PHYSICAL CHEMISTRY 2018

14th International Conference
on Fundamental and Applied Aspects of
Physical Chemistry

Proceedings
Volume I

September 24-28, 2018
Belgrade, Serbia

ISBN 978-86-82475-36-1
Title: Physical Chemistry 2018 (Proceedings)
Editors: Željko Čupić and Slobodan Anić
Published by: Society of Physical Chemists of Serbia, Studentski Trg 12-16, 11158, Belgrade, Serbia
Publisher: Society of Physical Chemists of Serbia
For Publisher: S. Anić, President of Society of Physical Chemists of Serbia
Printed by: "Jovan", <Printing and Publishing Company, 200 Copies
Number og pages: 550+6, Format B5, printing finished in September 2018

Text and Layout: "Jovan"

200 - *Copy printing*

CONTENT

Volume I

Organizer	IV
Comittes	V
Sponsors	VI
Plenary Lecture	1
Chemical Thermodynamics	57
Spectroscopy, Molecular Structure, Physical Chemistry of Plasma	71
Kinetics, Catalysis	157
Nonlinear Dynamics, Oscillatory Reactions, Chaos	253
Electrochemistry	361
Biophysical Chemistry, EPR investigations of biosystems, Photochemistry, Radiation Chemistry	419

PHYSICAL CHEMISTRY 2018

14th International Conference on
Fundamental and Applied Aspects of
Physical Chemistry

Organized by

The Society of Physical Chemists of
Serbia

in co-operation with

Institute of Catalysis Bulgarian Academy of Sciences

and

Boreskov Institute of Catalysis Siberian Branch of
Russian Academy of Sciences

and

University of Belgrade, Serbia:

Faculty of Physical Chemistry
Institute of Chemistry, Technology and Metallurgy
Vinča Institute of Nuclear Sciences
Faculty of Pharmacy
Institute of General and Physical Chemistry, Belgrade, Serbia

Organizing Committee

Chairman: *S. Anić (Serbia)*

Vice-chairmans: *M. Gabrovska (Bulgaria)*
A. A. Vedyagin (Russia)
S. N. Blagojević (Serbia)

Members: *N. Cvjetičanin (Serbia), S. M. Blagojević (Serbia), M. Daković (Serbia), J. Dimitrić-Marković (Serbia), T. Grozdić (Serbia), Lj. Ignjatović (Serbia), D. Jovanović (Serbia),J. Jovanović (Serbia), M. Kuzmanović (Serbia), D. Marković (Serbia), B. Milosavljević (USA), M. Mojović (Serbia), N. Ostrovski (Serbia), N. Pejić (Serbia), M. Petković (Serbia), A. Popović-Bjelić (Serbia), B. Simonović (Serbia), D. Stanisavljev (Serbia), M. Stanković (Serbia), Z. Šaponjić (Serbia), B. Šljukić (Serbia), G. Tasić (Serbia), S. Veličković (Serbia), N. Vukelić (Serbia)*

Scientific Committee

Chairman: *Ž. Čupić (Serbia)*
Vice-chairmans: *V. Bukhtiyarov (Russia)*
S. Todorova (Bulgaria)
B. Adnađević (Serbia)

Members: *S. Anić (Serbia), A. Antić-Jovanović (Serbia), D. J. Biswas (India), R. Cervellati (Italy), G. Ćirić-Marjanović (Serbia), V. Dondur (Serbia), S. D. Furrow (USA), A. Goldbeter (Belgium), R. Jerala (Slovenia), M. Jeremić (Serbia), A. Jovović (Serbia), Y. Kalvachev (Bulgaria), E. Kiš (Serbia), Lj. Kolar-Anić (Serbia), U. Kortz (Germany), T. Kowalska (Poljska), V. Kuntić (Serbia), G. Lente (Hungary), Z. Marković (Serbia), S. Mentus (Serbia), K. Novaković (UK), B. Novakovski (Poljska), S. Otto (Netherlands), V. Parmon (Russia), R. Pascal (USA), M. Perić (Serbia), M. Plavšić (Serbia), J. Savović (Serbia), G. Schmitz (Belgium), I. Schreiber (Czech), L. Schreiberova (Czech), H. W. Siesler (Germany), E. M. Barbosa Souto (Portugal), N. Stepanov (Russia), E. Szabó (Slovakia), R. Tomovska (Spain), Á. Tóth (Hungary), M. Trtica (Serbia), V. Vasić (Serbia), D. Veselinović (Serbia), D. Vučković (Canada), V. Vukojević (Sweden), P. Walde (Switzerland)*

