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Bioelectricity Production from Algal Water Sample Using Microbial Fuel Cells

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ABSTRACT:
Renewable energy source is a need of developing countries to fulfill their present and future energy requirements. Microbial fuel cell technology represents a new form of renewable energy by generating electricity from algal sample. The demand for electrical energy to some extent can be fulfilled by this technology. Biomass is a good choice of electricity and algae are the most easily available source of biomass. The present study was aimed to find out the potency of bioelectricity produced by microalgae based microbial fuel cell (MFC) technology using algal water sample. This technology produces energy with maximum efficiency and minimum cost. The work was focused on the feasibility and potential generation of bioelectricity from algal water sample. The bioelectricity production was carried by using six chamber systems and it was found to generate up to 3 volts of energy. The scale up studies on this in future may lead to the fulfillment of electric energy needs by green earth initiatives and achievement of sustainability in energy production.
Keywords: Algae, Microbial Fuel Cell (MFCs), Bioelectricity, Energy.

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INTRODUCTION

Conventional methods of electrical energy generation are posing threat to Green Earth. Hence, there is a dire need for Green Earth initiatives and achievements of sustainable energy as evident from the recently held discussions during United Nations Climate Change Conference 2022 (COP27, Egypt, November 2022). Study on application of Microbial Fuel Cell (MFCs) employing algal biomass could be answer for reducing the harm caused by conventional methods of electrical power generation as well as a treatment of algal water [1]The recent work was aimed to study electrical energy generation by employing Microbial Fuel Cell (MFCs) using algal water samples.

Significance of Algae

Biomass is a good choice of electricity and algae are the most easily available source of biomass. [2]It is a bioenergy producing technology with maximum efficiency at minimum cost. This process combines the biomass production with efficient conversion to electrical energy. Algae not only produces energy but also consume carbon dioxide [CO_2] Algae can consume 1 ton CO_2 in merely one year, whereas the tree does it in its whole lifetime [2] It is an alternative energy source which is renewable and eco-friendly. Light and water are used by microalgae as the energy source in conducting CO_2 metabolism to produce biomass as explained in the following photosynthetic reaction [3]

$$6CO_2 + 6H2O + \text{Sunlight} \longrightarrow C_6H_{12}O_6 + 6O_2 \text{ Electrical Energy}$$

MATERIALS AND METHODS:

Collection of Algal water sample.

Algal water sample was collected from Phurusungi, Ramdara Road Loni Kalbhor, Haveli, Pune, Maharashtra, India in plastic containers and kept in laboratory at room temperature in presence of photosynthetic conditions.

Determination of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD).

The physico-chemical parameters such as Biological Oxygen Demand (BOD) and Chemical Oxygen

Demand (COD)) were analyzed at first day and five days using standard manual protocol [4, 5].

Microbial Fuel Cells (MFCs) Assembly Preparation.

Microbial cell set up was prepared by using reusable plastic bottles, Copper wire, and Aluminum sheet as well as wire. Six sets of MFCs were prepared **(Fig.1)**. The design of the MFCs was consisted of six chambers where the algal water sample was directly used as fuel. [6]Different types of electrodes were used. The length and breadth of electrode was 8 cm and 1 cm respectively. The electrodes were directly used for MFCs assembly preparation. To study the effect of electrode on power generation, six sets of electrodes were used in six chambers. In addition to this, individual identified algae sample was used in single chamber and then these six chambers and compared. Subsequently, these six microbial fuel cells were connected in series with the help of wire **(Fig.2)**. In the preparation of MFCs assembly, one assembly is connected to another assembly aluminum sheet to copper wire and the copper wire to aluminum sheet and then prepares six microbial fuel cells chamber in a same manner.

Use of Aluminum as a cathode and Copper act anode.

Copper and aluminum are strong electrical conductors and have low resistance allowing electricity to flow freely through them [6] Aluminum is easier oxidation than copper to form metal oxide for electrochemical oxidation. Aluminum will be also very susceptible to galvanic corrosion in contact with copper. Due to their metallic properties, they have a large number of free electrons. Copper is less oxidative than aluminum metal, which prevents it from corrosion while still allowing it to carry electricity. Copper is less oxidizing and has a lower resistance. Metals having a low resistance will have a higher conductivity [7]. Copper is metal and thus can be drawn into thin wires. Copper wire is used as the negative electrode for the anode current collector and Aluminum foil is used as the positive electrode for the cathode current collector.

