KAZAN SCIENCE WEEK 2025

ABSTRACTS

KAZAN SCIENCE WEEK

ABSTRACTS OF THE
INTERNATIONAL CONFERENCES
“MODERN DEVELOPMENT OF MAGNETIC RESONANCE”

KAZAN, SEPTEMBER 22 – OCTOBER 03, 2025

oral

EPR study of the content of nitric oxide and copper in the liver of rats after modeling combined brain and spinal cord injuries

Kh.L. Gainutdinov[1,2], V.V. Andrianov[1,2], L.V. Bazan[1], T.K. Bogodvid[2,3], I.B. Deryabina[2], G.G. Yafarova[2], A.I. Arslanov[1], T.S. Zharkova[2], R.V. Etkhemova[2], S.G. Pashkevich[4], T.A. Filipovich[4], V.A. Kulchitsky[4]

[1] Zavoisky Physical-Technical Institute, FRC Kazan Scientific Center of RAS, Kazan 420029, Russian Federation;
[2] Institute of Fundamental Medicine and Biology of Kazan Federal University, Kazan 420008, Russian Federation;
[3] Volga Region State University of Physical Culture, Sport and Tourism, Kazan 420010, Russian Federation;
[4] Institute of Physiology of Nat. Acad. of Sci. of Belarus, Minsk 220072, Belarus
kh_gainutdinov@mail.ru

The discovery of the ability of mammalian cells to synthesize nitric oxide (NO) has stimulated enormous research efforts to study the role of NO in all areas of chemistry, biology and medicine [1, 2]. NO, as a key signaling molecule, is involved in the regulation of many physiological functions of the body, including the nervous system [3]. NO is widely distributed in the nervous [4, 5], cardiovascular [6, 7] and other functional systems of the body [8]. Since NO is a chemically highly reactive free radical capable of acting as both an oxidizer and a reducer [1], an assumption arises about its diverse effects in biological tissues. Of great interest is the participation of NO in the mechanisms of development of various pathological conditions of the body [9]. One of the reasons for the involvement of NO in the pathological process is a long-term lack of oxygen, which leads to brain hypoxia [10, 11]. However, there are contradictions in the data on the role of NO in these processes, which allow us to state that at present there is no consensus on the role of endogenous NO in the processes occurring during damage to the nervous system [3, 10].

There are many methods for measuring NO production in biological systems. Accurately measuring both the constant concentration of NO and the rate of NO production in biological systems is challenging due to the low activity of NO synthases and its short half-life. In recent years, electron paramagnetic resonance (EPR) was proven as one of the most effective methods for the detection and quantification of nitric oxide in biological tissues [10, 12, 13]. According to this we tried to detail some of the biophysical patterns of nitrogen monoxide formation in combined trauma of the brain and spinal cord

EPR spectroscopy was used to study the dynamics of NO content in the brain of rats after modeling combined brain and spinal cord injuries. The intensity of NO production by EPR spectroscopy was measured using the spin trap method [10, 12], which is based on the reaction of NO with a spin trap. The complex of Fe^{2+} with diethyldithiocarbamate (DETC) was used for capture NO with generating a stable ternary complex $(DETC)_2$-Fe^{2+}-NO in animal tissue. These complexes are characterized by an easily recognizable EPR spectra with a *g*-factor value of $g = 2.035$–2.040 and a triplet hyperfine structure [1, 12, 13]. The measurements of spectra of complex of biological samples $(DETC)_2$-Fe^{2+}-NO and Cu^{2+}-$(DETC)_2$ were made using a Bruker X-band (9.5320 GHz) EMX/plus spectrometer.

The intensity of NO production and copper content in the liver of rats after the formation of combined injury were studied using the EPR spectroscopy method. It was shown that 7 days after modeling combined injury of the brain and spinal cord, there was a significant (reliable) decrease in NO production in the liver by 2 times. Copper content in the liver also decreased, but not significantly.

The work was supported by the framework of a state assignment to Zavoisky Physical-Technical Institute of RAS and the Strategic Academic Leadership Program of Kazan Federal University (PRIORITY 2030).

1. Vanin A.F.: Nitric Oxide **54**, 15–29 (2016)
2. Ignarro L.J. et al.: J Cardiovasc Pharmacol. **34**(6), 879–886 (1999)
3. Lundberg J.O.; Weitzberg E.: Cell **185**, 2853–2878 (2022)
4. Steinert J.R. et al.: Neuroscientist **16**, 435–452 (2010)
5. Chachlaki K.; Prevot V.; British J. Pharmacol. **177** (24), 5437–5458 (2020)
6. Zaripova R.I. et al.: Zhurnal tekhnicheskoy fiziki **92**(7), 999–1003 (2022)
7. Lakomkin V.L. et al.: Nitric Oxide: Biology and Chemistry **16**(4), 413–418 2007
8. Boehning D.; Snyder S.H.: Annu. Rev. Neurosci. **26**, 105–131 (2003)
9. Pacher P. et al.: Physiol. Rev. **87**, 315–427 (2007)
10. Wierónska J.M. et al.: Biomolecules **11**, 1097 (2021)
11. Shlapakova T.I. et al.; Bioorganic Chemistry 46(5), 466–485 (2020)
12. Mikoyan V.D. et al.: Biochim. Biophys. Acta **1336**, No 2, 225–234 (1997)
13. Gainutdinov Kh.L. et al.: Technical Physics **65**(9), 1421–1426 (2020)