Journal of Pollution Effects & Control
ISSN: 2375-4397

Olapade, J Pollut Eff Cont 2013, 1:2
DOI: 10.4172/2375-4397.1000e106

Editorial Open Access

Occurrence, Ubiquity and Proficiency of Hydrocarbon-Degrading Microbial Assemblages in Nature

Ola A Olapade*

Biology Department and the Center for Sustainability and the Environments, Albion College, Michigan, USA

The ecological importance of diverse microbial assemblages with putative hydrocarbon-utilizing potentials in nature cannot be overemphasized, especially given large quantities of various hydrocarbon-based products that are commonly found in various environments, and coupled with the obvious limitations associated with alternative cleanup approaches (e.g., chemical and physical methods) that are often applied to remedy hydrocarbon-contaminations [1]. Generally, high quantities of hydrocarbon pollutants constantly find their way into natural environments as a result of several anthropogenic influences, including but not limited to, accidental spills of petroleum-based fuels, constant leakage during underground storage as well as frequent use and disposal of synthetic petroleum-based products [2-4]. Although most petroleum residues are known to be easily degraded by indigenous microbial assemblages in contaminated sites [5], however some organic pollutants often persist in the environment as a result of their toxic and carcinogenic potentials [6-8], causing the destruction of the inner membranes in gram-negative bacteria [9].

Therefore, since various hydrocarbon types, such as the aromatics (i.e. benzene, toluene and xylene isomers), that are major constituents of petroleum and industrial solvents are ubiquitously found in the environment, it is not at all surprising that various autochthonous microorganisms with putative hydrocarbon-utilizing potentials have also been isolated from diverse environments [10-13]. Even though the exclusive dominance of bacterial members belonging to the *Proteobacteria* has been well established in hydrocarbon-utilization [13,14], similarly, the metabolic capabilities of various other gram-negative and gram-positive bacterial phylotypes as well as fungi have also been well documented [15,16].

Mostly, the degradative proficiencies of hydrocarbon-utilizing microbes especially under aerobic conditions are somewhat dependent on the possession of oxygenase-catalysed enzyme complexes [17] as well as the influences of various environmental variables, including oxygen, water, nutrients (mostly nitrates and phosphates), pH and temperature, at polluted site [3]. Although less efficient microbial degradation of various mono-aromatic hydrocarbon residues are also not uncommon under anaerobic, denitrifying, iron-reducing, sulfate reducing and methanogenic conditions [18].

Overall, while it may be somewhat difficult to accurately predict or estimate the effects of wide array of organic pollutants on autochthonous microbial assemblages in nature, it is however safe to assume that hydrocarbon contaminants, at the least will probably alter and/or shift the community structures and compositions in favor of phylotypes with putative degradative potentials [14]. Therefore, to reduce the obvious burden constantly exerted by various organic chemicals on microbial assemblages in nature, there is urgent need to heed the call to explore and embrace alternative products and technologies with benign impacts on our environments [19].

References

1. Mikesell MD, Kukor JJ, Olsen RH (1993) Metabolic diversity of aromatic hydrocarbon-degrading bacteria from a petroleum-contaminated aquifer. Biodegradation 4: 249-259.
2. Young LY, Cerniglia CE (1995) Microbial transformation and degradation of toxic organic chemicals. Wiley, NewYork, USA.
3. Maier RM, Pepper IL, Gerba CP (2000) Environmental Microbiology. Academic Press, USA.
4. Kostka JE, Prakash O, Overholt WA, Green SJ, Freyer G, et al. (2011) Hydrocarbon-degrading bacteria and the bacterial community response in gulf of Mexico beach sands impacted by the deepwater horizon oil spill. Appl Environ Microbiol 77: 7962-7974.
5. Smith MR (1990) The biodegradation of aromatic hydrocarbons by bacteria. Biodegradation 1: 191-206.
6. Beck AJ, Alcock RE, Wilson SC, Wang MJ, Wild SR (1995) Long-term persistence of organic chemicals in sewage sludge-amended agriculture land: a soil quality perpective. Adv Agron 55: 345-391.
7. Nahar N, Alauddin M, Quilty B (2000) Toxic effects of toluene on the growth of activated sludge bacteria. World J Microb Biot 16: 307-311.
8. Olapade OA, Leff LG (2003) The effect of toluene on the microbial community of a river in Northeastern Ohio, USA. J Freshwater Ecol 18: 465-477.
9. de Smet MJ, Kingma J, Witholt B (1978) The effect of toluene on the structure and permeability of the outer and cytoplasmic membranes of Escherichia coli. Biochim Biophys Acta 506: 64-80.
10. Tay ST, Hemond HF, Polz MF, Cavanaugh CM, Dejesus I, et al. (1998) Two new Mycobacterium strains and their role in toluene degradation in a contaminated stream. Appl Environ Microbiol 64: 1715-1720.
11. Tay ST, Hemond HF, Polz MF, Cavanaugh CM, Krumholz LR (1999) Importance of Xanthobacter autotrophicus in toluene biodegradation within a contaminated stream. Syst Appl Microbiol 22: 113-118.
12. Zhang H, Kallimanis A, Koukkou AI, Drainas C (2004) Isolation and characterization of novel bacteria degrading polycyclic aromatic hydrocarbons from polluted Greek soils. Appl Microbiol Biotechnol 65: 124-131.
13. Cavalca L, Di Gennaro P, Colombo M, Andreoni V, Bernasconi S, et al. (2000) Distribution of catabolic pathways in some hydrocarbon-degrading bacteria from a subsurface polluted soil. Res Microbiol 151: 877-887.
14. Olapade OA (2013) Molecular Characterization of Bacterial Phylogenetic and Functional Groups at the site of the Deepwater Horizon Oil Spill along the Gulf of Mexico. Journal of Petroleum and Environmental Biotechnology 4: 1-6.
15. Weber FJ, Hage KC, de Bont JA (1995) Growth of the fungus Cladosporium sphaerospermum with toluene as the sole carbon and energy source. Appl Environ Microbiol 61: 3562-3566.
16. Van Hamme JD, Singh A, Ward OP (2003) Recent advances in petroleum microbiology. Microbiol Mol Biol Rev 67: 503-549.
17. Riser-Roberts E (1998) Remediation of petroleum contaminated soils. Lewis Publishers, Washington DC, USA.

***Corresponding author:** Ola A Olapade, Biology Department and the Center for Sustainability and the Environments, Albion College, Michigan, USA, Tel: 517-629-0296; E-mail: oolapade@albion.edu

Received November 14, 2013; **Accepted** November 15, 2013; **Published** November 18, 2013

Citation: Olapade OA (2013) Occurrence, Ubiquity and Proficiency of Hydrocarbon-Degrading Microbial Assemblages in Nature. J Pollut Eff Cont 1: e106 doi: 10.4172/2375-4397.1000e106

18. Edwards EA, Grbić-Galić D (1994) Anaerobic degradation of toluene and o-xylene by a methanogenic consortium. Appl Environ Microbiol 60: 313-322.

19. Anastas PT, Warner IM (1998) Green Chemistry: Theory and Practice. Oxford University Press, New York, USA.