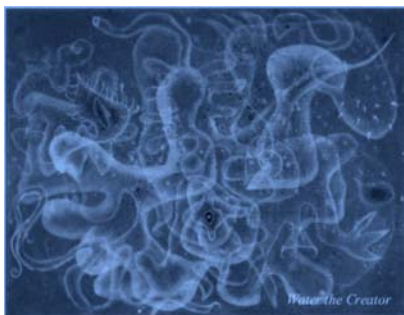




THE SECOND SCIENTIFIC INTERNATIONAL CONFERENCE

WATER AND NANOMEDICINE

August 30, 2011



AND THE FIRST SUMMER SCHOOL

Water and Nanomedicine

August 31, 2011

Academy of Sciences and Arts of Republic of Srpska

Banja Luka

**PROGRAMME
and
THE BOOK OF ABSTRACTS**



PROGRAMME OF THE
SECOND INTERNATIONAL CONFERENCE ON
WATER AND NANOMEDICINE

organized by

Academy of Sciences and Arts of the Republic of Srpska

and

NanoLab, Faculty of Mechanical Engineering, University of Belgrade, Serbia

Under the auspices of

Ministry of Science and Technology of the Republic of Srpska

Ministry of Health and Social Welfare of the Republic of Srpska

University Clinical centre Banjaluka

Faculty of Medicine, University of Banjaluka, Republic of Srpska

The Republic of Srpska Medical Association



*August 30, 2011, Academy of Sciences and Arts of Republic of Srpska
Banja Luka, Republic of Srpska, B&H*

PROGRAMME
and
THE BOOK OF ABSTRACTS

*The Second Scientific International Conference on
WATER AND NANOMEDICINE
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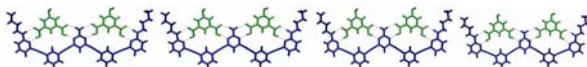
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International Conference on Water and Nanomedicine
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INTRODUCTION

It is reported that Thales predicted an eclipse of the Sun on May 28, 585 BC. In that time it was equal challenge as today prediction of experiments by Large Hadron Collider (LHC) in Geneve. Also, he believed that *water constituted the principle of all things*. If so, than water is not only important for biological life, but in general for understanding matter. How it can make sense? In modern science we beliThales of Miletus eve that hydrogen (and helium) is formed as general cosmic processes, wile oxygen is result of local cosmic activity in stars. Relation between *whole* and *part*, or *general* and *local*, base on the best harmony (the golden mean properties) are present in water molecule. Even more water, as set of water molecules interconnected by hydrogen bonds, satisfied the law of *large numbers*, what lead us to statistical mechanics, entropy and information theory.



Thales of Miletus
(624 – 546 BC)

GOAL OF THE CONFERENCE

The primary goal of the WHBM&NM Workshop is devoted to a broad international forum on the nature of hydrogen bond, science and technology of hydrogen bonding materials and devices. Particular accent will be put on both theoretical and experimental approaches of ordinary, clusters and crystalline water, DNA hydrogen bonding, proteins, metals and other materials. Special attention will be given to role and importance of hydrogen bonds in bulk and nano-structured materials, molecular recognition and water properties and behavior in biology and devices. One of the best expression about importance of hydrogen bonds for system functionality is given by Linus Pauling, who wrote seventy years ago "I believe that as the methods of structural chemistry are further applied to physiological problems, it will be found that the significance of the *hydrogen bond* for physiology is greater than that of any other single structural feature".



Linus Pauling
(1901-1994)

納米科學, 納米技術, 納米醫學



納米統一的水 ~ 納米統一的水 ~ 納米統一的水 ~ 納米統一的水 ~ 納米統一的水 ~ 納米

9:00 – 9:15	Opening ceremony
9:15 – 10:30	Gerald Pollack The University Washington, Seattle, USA <i>The Secret life of Water: $E = H_2O$</i>
10:30 – 11:15	Martin Chaplin Southbank University, London, UK <i>Is water even more complex than we thought?</i>
11:15 – 11:30	Coffee break
11:30 – 12:00	Roumiana Tsenkova Kobe University, Kobe, Japan <i>Aquaphotomics for diagnosis</i>
12:00 – 12:30	Masato Yasui Keio university, Tokyo, Japan <i>Roles of aquaporins in water dynamics of the cells</i>
12:30 – 13:00	Yukio Kosugi Tokyo Institute of Technology, Tokyo, Japan <i>Hyperspectral manipulation for the detection of water based biological abnormalities</i>
13:00 – 13:30	Mae-Wan Ho Institute of Science in Society, London, UK <i>Water, Ions, and the Living Molecular Energy Machine</i>
13:30 – 15:00	Lunch

- 15:00 – 15:20 Milan Jokanović
Faculty of Medicine, University of Banja Luka,
Republic of Srpska, B&H
*The current methods of Nanotoxicity testing in vitro
and in vivo*
- 15:20 – 15:45 Aoife Gowen
Royal College of Dublin, Ireland
Water and Food Quality
- 15:45 – 16:05 Gradimir N. Mišević, Jovana Krstić-Simić, Pascal
Ballet, Maja Mišević, Marko Radisavljević and
Octavian Popescu
*Glycan-Glycan Self-Assembly and Role of water in
Self Non-Self Recognition and Adhesion Implicated
in Evolution of Multicellularity*
- 16:05 – 16:25 Božica Bojović, Đuro Koruga
Faculty of Mechanical Engineering, University of
Belgrade, Serbia
*Micro and nano lubricant behavior of tear film
aqueous layer*
- 16:25 – 16:40 Coffee break
- 16:40 – 17:00 Kewal K. Jain
Jainpharmabiotech, Basel, Switzerland
Nanotechnology and water

- 17:00 – 17:20 Lidija Matija, Roumiana Tsenkova
NanoLab, Faculty of Mechanical Engineering,
University of Belgrade, Serbia
Kobe University, Kobe, Japan
Aquaphotomics of hydrogenated fullerenes
- 17:20 – 17:40 Milena Papić-Obradović
Clinic of Gynecology and Obstetrics Narodni front
Belgrade, Serbia
*Pap smears characterization based on water physical
properties*
- 17:40 – 17:55 Siniša Ristić
Medical Faculty, University of East Sarajevo, Foča,
Republic of Srpska, B&H
The regulation of fluid intake
- 17:55 – 18:10 Jovan Vojinović, Slobodan Čupić,
Dragoslav Đukanović, Đorđe Mirjanić
Medical Faculty Banjaluka, Department of dentistry.
Republic of Srpska B&H
Nanoapatite and the dental enamel remineralization
- 18:10 – 18:25 Đuro Koruga
NanoLab, Faculty of Mechanical Engineering,
University of Belgrade, Serbia
*Water diamagnetic/paramagnetic properties and
golden mean "memristor"*
- 18:25 – 20:00 Poster session and coffee break
- 20:30 – 23:30 Dinner

POSTERS

1. Aleksandar Tomić, Danica Mladenović, Marija Tomić,
Ivan Đuričić, Rudolf Vojnić-Tunić, Đuro Koruga
*Deuterium contents in water and conductivity of water correlated
with spectral parameters in opto-magnetic method*
2. Dragoljub Lj. Mirjanić, Ana J. Šetrajčić Tomić,
Vladan D. Mirjanić, Jovan P. Šetrajčić *Core-multy-shell model for
drug delivery*
3. Svjetlana Pelemiš, Dragoljub Lj. Mirjanić, Jovan P. Šetrajčić
Nanostructure for rentgen diagnosis
4. Želimir Erić, Zvezdana Rajkovača, Mirko Stanetić,
Predrag Kovačević, Z. Bajić
Water physiology of the neonate
5. Peđa Kovačević, Mirko Stanetić, Zvezdana Rajkovača, Jadranka
Vidović, Tijana Marinković, Saša Dragić
The significance of extravascular lung water in criticall ill patients
6. Zora Levi, Jelena Penavin, Slavica Sladojević, Jovan B. Škundrić,
Darko Bodroža, Branko Škundrić
*Study of phenol adsorption from the aqueous environment on the
modified alumina*
7. Saša Zeljković, Jelena Penavin Škundrić, Dijana Jelić,
Jovan Škundrić
*Adsorption of methyl violet from the water environment on
 $\text{BaCe}_{0.9}\text{Gd}_{0.1}\text{O}_3$ perovskite*
8. Predrag Milosavljević
Geometric and constructible simplicity of the water molecule structure
9. Zorana Golubović
Studies of exclusion zones in water and aqueous solution

10. Jelena Munćan
A comparative study of structure and properties of water by IR and Opto-magnetic spectroscopy.
11. Čedo Lalović, Jelena Munćan
Biological value of water
12. Goran Janjić, Jelena Munćan
Influence of carcinogen compounds on hydrogen bonds in water
13. Marija Tomić, Dragomir Stamenković, Nikola Jagodić, Jovana Šakota,
Contact lenses material influence on aqueous solutions
14. Suzana Miljković, Dušan Šarac
Epidermal water importance for skin properties
15. Danica Mladenović, Branislava Jeftić, Jadran Bandić
Solid materials, skin and water characterization by opto-magnetic method
16. Marko Đukić, Ivana Mileusnić
Water importance in extracellular space
17. Igor Hut, Vojin Munćan
Water importance in cytoplasm
18. Jovana Šakota, Ružica Sofrenić, Nikola Jagodić
Water importance for human eye functionality
19. Jovan Vojinović, Čupić Slobodan, Olivera Ilić, Vladan Mirjanić, Slava Sukara, Marija Obradović
Nanocaracteristics of materials for reparation of demineralized enamel
20. Nataša Mišić
A Potential Fundamental Role of Water in the Selection of Canonical Amino Acid Set

