Project ID: (To be provided by OMEIAT upon registration)

Project Title: Generating Electricity from Kitchen Waste using Microbial Fuel Cells

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a. Introduction:

The area of this research falls under Environmental Science and Renewable Energy. The project focuses on the development of a low-cost and sustainable method for generating electricity from biodegradable kitchen waste using microbial fuel cells (MFCs). This research will be important in addressing the dual problems of food waste disposal and the growing demand for clean energy. The scope of the research outcome will be the demonstration of how daily kitchen waste can be converted into electrical energy while also reducing environmental pollution.

b. Selection of Problem and Background Information:

A large quantity of kitchen waste is produced daily in households, restaurants, and institutions. Most of this waste ends up in landfills, producing greenhouse gases such as methane and contributing to pollution. Simultaneously, the demand for renewable and eco-friendly energy sources continues to rise.
Microbial fuel cells are devices that use microorganisms to break down organic matter and release electrons, which can be harnessed as electricity. Previous studies have shown that organic substrates such as food waste and wastewater can generate measurable electricity through microbial metabolism. This research will test the use of simple kitchen waste as the substrate to produce power using an MFC system. The project will also highlight the societal impact by offering an eco-friendly solution for waste management while reducing reliance on non-renewable energy.

c. Objectives:

- To design and construct a simple microbial fuel cell using cost-effective materials.
- To use biodegradable kitchen waste as a substrate to generate electricity.
- To measure and analyze the voltage and current produced.
- To demonstrate waste reduction and energy generation as a combined outcome.

Research Problem: How effectively can kitchen waste be used to generate electricity using microbial fuel cells?

Research Question: Can microorganisms in kitchen waste slurry release sufficient electrons to generate measurable electricity in an MFC setup?

Variables:

Independent Variable: Type and amount of kitchen waste used (vegetable peels, fruit skins, rice, etc.).
Dependent Variable: Amount of electricity generated (voltage, current).

Controlled Variables: Temperature, electrode material, chamber volume, and pH conditions.

Cause and Effect: The type and concentration of kitchen waste (cause) will directly affect the electricity output (effect).

Control in Study: A control setup with plain water (no organic waste) will be used to compare against the waste-fed MFC system.

d. Hypothesis:

If microorganisms in kitchen waste are provided with anaerobic conditions inside the MFC, then they will break down the organic matter and release electrons. These electrons will flow through an external circuit and generate measurable electricity. It is hypothesized that higher organic content in the waste slurry will produce higher voltage and current.

e. Procedure

Experimental Design:

The research will be carried out in three phases:

1. Preparation Phase

Kitchen waste (vegetable peels, rice, fruit skins, etc.) will be collected.

Waste will be blended and mixed with water to form a slurry.

Electrodes (carbon rods/graphite plates) will be prepared.

A salt bridge/proton exchange membrane will be prepared using agar and salt solution.

2. Construction Phase

An anode chamber will be filled with the kitchen waste slurry under anaerobic conditions.

A cathode chamber will be filled with aerated water.

The two chambers will be connected by the salt bridge.

Electrodes will be inserted in each chamber and connected with wires through an external circuit.

3. Operation and Data Collection Phase

The microbial decomposition of waste will release electrons into the anode.

Electrons will flow through the external circuit, generating electricity.

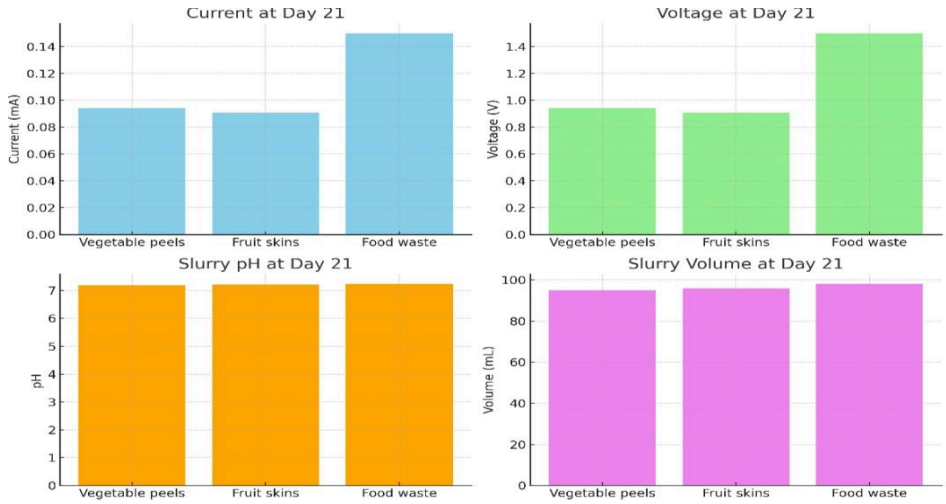
Protons will migrate through the salt bridge and react with oxygen in the cathode chamber.

