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Bioelectricity from Antibiotic Resistant *Micrococcus luteus* of Computer Key Boards and Mice

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Abstract

In this study electricity generation was evaluated in a simple set up of two electrodes, immersed with cell suspensions of *Micrococcus luteus*isolated from computer key boards and Mice, with copper and Zinc electrodes. Fresh broth cultures of bacterial isolates grown in nutrient media and cells were concentrated by centrifugation. These cells were suspended in sterile water and subjected for assay. All the isolates showed positive result for current production which was measured using Voltmeter of 500 milli volts capacity. The amount of current generated by all the six isolates ranged between 0.49 -0.91 milli volts. The stability in current production (0.60) was observed up to three days in key board isolate [K4] whereas the *Micrococcus luteus*showed increase in current production from 0.53- 0.64 milli volts, and decreased production was observed in remaining isolates. Further studies on factors influencing current production like size, type of electrodes used, and concentration of substrates used and length of incubation by these isolates are under progress.

Key-Words: Bioelectricity, Bacterial isolates, Voltmeter, Millivolts

Introduction

Bioelectricity refers to electric potentials and currents produced by living organisms. Bioelectric potentials are generated by a variety of biological processes and generally range in strength from one to a few hundred (Bennetto, 1990). Bioelectric potentials are identical with the potentials produced by devices such as batteries or generators. In nearly all cases, however, a bioelectric current consists of a flow of ions (*i.e.*, electrically charged atoms or molecules), whereas the electric current used for lighting, communication, or power is a movement of electrons (Zhang et al, 2009; Zian et al, 2011).

The tiniest living organisms on Earth could become key to addressing some of the world's biggest energy challenges (Rabaey K and Verstraete W, 2005). For decades, researchers have pursued energy generation by bacterial processes; these bioreactors are powered by select strains of bacteria capable of transferring electrons from their outer cell surface to an external electrode, thereby producing electrical current (Niessen et al, 2004). This characteristic makes electrogenic bacteria excellent candidates for use in electricity-generating devices.

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MFCs use a pair of battery-like terminals (anode and cathode electrodes) connected to an external circuit and an electrolyte solution to conduct electricity. When bacteria physically attach to the anode, electrons generated in the interior of the cell are transferred to an external electrode, producing electrical current (Mali, 2012). The aim of present study was to investigate the potential of current production from multi drug resistant bacterial isolates from computer key boards and mice of Cyber centres.

Material and Methods

Microorganisms

Surface sample was taken from computer keyboards and mice. Samples were collected from frequently used computers by using sterile cotton swabs, moistened with sterile saline solution. The collected samples were serially diluted up to 10^{-9} dilutions and then subjected to pour plate method by using nutrient agar media (NA).All the inoculated plates were incubated at 37°C for 24-48 hours and observed for the appearance of colonies (Cappucino,1999. Aneja, 1996, N Kannan, 2002).

MFC Components

Microbial Fuel Cell majorly constitutes Electrodes, (Cu as cathode and Zn/Al as anode) of size of 3×5cm , the Multimeter and concentrated cell suspension of

bacterial isolates. Entire set up was maintained in aerobic condition. The salt bridge that forms a bridge between cathodic and anodic chamber facilitates the transfer of ions (protons).

Measurement of Output

About 600ml of nutrient broth culture of each test bacteria was prepared in sterile condition. The electric current generated was taken in day by day manner. About 200ml of samples (bacterial cultures) was taken in conical flaks. Each 200ml sample was divided in two100ml samples in beakers of 100ml capacity (Muralidharan et al, 2011; Moon et al, 2006; Nissen et al, 2006).

One 100ml sample was centrifuged, pellet of bacterial cells was collected and supernatant was discarded. To the collected bacterial cells, 100ml of sterile distilled water was added. Two electrodes (Cu as positive and Zn/Al as negative in size of 3×5cm) dipped in cell suspension.The output of the MFC was expressed by means of current (μa). For this purpose multimeter was used. Readings from the multimeter were noted only after a steady and constant value was obtained (Lovely and Derek, 2008; Mathuriya and Sharma, 2009) which took 3-4 hours. The multimeter was connected in series with MFC when measuring (Liu, 1990). The above procedure was done for all bacterial cultures. After taking reading of individual organism all M F cells wore connected in series manner to know total potential of all M F cells and readings were noted down(Mali,2012; Biffinger,2009). All these procedures were done up to four days with continuous incubation at 37˚C with agitation (Aelterman et al, 2006; Pandey et al 2011; Mathis et al 2008).