The First International Summer School on

WATER AND NANOMEDICINE

August 31, 2011, Banja Luka, Republic of Srpska, B&H

9:00 – 10:30	Kewal K. Jain	<i>NanoOncology-Overview</i>
10:30 – 12:00	Masato Yasui	<i>Water Biology: From aquaporin to MRI</i>
12:00 – 12:15	Coffe break	
12:15 – 13:15	Yukio Kosugi	<i>Hyperspectral imaging and analysis</i>
13:30 – 15:00	<i>Lunch</i>	
15:00 – 16:30	Gerald Pollack	<i>Water: the Untold Story</i>
16:30 – 17:30	Martin Chaplin	<i>Water and Life</i>
17:30 – 17:45	Coffe break	
17:45 – 18:30	Mae -Wan Ho	<i>Energy transduction in living organism s</i>
18:30 – 19:15	Aoife Gowen	<i>Basis of techniques for understanding the role of water in biological systems</i>
19:15 – 19:35	Milan Jokanović	<i>Chemical cancerogenesis</i>
19:35 – 19:55	Milan Jokanović	<i>Toxically effects of chemical and medicinal products on the skin</i>
20:00 – 22:00	Dinner	

PLENARY SESSION

THE SECRET LIFE OF WATER: $E = H_2O$

Gerald H. Pollack, PhD
University of Washington, Seattle

School children learn that water has three phases: solid, liquid and vapor. But we have recently uncovered what appears to be a fourth phase. This phase occurs next to water-loving (hydrophilic) surfaces. It is surprisingly extensive, projecting out from the surface by up to millions of molecular layers. Of particular significance is the observation that this fourth phase is charged; and, the water just beyond is oppositely charged, creating a battery that can produce current. We found that light recharges this battery. Thus, water can receive and process electromagnetic energy drawn from the environment – much like plants. The absorbed light energy can then be exploited for performing work, including electrical and mechanical work. Recent experiments confirm the reality of such energy conversion. The energy-conversion framework implied above seems rich with implication. Not only does it provide an understanding of how water processes solar and other energies, but also it may provide a foundation for simpler understanding natural phenomena ranging from weather and green energy all the way to biological issues such as the origin of life, transport, and osmosis. The lecture will present evidence for the presence of this novel phase of water, and will consider the potentially broad implications of this phase for physics, chemistry and biology, as well as some practical applications for engineering (all in one hour!).

References:

[1] Zheng, J.M., Chin, W. C, Khijniak, E., Khijniak, E., Jr., Pollack, G. H. *Surfaces and Interfacial Water: Evidence that hydrophilic surfaces have long-range impact.* Adv. Colloid Interface Sci. 127: 19-27, 2006.

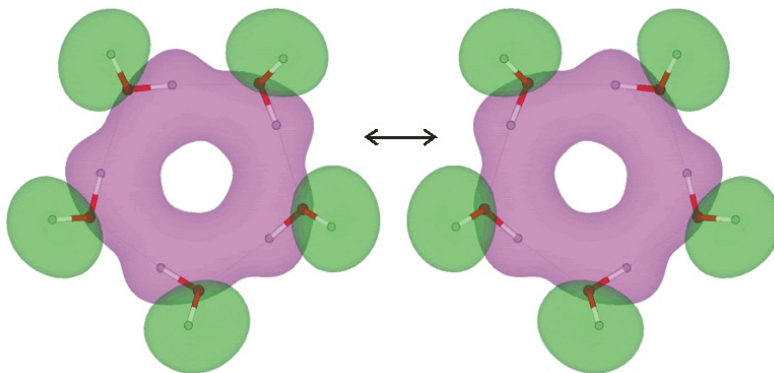
[2] Pollack, GH and Clegg, J: *Unsuspected Linkage Between Unstirred Layers, Exclusion Zones, and Water.* In: Pollack, G.H. and Chin, W.-C. *Phase Transitions in Cell Biology*, Springer, pp 143 – 152, 2008.

[3] Chai, B, Yoo, H. and Pollack, GH: *Effect of Radiant Energy on Near-Surface Water.* J. Phys. Chem B 113: 13953-13958, 2009.

IS WATER EVEN MORE COMPLEX THAN WE THOUGHT?

Martin Chaplin, PhD CChem FRCS,
Emeritus Professor, Southbank University, London, UK

Everyone knows some of the properties of liquid water. Often they think of these properties as typical of liquids in general; for example, most people mistakenly believe most liquids dissolve gasses less well at higher temperatures. However liquid water only behaves similar to most other liquids at very high temperatures (i.e when superheated) and atypically behaves strangely at low temperatures. Overall, liquid water can be considered as an intimate mixture of two miscible liquid phases, one predominant at lower temperatures and the other predominant at higher temperatures. Hydrogen bonding is generally said to be the cause of these phenomena but confusion still exists over what 'hydrogen bonding' in water entails. No longer should we simply describe (or model) liquid water in terms of individual water (H₂O) molecules or describe water's hydrogen bond as simple electrostatic interactions between discrete molecules. We must consider both proton quantum effects and extensive electron delocalization within network(s) of water molecules (i.e. neither water's protons nor its electrons are pinned to individual molecules. Although these concepts run counter to the commonly held belief that liquid water may be treated as other liquids, such obstructive philosophy runs counter to experimental science. This lecture attempts to put the record straight and describe the true picture that is 'liquid water'.



Electron and proton delocalization in a water pentamer (H_2O)₅. Shown is molecular orbital eleven out of twenty-five showing the electron overlap possible for extended hydrogen bonding.

References:

- [1] M. F. Chaplin, *Water structure and science*, (2011) <http://www.lsbu.ac.uk/water/index2.html>
- [2] E. Del Giudice, E. C. Fuchs and G. Vitiello, *Collective molecular dynamics of a floating water bridge*, WATER 2 (2010) 69-82.
- [3] G. F. Reiter, A.I. Kolesnikov S. J. Paddison, P. M. Platzman, A.P. Moravsky, M. A. Adams and J. Mayers, *Evidence of a new quantum state of nano-confined water*, arXiv:1101.4994v1 [cond-mat.mes-hall] 26 Jan 2011.

AQUAPHOTOMICS FOR DIAGNOSIS

Roumiana Tsenkova, Kobe University, Japan

Water absorbance patterns of biological fluids have been analyzed under various physiological conditions. Typical spectral patterns have been found for estrus detection when analyzing urine of Giant Panda and milk from a dairy cow. Multivariate analysis of spectral data acquired from several animals and in a monitoring manner proved that the best diagnostic results were obtained when using the wavelength range of the first overtone of water absorbance. Water absorbance patterns showed changes adequate with the hormonal changes. These results proved the concept of aquaphotomics presenting water as an extended mirror on molecular level where water molecular structure is shaped by the rest of the molecules in the system changing under perturbations and near infrared light makes these changes visible.

References:

- [1] Tsenkova, R. 2009. *Aquaphotomics: dynamic spectroscopy of aqueous and biological systems describes peculiarities of water*. Journal of Near Infrared Spectroscopy 17: 303-313.
- [2] Tsenkova, R., Atanassova, S., Morita, H., Ikuta, K., Toyoda, K., Iordanova, I. K. and Hakogi, E. 2006. *Near infrared spectra of cows' milk for milk quality evaluation: disease diagnosis and pathogen identification*. Journal of Near Infrared Spectroscopy 14: 363-370.
- [3] Tsenkova, R., Atanassova, S., Ozaki, Y., Toyoda, K. and Itoh, K. 2001. *Near-infrared spectroscopy for biomonitoring: influence of somatic cell count on cow's milk composition analysis*. International Dairy Journal 11: 779-783.

ROLES OF AQUAPORINS IN WATER DYNAMICS OF THE CELLS

Masato Yasui

Department of Pharmacology
School of Medicine, Keio University, Tokyo, Japan

The discovery of the water channel aquaporin (AQP) greatly expanded our understanding of the regulation of the water permeability of biological membranes (1). The atomic structure of aquaporin-1 (AQP1) demonstrated how aquaporin is freely permeated by water but not protons, and provided marked insight into several human disorders (2). 13 mammalian AQPs have been identified, each with a distinct distribution. A live imaging of AQP-mediated water transport will facilitate our understanding of the biological relevance of AQP. We have developed a nonlinear optical microscopy technique, the coherent anti-stokes Raman scattering (CARS) imaging, to directly and quantitatively image water transport through cell membranes. We also apply molecular dynamics simulation to understand the water dynamics adjacent cell membranes (3). I will present our recent findings regarding to water dynamics of the cells as well as AQP functions.

References:

- [1] Preston GM, Carroll TP, Guggino WB, et al: *Appearance of water channels in Xenopus oocytes expressing red cell CHIP28 protein*. Science 1992; 256(5055): 385-7
- [2] Kozono D, Yasui M, King LS, et al: *Aquaporin water channels: atomic structure molecular dynamics meet clinical medicine*. J Clin Invest 2002; 109(11): 1395-9
- [3] Hirano Y, Okimoto N, Yasuoka K, Taiji M, Suematsu M, and Yasui M: *Molecular Mechanisms How Mercury Inhibits Water Permeation of Aquaporin-1: Understanding by Molecular Dynamics Simulation*. Biophys J. 21;98(8): 1512-9, 2010

HYPERSPECTRAL MANIPULATION FOR THE DETECTION OF WATER BASED BIOLOGICAL ABNORMALITIES

Yukio Kosugi¹, Kuniaki Uto², Hamed Akbari³,
Kazuyuki Kojima⁴, Naofumi Tanaka⁵
^{1,2,3} Tokyo Institute of Technology
^{4,5} Tokyo Medical and Dental University

Activities in biological tissues as well as in vegetables inevitably depend on the water and the abnormal status will accompany some changes in water. By combining the reflectance values, we may effectively find out these changes. In this presentation, we will discuss the hyperspectral methods for the detection of biological tissue abnormalities, including water stress of forests and agricultural plants, ischemia and gastric cancers for medical purposes. The first case is the hyperspectral analysis for the evaluation of water stress in vegetables. For promoting the Green Innovation, it is important to protect CO₂-absorbing forest. One of the most simple and effective evaluation of water stress is to combine the reflectance values at 1280 nm and 1460nm as:

$NWI_{SWIR} = -(R_{1280} - R_{1460}) / (R_{1280} + R_{1460})$, based on the water absorption profile shown in Fig.1. Japanese oak wilt which has been rapidly spreading throughout Japan in recent years [1], can be evaluated from remotely sensed hyperspectral images. Water stress evaluation is also important for producing good-taste agricultural products.

