



## **8<sup>th</sup> EUROPEAN SUMMER SCHOOL ON BIORHEOLOGY AND SYMPOSIUM ON MICRO- AND NANOMECHANICS AND MECHANOBIOLOGY OF CELLS, TISSUES AND BIOLOGICAL SYSTEMS (BIORHEO 2024)**

The 8<sup>th</sup> European Summer School on Biorheology and the Symposium on Micro- and Nanomechanics and Mechanobiology of Cells Tissues and Systems (BIORHEO 2024) was held at the International Home of Scientists “Frederick Joliot-Curie” in the famous resort “St. Konstantin and Elena”, near Varna Bulgaria from August 28<sup>th</sup> – 30<sup>th</sup>, 2024 in person and remotely. The meeting was organized by the Bulgarian Society of Biorheology – in cooperation with the European Society of Clinical Hemorheology and Microcirculation (E.S.C.H.M) and co-organizer the Institute of Mechanics at the Bulgarian Academy of Sciences. The aim of BIORHEO 2024 was to contribute to the international cooperation and contacts of scientists, to attract students, PhD students, postdoctoral fellows and young researchers to improve their training, as well as to present original research in the field of biorheology, micro- and nanomechanics and mechanobiology of cells, tissues and biosystems by bringing together specialists in biorheology and biomechanics from different countries and continents.



Photo of some of the participants in the Biorheo 2024 at the International Home of Scientists “F. Joliot-Curie” in Varna, August 28-30, 2024

The participants in the meeting - 60 scientists from national and internationally recognized universities, institutes and laboratories from 13 countries - Austria, Argentina, Belarus, Bulgaria, Germany,

Greece, Mexico, Poland, Russia, Serbia, Turkey, Hungary and Japan presented 46 reports in seven sessions - 18 lectures, 20 oral presentations and 8 posters.

**Prominent speakers presented plenary reports, namely:**

Prof. Norbert Nemet from the University of Debrecen, Hungary, Vice President of the European Society of Clinical Hemorheology and Microcirculation gave a report „Microcirculatory and micro-rheological relations of lymphedema“. Theoretical and applied scientific contributions from current research, developments and results were also discussed during the session "Clinical Hemorheology and Hyperviscosity Syndrome", at which Prof. Toru Maruyama from Haradai Hospital, Japan, in a joint report with Dr. Michinari Hieda, presented their clinical experience on "Hemodynamics of BRASH Syndrome Observed in Gerontology". Prof. Aneta Teległów from the University of Physical Education - Krakow, delivered a report on „Changes in red blood cell deformability at the beginning of the winter swimming season and at the end of another, in females and males: preliminary reports “.

Results of long-term research on the relationships between hemorheological and neurosonographic parameters in patients with cerebrovascular disease were presented by Assoc. Prof. Dr. Irena Velcheva from Uni Hospital, Panagyurishte, in the lecture “Significance of whole blood viscosity in acute ischemic stroke”. Prof. Alexey Muravyov and his team from the Yaroslavl State Pedagogical University “K. D. Ushinsky”, Russia, summarized the new data they obtained on “Microrheological responses of erythrocytes to gasotransmitters, by inhibiting guanylate cyclase, NO synthase and blocking ATP-dependent and calcium-dependent potassium channels”.

During the scientific session “Hemorheology and Microcirculation”, Prof. Alexander Priezzhev from the Faculty of Physics of Lomonosov Moscow State University delivered a lecture on the assessment of the microrheological properties of blood using a new in vitro optical method of “laser tweezers” – “Application of laser-optic techniques in the studies of blood microrheology in norm and pathology”. Assoc. Prof. Dr. Andrey Lugovtsov from the same faculty presented a talk "Blood microrheological and microcirculation alterations under age-associated diseases of the cardiovascular system". New results on "Protective effect of two standard preservation media on irradiated and storage erythrocytes: Rheological comparative evaluation", obtained by the team of Prof. Bibiana Riquelme at the National University of Rosario, Argentina, were presented by Dr. Analia Alet.

