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Isolation and Identification of Bacteria from E-Waste Contaminated Soil and the Presence of Heavy Metal

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A B S T R A C T

Electronic waste or E-waste describes discarded electrical or electronic devices. It includes discarded computers, office electronic equipment, entertainment device electronics, mobile phones, television sets, and refrigerators. Some of them are reusable. There are many hazardous and non-hazardous heavy metals present in E-wastes. The dumping of these substances into the environment causes many detrimental effects to the living organisms. Microorganism plays an important role in the degradation of heavy metal contaminated soil as well as waste water. In the present study bacteria was isolated from E-waste contaminated soil which was collected from an integrated waste management industry. Direct inoculation method was carried out for the isolation of the bacteria. Nutrient broth was used as the medium. Soil was serially diluted up to 10^{-10} dilutions. Out of 10 dilutions $10^{-5}$and 10^{-6}serial dilution onto the nutrient agar medium by spread plate method. It was then sub cultured into nutrient broth. Morphological and biochemical characterization were done for the tested microorganisms to obtain the effective isolate. The isolate was found to be gram positive rods.

Introduction

Industrial pollutants have been released to the environment in enormous quantities for many years. In India the solid waste management is a difficult task, and is becoming very complicated due to the invasion of E-waste. Electronic waste or E-waste includes Computers, Television, Mobile phones etc which are made of materials like plastics, metals etc (Widmer, 2005). There are hazardous and non-hazardous metals present in the E-waste. Some metals are not harmful in their natural state but their use in manufacture of electronic machines and equipment results in the formation of some compounds which are highly toxic (chromium becomes chromium IV) (Brandl *et al.*, 2001). Some of the toxic substances present in the e waste are given as follows:

Chromium: Chromium IV are irritating to eyes and can cause permanent eye injury and continuous exposure cause DNA damage (Jonathan *et al*., 2001).

Mercury: It is the mostly used metal in the electronic industry and are highly toxic. If inhaled or ingested it causes brain and liver damage (Haluk *et al*., 2004).

Lead: It is the fifth most widely used metal. Short term exposure to lead can cause diarrhoea, vomiting, Kidney damage, Convulsions even death. It also causes brain and blood disorders in young children (Alaluusua *et al*., 2004).

Brominated flame retardants (BFRs): It causes hormonal disorders (Lim *et al*., 2010).

Chloroflurocarbons: It causes skin cancer and genetic damage in organisms (Yost, 1984).

Non-hazardous substances includes Aluminium, Copper, Germanium, Gold, Iron, Lithium, Nickel, Silicon, Tin and Zinc

The lifespan of many electronic goods has been substantially shortened due to advancements in electronics, attractive consumer designs and marketing and compatibility issues.

Biological degradation of E waste have become an emerging alternative for the solution of environmental problem caused. Reports have been showed that some bacterial species like *Bacillus, Chromobacterium, Pseudomonas* can solubilize Nickel, Chromium (Gopalan *et al*., 1994) and cadmium (Yan *et al*., 2003). *Thiobacillus ferroxidans* and *Leptobacillus ferroxidans*have the ability to utilize ferrous iron (Oh *et al*., 2003). Some mesophilic, cyanogenic and acidophilic bacteria can solubilize copper from scraps of T.V circuit boards (Bas *et al*., 2013).

Materials and Methods

Collection and preparation of soil

Soil sample was collected from Coimbatore integrated waste management. The sample (approximately 10g) was collected using clean, dry and sterile polythene bag along with sterile spatula. The sample was transferred to lab; It was then sent to Tamil Nadu agricultural university to check the presence of heavy metal in the soil.

Isolation of bacteria

For the isolation of bacteria from E-waste contaminated soil, nutrient broth was used as media

Direct inoculation method

Under sterile conditions, 1 g of soil sample was added to 99mL of sterile distilled water and was serially diluted upto 10^{-10} dilutions. Plating was performed by spread plate method. After incubation for 24 hrs at (27±2) ˚C colonies were isolated. From 10^{-5}diluted plate purification was performed by quadrant streaking onto nutrient agar medium. It was further sub cultured into nutrient broth (Wu *et al*., 2012).

Morphological and Biochemical Characterization

According to Bergey's Manual various biochemical tests were performed. Gram staining, IMViC, Endospore staining and Catalase test were done for the tested microorganisms to obtain the effective isolate (Veit *et al*., 2002).

Results and Discussion

Identification of heavy metal

The heavy metals present in the soil were Chromium and Nickel and the concentration were 51.28ppm and 40.80ppm respectively. The contamination in soil for Chromium: 4700mg^{-1}kg and Nickel: 5100mg^{-1}kg (Desjardin *et al*., 2002).

Table.1 Biochemical characterization of the Isolate

Sl.No	Name of The Test	Result
1.	Indole	Negative
2.	Methyl Red	Negative
3.	Voges Proskauer	Positive
4.	Cimmon's citrate agar	Positive
5.	Gas	Negative
6.	Oxidase	Positive
7.	Catalase	Positive
8.	Urease	Negative

Isolation of Bacteria

A total of 2 isolates were obtained on nutrient agar plates. Based on cellular and morphological characterization one isolate was chosen for further studies.

Based on different biochemical characterization, the isolate was found to be Gram positive rods, spore forming bacteria as *Bacillus* sps.

Heavy Metal Tolerance of Isolated Bacteria
All strains were able to tolerate a variety of heavy metals at different concentrations (0.5mM, 1.0mM, 3.0mM and 5.0mM).

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