Local Executive Committee

Chairman: *S.N. Blagojević*
Vice-chairmans: *A. Ivanović-Šašić*
A. Stanojević

Members: *M. Ajduković, I. N. Bubanja, A. Dobrota, J. Dostanić, D. Dimić, A. Ignjatović, S. Jovanović, Z. Jovanović, A. Jović, N. Jović-Jovičić, D. Lončarević, M. Kragović, J. Krstić, S. Maćešić, J. Maksimović, S. Marinović, V. Marković, D. Milenković, M. Milovanović, T. Mudrinić, B. Nedić, M. Pagnacco, A. Pavićević, N. Potkonjak, D. Ranković, M. Ristić, B. Stanković, K. Stevanović, M. Stević, A. Stoiljković*

SPONSORS

Ministry of Education, Science and Technological Development
University of Belgrade, Belgrade
Institute of General and Physical Chemistry, Belgrade
Analysis d.o.o.
Institut Mol d.o.o.

INFLUENCE OF THE LOW FREQUENCY RANGES OF MAGNETIC FIELD ON *SACCHAROMYCES CEREVISIAE* RESPIRATION

I. N. Bubanja[1], B. Lončarević[2], M. Lješević[2], V. Beškoski[3], G. Gojgić-Cvijović[2], Z. Velikić[4] and D. Stanisavljev[1]

[1]*Faculty of Physical Chemistry, University of Belgrade, Studentski trg 12-16, Belgrade, Serbia (itana.bubanja@ffh.bg.ac.rs)*
[2]*Department of Chemistry, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Njegoševa 12, Belgrade, Serbia*
[3]*Departmet of Biochemistry, Faculty of Chemistry, University of Belgrade, Studentski trg 12-15, Belgrade, Serbia*
[4]*Institute of Physics, University of Belgrade, Pregrevica 118, Zemun, Serbia*

ABSTRACT

In this paper influence of the low frequency magnetic field on *Saccharomyces cerevisiae* respiration was examined. Influence of four low frequency magnetic field ranges was examined: 10-200 Hz, 200-300 Hz, 300-650 Hz and 650-1000 Hz. All analyzed frequency ranges gave the same influence on the yeast cells respiration.

INTRODUCTION

Over the years, due to the fast technological development, our environment has become more and more influenced by man-made low frequency electromagnetic fields (EMFs). Therefore it is not surprising that this increasing exposure of the population in everyday life to EMFs has earned such a wide public interest. Recently, effects of electric fields (EFs), magnetic fields (MFs) or EMFs on different microbes have become a very popular topic since the mentioned physical fields could potentially act as a stress factors and thus affect the survival of the microbial cells as well as their metabolism and behavior [1]. The influence of static (0 Hz) and 50 Hz magnetic fields on growth of the *Saccharomyces cerevisiae* (by the measurements of solution optical density at 600 nm) was already examined by many authors [2,3]. In this study the influence of different low frequency ranges of the magnetic fields (up to 1 kHz) were examined on the yeast cells respiration. To the best of our knowledge, this is the first time that the influence of magnetic fields is examined on yeast cells by using Micro-Oxymax® respirometer and constant frequency scan regime in the given ranges.