Research related to hemorheological damage and hemostasis, as well as microcirculatory disorders in the post-COVID-19 period, was presented in the report “Interrelation of blood rheology and hemostasis with metabolism of NO and H<sub>2</sub>S in post-COVID period” by Prof. Irina Tikhomirova from Yaroslavl State Pedagogical University “K. D. Ushinsky”, Yaroslavl, Russia. Prof. Aristotle Koutsiaris from the Laboratory of Medical Informatics and Biomedical Imaging (MIBI), Faculty of Medicine at the University of Thessaly in Larissa, Greece, summarized the results of “Long COVID and Microcirculation”.

Assoc. Prof. Dr. Ursula Windberger from the Medical University of Vienna, Austria presented a report on: “Blood rheology on modified rheometer surfaces”. Assoc. Prof. Dr. Plamen Chukov from the Institute of Physical Chemistry at the Bulgarian Academy of Sciences presented a report on “Non-Newtonian behavior of complex fluids studied in nano/micro-scale confinements”. Dr. Elena Konstantinova from Minsk, Belarus presented a report “Estimation of IHD patients' parameters of oxygen transfer for creation of binary classification models of functional state of the microcirculation system”.

Many interesting contributions with applications in clinical practice were presented during the scientific sessions "Erythrocyte Aggregation and Deformability", as well as "Rheology, Micro and Nanomechanics of Blood Cells" from the team from the Department of Medical Physics and Biophysics at the Medical University of Sofia: Senior Asst. Professors Dr. Svetoslav Yovtchev, Dr. Svetla Miteva and Dr. Svobodan Aleksandrov presented results from long-term research on "Red blood cell aggregability in hypertension", "Neutral polymer properties affecting red blood cell aggregation" and “Polymer depletion from biological surfaces – an electrophoretic investigation”. Assoc. Prof. Dr. Ivan Antonov presented results on "Synthesis and physical characteristics of magnetic nanoparticles coated with albumin and casein for the nanomedicine needs. A theoretical and experimental study", and Senior Asst. Prof. Dr. Blagovest Bechev presented results on "Impact of albumin and casein modified magnetic nanoparticles on blood

hemorheological parameters and the functional state of human neutrophils by evaluating their chemiluminescent response upon stimulation with Zymosan, fMLF and PMA".

Prof. Sami Aydogan from Ankara, Turkey delivered a report on "Overview of the lifespan of platelets (The Relationship Between Structural, Functional and Behaviour Properties)". Prof. Margarita Stoycheva from the University of Baja California, Mexicali, Mexico presented a study of Prof. Rumen Zlatev, Prof. Nadia Antonova and a team on "Innovative AC Phase Shift Technique for Rapid and Precise Blood Clotting Time Measurement"; Dr. Ivana T. Drvenica from the Institute for Medical Research, National Institute of the Republic of Serbia, University of Belgrade presented a study on "Elongation index derivative: a promising hemorheological parameter in Diabetes mellitus erythrocyte analysis"; Representatives of the Perm National Research Polytechnic University in Perm, Russia Prof. Alex Kuchumov delivered a lecture on "Biomechanics of aortic valve: numerical simulation and additive manufacturing" and Dr. Polina Killina – "Selective laser melting technology development for coronary stents". Prof. Natia Jojua from the European University in Tbilisi, Georgia presented the research and teaching experience in the report "Training High School Students in First Aid: A Peer-Led Initiative by Medical Students". Prof. Nadia Antonova from the Department on Biomechanics at the Institute of Mechanics at the Bulgarian Academy of Sciences in her report "Methodological Aspects in Blood Rheology - From Experiments to Numerical Simulations and Instrument Development" summarized many years of research.



Interesting results on "Characterization of explanted hernia meshes" were reported by Assoc. Prof. Dr. Miglena Kirilova-Doneva; Assoc. Prof. Dr. Yordanka Gluhcheva from IEMPAM-BAS presented two reports – on "Hematological and hemorheological parameters of blood platelets as biomarkers in diabetes mellitus type 2. A comprehensive review" by Assoc. Prof. E. Zvetkova and co-authors, as well as on "Hematological changes in adult rats in conditions of diabetes mellitus and cadmium exposure", Assoc. Prof. Dr. Evgeni Koytchev – "Biomaterials for treating consequences of periimplantitis. Strategies for development and application", Assoc. Prof. Dr. G. Nikolova and Prof. D. Danchev – "Girls versus boys' tennis players: Comparison of body composition contents", Assoc. Prof. Dr. Ivan Ivanov – "Biomechanical jump performance of adolescent basketball female players after an isometric stretching program", Senior

