Session 17: Biochemistry and biotechnology of fungi

Lectures

L.17.1

Spotlight on the Fungi: from photoreception to biotechnology

Anna Pawlik

Department of Biochemistry and Biotechnology, Institute of Biological Sciences, Maria Curie-Skłodowska University, Poland
Anna Pawlik <anna.pawlik@mail.umcs.pl>

Sunlight is a very important signal for every living organism, serving either as a source of energy or information from the surrounding environment, and it can be considered crucial for effective competition and survival in nature. In fungi, light controls e.g. metabolic processes, developmental decisions, physiological adaptations, morphogenesis, circadian clock and cellular stress response. These organisms are able to receive light stimuli via protein receptors, which are responsible for reception light of different intensity and wavelength (color), suggesting the ability of fungi to detect specific light signals.
The reaction of fungi to a light stimulus is multidirectional and varies across fungal species. In recent years, it has been repeatedly proven that, using up to 11 photoreceptors and signaling cascades, fungi change their global gene expression profile, which regulates their metabolism and numerous signal transduction pathways. Changes in response to light were mainly observed in the metabolism of carotenoids, polysaccharides, carbohydrates, fatty acids, nucleotides and nucleosides, and the regulation of secondary metabolite production. The research conducted so far in the field of fungal photobiology focuses on the physiological importance of light for fungi, as well as on the regulation of metabolism and enzyme activity by light and the possibility of using this property to improve biotechnological processes.

L.17.2

An effective inhibitor of SARS-CoV-2 main protease revealed by yeast system

Wojciech Grabiński[1], Anna Kicińska[1], Ewa Kosicka[1], Martyna Baranek-Grabińska[1], Ewelina Hejenkowska[2], Joanna Budzik[1], Paulina Śliska[1], Weronika Śliwińska[1], Andonis Karachitos[1]

[1]Department of Bioenergetics, Faculty of Biology, Institute of Molecular Biology and Biotechnology, Adam Mickiewicz University, Poznań, Poland.; [2]Department of Pediatrics, University of Virginia, Charlottesville, VA 22903, USA
Andonis Karachitos <andonis@amu.edu.pl>

The COVID-19 pandemic caused by SARS-CoV-2 has had a significant impact on global health and economies. Despite the availability of vaccines, their limited accessibility and vaccine hesitancy pose challenges in controlling the spread of the disease. Effective therapeutic strategies, including antiviral drugs, are needed to combat the future spread of new SARS-CoV-2 virus variants. The main protease (Mpro) is a critical therapeutic target for COVID-19 drugs, and its inhibition impairs viral replication. However, the use of drugs that inhibit Mpro may induce selection pressure, and it is critical to monitor viral resistance to known drugs and to develop new drugs. We have developed a yeast system for the identification of Mpro inhibitors as an alternative to costly and highly biosecure techniques. The system is based on stable expression of Mpro and does not require selection media. It can be cultured on a rich carbon source, providing rapid growth and screening results. In screening the drug library, the system found several drugs with Mpro inhibitory properties. One drug, not yet known for its Mpro inhibitory potential with high efficacy, may contribute to the development of new derivative molecules effective against SARS-CoV-2 and other beta-coronaviruses.

Acknowledgements

This work was supported by the research grant of Adam Mickiewicz University, Poznan, Grant Number 6/2020 "Research on COVID-19".

Oral presentations

O.17.1

Fungal melanins – complexity and analytical challenges

Jan Pukalski[1], Natalia Marcol-Rumak[1], Shosuke Ito[2], Kazumasa Wakamatsu[2], Przemysław Mieszko Płonka[3], Dariusz Latowski[1]

[1]Jagiellonian University, Faculty of Biochemistry, Biophysics and Biotechnology, Department of Plant Physiology and Biochemistry, Kraków, Poland; [2]Institute for Melanin Chemistry, Fujita Health University, Toyoake, Japan; [3]Jagiellonian University, Faculty of Biochemistry, Biophysics and Biotechnology, Department of Biophysics and Cancer Biology, Kraków, Poland
Jan Adam Pukalski <jan.pukalski@doctoral.uj.edu.pl>

Melanins are biopolymers found in i.e. animals, plants, bacteria and fungi. They play versatile roles such as antioxidants, radioprotectants, or binding sites for xenobiotics, thus they gain growing interest in the scientific community. Whereas the analytical methods for studying melanins of higher animals are well established, studies of fungal melanins are still very challenging due to additional types of the pigments, for instance, 1,8-dihydroxynaphthalene derived melanins, which do not occur in animals [1].
In the presentation, the actual state of the art in fungal melanin analyses would be shown and the challenges remaining in the field would be discussed. Next, the results of studies of melanins synthesized by *Plenodomus biglobosus* (Shoemaker & Brun, 2001), using methods such as electron paramagnetic resonance (EPR) spectroscopy, analysis of melanin degradation products (methods by Ito and Wakamatsu) and specific inhibitors of biosynthetic pathways would be presented. Performed experiments revealed that *P. biglobosus* is capable of synthesizing additional types of melanins except for previously detected benzothiazine pheomelanin [2]. Finally, the application of the obtained data in the studies of melanin interactions in fungal dual cultures would be shown.

References

1. ER Mattoon, RJB Cordero, A Casadevall. *Journal of Fungi (Basel)*, 2021, 7(6): 488.
2. J Pukalski, N Marcol-Rumak, N Wolan, PM Plonka, P Ryszka, T Kowalski, D Latowski. *Acta Biochimica Polonica*, 2020, 67(3): 295-301.

O.17.2

A new model for fungal dual cultures

Jan Pukalski[1], Monika Olchawa-Pajor[2], Natalia Marcol-Rumak[1], Paweł Jedynak[1], Katarzyna Nawrot-Chorabik[3], Dariusz Latowski[1]

[1]Jagiellonian University, Faculty of Biochemistry, Biophysics and Biotechnology, Department of Plant Physiology and Biochemistry, Kraków, Poland; [2]University of Applied Sciences in Tarnow, Faculty of Mathematics and Natural Sciences, Department of Environmental Protection, Tarnów, Poland; [3]University of Agriculture in Krakow, Department of Forest Ecosystems Protection, Kraków, Poland
Dariusz Latowski <dariusz.latowski@uj.edu.pl>

A new model of fungal dual cultures has been proposed. It eliminates the influence of physical factors on the fungus under study, such as the edge of the Petri dish closest to the fungus culture or the physical presence of a second colony. The model accurately determines the culture start conditions and requires calibration of the culture completion time. In the start of the dual culture of our model, it is crucial to maintain equal distances from the physical barriers of both fungi, which can be a variable depending, for example, on the diameter of the dish. The fungal inocula are arranged along the diameter of the dish. The distance of both fungal inocula from the proximal edge of the pathway and between inoculum centres should be the same. A calibration of the culture completion time should be performed before starting the dual culture. The calibration is based on a monoculture of the pathogen whose inoculum is placed under exactly the same conditions and in the same position as it will be in the dual culture. The time of the end of the parameterisation of the dual culture with the pathogen under test determines the time of the monoculture, in which the effect of inhibition of mycelial growth by the proximal edge of the dish is observed. This occurs when the size of the monoculture colony radii, measured along the diameter of the dish, towards the proximal and distal edges of the mycelium become statistically significantly different.