In the case of intestinal ischemia, water related reflectance changes can be significantly observed both in NIR and SWIR regions, to be manipulated by a support vector machine for the detection of ischemic region [2]. In the third case, we have evaluated the variance of the reflectance in the SWIR wavelength domain as well as in the special domain, for the detection of cancerous area on the gastric tissues [3].

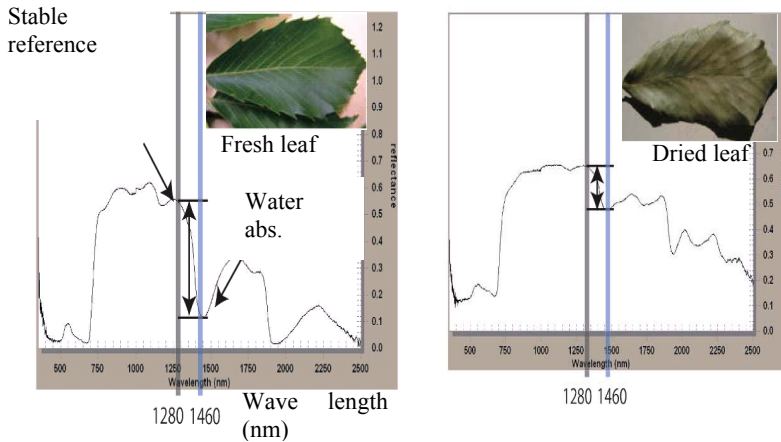


Fig.1 Reflectance profiles for fresh and dried leaf of oak tree

Refereces:

- [1] Kuniaki Uto, Yukio Kosugi: *Evaluation of oak wilt index based on genetic programming*, Proc. First Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (Grenoble 2009)
- [2] Hamed Akbari, Yukio Kosugi, Kazuyuki Kojima and Naofumi Tanaka: *Detection and Analysis of the Intestinal Ischemia Using Visible and Invisible Hyperspectral Imaging*, *IEEE Trans. on Biomedical Engineering*, Vol.57, No.8, pp. 2011-2017 (2010)
- [3] Hamed Akbari, Kuniaki Uto, Yukio Kosugi, Kazuyuki Kojima and Naofumi Tanaka: *Cancer Detection Using Hyperspectral Imaging*, *Cancer Science* (in press 2011)

LIQUID CRYSTALLINE WATER AND THE “ENGINE OF LIFE”

Mae-Wan Ho,
Institute of Science in Society, London, UK

Liquid crystalline water is the multiple layers of polarized water molecules that form dynamically coherent units with the macromolecules embedded in it. It's been 19 years since we discovered in my laboratory that organisms are liquid crystalline and quantum coherent; and the two are intimately linked. The highly polarized continuum of liquid crystalline proteins and water extends throughout the intracellular matrix into the interior of every single cell, enabling each cell (or ultimately each molecular energy machine) to intercommunicate with every other, which is what quantum coherence of the organism entails.

Since then, many relevant research findings have been published on the remarkable properties of bulk liquid water as well as water of hydration of macromolecules and ions. However, the major mystery of liquid crystalline water in the organism and in the cell has remained almost untouched.

In my lecture, I shall review some of the most relevant discoveries made by mainstream researchers within the past five years, which lend support to the idea that water's quantum coherence is the basis of life. I shall then go on to connect and reinterpret those findings with perhaps the most important unrecognized body of work in cell physiology – that of Gilbert Ling and those inspired by him – to give an up-to-date picture of the quantum coherent liquid crystalline organism. Finally, I shall indicate some major gaps in our knowledge and how they could be addressed.

References:

- [1] Ho MW. *The Rainbow and the Worm, the Physics of Organisms*, 1993, 1998 (2nd ed), 2008 (3rd ed), World Scientific, Singapore, London.
- [2] Ho MW. *Water's quantum jazz*. *Science in Society* 48, 6-21, 2010.

[3] Ling GN. *Life at the Cell and Below-Cell Level, The Hidden History of a Fundamental Revolution in Biology*, Pacific Press, New York, 2001.

[4] Ho MW, Zhou Y-M, Haffegge J, Watton A, Musumeci F, Guisepp Privitera G, Scordino A and Triglia A. *The liquid crystalline organism and biological water. In Water and the Cell* (Pollack GH, Cameron IL and Wheatley DN eds), pp. 219-34, Springer, 2006, <http://www.i-sis.org.uk/onlinestore/papers1.php#section3>

[5] Collins KD. *Ion hydration: implications for cellular function, polyelectrolytes, and protein crystallization*. Biophysical Chemistry 2006, 119, 271-81.

[6] Ling G. *Nano-protoplasm: the ultimate unit of life*. Physiol Chem Phy & Med NMR 2007, 111-234.

THE CURRENT METHODS OF NANOTOXICITY TESTING IN VITRO AND IN VIVO

Milan Jokanović

Academy of Sciences and Arts of the Republic Srpska, Banjaluka

Nanotoxicology refers to the study of the interactions of nanomaterials with biological systems with an emphasis on elucidating the relationship between the physicochemical properties (size, shape, surface chemistry, composition, aggregation) of nanomaterials with induction of toxic biological responses. In the past, a majority of nanotoxicity research has focused on cell culture systems. The results obtained in these studies are frequently of limited importance since the nanomaterials are not exposed to biological processes in living organisms. In vivo nanotoxicity testing is very complicated and the interactions of the nanomaterials with biological systems, such as cells, proteins and other macromolecules, could lead to specific absorption, distribution, metabolism, elimination as well as inflammatory, immune and other responses. In this short presentation, the current methods of nanotoxicity testing will be discussed.

WATER AND FOOD QUALITY

Aoife A. Gowen

Royal College of Dublin, University College Dublin, Ireland

Food quality is essentially a multivariate concept, encompassing a number of quantifiable properties, such as color, moisture content, texture, and other, more elusive, properties such as aroma and taste. Most fresh foods contain more than 70% water, thus water status is a deeply related to quality. Drying prolongs the shelf life of foods by reducing the amount of water available for undesirable chemical reactions and microbial proliferation. In order to maximize consumer acceptability, it is generally accepted that the dry product should resemble the fresh one as much as possible. However, the removal of water during drying inevitably alters food structure and composition, and can result in quality deterioration, the extent of which depends both on the drying method and processing conditions. Therefore, in order to optimize any drying method it is necessary to quantify the extent of quality change that occurs during the drying process. The concept of water activity has enjoyed widespread use in the estimation of food quality since the 1970's, when it was found that water activity, rather than moisture content, could explain many of the deteriorative reactions occurring in foods (Labuza, 1980). Water activity (a_w) is a dimensionless measure of the free water in a food system, available to support biological, physical and chemical reactions. It is related to the concept of vapor pressure, i.e. the pressure exerted by a vapor held in equilibrium with its solid or liquid state. More precisely, water activity can be defined as the ratio of vapour pressure of water (in a food or otherwise) to that of pure distilled water at the same temperature. During dehydration, the majority of free water contained in a food is removed and a_w subsequently decreases, inhibiting the onset of undesirable reactions such as lipid oxidation and microbial growth. Near infrared spectroscopy (NIRS) has been developed as a non-destructive tool for food quality monitoring. It has been observed that in many foods the NIR signal is dominated by the absorbance of water and multivariate analysis of NIRS shows again and again the water absorbance band, located around 1300-1500 nm, is the

main contributor to quality prediction. This confirms that water status is a key indicator of food quality. Indeed, the concept of water activity is intimately related to NIRS: as the amount of free water in a system is increased, spectral features around 1400 nm increase in intensity. More recently, NIRS has been applied for the evaluation of water status in food systems. This can be understood within the framework of Aquaphotomics, a new scientific discipline that investigates the structure of water in biological systems through the prism of NIRS. Aquaphotomics has been applied to understanding the role of water in food quality, for instance in the detection of surface damage in mushrooms or for the quality prediction of milk (Tsenkova, 2010). However, despite these recent advances, our understanding of the role of water in foods is still in its infancy. The role of water in food flavor is one area that remains relatively unexplored. The development of new food products with increased functionality and health promoting properties (e.g. reduced salt and fat) all require knowledge of the function of water in food systems. It is envisaged that the development of novel techniques for understanding the role of water in biological systems, such as Terahertz time domain spectroscopy and opto-magnetic fingerprinting, will open up new avenues of research on this fascinating subject.

References:

- [1] T.P. Labuza, *The effect of water activity on reaction kinetics of food deterioration*, Food Technology 34 (4) (1980), pp. 36–41 59.
- [2] R. Tsenkova, *Introduction Aquaphotomics: dynamic spectroscopy of aqueous and biological systems describes peculiarities of water*, Journal of Near Infrared Spectroscopy. 17 (2009) 303-313.

**GLYCAN-GLYCAN SELF-ASSEMBLY AND ROLE OF WATER
IN SELF NON-SELF RECOGNITION AND ADHESION
IMPLICATED IN EVOLUTION OF MULTICELLULARITY**

Gradimir N. Mišević^{1*}, Jovana Krstić-Simić², Pascal Ballet³, Maja Mišević⁴,
Marko Radisavljević¹, Octavian Popescu⁵

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⁵ Molecular Biology Center and Institute for Interdisciplinary Experimental

Research, Babes-Bolyai University, and Institute of Biology,

Romanian Academy, Bucharest, Romania

Glyconectin glycan are the self-assembling nano-molecular-velcro system mediating initial steps of self non-self recognition and cell adhesion in Porifera, the first descendants of the most simple primordial multicellular organisms.

