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A novel gas production bioassay of thiosulfate utilizing denitrifying bacteria (TUDB) for the toxicity assessment of heavy metals contaminated water

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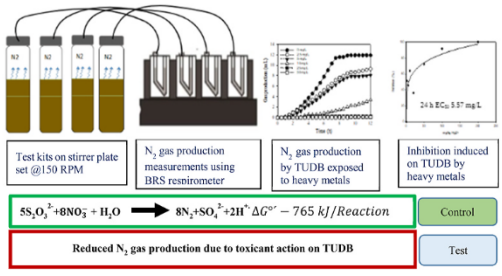
HIGHLIGHTS

- A novel gas production bioassay of TUDB was developed.
- Gas production by TUDB was sensitive in detecting heavy metal-induced water toxicity.
- Gas production was inversely proportional to the concentration of heavy metals.
- Decreasing inhibitory order of the tested heavy metals was $Cr^{6+}>Cu^{2+}Ag^{+}>Ni^{2+}>As^{3+}>Cd^{2+}>Hg^{2+}>Pb^{2+}$.

GRAPHICAL ABSTRACT



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ABSTRACT

This study reports for the first-time the possibility of deploying gas production by thiosulfate utilizing denitrifying bacteria (TUDB) as a proxy to evaluate water toxicity. The test relies on gas production by TUDB due to inhibited metabolic activity in the presence of toxicants. Gas production was measured using a bubble-type respirometer. Optimization studies indicated that 300 mg NO_3^- – N/L, 0.5 mL acclimated culture, and 2100 mg $S_2O_3^{2-}$/L were the ideal conditions facilitating the necessary volume of gas production for sensitive data generation. Determined EC_{50} values of the selected heavy metals were: Cr^{6+}, 0.51 mg/L; Ag^{+}, 2.90 mg/L; Cu^{2+}, 2.90 mg/L; Ni^{2+}, 3.60 mg/L; As^{3+}, 4.10 mg/L; Cd^{2+}, 5.56 mg/L; Hg^{2+}, 8.06 mg/L; and Pb^{2+}, 19.3 mg/L. The advantages of this method include operational simplicity through the elimination of cumbersome preprocessing procedures which are used to eliminate interferences caused by turbidity when the toxicity of turbid samples is determined via spectrophotometry.

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