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Genetic modification of bacteria to detect metallic toxins in environmental samples

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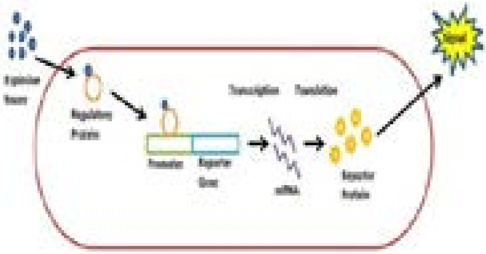
The main sources of human exposure to environmental toxins are water and food. According to WHO, various types of public health problems ranging from liver and kidney malfunctions, cancer, cardiovascular diseases, diarrhea, etc., have been implicated in recurrent exposure to toxic substances. Heavy metals are essential micronutrients that play important roles in many biological processes in microorganisms, plants and animals. However, at elevated concentrations, all heavy metals become toxic as they inhibit the normal biological processes in living organisms. The Gutzeit method, the basic method of arsenic assay, gives accurate measurement but adds to public health problem as the toxic arsine gas produced by the reduction of arsenite and arsenate reacts with mercuric salts to generate a colored compound. Atomic absorption spectrophotometry, ICP mass spectrometry and atomic fluorescence detection are also employed in detecting heavy metals in environmental samples, but these methods are expensive, laborious and less sensitive, and usually require trained staff and sophisticated facilities. The employment of whole-cell biosensors using recombinant DNA technology can prove possible alternative for solving these problems. This involves the use of genetically modified bacteria to generate signals which are detectable when exposed to the analyte(s) of interest. This study aimed to develop a disposable, simple, cheap and accurate biosensor device for co-detection of heavy metals and coliforms in drinking water. The results obtained showed that a pre-existing arsenic biosensor detected arsenate level below 10 ppb. The newly developed zinc and copper biosensors accurately detected zinc, lead, cadmium, mercury, copper, silver and gold concentrations below the recommended WHO limits. Since the whole-cell biosensors of interest in this project work by detecting growth, we aim to adapt them to additionally detect the growth of other bacteria, such as coliforms, so the same format of sensor detects both toxic metals and coliforms in a single unit.



Biography

Christopher N Nwankwo is a final year PhD student of the University of Edinburgh, Institute of Quantitative Biology, Biochemistry and Biotechnology. He has studied Microbiology at the University of Ilorin, Nigeria and has completed his Master's degree in Biotechnology at the University of Edinburgh. He has major interests in Environmental and Industrial Microbiology using modern Biotechnology and Molecular Biology approaches for the detection of toxins in environmental samples.

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