Optimisation and dose responses of bioluminescent bacterial biosensors induced with target hydrocarbons

ABSTRACT

Routine analytical methods are constrained in the speed of application, sample throughput and inability to determine the right bioavailable loading of pollutants. Microbial biosensor technology resolved these constraints by offering the most rapid, sensitive, reliable and cost-effective technology, especially in a bioavailable context. This study describes the growth characterisation and optimisation of three different lux-marked biosensors and their induction bioassay, thus testing their responses to doses of target hydrocarbons (naphthalene, toluene, Isopropylbenzene) and solution of mixed hydrocarbons. These biosensors, Pseudomonas fluorescence HK44, Escherichia coli HMS174 and Pseudomonas putidaTVA8 harbours luxCDABE reporter genes coupled to induction by hydrocarbons. Biosensors harvested at optimal exponential phase and induced with hydrocarbon using the optimised assay conditions are highly sensitive and responsive to their inducers in a proportionate dose-dependent status. The established dose responses of these catabolic biosensors signify the prospect of extrapolation for estimating the genuine contamination loading of pollutants for environmental relevance. However, several factors may contribute to the quenching effect at high concentration of inducers. Robust responsiveness to mixed hydrocarbon solution has been also realised accentuating its feasibility in analysing of real environmental samples containing heterogenous pollutants. This study emphasises the suitability of bioluminescent bacterial biosensors for pollutants analysis and notably the detection of soluble bioavailable fractions of diverse hydrocarbons, hence, serves as a reliable bioindicator of hydrocarbon pollution in an environment. Even so, the real value of biosensors is for a suite of ecologically justified biosensors to be applied in complementary combinations with other focused analytical or chemical methods for broad and resourceful inference.

Keyword: Biosensors; Bioreporters; LuxCDABE; Bioavailability; Naphthalene; Toluene; Isopropylbenzene; Hydrocarbon