Electricity generating by Microbial Fuel Cell

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ABSTRACT

In this study we tried to convert the chemical energy to electrical energy by using microbial fuel cell (MFC) consist of two chambers (anode and cathode) in presence of bacteria *(Escherichia coli, pseudomonas aeroginosa*) and yeast *(Saccharomyces cervesia*) in the anode chamber to generate electrons. The system was started with glucose concentration 5gm/l in different pH value from (5-8). From the results we get the great generation of electricity with *S. cervesia* at pH 5 and the maximum voltage was 833mv. In case of bacteria that used in our experiment, the suitable pH for generation the electricity was.(7)

الخلاصة

حاولنا في هذه الدراسة تحويل الطاقة الكيميائية الى طاقة كهربائية باستخدام خلية الطاقة الميكروبية المكونة من غرفتين (الانود و الكاثود) ويحتوي الانود على بكتريا (*E.coli,Pseudomonas aeruginosa*) والخميرة *Saccharomyces cervesia*وبصورة منفصلة لتوليد الالكترون . تم استخدام وسط الاكار المغذي في حالة البكتريا اما في الخمائرتم استخدام تركيز (5) غرام من الكلوكوز وعند اس هيدروجيني (5-8) ومن خلال النتائج حصلنا على اعلى توليد للطاقة (833ملي فولت) باستخدام الخميرة وفي اس هيدروجيني(5) اما في حالة البكتريا كان الاس الهيدروجيني الملائم لتوليد الكهربائية هو (7).

INTRODUCTION

We can expect that the fuel will be exhausted in 24 years so we need to find alternatives to provide energy sources. Microbial fuel cell is the technology to generate electricity to the future in this technology bacteria oxidize organic and inorganic matter and give electricity [1] it is depend on microorganism to generate electricity [2].

MFCs consist of two chambers anaerobic anode chamber and cathode chamber separated by salt bridge to allow transferring the electron to the cathode chamber [3].

Anode chamber contain bacteria and in cathode chamber the electron will react with oxygen so biofuel cell convert chemical energy to electrical energy. [4] Anode chamber should be an aerobic to keep the bacteria away from the oxygen [5]. In some researches, they used potassium ferricyanide in cathode chamber to accept electrons and increase the power 50-80% [6]. The aim of this study to determine the species of microorganism, which can be used in microbial fuel cell to generate electricity without using mediators or toxic materials. In addition, investigate the suitable pH for the bacteria and yeast to generate the electricity.

MATERIALS AND METHODS

Biofuel chambers

We used two chambers made of glass 500ml in size connected to each other with salt bridge made of silicon tube (diameter 5cm, long10cm) this bridge to help in flowing the electron from anode to cathode chamber it is consist of 2%agar added to 3M KCL by heating this mixture till agar was dissolve using sterile syringe we applied agar – KCL to the silicon tube. (Figure-1-), The same size of graphite plate was used in anode and cathode chamber (12cm×3cm)from the carbon rod in used batteries the electrodes immersed completely in the anode and cathode solutions .[7]

Bacterial inoculums

Different isolates were used in anode chamber *S.cervisea, P.aeroginosa* and *E.coli* separately to generate electricity for *P.aeroginosa* and *E.coli* we put one colony in 50ml nutrient broth and incubated at 37◦C for 24hour, 2ml of this culture mixed with 120 ml nutrient broth and incubated for 48hours at 37◦C after centrifugation at 8000 rpm for 10min. The pellets of the bacteria were washed with sterile saline and the resespended in 19ml phosphate buffer (50mM in different pH 5-8) [8] with optical density of 3×10^8cell/ml.

In cathode chamber, we put 38ml of 100 mM phosphate buffer with 50mM potassium ferricyanide. In case of *Saccharomyces*, we used glucose yeast extract instead of nutrient broth.

Effect of pH and operation time on MFCs

The effect of pH on generation of electricity in MFCs was studied in different pH(5,6,7 and8)using 25mM phosphate buffer in the anode chamber and 100mM phosphate buffer in the cathode with the same rang of pH we operated the MFCs for (10, 20, 30, 45, 60, 90, 120, 180 and 210)min.in reactor volume 500ml[8] .

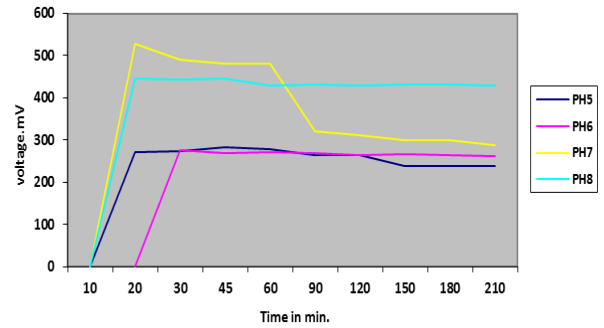
RESULTS AND DISCUSSION

The technology of MFCs is not developed enough to produce a large quantities of power. In present study we focused on bacteria *P.aeroginosa, E.coli* and yeast *S.cervesia* in MFC by using cultures without mediator to transfer the electrons to the anode electrode. Some

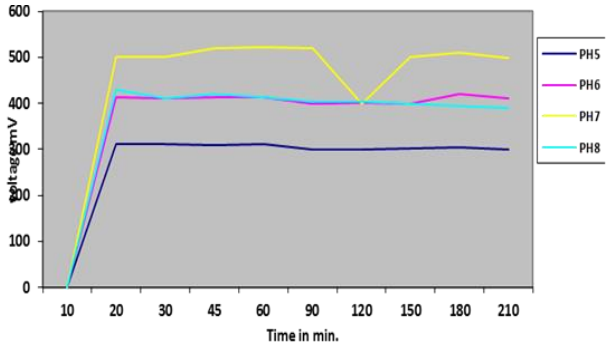
researchers proposed that the pyocyanin that produce by *pseudomonas* works as electron shuttle [5].