EXPERIMENTAL

All experiments were performed, in two specially designed glass bottles. Both bottles contained 3 mL of yeast suspension. One bottle was a control sample while the other one was set up inside of the spiral Cu-coil where the low frequency magnetic fields were generated. In order to avoid undesirable temperature increase of the yeast sample because of the heating effect of the coil, sample bottle was set up in a glass water recirculation jacket and all together wrapped in Cu-coil. Control vessel was connected in line with working vessel to minimize possible temperature differences between samples. Arbitrary function generator (Gw Instek AFG-2105, Good Will Instrument Co., Ltd, Taiwan) was used to set up a desired frequency range and a scan interval during which frequencies from set up range are continuously changed from lowest to highest. In this paper we examined influence of four different low frequency ranges: 100-200 Hz, 200-300 Hz, 300-650 Hz and 650-1000 Hz. In all experiments the scan interval was 100 s and total time of exposure was 24 h. In order to achieve the maximal effective current of 2,00 A trough the coil a signal amplifier was used. Maximal effective current of 2,00 A corresponds to magnetic induction of 33 mT. Before every experiment, oscilloscope was used to adjust maximal current. Respiration activity of *Saccharomyces cerevisiae* was measured by a twelve-channel Micro-Oxymax® respirometer (Columbus Instruments, USA). Cell respiration was measured every 20 min during 24 h. Cumulative O_2 consumption and cumulative CO_2 production (in mL) were determined. Experimental setup is shown in Figure 1.

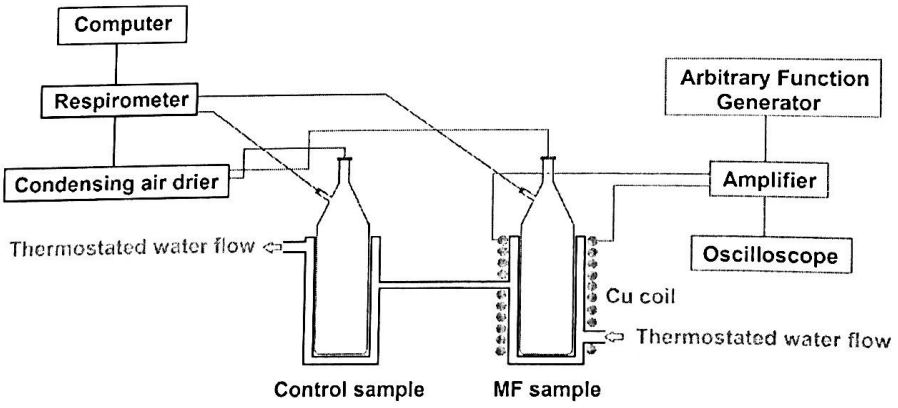

Figure 1. Experimental setup.

RESULTS AND DISCUSSION

Like it was mentioned in Experimental part of this work influence of four low frequency ranges (100-200 Hz, 200-300 Hz, 300-650 Hz and 650-1000 Hz) on yeast respiration were examined.

