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ORIGINAL ARTICLE

Consequences of crude oil contamination on the structure and function of autochthonous microbial community of a tropical agricultural soil

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Abstract
Crude oil contamination of soil matrices is a persistent problem with deleterious consequences due to the recalcitrant, toxic and mutagenic properties of its constituents. To decipher the effects of crude oil contamination on the microbial community structure and function of an agricultural soil, field moist soil microcosms 2S (agricultural soil) and AB6 (agricultural soil polluted with crude oil) were set up. Taxonomic profiling of the two microcosms using next generation shotgun sequencing revealed massive decline in the number of recovered sequences from 3,267,616 (2S) to 250,241 (AB6). It also revealed the dominance of the phyla *Actinobacteria* (46.86%), and *Firmicutes* (51.20%) in 2S and AB6 with preponderance of *Conexibacter* (11.40%), and *Singulisphaera* (4.43%) in 2S, and *Bacillus* (38.52%), *Sphingobium* (10.51%), and *Clostridium* (7.06%) in AB6, respectively. Gas chromatographic fingerprints of residual crude oil in AB6 revealed complete disappearance of 50% of the hydrocarbon fractions at the end of 42 days while the others were degraded to < 6% of their initial concentrations. Functional annotation of the predicted ORFs in the two metagenomes revealed diverse metabolic features of the autochthonous microbial community. It also revealed the exclusive detection of diverse genes in AB6 metagenome responsible for degradation of various classes of hydrocarbons and the detoxification, transport and resistance to heavy metals. This study has established the deleterious effects of crude oil contamination on the microbial community structure of a tropical agricultural soil and revealed the adaptive features of the microbial community to various environmental stressors.

Keywords Crude oil · Agricultural soil · Soil microcosm · Microbial community structure and function · Hydrocarbon degradation

Introduction

Crude oil, arguably the worlds' most compositionally complex organic mixture is a regular contaminant of diverse environmental matrices (Bossert and Bartha 1984; Margesin and Schinner 1997). Its deliberate or accidental discharge into the environment provokes deleterious health challenges and ecological perturbations due to the recalcitrance, mutagenic and toxic properties of its constituents (Bundy et al. 2002; Okoh 2006; Salam et al. 2017). Persistent exposure to high crude oil concentration may elicit elevated rates of cancer of the stomach, kidney, cervix and the lymph node (Hurtig and Sebastian 2004). It could also affect aquatic lives, impair plant growth and metabolism and stimulate massive decline in richness and diversity of soil flora and fauna (Odjegba and Sadiq 2006; Salam 2016; Salam et al. 2017).

The increasing rate of global warming, desertification and various anthropogenic activities has resulted in loss of arable land and render many soils unfit for agricultural purpose. Remediation of hydrocarbon-contaminated matrices is important as a response to the risk of adverse health or environmental effects caused by contamination and to reclaim the polluted site for use. While the use of physical and chemical methods for the remediation of oil-impacted soil is an

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