Comparing Natural and Artificially Designed Bacterial Consortia as Biosensing Elements for Rapid Non-Specific Detection of Organic Pollutant through Microbial Fuel Cell

Maira Anam, Sameen Yousaf, Iqra Sharafat, Zargona Zafar, Kamran Ayaz, Naeem Ali*

Department of Microbiology, Quaid-i-Azam University, Islamabad, Pakistan

*E-mail: naeemali2611@gmail.com

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The standard 5-days biochemical oxygen demand (BOD) method used for determination of biologically oxidizable organic material in wastewater considered to be laborious, time consuming and costly. Mediator-less microbial fuel cell (MFC) based biosensor offers an efficient alternative approach for real time monitoring of biodegradable organic matter in wastewater. Here we constructed an H-shaped MFC biosensor for comparing the efficiency of a complex natural (activated sludge) and artificially designed bacterial (*Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus circulans*) consortia as biological sensing elements for BOD measurements. Initially, the MFC biosensor was optimized and calibrated at pH 7 and temperature 37°C using 100 mM phosphate buffer with 100 mM NaCl solution as catholyte at 10 kΩ external resistance. Maximum power density of 14.2 mW/cm² was generated by MFC-I with sludge consortium and it was 5 folds higher than MFC-II with artificial consortium. Standard glucose and glutamic acid (GGA) solutions were used for establishing the calibration curves between different BOD concentrations (50-250 mg/L) and voltage (mV) outputs in MFC. The regression equations for MFC-I and MFC-II biosensors were recorded as $y_1 = 0.7834x - 11.638$ and $y_2 = 0.1667x + 0.8476$ respectively. Linear regression analysis revealed that 1 unit (mg/L) increase in organic load caused a voltage increase of 0.78 mV and 0.16 mV in the MFCs (I and II) reactors respectively. The relative performance in terms of stability (55-60 days) and reproducibility (within ±15.4%) of MFC-I BOD biosensor was almost double than MFC-II. The varying low concentrations of different electron acceptors (phosphate, nitrate and nitrite) in anodic compartments did not affect the performance of MFC biosensors.

Keywords: MFC biosensor, Biochemical oxygen demand (BOD), Natural consortia, Artificial consortia, Pyrosequencing

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