Fast screening of mud microbial electrogenesis

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The increase in world energy demand requires the investigation of novel sources of renewable energy. The development of microbial fuel cells (MFCs) can solve this problem. MFCs are devices that generate the electrical energy from various biological objects and organic materials, e.g., fungi, soil, algae, etc. However, previous checking of the energy effectiveness of different microbial sources is an essential step in the development of MFCs [1-3].

This work describes a fast and cost-effective method of mud screening which can be used as a component of MFC to evaluate a soil microbial electrogenesis. The device is made of a plastic tray (*l = 9 cm, w = 14 cm, h = 4 cm*) previously used for paper electrophoresis. The proposed MFC consists of a cathode or aerobic chamber and anode or anaerobic chamber, electrodes (*l = 7.5 cm; w = 3 cm*), and a middle chamber, i.e., bridge (fig. 1). Anaerobic chamber content was the source of microbial electrogenesis. Soil mud was used for this purpose. Aerobic chamber was filled with the saline solution. Voltage measurements are conducted by filling the middle chamber with electrolyte solution and connecting probes of the multimeter to clams of the tray.

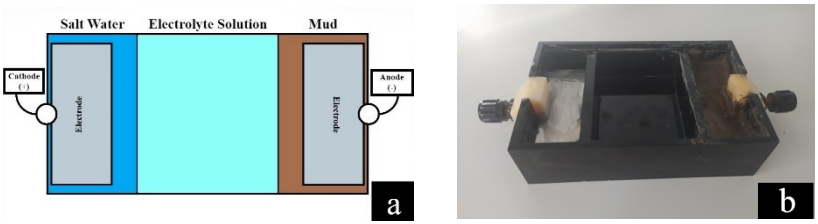

Fig. 1. Soil microbial fuel cell
a – the principle scheme; *b* – the real device

Before performing the measurement of voltage, the filled MFC was incubated in a portable thermostat Cultura M, 70700K at 33 ˚C for 30 minutes (fig. 2). After incubation the bridge was filled with electrolyte, and measurements of voltage were conducted. Then all liquid content was discarded, the aerobic chamber was refilled, and the process was repeated.

Fig. 2. Incubation of soil mud

Generated voltage was measured every 30 min for each soil mud sample. The results of voltage measurements are shown in table 1.

Table 1. Voltage measurements

Mud type	Time, h		
	0.5	1.0	1.5
Chornozem *Dyakivtsi, Vinnytsia*	Min: 0.51 V Max: 1.70 V	Min: 0.04 V Max: 0.05 V	Min: 0.05 V Max: 0.07 V
Clay soil *Liudavka, Vinnytsia*	Min: 0.02 V Max: 1.64 V	Min: 0.89 V Max: 1.37 V	Min: 0.11 V Max: 0.13 V
Urbanozem *Vinnytsia, Ukraine*	Min: 2.50 V Max: 2.85 V	Min: 0.08 V Max: 17.12 V	Min: 0.12 V Max: 0.16 V

As a result, authors propose the three-compartment MFC for fast screening of mud microbial electrogenesis. The indicated dimensions of chambers and the size of electrodes are considered enough to detect a measurable voltage difference between the soil samples.

Compared to a previous MFC model [4], the proposed one has several notable advantages:

- It gives the measurable results of a generated voltage that can be compared faster (in 30 min). This is the necessary condition for identification of the most promising source of electrogenic microorganisms. Maximum voltage obtained was 17.12 V in the course of experiment with the urbanozem mud sample.
- This type of device can be easily replicated as a single unit with the help of a 3D printer.
- It does not require the fabrication of an electron-permeable bridge from the agar or special membrane.

References:

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