Biogenic magnetic nanoparticles in representatives of kingdom Fungi

Svitlana Gorobets[1], Oksana Gorobets[1,2], Maryna Bulaievska[1], Veronika Mendosa Valverde[1], Kseniia Hetmanenko[1], Iryna Sharay[2]

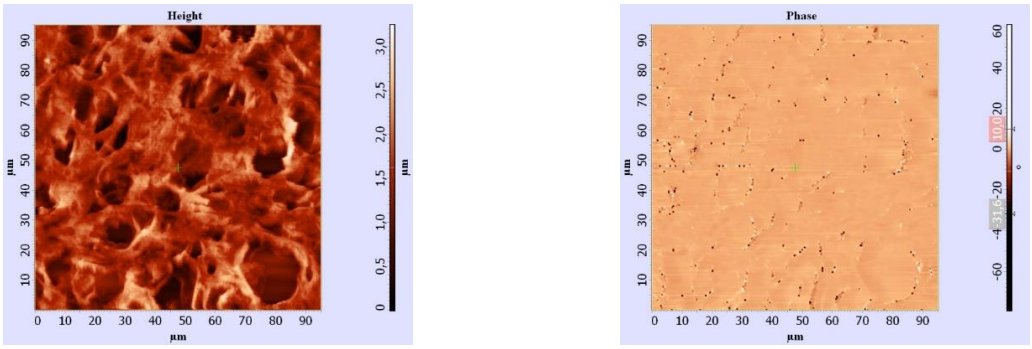
[1]National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine

[2]Institute of Magnetism NAS of Ukraine and MESYS of Ukraine, Kyiv, Ukraine

Magnetic nanoparticles of natural origin, i.e. biogenic magnetic nanoparticles (BMNs) have been found in many prokaryotes, archaea and eukaryotes [1]. However, experimental studies of BMNs in fungi are few. Therefore, to date, it is important to search for potential producers of BMNs among the representatives of kingdom Fungi, and to examine the samples of the common mushroom *Agaricus bisporus* to establish the presence of BMNs in them. This will give an impetus to a detailed study of the role of BMNs in fungi, and prediction their functions.

Search for potential producers of BMNs among 75 species of fungi, relating to 6 divisions: *Basidiomycota*, *Ascomycota*, *Microsporidia*, *Zygomycota*, *Chytridiomycota*, *Glomeromycota*, was conducted using comparative genomics methods. The proteome of fungi was aligned with the magnetotactic bacterium *Magnetospirillum gryphiswaldense* MSR-1 proteome, the BMNs biomineralization mechanism in which has been studied in detail. Based on the results of alignment, the studied fungi are classified into 4 groups according to the properties of BMNs and the location of their localization in the cell.

Samples of the common mushroom *Agaricus bisporus* fruiting body are investigated using methods of atomic force microscopy (AFM) and magnetic force microscopy (MFM). In Figure 1, BMNs are represented by black and white dots on MFM images.



a) b)

Figure 1. Images of common mushroom *Agaricus bisporus*: a) – AFM image, b) – MFM image.

The carried out bioinformation analysis showed that all studied species of fungi are potential producers of BMNs. Of these, 15 species are able to synthesize amorphous extracellular BMNs, 54 species are able to synthesize crystalline extracellular BMNs, 4 species of fungi are able to synthesize amorphous intracellular BMNs and only 2 species are able to synthesize crystalline intracellular BMNs. After analyzing the MFM image it can be concluded that the samples of the common mushroom *Agaricus bisporus* fruiting body contain both separate BMNs and their chains, hence the common mushroom *Agaricus bisporus* is the producer of BMNs.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 644348 (MagIC).

[1] Gorobets O. Yu. Biogenic Magnetic Nanoparticles: Biomineralization in Prokaryotes and Eukaryotes / O. Yu. Gorobets, S. V. Gorobets, Yu. I Gorobets. // Dekker Encyclopedia of Nanoscience and Nanotechnology, Third Edition. CRC Press: New York. – 2014. – P. 300 – 308.