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Comparative Evaluation of Biodegradation Potential of Arthrobacter chlorophenolicus and Microbacterium esteraromaticum for Cyclic Nitramine Explosive Octahydro- 1,3,5,7- Tetranitro- 1,3,5.7- Tetrazocine (HMX)

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Best known for its explosive properties, HMX is also an environmental pollutant of concern contaminating numerous military sites in India and world around. Many years of manufacture, processing and use of Octahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine (HMX) in military installations worldwide have caused widespread contamination of water, soil and sediments. Pollution of the environment by munitions occurs primarily through the discharge of untreated process wastes and residues from explosives manufacturing and processing plants. HMX, a possible human carcinogen, is toxic to biological system, and is recalcitrant to degradation. Therefore, the removal of HMX from explosive contaminated environment is crucial for the safety of ecosystems and human health. Among the several existing remediation approaches, microbial biodegradation is the most economical and eco-friendly cleanup option.

In this study, we evaluated biodegradation efficiency of two bacteria viz. Arthrobacter chlorophenolicus and Microbacterium esteraromaticum isolated from contaminated soil towards HMX under aerobic conditions. HMX degradation was carried out in shake flasks containing Minimal Salt Medium (MSM) with 20.27 μM of HMX. During degradation, treatment of HMX was monitored by high-performance liquid chromatographic (HPLC) analysis and achievement of degradation was calculated in percentage. Bacterial growth under contaminated conditions was monitored by measuring Optical Density (OD) at 600 nm. Increase in bacterial growth under contaminated conditions with increasing incubation period is suggestive of HMX utilization by bacteria as nitrogen source. The isolates mineralized 80-90 % of HMX in 20 days of incubation at 35˚C and 120 rpm under aerobic conditions with the Arthrobacter chlorophenolicus demonstrating the higher mineralization efficiency. Removal of HMX by both the isolates was accompanied by the concurrent release of nitrite. Analysis of HMX degradation and nitrite production indicated that maximum 01 mole of nitrite is produced per mole of HMX degraded. Since the bacteria under study were capable of utilizing HMX under nitrogen limiting conditions with no requirement of additional nutrients (i.e. acetate, yeast etc.), it shows high potential for a cost effective field application. These experimental [U+FB01]ndings suggest that the microbes under study may be employed for detoxification of contaminated sites with residues from HMX.

Key Words: Octahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine (HMX), Aerobic Degradation, Contaminated site, Arthrobacter chlorophenolicus and Microbacterium esteraromatic