Three original findings will be described: i) Velcro like concept based on highly polyvalent and specific intermolecular glycan to glycan associations with extremely low affinity of the single binding site, and ii) novel structures of the large and newly emerging family of glyconectin like glycan molecules, iii) role of water and ions in glyconectin type of glycan to glycan self-assembly. The emphasis will be put on the interdisciplinary approach for studying structure to function relationship at the different size scale levels by combining the knowledge and technologies (instrumentation and methods) of physics, chemistry, biology and mathematics. Applying such strategy which is crossing the boundaries of different science disciplines enabled us to develop a new Atomic Force Microscopy (AFM) based nano-bio-technology and perform the first quantitative measurements of intermolecular binding forces at the single molecular level under physiological conditions.

We propose that nano-velcro systems of the glyconectin glycans, which are the constituents on the cell surface that are the most exposed to

the environment, were responsible for the molecular self non-self recognition and adhesion processes that underpinned the emergence of multicellular life forms.

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MICRO AND NANO LUBRICANT BEHAVIOR OF TEAR FILM AQUEOUS LAYER

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Tear film is comprised of three layers that covers the cornea and conjunctiva. The outer lipid layer seals the middle aqueous layer tear film on the eye and helps to prevent evaporation. The inner mucus layer coats the cornea, forming a foundation so the tear film can adhere to the eye. This aqueous layer is made of 98% water contains substances that inhibit the growth of microorganisms, along with proteins, salt and other compounds. Tears provide moisture and supply oxygen and other important nutrients to the cornea, mechanically trap and flush out foreign bodies and chemicals and keep the surface of cornea smooth and in that way make it optically clear. The accessible results support a value of approximately 3 μ m for the thickness of the human pre-corneal tear film and approximately 2 μ m for dry eye. During blinking, tear film lubricates the friction area between lids and ocular surface.

The tear film breakup is most severe in subjects with thin tear films, especially contact lens wearers. The presence of any contact lens on the front surface of the eye influences and disturbs tear film stability. Additionally, the contact lens wearers often suffer from dryness because of the tear film absorption, causing proteins to form on the surface of the lens. These changes in the tear film are caused by contact lens design, surface, material and applied solution for conditioning. The thickness is one of many factors that influence the symptoms of dryness and discomfort with contact lens wear. In case of application of gas-permeable contact lens, the multi-factorial problem of tear film stability and therefore maintaining of lubrication function are main goals in the ongoing investigation.

This paper focuses on applied research of gas-permeable contact lens basic material. The aim is to test the response of material's surface roughness quality to retain tear film on the micro and nano-level using a

gliding-box method for lacunarity analysis. The topology of contact lens surface with tear film as the lubricant is studied considering water as primary consistent in its bulk liquid form, as well as confined water film organized into layers in a nanometer-sized channel. Contact lens surface topology observed on micro and nano scale indicates different lubrication behavior of aqueous tear layer. Opposing to bulk water as a disordered medium in micro scale that flows very readily, nanowater demonstrates the behavior effectively like some phases of liquid crystals.

Lacunarity analysis (Latin word “lacuna” meaning lake) is a method that additionally describes surface topography and provides comparison. Distribution of asperities accumulated in a specific way form lacunas that represent an empty space that will be filled with lubricant. Lacunarity analysis is applied to contact lens images gathered by atomic force microscopy. Images are processed by the gliding box method, an in-house made Matlab application. Contact lens frontal surface has to maintain tear film between blinks and therefore, results of lacunarity analysis contribute to adequate surface topology selection for convenient use.

To conclude with words that prof. Riedo who found evidence suggesting that pure water was organized into layers in a nanometer-sized channel “Water is a wonderful lubricant, but it flows too easily for many applications. At the one nanometer scale, water is a viscous fluid and could be a much better lubricant.”

NANOTECHNOLOGY AND WATER

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This presentation will start with role of nanobiotechnology in study of biological systems in a water environment, e.g. functional nanometer-scale structures in the cell such as genetic material, membranes, enzymes and molecular machines. The knowledge gained has applications in nanomedicine. Nanoparticles have practical applications in detection of water pollution and water purification, which is of public health importance worldwide.

AQUAPHOTOMICS OF HYDROGENATED FULLERENES

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A spectrum of water in the VIS-NIR range 680-2500 nm has the first and the second overtones. A dynamic spectroscopy of the second overtone has been used to explore water as a system of 12 specific wavelengths in the domain 1330-1520 nm [1, 2]. In this research NIR spectroscopy, in the range 890-1120, is used to characterise 18.2 MΩ water and NHS¹ (Fig.1a). A significant difference of spectrum has been observed. In the second step a human skin is characterised under three different conditions: non treated, treated by the emulsion (a solution of cream base) and the cream with NHS (Fig.1b). Despite skin is 70% water, the spectra of water (Fig.1a) and non treated skin (Fig.1b) are showing a significant difference. However, the difference in the spectra between water (Fig.1a) and skin treated with emulsion (Fig.1b) is less. The spectra of NHS (Fig.1a) and skin treated by cream (which contain NHS) are similar (Fig.1b).

¹ NHS-Nano-Harmonized Substance is mixture 50 µg/l of [C₆₀(OH)₂₄@ 72 H₂O]^{®/®} and 18.2MΩ water

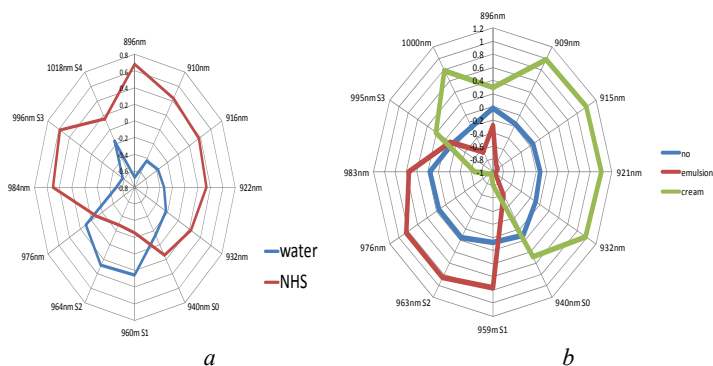


Fig.1. a) aquagram of water and NHS in the first overtone, b) spectrum of human skin: not treated, treated by emulsion and treated cream which contains NHS

Further work is needed for deeper understanding of relation between the first and second overtone, and meaning of wavelengths for NHS, emulsion and cream.

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PAP SMEARS CHARACTERIZATION BASED ON WATER PHYSICAL PROPERTIES

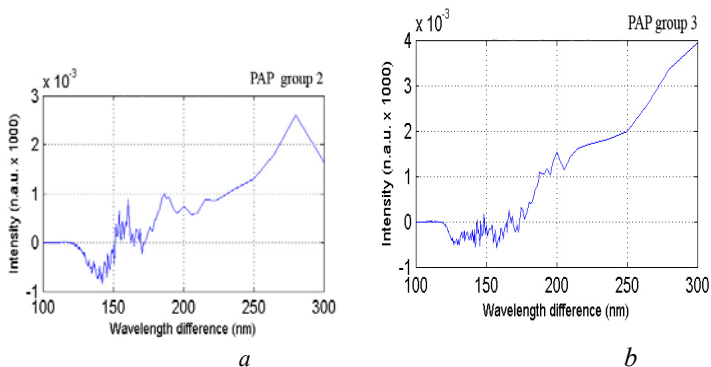
Milena Papić-Obradović^{1,2}

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Cervical cancer and endometrial carcinoma are the most common invasive cancers of the female genital tract and account for 12% of all invasive cancer in women, excluding skin cancer [1]. In this study, we used samples prepared for PAP test and examined them using digital imaging spectroscopy (DI-OMS) [2]. Based on previous investigation [3] our goal is to apply same method to detect normal, dysplastic and cancerous cells, with as higher as possible accuracy. Samples were prepared, according to standard and staining procedures used for Pap smear tests during regular colposcopic examination.

DI-OMS method is based on image analysis using red and blue channels of water and tissue. Algorithm for analysis of light-matter interaction is based on spectral convolution technique [2].



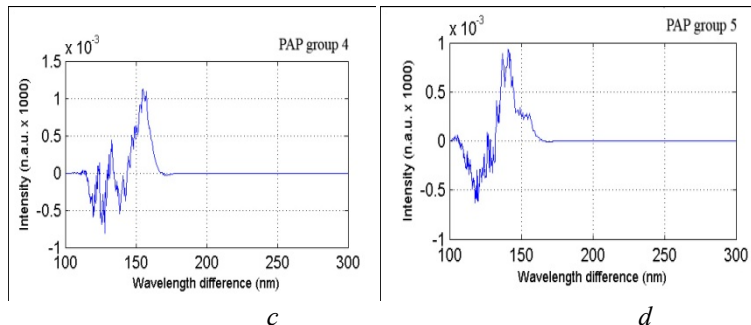


Fig. 1: Digital imaging spectroscopy of PAP smears: a) normal cells, b) dysplastic cells, c) carcinoma in situ d) carcinoma

Our future work is directed towards to water based medicine and water behavior on nano scale. This approach could contribute with finding higher sensitivity to tissue changes and will enable us to conduct a more objective systematization of the results and fully appreciate the possibilities that are offered.

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THE REGULATION OF FLUID INTAKE

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The regulation of fluid intake by the brain is complex and multifactorial. Thirst, which is important for maintaining body fluid homeostasis, may arise from intracellular or extracellular fluid volume deficit or hyperosmolarity. Various signals like as osmotic, ionic (hypernatremia), hormonal (ADH, aldosterone, ANP, angiotensin II, etc), and nervous (relayed from baroreceptors) converge on, and are integrated within, the brain. Consequentially, neural circuitry that subserves the conscious perception of thirst, like as organum vasculosum laminae terminalis, area postrema and other structures may become activated. The efferent pathways from that structures which mediate thirst are unknown.