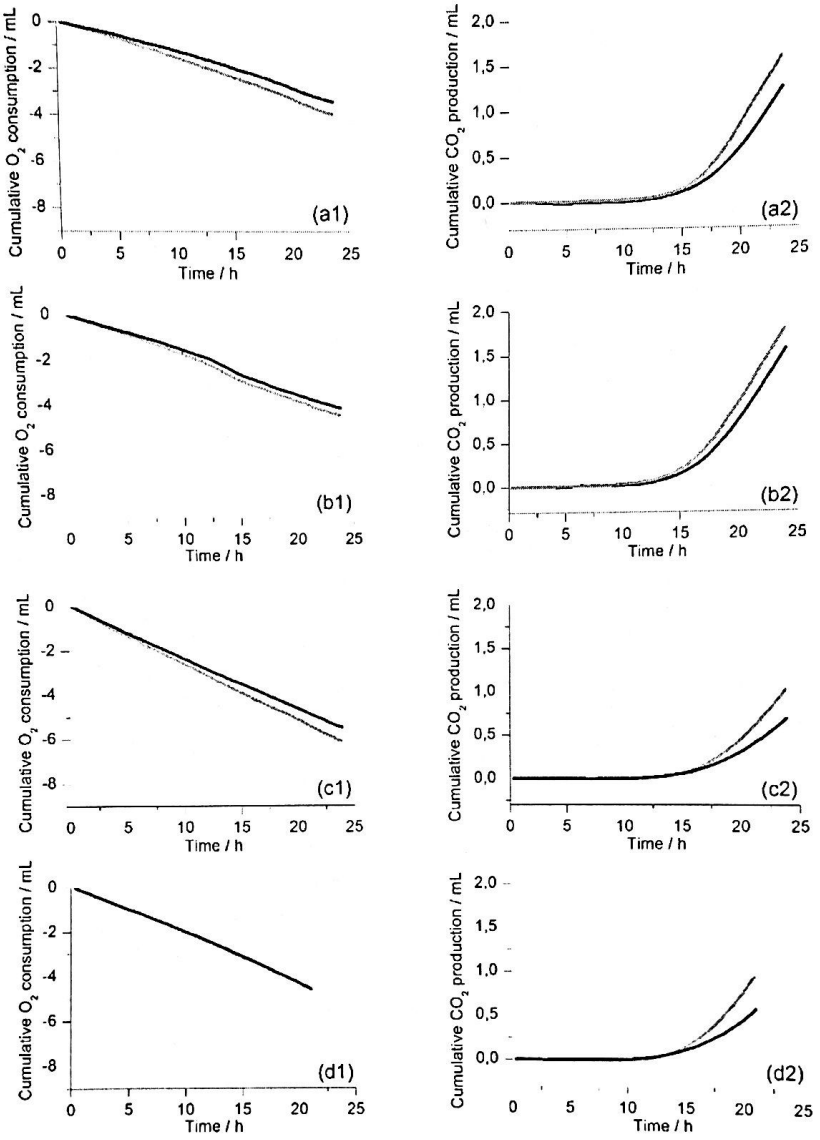

Figure 2. Experimentally obtained cumulative O_2 consumption in mL (a1, b1, c1, d1) and cumulative CO_2 production in mL (a2, b2, c2, d2) over 24 h of exposure, for different frequency ranges (100-200 Hz (a1, a2), 200-300 Hz (b1, b2), 300-650 Hz (c1, c2) and 650-1000 Hz (d1, d2)). Gray curve represents changes in control sample and black curve changes of the O_2 and CO_2 in magnetic field sample.

Cumulative O_2 consumption and cumulative CO_2 production were followed in control and magnetic field samples during 24h. Figure 2. shows cumulative O_2 consumption and cumulative CO_2 production in control and magnetic field samples over 24 h obtained for analyzed frequency ranges. Cumulative O_2 consumption is negative because oxygen at the beginning of the experiment (of 21% in air) is taken as reference (0 mL). As it can be seen from Figure 2, up to 15th hour the differences in cumulative CO_2 production between control and magnetic field sample at all investigated frequency ranges are negligible. After 15th hour those differences begin to grow and are the biggest at the end of exposure. Cumulative CO_2 production in magnetic field sample was lower in comparison to control sample for all frequency ranges. Cumulative O_2 consumption, for frequency ranges from 100-200 Hz, 200-300 Hz, 300-650 Hz, in magnetic field sample was lower in comparison to control sample but for 650-1000 Hz range difference is negligible.

CONCLUSION

All experiments showed lower cumulative O_2 consumption and lower cumulative CO_2 production in magnetic field which confirms magnetic effects. Considering mentioned lower consumption/production of gases, this influence is probably due to deceleration of yeast metabolism or cell division, which should be further investigated and confirmed by statistical tests. It is challenging task to design magnetic treatment to produce desired metabolic changes without using chemical reagents. Obtained results are preliminary and further investigations are necessary to verify proposed hypothesis.

Acknowledgement

This research was financially supported by the Ministry of Education, Science and Technological Development of Republic of Serbia, through Projects No. OI 172015 and III 43004.

REFERENCES

[1] W. Fan, Z. Huang, B. Fan, Microbial Pathogenesis 2018, **115**, 117–122.
[2] M. J. Ruiz-Gomez, M. I. Prieto-Barcia, E. Ristori-Bogajo, M. Martınez-Morillo, Bioelectrochemistry 2004, **64**, 151– 155.
[3] J. Novák, L. Strašák, L. Fojt, I. Slaninová, V. Vetterl, Bioelectrochemistry, 2007, **70**, 115–121.