Results and Discussion

Electricity production by bacterial isolates recovered from computer key boards and mice of different cyber centres was carried out in the present work. The isolates were characterised as *Micrococcus* and *Enterococcus* species based on morphological and biochemical charecterization studies.Two isolates were found to be Enterococcus and three as micrococcus luteus species , which exhibited varying results in production of current (Table 1). One isolate (M10) has showed enhanced current production in all the four days tested(Fig 1). All the isolates showed optimum production of current up to four days. After the fifth day drastic decrease in production was observed. Measurement of current densities with the cells suspended in sterile water was done to eliminate the probable enhancement in current production because of the presence of conducting medium and any charged ions. However the ability of current production was enhanced when the cells were subjected for current production in the presence of electrolyte like Nacl.

It has been known for almost one hundred years that bacteria could generate electricity [Mokhtarion et al, 2012], but only in the past few years has this capability become more than a laboratory novelty. The reasons for this recent interest in using bacteria to generate electricity are a combination of the need for new sources of energy, discoveries about microbial physiology related to electron transport and the advancement of fuel-cell technologies.

The need for alternate eco-friendly fuel is growing rapidly with depletion of non-renewable energy resources(Moon et al,2006; Munoz et al,2011). Microbial fuel cells (MFCs) represent a new form of renewable energy by converting organic matter into electricity with the help of bacteria Aelterman, (2006). The present work was carried out with the interest in potential of newly isolated bacteria from computer keyboards and mice surfaces. This work was oriented towards screening of current production from pure cultures of *Micrococcus* and *Enterococcus* spp. It was different from the earlier works carried out by different workers(Mathuriya et al , 2009) who concentrated mainly on current production from isolates recovered from organic matter rich substrates like sewage or Marine sediments (Mathis,2008; Pandey,2011).

The present work was done to screen the electricity production from antibiotic resistant bacterial isolates recovered from computer key boards and Mice. The interest in current production by these isolates was because of their recovery from electronic surfaces which may influence the enhanced production of electric potential by these isolates. These isolates were charecterised as *Micrococcus* and *Enterococcus* spp. Variations in current production by the isolates of same genus (Micrococcus)was significant finding of the present work. Comparitive studies of current production by the stadard cultures of *Micrococcus* procured from NCIM pune are under progress. Earlier works also concentrated on electricity generation from mixed cultures (Fatemi et al,2012; Zian et al, 2011). Even in the present work attempt has been made to check the potential by mixed cultures of all the five isolates of bacteria which yielded moderate results.

Conclusion

The present work was successful in exploring interesting capacity of bioelectricity production from antibiotic resistant *M.luteus*recovered from Computer Key boards and Mice of Cyber centres in Sorroundings of Sahyadri Science College (aut.),Shimoga.

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Table 1: Current production by bacterial isolates

	1st Day	2ed Day	3rd Day	4th Day
K_4	0.6	0.6	0.6	0.59
K_6	0.63	0.6	0.57	0.49
K_{25}	0.63	0.6	0.57	0.49
M_2	0.63	0.6	0.57	0.49
M_{10}	0.53	0.55	0.58	0.64

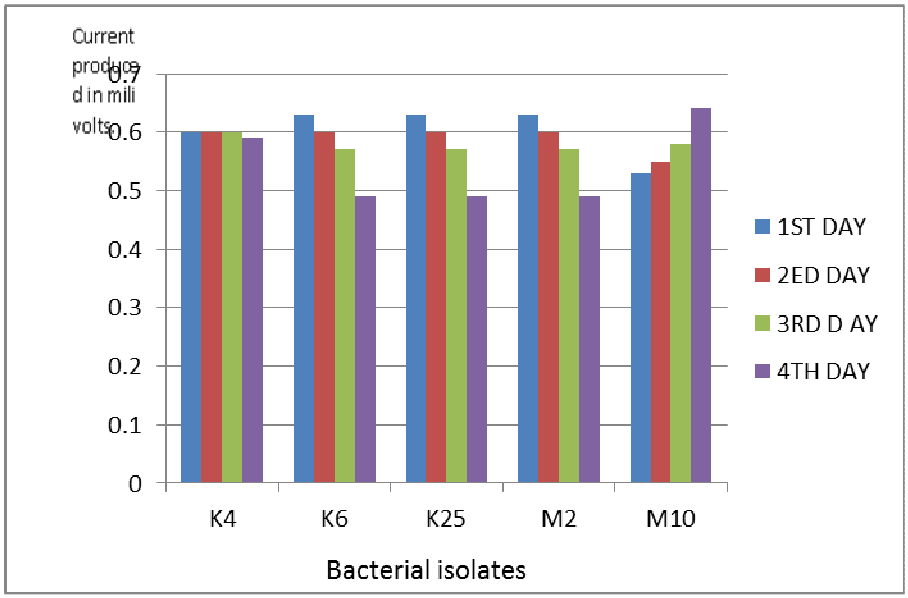

Fig. 1: Comparison of electricity production from bacterial isolates

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