NANOAPATITE AND THE DENTAL ENAMEL REMINERALIZATION

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Dental caries and enamel erosions are the most prevalent dental pathology conditions leading to sever tooth damages. The basic pathological mechanisms are mineral loss from the complex inorganic phase. Specific ultra structural hierarchy of enamel formed trough enamel protein matrix reorganization, named maturation, lack in the cellular guided reparation. On the sounded enamel surface there is dynamic exchange of calcium and phosphate minerals. External factors could disturb the equilibrium, stimulating demineralization with the final result in the cavity formation. The only scientifically proved way to induce remineralisation since now is the presence of fluoride on the tooth surface imbibed in the saliva supersaturated with calcium and phosphor ions. They are transformed into the crystalline lattice of carbonated hydroxyl apatite (CHA). Fluorides are connected with some health and ecological risks, and there is need to search some new regenerative ageneses. In the article is presented the application of nanoapatite complexes as a direct reservoir for the enamel mineral phases reparation. The comparative comparison was made with fluorides and other regenerative materials. This material is similar to basic enamel crystals (less than 100 nm) and is capable to incorporate in the enamel prisms defects and form compact, mechanically resistant surface layer. Investigations support that the layer, as a biological replica, could inhibit dental biofilm formation, has higher acid resistance, and remineralizes early lesions without adverse effects. This material is similar to basic enamel crystals (less than 100 nm) and is capable to incorporate in the enamel prisms defects and form compact, mechanically resistant surface layer. Investigations support that the layer, as a biological replica, could inhibit dental biofilm formation, has higher acid resistance, and remineralizes early lesions without adverse effects. It is also presented the influence of enamel proteins upon the formation of nanoapatite complexes in enamel prisms and possible bioengering induction of enamel formation.

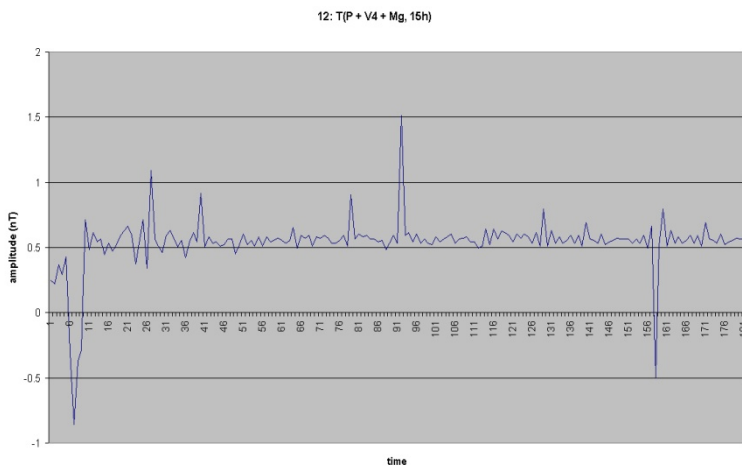
WATER DIAMAGNETIC/PARAMAGNETIC PROPERTY AND GOLDEN MEAN “MEMRISTOR”

Đuro Koruga

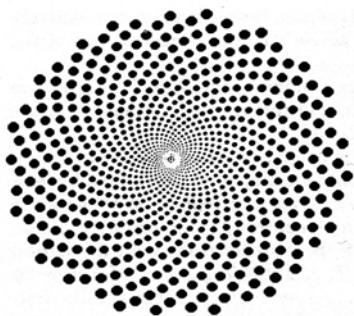
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For many years there is a controversy about “water memory”. Does water under certain conditions may have memory property? If *not*, we have the problem to explain origin of life and crucial functionality of living systems, but if *yes* we are have the problem to explain how it is possible. In this paper this dilemma is considered from diamagnetic/paramagnetic dynamics of water during its clustering. The experimental result obtained (Fig.1a) indicate that water clusters, as nanoscale structures, posses magnetic flux linkage (Φ_m), which depends on the amount of charge q that has passed between a two-terminal variable resistor of cluster. In this case water cluster resistance is a function of the history of the current through and voltage across the structure. This leads to appearance of water memory (M) based on water/clusters resistance; $M = d\Phi_m/dQ$, and has the “memristor” property.

The idea of “memristor” existence, as a forth basic circuit element (resistor, capacitor, inductor) came from Leon Chua in 1971 [1], strongly supported in 2004 [2], and finally experimentally proved 2008 [3]. Using a water, here is shown that memristance arises naturally in clustering water (nanoscale systems) in which cluster “solid state electronic” and ionic transport are coupled under an external bias voltage/external oscillatory magnetic field with the Larmor frequency. According to paramagnetic/diamagnetic values of a water dynamics (Fig1a), clustered water under the treatment by the Larmor frequency posses the Golden mean memristor.



a



b

Fig. 1: a) Paramagnetic (up peaks)/ diamagnetic (down peaks) dynamics of water, which was ten hours before measurement under influence of oscillatory magnetic field with the Larmor frequency (water with constant paramagnetic property of about 0.5 nT). b) schematic image of "water Golden mean memristor" based on paramagnetic/diamagnetic (left/light dots spiral) water dynamics.

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POSTER SESSION

DEUTERIUM CONTENTS IN WATER AND CONDUCTIVITY OF WATER CORRELATED WITH SPECTRAL PARAMETERS IN OPTO-MAGNETIC METHOD

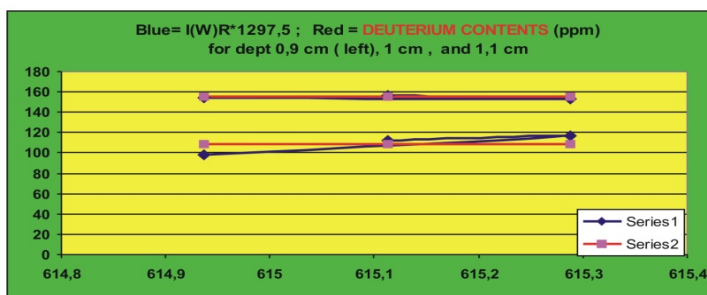
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Physical method for characterization of mater, denoted as opto-magnetic, in which are used specifically Raman type spectra in physiologically diffuse white and polarized white light (Koruga, Tomić, 2009), now we tested to description of deuterium contents in water and independent to water conductivity. This method gives a lot possibility for description of mater, presents a non invasive reliable method for medical diagnostics etc. (Tomić A., 2010).

In previous attempts we confirmed our presumption that by application so sensitive method as it is opto-magnetic, must be present dependence of water response from water layer thickness. Here we used thickness 0,9 cm, 1 cm and 1,1 cm. Opto-magnetic parameters appeared for these values as slowly depending of thickness, what gives possibility for estimation of water dept by conductivity measure realized independent.



Description of experiment and obtained results would be presented. Because this method is very simple to application, and giving reliable repeatable results from these follows interest for this method application.

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CORE-MULTY-SHELL MODEL FOR DRUG DELIVERY

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The subject of the research in this paper include modeling of nanomaterials in the field of pharmaceutical technology for biomedical application. This includes very precise in the human tissue or organ and disintegrating of capsule – drug carrier, so that the medicament can start producing its effect. The goal of multidisciplinary researches with biocompatible molecular nanomaterials is to find the parameters and the possibilities to construct boundary surfaces that will, in interaction with biological environment, create such properties of nanolayers that are convenient for use for layers of drug carrier capsules, biochips and biomarkers

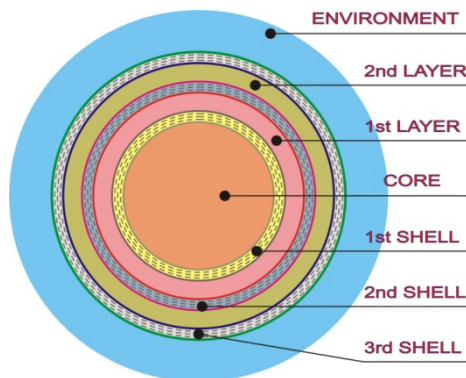


Fig. 1. Core-multy shell ultrathin crystalline model

In this paper we developed innovated core-shell model which is consisted by core and more shells (Fig. 1)- core-multi shell model. According to this model one shell could consist antibiotic, another shell could consist some other medicament, and core could be consisted by third medicament. We conducted this research with the help of two-time dependent Green's function method, adjusted to ultrathin crystalline structure analysis. It is shown that specific resonant absorption lines appear in these structures, the number of which depends on crystal layers position and on values of parameters on multi shell-structure boundary surfaces. Afterwards, we expect that analyze will show that time of desintegration of each shell depends on need and that position of Q-dots in body will be observed.

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NANOSTRUCTURE FOR RENTGEN DIAGNOSIS

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Nanostructures represents a new type of contrast fascilities which can be used for medical diagnosis by the application of magnet resonance, rentgen computer tomography, ulatrasound diagnosis etc. Teh picture got by computer tomography can be improved significantly by using nano-structured contrast fascilities. Ionization radiation in medicine is very important fascility in diagnostic. Instead of developing of alternative methods, diagnosis methods with the X-ray application are non-substitutable.

New diagnostic techniques are based on application of rentgen radiation i new technological digital solutions. Nanostructures can significantly respond on improving of clearence of in vivo picture, as well as of some other biological systems and living organisms.

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WATER PHYSIOLOGY OF THE NEONATE

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Water and electrolyte homeostasis in newborn infants is influenced by physiologic adaptations following birth and developmental effects on the distribution of total body water and water loss. The mechanisms contributing to water balance can be outlined as: afferent and efferent mechanisms. Afferent mechanisms, involving hypothalamic osmoreceptors; non-osmotic arginine vasopressin sensors, activated by pain, stress, vomiting and extracellular fluid changes; and thirst sensors. Efferent mechanisms, including arginine vasopressin release, and increased thirst.

Total body water is composed of extracellular fluid (which includes interstitial fluid and intravascular) and intracellular fluid. The distribution between these compartments changes and depends of the gestational age. Extracellular fluid comprises: blood plasma, lymph, transcellular fluids (intra-ocular, pericardial, peritoneal, pleural and synovial fluids), cerebrospinal fluid and glandular secretions. Normal blood volume for: preterm infant is 90–105 ml/kg, term infant is: 85 ml/kg, and >1 month age is: 75 ml/kg. Daily fluid requirements for premature infant (<2 kg birth weight) is 150 ml/kg, and for neonates and infants (2–10 kg) are 100 ml/kg for the first 10 kg.

