez, A., Bachurin, S.O. and Aliev, G. (2018) Cerebrospinal Fluid, Brain Electrolytes Balance,

and the Unsuspected Intrinsic Property of Melanin to Dissociate the Water Molecule. *CNS & Neurological Disorders and Drug Targets*, **17**, 743-756. https://doi.org/10.2174/1871527317666180904093430

[5] Kleiner, S.M. (1999) Water: An Essential But Overlooked Nutrient. *Journal of the American Dietetic Association*, **99**, 200-206. https://doi.org/10.1016/S0002-8223(99)00048-6

[6] Sawka, M.N., Cheuvront, S.N. and Carter, R. (2005) Human Water Needs. *Nutrition Reviews*, **63**, S30-S39. https://doi.org/10.1111/j.1753-4887.2005.tb00152.x

[7] Parker, M.K., Davy, B.M. and Hedrick, V.E. (2021) Current Knowledge Base of Beverage Health Impacts, Trends, and Intake Recommendations for Children and Adolescents: Implications for Public Health. *Current Nutrition Reports*, **10**, 427-434. https://doi.org/10.1007/s13668-021-00376-y

[8] Miller, V.S. and Bates, G.P. (2010) Hydration, Hydration, Hydration. *Annals of Occupational Hygiene*, **54**, 134-136.

[9] Maughan, R.J. (2012) Hydration, Morbidity, and Mortality in Vulnerable Populations. *Nutrition Reviews*, **70**, S152-S155. https://doi.org/10.1111/j.1753-4887.2012.00531.x

[10] Wagner, S., Merkling, T., Girerd, N., Bozec, E., Van den Berghe, L., Hoge, A., Guillaume, M., Kanbay, M., Cakir-Kiefer, C., Thornton, S.N., Boivin, J.M., Mercklé, L., Laville, M., Rossignol, P. and Nazare, J.A. (2022) Quality of Beverage Intake and Cardiometabolic and Kidney Outcomes: Insights from the STANISLAS Cohort. *Frontiers in Nutrition*, **8**, Article ID: 738803. https://doi.org/10.3389/fnut.2021.738803

[11] Moe, C.L. and Rheingans, R.D. (2006) Global Challenges in Water, Sanitation and Health. *Journal of Water and Health*, **4**, 41-57. https://doi.org/10.2166/wh.2006.0043

[12] Sobsey, M.D. and Bartram, S. (2003) Water Quality and Health in the New Millennium: The Role of the World Health Organization Guidelines for Drinking-Water Quality. *Frontiers in Nutrition*, **56**, 396-405.

[13] Murphy, S. (2006) Boulder Area Sustainability Information Network Website. Dissolved Oxygen|US EPA, 02/24/2022.

[14] Herrera, A.S. (2017) Towards a New Ophthalmic Biology and Physiology: The Unsuspected Intrinsic Property of Melanin to Dissociate the Water Molecule. *MOJ Cell Science & Report*, **4**, 49-60. https://doi.org/10.15406/mojcsr.2017.04.00084

[15] Mariacher, S. and Szurman, P. (2015) Künstlicher Glaskörper: Strategien zum Glaskörperersatz [Artificial Vitreous Body: Strategies for Vitreous Body Substitutes]. *Ophthalmologe*, **112**, 572-579. https://doi.org/10.1007/s00347-015-0057-z

[16] Ueki, S., Suzuki, Y. and Igarashi, H. (2021) Retinal Aquaporin-4 and Regulation of Water Inflow into the Vitreous Body. *Investigative Ophthalmology & Visual Science*, **62**, 24 p. https://doi.org/10.1167/iovs.62.2.24

[17] Banks, J.L., Ross, D.J., Keough, M.J., Eyre, B.D. and Macleod, C.K. (2012) Measuring Hypoxia Induced Metal Release from Highly Contaminated Estuarine Sediments during a 40 Day Laboratory Incubation Experiment. *Science of the Total Environment*, **420**, 229-237. https://doi.org/10.1016/j.scitotenv.2012.01.033

[18] Patisaul, H.B. (2021) Reproductive Toxicology: Endocrine Disruption and Reproductive Disorders: Impacts on Sexually Dimorphic Neuroendocrine Pathways. *Reproduction*, **162**, F111-F130. https://doi.org/10.1530/REP-20-0596

[19] Patisaul, H.B. (2021) Endocrine Disrupting Chemicals (EDCs) and the Neuroendocrine System: Beyond Estrogen, Androgen, and Thyroid. *Advances in Pharmacology*, **92**, 101-150. https://doi.org/10.1016/bs.apha.2021.03.007

[20] Amir, S., Shah, S.T.A., Mamoulakis, C., Docea, A.O., Kalantzi, O.I., Zachariou, A., Ca-

lina, D., Carvalho, F., Sofikitis, N., Makrigiannakis, A. and Tsatsakis, A. (2021) Endocrine Disruptors Acting on Estrogen and Androgen Pathways Cause Reproductive Disorders through Multiple Mechanisms: A Review. *International Journal of Environmental Research and Public Health*, **18**, 1464. https://doi.org/10.3390/ijerph18041464

[21] León-Olea, M., Martyniuk, C.J., Orlando, E.F., Ottinger, M.A., Rosenfeld, C., Wolstenholme, J. and Trudeau, V.L. (2014) Current Concepts in Neuroendocrine Disruption. *General and Comparative Endocrinology*, **203**, 158-173. https://doi.org/10.1016/j.ygcen.2014.02.005

[22] Patisaul, H.B. and Adewale, H.B. (2009) Long-Term Effects of Environmental Endocrine Disruptors on Reproductive Physiology and Behavior. *Frontiers in Behavioral Neuroscience*, **3**, Article No. 10. https://doi.org/10.3389/neuro.08.010.2009

[23] Dickerson, S.M. and Gore, A.C. (2007) Estrogenic Environmental Endocrine-Disrupting Chemical Effects on Reproductive Neuroendocrine Function and Dysfunction across the Life Cycle. *Reviews in Endocrine and Metabolic Disorders*, **8**, 143-159. https://doi.org/10.1007/s11154-007-9048-y

[24] Herrera, A.S., Del, C.A., Esparza, M., Md Ashraf, G., Zamyatnin, A.A. and Aliev, G. (2015) Beyond Mitochondria, What Would Be the Energy Source of the Cell? *Central Nervous System Agents in Medicinal Chemistry*, **15**, 32-41. https://doi.org/10.2174/1871524915666150203093656