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Development of novel whole-cell biosensors for co-detection of metals and coliforms in drinking water and urine

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More than 100 million people globally are estimated to be affected by groundwater contaminated with arsenic, with Bangladesh, West Bengal and Taiwan being the worst hit. Heavy metals play significant roles in the growth and development of living organisms but when in elevated concentrations can be lethal due to their interference with normal biological processes. Drinking water available to the growing world population is constantly contaminated by natural and anthropogenic sources which pose serious threat to human lives. The traditional laboratory-based analytical investigations for environmental contaminants are expensive, laborious and usually require trained staff and sophisticated facilities. A disposable, inexpensive, simple and accurate device is necessary for detecting environmental toxins in water and urine which is the aim of this research. This work analyses the reliability of whole-cell biosensor systems for detecting environmental toxins in water and urine. Arsenate level below 10 ppb was detected using a pre-existing arsenic biosensor with stationary overnight incubation. The arsenic biosensor was tested in artificial urine medium and was found to detect arsenic concentration below 10 ppb. Air-dried and freeze-dried cells of the arsenic biosensor stored for 120 days at room temperature and resuspended in sensor medium were also tested and found to detect arsenic concentration below 10 ppb. A novel zinc biosensor was constructed using recombinant E. coli JM109 transformed with plasmids with copies of endogenous zinc-binding transcription factor, ZntR, using lacZ'α as a reporter. The Zn biosensor accurately detected zinc concentrations below the recommended WHO limit of 0.046 mM. For practical reasons, it was also desired to incorporate a coliform assay into biosensor devices to allow simultaneous monitoring of microbial and chemical quality of water. Coliforms were readily detected based on lactose fermentation using a variant of the same growth medium used for biosensor organisms to allow for easy generation of a combined coliform/metal sensor device. Further work aims at developing cheap, simple, accurate and disposable combined biosensors for detection of environmental toxins in water and urine.

Biography

Christopher Ndubuisi Nwankwo is currently a 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 & industrial microbiology using modern biotechnology and molecular biology approaches for the detection of environmental toxins in drinking water and clinical samples.

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