Infants normally lose weight during the first week after birth. This weight loss is greater in preterm than term infants (approximately 15 versus 5 percent) and is associated with a diuresis. The postnatal diuresis is approximately 1 to 3 mL/kg (per hour), in term infants and is greater in preterm infants. Sensible losses: urine, stools and sweat. Insensible losses: skin loss (insensible perspiration); exhaled air from the respiratory tract. Physiologic weight loss results primarily from an isotonic reduction in extracellular water, although the mechanism for this process is uncertain.

THE SIGNIFICANCE OF EXTRAVASCULAR LUNG WATER IN CRITICALLY ILL PATIENTS

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Jadranka Vidović, Tijana Marinković, Saša Dragić
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The organ reperfusion as well as its continuity is set up as a primary goal in most of critically ill patients. One way for optimizing the cardiac preload is intravenous application of various fluids.

Treatment by fluid resuscitation can cause undesirable effects though, and the most common one is the lung oedema, hence treatment of these patients requires balancing between lung oedema development and adequate cardiac preload. The clinical assessment of the rate of vascular permeability and lung oedema development is quite difficult, and one way for hemodynamic monitoring which provides the insight into pulmonary vascular system function is the extravascular lung water measurement.

Thermodilution coloring method represents the most common method where freely diffusible indicator (cold) and plasma-bonding indicator (indocyanin green) are infused at the same time. This technique is mostly validated in animal models using gravimetry, while in humans it is done by using radionuclide techniques.

Although we have been familiar with the extravascular lung fluid for years, its measurement was not possible until modern techniques of haemodynamic measurement were introduced into practice (PiCCO technology).

STUDY OF PHENOL ADSORPTION FROM THE AQUEOUS ENVIRONMENT ON THE MODIFIED ALUMINA

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The study observed phenol adsorption from the aqueous environment on the alumina and the alumina modified by a surface active substance (cationic surface active substance – pröpagen – PAM). The examination of adsorption characteristics of alumina has a great significance for the processes taking place on the surface of that material, both for the adsorption and the catalysis in which alumina may have a role of the catalyst carrier. The character and concentration of active centers responsible for adsorption are of the fundamental importance for the surface chemistry of alumina, and the acidity of environment has certainly an additionally significant role for the adsorption of phenol. The content of phenol before and after adsorption was determined by the spectrophotometry based on measuring colour intensity of the compound of quinoid type that results in the reaction of phenol with 4-aminoantipyrine along with potassium hexacyanoferrate (III), as the oxidant, in the base environment (pH = 10), what is of great interest in area of nanomedicine. The additional surfactant, pröpagen, brings about the change of character of the alumina surface, which affects the form of the adsorption isotherm. Since phenol is one of the chief organic poisonous componenets of the industrial wastewater, this study is an attempt to find a better and more economical adsorbent for the purification of wastewater from phenol.

Key words: phenol, wastewater, adsorption, surface active substances

**ADSORPTION OF METHYL VIOLET FROM THE WATER
ENVIRONMENT ON $\text{BaCe}_{0,9}\text{Gd}_{0,1}\text{O}_3$ PEROVSKITE**

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Perovskite crystalline ceramics are promising materials for use in many advanced technologies, especially in developing of the fuel cells. By its structure perovskites are mixed oxides with nonstoichiometric composition, which can contain various ions of different valence states. Thereby, the crystal structure of these ceramics appear to be characterized by thermodynamic instability, excess electron density, and that may pose a significant active sites for the adsorption process in the gas and the liquid phase, what is of great interest in area of nanomedicine. The structure of synthesized $\text{BaCe}_{0,9}\text{Gd}_{0,1}\text{O}_3$ (BCG) perovskite was examined by XRD, SEM, DTA and TGA analysis. $\text{BaCe}_{0,9}\text{Gd}_{0,1}\text{O}_3$ perovskite was used as an adsorbent for the removal of methyl violet from simulated wastewater in the laboratory. Adsorption results are shown and explained on the basis of adsorption isotherms of Freundlich and Dubinin - Radushkevich – Kaganera.

GEOMETRIC AND CONSTRUCTIBLE SIMPLICITY OF THE WATER MOLECULE STRUCTURE

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Simplicity of approach is an important precondition for the analysis of water molecule geometry and the attempt to rationally and constructively define the experimental results and geometric solutions relevant to future molecular and nanotechnological architecture and engineering. Further understanding of the water molecule structural geometry can be achieved by development and logical complexity of the constructible geometrical solution based on the synthesis of proportional and structural properties of molecular elements.

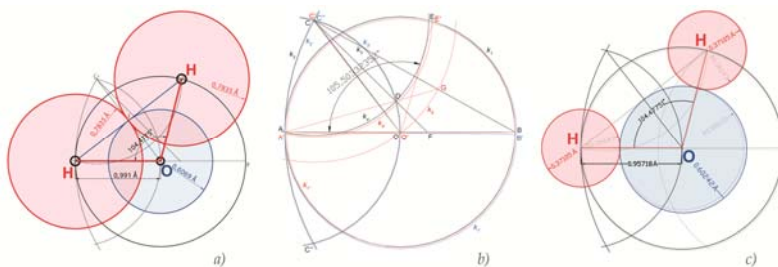


Fig. 1 A simple geometric method for constructing the water molecule structure

Experimental results concerning the water molecule geometry have ensured that, in the form of broader research and analysis of the proportional relations, the molecular structure can be related to a special method of geometric construction of the golden ratio – *scalar/angular divisions by golden ratio*. The construction indicates that the stable state of the water molecule structure depends on the special geometric properties of

its molecular elements, proportionally contingent upon the geometry and position of the golden ratio within the molecular structure. According to the above-mentioned method, and in relation to the length of the O-H distance (0.95718 Å - 1.01 Å), viewed as the radius and constructional starting point, it is of particular importance to define the diagonal position and arrangement of the relation between $\frac{\sqrt{6}}{4}$ and $\frac{\sqrt{5}-1}{2}$. This approach has led to the constructible geometric solution that indicates some special aspects of geometrical interdependence between the orbital (perihelion) radius positions and the position of electron distribution (replacement) within the hydrogen and oxygen atoms. When the construction is made more complex, the achieved results give insight into the substructural properties of vibrational and absorbing states within the water molecule geometry as well as the values equivalent to 'the open structures' of molecular clusters, whose basic properties are reduced to regular polygons and polyhedrons – *Platonic solids*, especially to pentagonal, tetrahedral, dodecahedral and icosahedral arrangements.

The simple constructible procedure shows that it is possible to geometrically simplify different equilibrium states of water molecules. Their structural differences enable a precise description of molecular symmetry characterized by $\angle\text{HOH} = 104.47^\circ$ (when water is in the gaseous state) and the asymmetric bond characterized by $\angle\text{HOH} = 105.50^\circ$ (when water is in the liquid state). This way the insight is gained into proportional properties of the double-asymmetrical equilibrium state while restructuring (repositioning) the molecular elements. Correspondence between the experimental and geometrically constructible results can be also noticed on the level of polarizability radiuses within the water molecule – that are centralized around the oxygen atom (1.4146 Å) and hydrogen atoms (0.0836 Å), but also within the geometry of dimer defined by the distance between the oxygen atoms (2.976 Å) and the angle of 57° .

The results of broader research point to the fact that the substructural values within different geometry states of the water molecule are correspondent to the values of the astronomical (equatorial) refraction angle ($0.509^\circ = \angle\text{BAB}'$ – Fig. 1b), Brewster's polarization angle ($\angle 53.06^\circ = \angle\text{A}'\text{O}'\text{C}'$; $\text{AO}' = \text{AC}'$ – Fig. 1b) and the primary ($\angle 42.25^\circ$) and secondary ($\angle 52.23^\circ = \angle\text{AOC}$ – Fig. 1b) rainbow angles. Geometrical synthesis of

the above-mentioned structural and substructural properties of the water molecule and optical properties of the light propagation represent a significant indicator for further understanding of the influences that the changes in the environmental geometry have on the structural changes within the water molecule geometry, whose marginal values are proportionally reduced to the properties of the golden ratio (CO'/AB – Fig. 1b).

Keywords: Water molecule structure, Golden ratio, Geometrical constructability, Molecular architecture, Polarization of Light.

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STUDIES OF EXCLUSION ZONES IN WATER AND AQUEOUS SOLUTION

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Introduction

Descriptions and observations of solute-free interfacial zones in aqueous solutions were given in many studies. These zones, known as “exclusion zones” (EZ) are found next to the hydrophilic surfaces. With varying sizes in range of several hundred micrometers, they are regions where water arrangement is different, and more ordered than in bulk water.¹

Particles such as microspheres move away from hydrophilic surfaces, and leave behind space of the EZ, which represents area free of particles. Actually, the term exclusion zone is given because of this distinctive ability of zone to exclude solutes and particles.²

Materials and Methods

As the excluding surface is chosen Nafion, material with very hydrophilic properties. Its surface generates visible exclusion zones. Commercially it is available in tubular and sheet shape. In these experiments were used Nafion tubing (TT-030).

For making the particle suspensions were used 1 μm Polybeadcarboxylate microspheres diluted in deionized water (in different dilutions). Particles such microspheres migrate away from Nafion, and make solute free zones. In one experiment, fullerol was added to microspheres-DI water dilution in different molar concentrations (1 μM and 5 μM). Fullerol ($\text{C}_{60}\text{OH}_{24}$) is the chemical modification of carbonized nanoparticle fullerene (C_{60}) which is water soluble. Its diameter is approximately 1 nm.

Samples were analyzed by microscope with 2.5 objective lens, and were put in chambers of different sizes (3mm, 9mm, 27mm). Each chamber was made using the glass slide for bottom, and 1mm plastic (polycarbonate) thick block with circular hole in the center. For image re-

ording was used CFW digital camera with resolution of 1360x1044 pixels.

