

MICROBIAL BIOFUEL CELL BASED ON BAKER'S YEAST TREATED BY 9, 10-PHENANTHRENEQUINONE

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Over the years alternative energy sources such as microbial biofuel cells (MBFC) are becoming more prevalent. MBFC is an electrochemical device which converts biological energy into usable electric power using biological material as a catalyst for fuel in a redox reaction. Redox mediators used in this system help to transfer electric charge taken from the biological material to the anode [1]. Electrochemical systems that use biological components have desirable traits, such as the ability of cells to self-replicate, regenerate and self-assemble.

Baker's yeast can be employed as a catalyst in MBFC. It is a species of single-celled fungi that has great importance in brewing and scientific research. Baker's yeast is a simple eukaryotic organism with homology to mammalian and plant cells. Yeast cells are resilient to changing conditions such as pH, anaerobic conditions, temperature. Manipulation of yeast cells is also inexpensive to cultivate and has high metabolic activity, making it very suitable for microbial biofuel cells [2]. Although, bioelectrochemical systems have disadvantages, such as low efficiency and the need for redox mediators. Some of these drawbacks can be solved by employing yeast immobilization and modification methods.

In this work we focused on cell treatment by 9, 10-Phenanthrenequinone (PQ) in order to facilitate charge transfer from cells to the anode. PQ passes through the cell walls and sticks to the inner cell membrane [1]. There it is reduced by the enzymes in the cell and gains 2 electrons which then pass second redox mediator. The second mediator used in our study was potassium ferricyanide ($K_3[Fe(CN)_6]$) due to its conductivity and high solubility in water. After it accepts the electrons from PQ, the redox mediator transfers them to the anode.

It was found that PQ-modified yeast, used in MFBC helps to improve charge transfer from cells to the anode without noticeable effect on cells viability.

[1] Morkvenaite-Vilkonciene I, Ramanaviciene A, Ramanavicius A. 9, 10-Phenanthrenequinone as a redox mediator for the imaging of yeast cells by scanning electrochemical microscopy. *Sensors and Actuators B: Chemical*. 2016 Jun 2;228:200-6.

[2] Haslett, N. D., Rawson, F. J., Barrière, F., Kunze, G., Pasco, N., Gooneratne, R., & Baronian, K. H. R. (2011). Characterisation of yeast microbial fuel cell with the yeast *Arxula adenivorans* as the biocatalyst. *Biosensors and Bioelectronics*, 26(9), 3742–3747. doi:10.1016/j.bios.2011.02.011