For the growth of bacteria, it is need PH close to neutral [9] so it is necessary to determine the optimal pH for our MFCs and investigate if there is effect to the electrolyte pH on electricity generation. We can see from the results that the maximum electricity generation was at pH 7 in case of the bacteria and it is less at pH (5, 6) and (8). Figure [2(a,b)] shows voltage time curves for *pseudomonas aeroginosa & E.coli* at different pH value ,voltage were very low at pH (5,6) and little increase in pH (8) but the higher power was at pH7(520mV). In case of yeast the results was different, the suitable pH for generation electricity was (5) and we can see from the results that the maximum voltage was (833mV) and the current (46µA) Figure (3). The generation of electricity increase in the beginning because of the high level of glucose, which keep the metabolism of the microorganisms high. It is clear that the voltage and current increase till reach the maximum after (45min)in case of bacteria after that it became stable till decrease after 6 hours while in yeast the maximum was after (60min) this belong to the high level of glucose in the beginning and the microorganism metabolism was in the highest level and the activity of the cell was high this led to high rate of electron transfer [10].by the end of the experiment the energy became very low because of the death of bacterial cell and the low level of glucose [11]and the decrease in energy generation may be due to decrease the conductivity of phosphate buffer[12].

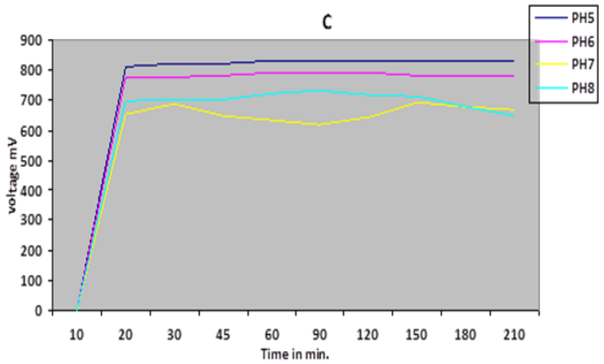
Figure 1 Microbial Fuel Cell



(a)

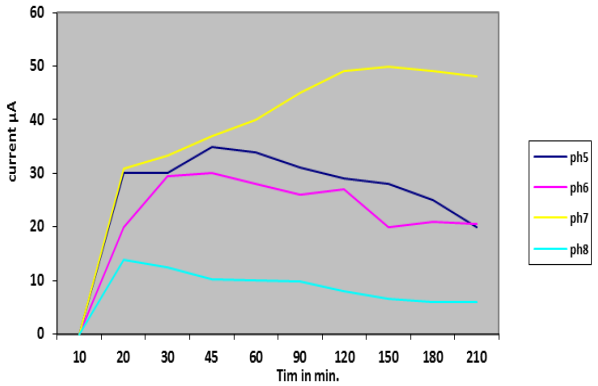


(b)

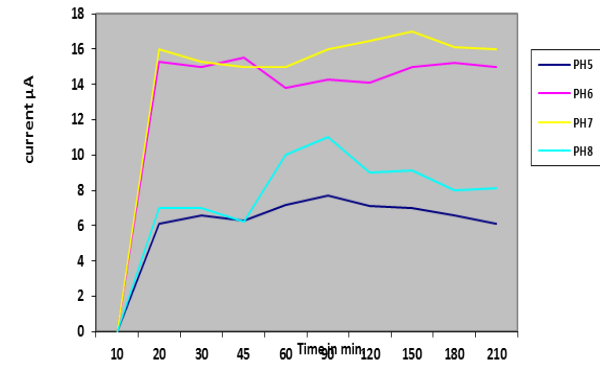


(c)

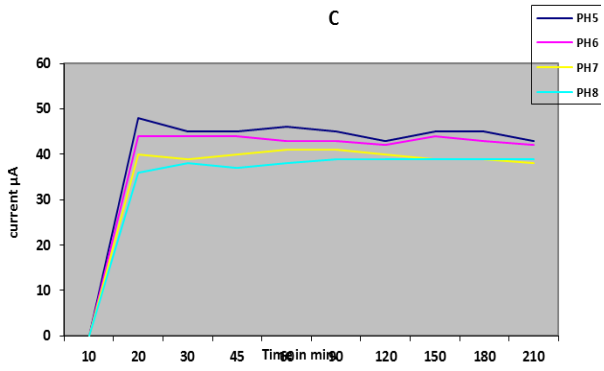
Figure 2 Voltage produced by microorganisms in different Ph a- *P.aeroginosa, b-E.coli c-S. cervisia)*



(a)



(b)



(c)

Figure 3 the current in MA in different pH generate by (a-*P.aeroginosa*, *b-E.coli*, *c-S. cervisia*)

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