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https://doi.org/10.30970/apmicro.2026.11

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THE RELATIONSHIP BETWEEN ELECTROGENESIS AND BIOFILM FORMATION IN ELECTROACTIVE BACTERIA

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Abstract. This study correlates biofilm formation with redox activity to assess the electrogenic potential of *Pseudomonas* strains (*P. aeruginosa*, *P. chlororaphis*, *P. fluorescens*) for microbial fuel cells. Cultivation showed *P. aeruginosa* developed dense, uniform biofilms, while others formed moderate, uneven ones. *P. aeruginosa* also exhibited a DREAM coefficient 4.6–5.8 times higher than the others within 4 h, indicating superior electron production. Ultimately, *P. aeruginosa* ATCC 27853 showed 3–8 times greater electron emission intensity, confirming a direct relationship between solid-surface biomass accumulation and redox capacity, validating these parameters for evaluating microbial current generators.
Keywords: microbial fuel cells, electrogenesis, biofilm, electroactive microorganisms, redox activity.

The search for efficient microorganisms for use as the basis of microbial fuel cells (MFCs) is based on evaluating their ability for electrogenesis and the formation of microbial associations. Key criteria include the intensity of microbial biomass accumulation on solid surfaces in the form of a biofilm and the ability of strains to produce compounds involved in redox reactions (Askitosari et al., 2019). This study focuses on analyzing the electrogenic potential of representatives of the genus *Pseudomonas* (specifically *P. aeruginosa*, *P. chlororaphis*, and *P. fluorescens* strains) through the quantitative determination of biofilm formation intensity and their level of redox activity. Establishing a correlation between these morphological and quantitative parameters allows for the identification of the most promising strains as current generators for MFCs.

The ability of microorganisms to form a biofilm was determined using crystal violet at 582 nm (O'Toole & Kolter, 1998). The redox potential was determined by the DREAM method, where methylene blue served as an indicator, and its reduction was recorded spectrophotometrically at 660 nm (Vishwanathan et al., 2015). The reliability of the results was evaluated using Student's t-test ($p \leq 0.05$) (Mavrodi et al., 2006).

The cultivation of microorganisms in polystyrene plates demonstrated an intensive accumulation of their biomass. The *P. aeruginosa* strains (ATCC 27853, ATCC 15692, ATCC 10145) formed a high-density biofilm with uniform cell layering. In contrast,

P. chlororaphis ONU 111 and *P. fluorescens* ONU 110 were characterized by a moderate intensity of biofilm formation, featuring an uneven cell distribution and the presence of gaps.

The ability of the studied microorganisms to function as the basis for microbial fuel cells (MFCs) was confirmed by their capacity to produce electrons and reduce methylene blue to a colorless leuco form (Rahimnejad et al., 2011).

The *P. aeruginosa* strains demonstrated a DREAM coefficient 4.6–5.8 times higher compared to *P. chlororaphis* and *P. fluorescens* as early as the 4th hour of the experiment. Over time, the redox activity increased, with the maximum intensity of electron emission recorded for the *P. aeruginosa* ATCC 27853 strain, showing values that exceeded the results of the other studied cultures by 3–8 times.

The analysis of the results established a direct correlation between the intensity of microbial biomass accumulation on a solid surface and the ability of the strains to engage in redox reactions. The *Pseudomonas* strains with a high level of biofilm formation and a mature, uniform biofilm (*P. aeruginosa*) demonstrated the highest capacity for electrogenesis. Accordingly, microorganisms with a lower rate of biofilm formation exhibited a significantly lower level of redox activity. The morphological and quantitative parameters of microbial association formation can be effectively utilized as criteria for evaluating microorganisms as current generators for MFCs.

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https://doi.org/10.30970/apmicro.2026.12

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BIOTECHNOLOGICAL SCREENING OF PLANT-ASSOCIATED BACTERIA FOR L-TRYPTOPHAN-DEPENDENT INDOLE-3-ACETIC ACID PRODUCTION

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Abstract. Indole-3-acetic acid (IAA) production by plant-associated bacteria represents a promising trait for agricultural biotechnology. This study evaluated strain-specific responses of six bacterial