Procedures

Two experiments were made. In the first experiment were used 3 sizes of chambers – 3mm, 9mm, 27mm with different dilutions of microspheres – 1:25, 1:50, 1:100. Small sample of nafion tube (figure 1) is put in the chamber, and then chamber is filled with different dilutions. Assembly was set on the microscope.

In the second configuration with the same setup chamber of 9 mm was filled with 3 different solutions: aqueous microspheres, 1 μ M fullerol, and 5 μ M fullerol dilutions.

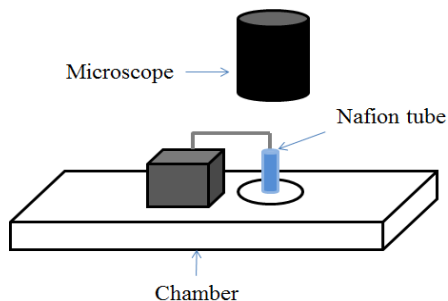


Figure 1: Experimental setup.

Results

In both experiments, following injection of microsphere dilutions, and fullerol microspheres dilutions, the microspheres migrated away from the edges of the Nafion tube, leaving a particle-free region. Exclusion zones were seen with all suspensions (figure 2).

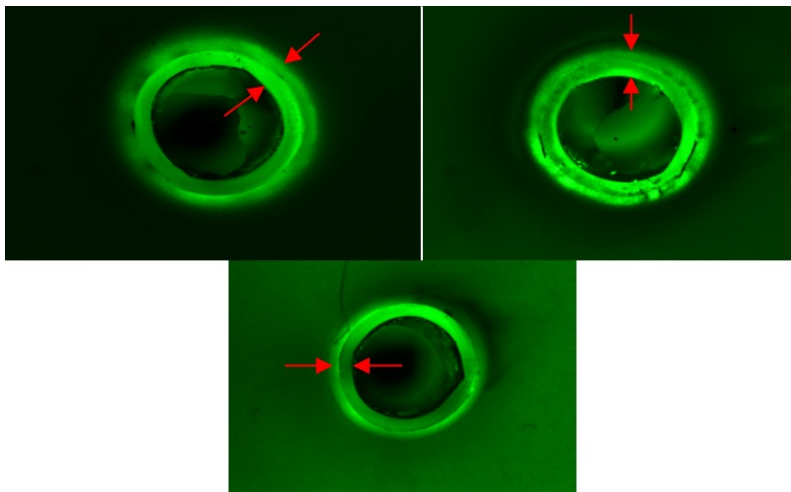


Figure 2: Exclusion zones in different solutions: aqueous microspheres, 1 μ M fullerol, and 5 μ M fullerol dilutions

Their sizes depended on suspension type. In the first experiment, for 1:25 dilution the sizes ($\sim 34\text{-}95\mu\text{m}$) were smaller than for 1:50 and 1:100 dilutions ($\sim 95\text{-}200\mu\text{m}$). In the second experiment, sizes varied depending of the solution. Smallest were for 5 μM fullerol solution (average 63 μm), and largest for 1 μM fullerol solution (average 84 μm).

Conclusion

It is found that exclusion zones are present in different aqueous solutions, polymer gel surfaces, polar liquid systems². According to this experiment, solutions with carbonized nanoparticles fullerol's together with microspheres have exclusion zones, and it remains to be clarified how these zones differ chemically and physically from those in other fluids.

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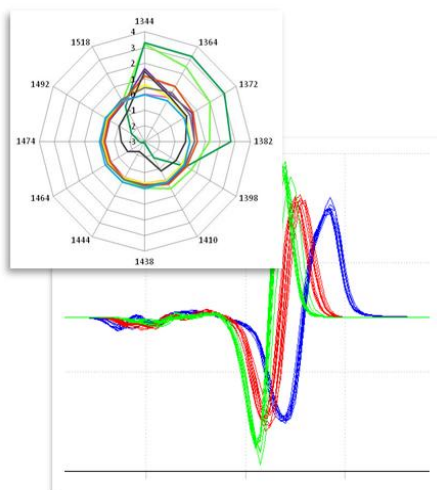
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A COMPARATIVE STUDY OF STRUCTURE AND PROPERTIES OF WATER BY IR AND OPTO-MAGNETIC SPECTROSCOPY

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Water is perhaps the most studied material today; it has been studied with different tools and methods, but its behavior and function remain elusive.



At molecular level, water is not a homogeneous structure, but rather dynamic equilibrium among changing percentages of assemblages of different oligomers and polymer species [1]. The structure and these assemblages or units themselves are dependent on temperature, pressure and composition [1]. Changes in structure of liquid water give rise to changes in its properties.

Using water-light interaction based methods we hoped to ‘shed some light’ on the water structure in a hope to see ‘inside the water’.

The methods used for research of several spring waters, commercial mineral waters and tap waters are - IR spectroscopy with novel Aquaphotomics approach [2] and Opto-magnetic spectroscopy [3].

Using these methods and applying multivariate statistics for data analysis, it was shown that under just slightly different conditions (atmospheric pressure, temperature, and humidity) not just that different waters behave differently, but the same water shows different behavior. This behavior which comes as a result of rich water dynamics - constant structuring and restructuring, as a response to change in its surroundings, was captured and described using aquagrams and opto-magnetic fingerprint spectra.

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BIOLOGICAL VALUE OF WATER

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Water has a very important role in cells and organisms and has a large influence on structure and behavior of all biomolecules. Studying biomolecules could not be complete without some insight into remarkable properties of water as a solvent. As a medium for all metabolic reactions – it is basically a matrix of life. Since majority of biological fluids is largely water-based (intracellular and extracellular fluid), water ensures delivery of nutritional substances to cell and also removes waste and helps in general cell cleaning. Cellular fluid also helps in resorption of pharmacological compounds, by solving and transporting them to organs and cells. Not all biomolecules are water soluble. Thanks to this, organisms can develop cell structures and build barriers (membranes) by using water non-soluble biomolecules. One of the revolutionary discoveries in cell biochemistry was discovery of ‘aquaporins’ i.e. membrane proteins which can build channels through which water molecules are transported in and out of cell. Water, as a solvent of organic and mineral compounds is the main component of human organism and comprises 60% of body mass in adult life, while 67-70% in earlier years.

The important role of water in biological organisms depends on the ability of its molecules to form hydrogen bonds. Special physical and chemical properties of water (boiling point, freezing point, high dielectric constant, high critical temperature, universality as a solvent, ability to create ions H^+ and OH^- , and role in building macromolecular structures) arose from the hydrogen bonds. Water and hydrogen bonds in organized clusters appear in cell nucleus (Fig 1).

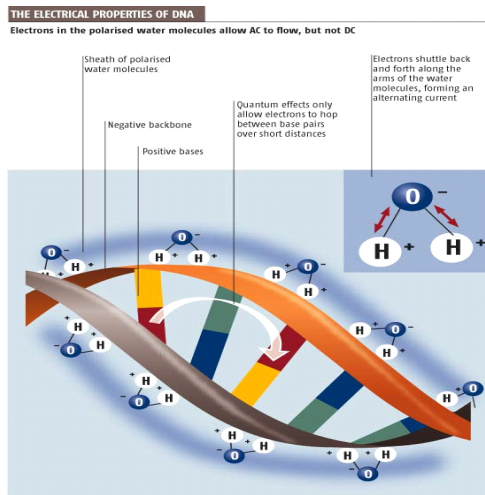


Fig 1. Water –DNA interaction: Hydrogen bonds importance for biological value of water

In conclusion, role of water in organism is ambiguous. Its biological value arises from the set of its physical and chemical properties, its microbiological parameters, relations between covalent and hydrogen bonds inside the water complex, and dimension and type of ion-water complex. Paramagnetism and diamagnetism should also be included as important biological values of water, because these properties represent dynamics of ion and water complex and dynamics of creating and breaking water clusters.

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INFLUENCE OF CARCINOGEN COMPOUNDS ON HYDROGEN BONDS IN WATER

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Arsenic (As) is a widely distributed element which is one of the most significant hazards in the environment. The exposure to its trivalent form and its mono- and dimethylated derivatives are associated with cancers of skin, lung, urinary bladder, kidney and liver, as well as several non-cancer diseases such as diabetes mellitus, hypertension, and cardiovascular and cerebrovascular diseases [1]. Drinking water contaminated with inorganic arsenic is the primary route of exposure.

With arsenic concentrations of approximately 71, 9 mg/l, tap water from the city of Zrenjanin, Serbia exceeds the limit of 10 μ g/l recommended in the WHO drinking water guideline [2]. Additionally, this water contains large amounts of boron and iron, and thus the use of this water either for drinking or preparing food, was prohibited several years ago. However, being left with little alternatives, population of this city still uses this water.

The effect of this water on tissues and organism in whole was reported in the previous study [3]. In continuation of our efforts to assess properties of this water in relation to its structure and dynamics, we employed near infra red spectroscopy and aquaphotomics [4], novel approach based on NIRS and multivariate analysis.

In comparison to other sufficiently high quality waters, the role of hydrogen bonding in mechanism of action of toxic, carcinogen compounds can be better understood.

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CONTACT LENSES MATERIAL INFLUENCE ON AQUEOUS SOLUTIONS

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In this paper we present the investigation of influence of new nanophotonic materials for contact lenses on aqueous solutions. The contact lenses we used were made of standard siloxane acrylate material with incorporated molecules C_{60} and another with fullerol $C_{60}(OH)_{24}$. The aim of the investigation was to compare the influences of those materials on different solutions, such as aqua purificata, saline and drops for dry eyes. For the analysis of different solutions, we used optomagnetic spectroscopy. The acquired spectra were commented and compared with the standard contact lens material, which was analysed by the same method, in order to show the differences in influence of this standard and new nanophotonic material. This research contributes to better understanding of the biocompatibility of new contact lens materials with biological water.