Voltage and current will be measured daily using a multimeter.

Observations will be recorded in tabular form.

Proposed Data Collection Tables:

S: no	Types of kitchen waste	Voltage (mV)	Current (mA)	pH of slurry	Time (days)	Temperature (°C)	Remarks
1)	Vegetable peels	0.94	0.094	7.20	21	28	Slightly decline, nearly stability
2)	Fruit skins	0.91	0.091	7.22	21	28	Slightly decline
3)	Food waste	1.5	0.15	7.23	21	28	Stable,best sustained output



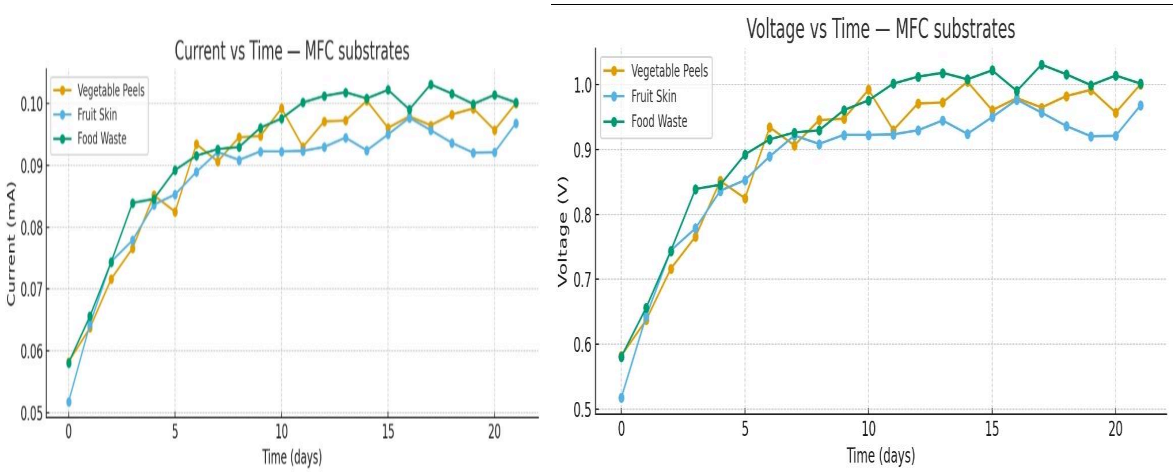
f. Risk and Safety

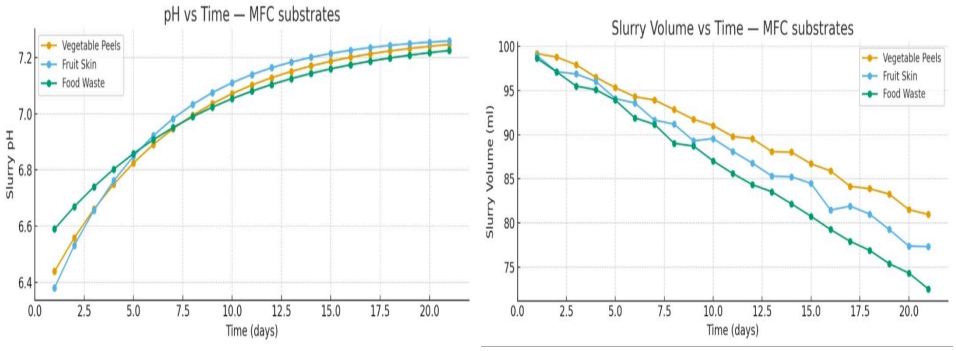
- Proper gloves and masks will be used while handling decomposing organic waste to avoid exposure to bacteria.
- The experimental chambers will be sealed to prevent foul odor and contamination.
- All waste after the experiment will be disposed of in an environmentally safe manner.
- Care will be taken while handling the electrical circuit and multimeter.

g. Data Analysis

The collected data will be analyzed using Graphical Analysis:

Voltage vs. Time and Current vs. Time graphs will be plotted.
pH slurry vs time and volume vs time graphs will be plotted





Comparative Analysis: Electricity generated from different types of kitchen waste will be compared.

Statistical Methods: Mean, variance, and standard deviation will be calculated to study reliability.

Cause-Effect Relationship: The relationship between the amount/type of waste and electricity generated will be studied by varying the independent variable while keeping other factors constant.

h. Bibliography

1. Logan BE, Regan JM. 2006. Electricity-producing bacterial communities in microbial fuel cells. Trends in Microbiology. 14(12):512–518.

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5. Hong P, Wong W. 2005. Gene Notes: a novel information management software for biologists. BMC Bioinformatics [Internet]. [Cited 2025 Sep 12]; 6:20. Available from: https://bmcbioinformatics.biomedcentral.com/