Asst. Prof. Dr. Vasilka Paskova from IMech-BAS – “Investigation of skin temperature oscillations during local heating and cold test in patients with type 2 diabetes mellitus”. Senior Asst. Prof. Dr. Teodora Apostolova from IBphBmE-BAS presented a review on “Influence of blood flow on the mechanical and rheological properties, as well as the activation and adhesion of white blood cells to the endothelium” and Senior Asst. Prof. Polimira Miteva from IPH-BAS presented a multidisciplinary study on “Biopsychosocial Determinants of Metabolic Control and Microvascular Health: An Interdisciplinary Approach”, Assoc. Prof. Dr. Vladimir Kotev and co-authors (IMech-BAS) - “Studying the mass-inertial characteristics in some NASA positions of astronauts: an investigation based on an improved 3D model of the human body”.

Very interesting results were presented in the Poster session too: PhD student Jan Bylica from the Department of Internal Medicine and Gerontology, Jagiellonian University, Medical College, Kraków, Poland presented “Erythrocytes’ Membranes’ Fatty Acid Profiles Post Laparoscopic Sleeve Gastrectomy for Obesity Management”, PhD Student Andreyan Georgiev from the Institute of Neurobiology to BAS – “Comparative in vitro investigation of viscoelasticity in aging of healthy/melatonin deficient rat aorta”, Senior Asst. Prof. Dr. Hristina Petkova and co-authors from the Institute of Physical Chemistry at BAS – “Properties of Lecithin Stabilized Water-in-Oil Thin Films and the Role of Interfacial Rheology”, Assoc. Prof. Dr. Ivan P. Yordanov – “An Application of the Method of Simplest Equation for Exact Real Solutions for Advection-Diffusion Interaction”, Senior Asst. Prof. Dr. Mario Iliev from the Faculty of Physics at Sofia University "St. Kliment Ohridski" Sofia, Bulgaria- “Semantic priming as modulator of saccade directions and pupil diameter in glaucoma patients”.

During the BIORHEO 2024 Summer School and Symposium, a competition for young scientists for the best scientific work was organized. Four of the presented reports were awarded with plaques:

- Ádám Varga from the Faculty of Medicine at the University of Debrecen, Hungary, supervised by Prof. Dr. Norbert Nemet, for the work “Changes in microcirculation and tensile strength in small intestine end-to-end anastomoses in experimental model”.

- Ádám Attila Mátrai from the Faculty of Medicine at the University of Debrecen, Hungary, supervised by Assoc. Prof. Dr. Ádám Deak, for the work “Investigating vascularization of mesenchymal mesoblastic nephroma: hemorheology, microcirculation and histomorphology”.

- Matvei K. Maksimov from the Faculty of Physics at the Lomonosov Moscow State University, supervised by Prof. A. Priezhev for the work "The impact of interferon-alpha on RBC-endothelium interaction: optical tweezers study”.

- Danila Umerenkov from the Faculty of Physics at Lomonosov Moscow State University, supervised by Prof. A. Priezhev for the work "Assessing the microcirculation and microrheology of blood in patients with type 2 diabetes mellitus by different optical techniques".

The scientific forum BIORHEO 2024 provided excellent conditions for an extensive exchange of knowledge and innovations, points of view, hypotheses, research experience, cooperation, social contacts and activities. Intensive contacts and cooperation between scientists working in the field of fundamental/theoretical and applied/practical biorheology and hemorheology could ensure continuity in research and will attract young researchers to scientific work. BIORHEO 2024 contributed to establishing and deepening the cooperation of Bulgarian scientists with scientists from abroad, stimulating the participation of young scientists in international scientific forums and providing conditions for better visibility of Bulgarian scientific research internationally.

A part of the lectures, reports and announcements presented at the BIORHEO 2024 are published in the current issue of the journal Series on Biomechanics. More detailed information about the Summer School and Symposium BIORHEO 2024 and its scientific program, photos and video recordings of the ZOOM sessions, can be found on the forum website (<http://biorheo2024.bsb-bg.eu>).

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Complier and Editor - Prof. Dr. Nadia Antonova  
Chairman of the BIORHEO 2024 Organizing Committee