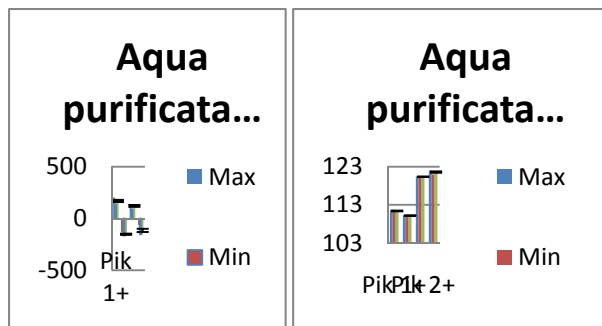


Fig.1. Results of optomagnetic spectroscopy of aqua purificata based on ten measurements

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WATER CONTENT REGULATION IN HUMAN BODY

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Water content in human body changes during aging proces together with an increase of fat tissue. In childhood, water reperesents amount of 65-75% of total body mass, in adult persons it contains approximately between 60% in man and 50% in women. $\frac{2}{3}$ of body water is in cells, where it is necessary for normal metabolic activity. Optimal concentration of H^+ ions in body fluids is also very important for normal activity of the body, for control of the enzymatic reactions and integrity of cell membranes. Changes in water content in cells and tissuess with aging influence metabolic activity in whole body and provoke toxic waste collection. Cells divide very slowly and regeneration processes are less efficient. Toxic products disturb normal cell activities and causes changes influencing the whole body. Prevention of the dehidratation and optimal water intake are necessary for health protection. Water content regulation in human body is very important process. The osmolality represents the total content of dissolved matters (Na^+ , K^+ , Cl^- , HCO_3^- , organic phosphates and proteins) in defined amount of water. Maintaining of serum osmolality between narrow, strictly defined borders is regulated by water intake or excretion. Kidneys have a central role in water excretion from the body. Water content in human body could be regulated for therapy reasons with different medications. Mechanisam of their action are various.

**SOLID MATERIALS, SKIN AND WATER
CHARACTERIZATION BY OPTO-MAGNETIC METHOD**

D. Mladenović, B. Jeftić, Jadran Bandić

It was necessary to make 100 photographs of each - skin, water and metal, to form the enclosed table. The analysis was made by processing the samples in matlab first; then the programme did the normalization and formation of the histogram and in the end filling in the excel table. For each sample a diagram was made (in the function of the intensity and wave length).

IMPORTANCE OF WATER IN HUMAN HAIR

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The human body is composed primarily of Water. The primary function of the skin is to act as a barrier against unwanted influences from the environment and to protect the body from water loss. Water is fundamental component of human hair. The amount of moisture in hair also plays a critical role in its physical and cosmetic properties. Similarly, hair dried with heat exhibit a lower moisture content than hair dried at room temperature. Undoubtedly, the several hydrophilic side chains (guanidino, amino, carboxyl, hydroxyl, phenolic, etc.) and peptide bonds of keratin fibers contribute to water sorption, although there is controversy over the primary water-binding groups. Spectroscopic studies of the nuclear magnetic resonance (NMR) of both human hair and wool fiber indicate that the protons of water in keratin fibers are hydrogen-bonded and are less mobile than in the bulk liquid. At relative humidities, below 25%, water molecules are principally bonded to hydrophilic sites of the fiber by hydrogen bonds and can be described fundamental theory for the absorption of gases on solids. At very high RH, above 80%, multimolecular sorption (water on water) becomes increasingly important. Also water is very important for hair elastic structure. When it's dry it's very fragile, and elastic characteristics are very low.

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WATER IMPORTANCE IN CYTOPLASM

Igor Hut, Vojin Munćan

Water, the most abundant compound on *Earth's surface* and the very essence of life as we know it. There is no substance that is studied and examined more than water and yet researchers are intrigued and astonished with its properties as never before. Water is a profoundly unusual liquid, and its peculiarities may make it uniquely suited to act as life's matrix. In this paper we will review the role of water in living cell cytoplasm. We will discuss how the effects of nanometre-scale confinement and inhomogeneities owing to surface effects are altering the liquid's properties in the cell relative to those in the bulk. Special attention will be given to interactions of intracellular water and cytoskeleton, role of water in cellular folding processes and its influence to various biomolecular interactions.

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WATER IMPORTANCE FOR HUMAN EYE FUNCTIONALITY

Jovana Šakota, Ružica Sofrenić, Nikola Jagodić

A person's sense of sight is very important to humans. Vision is arguably the most used of the five senses and is one of the primary means that we use to gather information from our surroundings. The human eye is the organ which gives us the sense of sight, allowing us to observe and learn more about the surrounding world than we do with any of the other four senses.

One of the most important components of the eye is the water itself. For instance, aqueous humor is of great importance for proper nutrition of the eye and its cornea.

Aqueous humour is a fluid made by cells of the ciliary body. Aqueous humor production is a metabolically active process sustained by the delivery of oxygen and nutrients and removal of metabolic waste by the ciliary circulation [1].

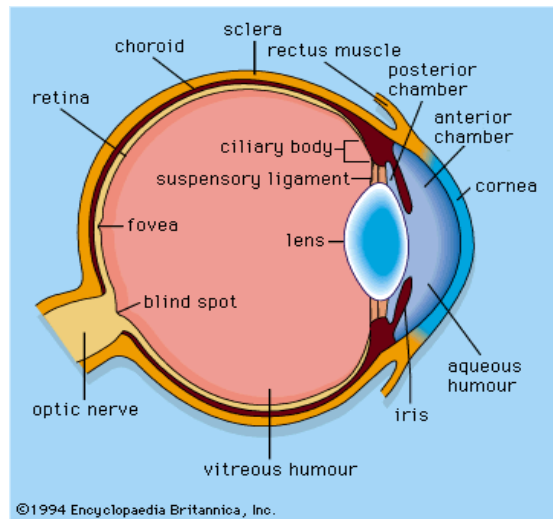
Within the anterior segment which consists of: the cornea, iris, ciliary body, and lens. are two fluid-filled spaces divided by the iris plane:

1) the anterior chamber between the posterior surface of the cornea (i.e. the corneal endothelium) and the iris.

2) the posterior chamber between the iris and the front face of the vitreous.

Aqueous humour fills these spaces within the anterior segment to provide nutrients to the lens and corneal endothelium, and its pressure maintains the convex shape of the cornea.

The rate of aqueous humour outflow varies between 2.0 $\mu\text{l}/\text{min}$ and 3.0 $\mu\text{l}/\text{min}$ via both the conventional (trabecular meshwork and Schlemm's canal) and the unconventional (uveoscleral) pathways. This rate is normally equal to the rate of aqueous secretion.



Aqueous humor circulation maintains the optical clarity of the cornea, anterior chamber, and crystalline lens, and is the source of intraocular pressure [2]. Small variations in the changes in production or outflow of aqueous humor will have a large influence on the intraocular pressure which can lead to major damage and blurred vision.

Corneal endothelium nutrition is a major challenge, because cornea does not have capillaries to provide necessary substances and oxygen. Therefore the proper function of the eye is in close connection to the aqueous humor i.e. water.

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NANOCHARACTERISTICS OF MATERIALS FOR REPARATION OF DEMINERALIZED ENAMEL

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On the enamel surface is continuously presented the equilibrium between remineralization and demineralization processes which determines the level of enamel integrity. Beside the surface pH the most important factor is the source of ions excluded from the lattice. As the substrata are more alike the basic unit of the enamel carbonated hydroxyl apatite (CHA) the remineralization process is more biological. In the article are presented evidence based data about remineralization potential of two contemporary materials recently introduced in clinical practice. CPP-ACP is Amorphous Calcium Phosphate stabilized by Casein Phosphopeptides which is the reach reservoir of lost Ca and P ions during demineralization processes. Nano apatite is the smallest basic unit of CHA crystalline lattice of enamel prisms. CPP-ACP enables better reparation mechanisms than calcium fluoride layer formed under solo fluoride influence, but more dominant are amorphous layer of calcium phosphate. Nanoapatite form continuous layer with original enamel CHA without visible border indicating existence of chemical bonds. It is since now the best achieved biomimetic procedure in the enamel perseverance.

A POTENTIAL FUNDAMENTAL ROLE OF WATER IN THE SELECTION OF CANONICAL AMINO ACID SET

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The fundamental role of water in the governing of physicochemical activity in living systems has been recently recognized [(Chaplin, 2006); (Voeikov, 2007)]. This general biological role water exerts thanks to its structure and dynamic organization as liquid crystal by generating “small active clusters and macroscopic assemblies, which can both transmit information on different scales” (Chaplin, 2006). The complex water organization with the coherent patterns is directly dependent on both the local and nonlocal influences, implying a primordial role of water in the origin of life (Pollack, Figueroa, Zhao, 2009).

This paper concerns a specific primordial role of water in the selection of canonical amino acid set based on some bioinformational processes. The considerations are motivated by the discovery of variety arithmetical regularities inside the genetic code which are linked its symmetrical architecture and the nucleon number of its constituents - the canonical amino acids and nucleotide bases, and which are determined by *decimal number 037* (shCherbak, 2003). Generalization of 037 showed that their main and unique characteristic is equidistant multiplying by a cyclic permutation and that they are associated with the cyclotomic polynomials and generalized polynomials of golden section (Mišić, 2010).

We reveal anew arithmetical regularity of canonical amino acid set using their molar masses, as well as some other unique mathematical properties of 037 such as its relation to centered hexagonal/star numbers, its decimal variations and anew relation to the golden section related to hyperbolic mapping. These regularities also indicated their relationship to the fine structure constant. The fact that water cluster structure on different hierarchical levels is fundamentally determined by the icosahedral symmetry (Chaplin, 2006) and rotational symmetry of order 6, suggests a potential central role of water in the selection of canonical amino acid set.

General conclusions concerning the possibility of water that, due to the realization of the enormous number of hierarchical different ordered clusters and dynamical states with some predefined general limits, could be the perfect medium for the nested biocoding and biocomputing which can perform the optimal selection of biological structure and dynamics and be a clue for omnipresent self-similar, i.e. fractal organization in the living matter.

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