Exploring the potential of yeast cells as biosensors for environmental monitoring

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Biosensors are among the emerging sensitive and cost-effective methods for detection of chemicals in the environment. Due to their amenability to genetic manipulation and sensitivity to different analytes, microorganisms are suitable for biosensor development. Recently, there is a growing interest in yeast-based biosensors due to their stability, higher tolerance to harsh environment and possession of advanced chemical receptors. In our laboratory, we aimed to design and develop Saccharomyces cerevisiae-based biosensors to be used in environmental applications (1). In this regard, we followed a multidisciplinary approach, combining biological, chemical, and electrical engineering knowledge. Thus, a polydopamine-yeast biohybrid system was developed and characterized for the detection of copper (2). We also found that different growth conditions, resulting in fermentative or respiratory metabolism, could affect the electrochemical performance of the cells and copper sensing. Procedures of cell immobilization, which is a critical step for the mechanical and chemical stability of the sensor assembly, were compared for different matrices with respect to manipulation time, cell survival and metabolic features. Obtained data indicated that polydopamine-yeast biohybrid showed a concentration dependent electrocatalytic response to copper sulphate and sodium alginate has a better effect on cell viability and metabolism when compared to agarose. Overall, we achieved a proof of concept for the development of a prototype in the form of an electronic device.

1) Wahid E. et al. (2023) Biological and technical challenges for implementation of yeast-based biosensors. Microb Biotechnol. 16(1):54-66.

2) Ocheja O. B. et al. (2024) Polydopamine-immobilized yeast cells for portable electrochemical biosensors applied in environmental copper sensing. Bioelectrochemistry 157:108658.