Potential difference by voltmeter.

The voltmeter is connected in a circuit in parallel to measure the voltage in the circuit.

Bioelectricity generation from algal biomass using microbial fuel cells(MFCs)

A six chambered MFC was constructed. Two holes of diameter 5 mm were made on each bottle lids for the insertion of the salt bridge and electrodes. Take a 700 ml algal water sample in each microbial fuel cell. Then the circuit was completed by using electrical wire 0.5 mm **(Fig.3)**. And LED bulb connected to anode and cathode, then observe the electricity generation; if the bulb glows or not.

RESULTS AND DISCUSSION:

The experiment of bioelectricity was carried for 360 hours i.e. 15 days in aerobic and photosynthetic conditions **(Fig.4)**. Outcome of these experiments showed bioelectricity production from algal water sample. [8] This is composed of naturally occurring microorganisms and organic load from commercial as well as algal biomass material. The potential difference is directly proportional to the number of microbial fuel cells (MFCs) and its photosynthesis condition whereas it is inversely proportional the amount of algal water sample.

The bioelectricity production was carried by using six chamber systems and it was found to generate up to 3 volts of energy. [9]

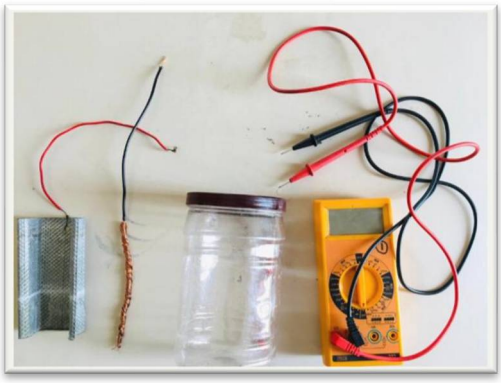

Fig. No.1. Microbial Fuel Cells Material

Fig. No.2. Microbial Fuel Cells Bottle

Fig No.3.Microbial Fuel Cells Bottles Connected in series with Algal Water

Fig.No.4 Light generation Bulb Glow

CONCLUSION

Bioelectricity production was carried out by microbial fuel cells (MFCs) using algal water sample. This algal water sample was checked for its potential to generate bioelectricity under aerobic and photosynthetic condition The experimental data showed the electricity generation by gradual increase from Day 1 to Day 15 The BOD and COD values and bioelectricity production of algal water sample was declined at the end of experiment.

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AUTHOR CONTRIBUTION:

Conception and design: UBB, VD-P, and GVM; collection of data: UBB and SRS; data analysis and interpretation: UBB and GVM; manuscript writing: VD-P; final approval of the manuscript: all authors.

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REFERENCES

1. Kannan, N and Donnellan P. (2021). Algae-assisted microbial fuel cells: A practical overview. Bioresource Technology Reports. 1: 100747.
2. Das, M P (2015). Bioelectricity production using algae in microbial fuel cell. Der Pharma Chemica . *7*(11):8-10.
3. Wang, Y (2013). Microalgae as the third generation biofuel: production, usage, challenges and prospects. Ph.D. thesis. Uppsala University, Department of Earth Sciences.
4. McKendry, P (2002). Energy production from biomass (part 1): overview of biomass. Bioresource technology, 83(1):37-46.
5. Samudro, G and Mangkoedihardjo, S (2010). Review on BOD, COD and BOD/COD Ratio: A triangle zone for toxic, biodegradable and stable levels. International Journal of Academic Research, *2*(4):235-239
6. Agnihotri, S., Godbole, S., Pawar, D., Patil, A., and Borade, U. (2017). Electricity generation using mircobial fuel cell technology by *Bacillus firmus*.
7. He, Z., Kan, J., Mansfeld, F., Angenent, L. T., and Nealson, K. H. (2009). Self-sustained phototrophic microbial fuel cells based on the synergistic cooperation between photosynthetic microorganisms and heterotrophic bacteria. Environmental Science and Technology. *43*(5): 1648-1654.
8. Chonde Sonal, G., Mishra, A. S., and Raut, P. D. (2013). Bioelectricity production from wastewater using microbial fuel cell (MFC). International Journal of Advanced Research in Engineering and Technology (IJARET). *4*(6): 62-69.
9. da Costa, C. (2018). Bioelectricity production from microalgae-microbial fuel cell technology (MMFC). In MATEC Web of Conferences. 156: 01017). EDP Sciences

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