Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous, carcinogenic, mutagenic and persistent environmental pollutants generated by natural combustion processes as well as from human activities. Anthropogenic inputs of PAHs from atmospheric deposition, industrial stack emission, crude oil production, refining, oil spills, ship traffic, urban runoff and illegal discharge of industrial effluents have caused significant accumulation of polycyclic aromatic hydrocarbons (PAHs) in marine environments. Crude oil is constituted from thousands of components which are separated into saturates, aromatics, resins and asphaltenes. Upon discharge into the sea, crude oil is subjected to weathering, the process caused by the combined effects of physical, chemical and biological modification. Saturates, especially those of smaller molecular weight, are readily biodegraded in marine environments. Aromatics with one or two aromatic rings are also efficiently biodegraded; however, those with four or more aromatic ring are quite resistant to biodegradation.

An effective wastewater treatment strategy was required to avoid damage to the ecosystems by crude oil wastewater discharge. High salinity limits microbial degradation of PAHs and makes conventional bioremediation procedures ineffective. In order to overcome this limiting factor, either halotolerant or halophilic microorganisms are used for successful bioremediation process. Thus in the present study a bacterial consortium
capable of degrading PAHs under saline condition was employed for bioremediation process.

In the present study the PAHs degrading bacterial consortium was enriched from seven different sampling sites which included petroleum and coal contaminated sites, salt pans and the sea-port of Chennai, India. The ability of the bacterial consortium to degrade PAHs was confirmed by clearing zones on PAHs sprayed plates. According to the number of rings and molecular weight, PAHs were divided into two groups: Low Molecular Weight PAHs (LMW) compounds with 2-3 fused rings and High Molecular Weight (HMW) PAHs compounds with more than 4 fused rings. The consortium was able to grow on both LMW and HMW PAHs at 30 g/L NaCl concentration. Carbon dioxide evolution and metabolites formed during the PAH (phenanthrene) degradation confirmed complete mineralization of PAH by the bacterial consortium. When NaCl concentration increased to 60 g/L the percent degradation was ≤45%. Addition of yeast extract enhanced the PAHs degradation at 60 g/L of NaCl concentration. The consortium was also capable of growing under non halophilic condition (1 g/L NaCl) and seem to be halotolerant in nature.

Further studies on different concentration of PAHs showed that the bacterial consortium utilized 95% of LMW PAH (Phenanthrene) up to 20 ppm. When phenanthrene concentration increased to 50 ppm and 100 ppm, maximum degradation was 89% and 74% in 4 days respectively. On HMW PAH, especially on pyrene as sole carbon source, the bacterial consortium showed 80 - 90% degradation up to 20 ppm. Further increase in pyrene
concentration to 50 ppm and 100 ppm showed 74% and 52% degradation in 4 days respectively.

The consortium was used in the lab scale reactor to treat the crude oil contaminated saline wastewater. The consortium showed 93% reduction in COD and potentially degraded the PAHs present in the crude oil contaminated saline wastewater. The LMW PAHs such as phenanthrene and fluorene present in crude oil contaminated saline wastewater was completely degraded in 5 days. The consortium degraded 85% and 80% of pyrene and benzo(e)pyrene (HMW PAHs) present in crude oil contaminated saline wastewater in 5 days.

The bacterial consortium consisted of three bacterial strains which are gram negative rod shaped. These strains were characterized with phenotypic and phylogentic analysis. The results confirmed the strains as Ochrobactrum sp., Enterobacter cloacae and Stenotrophomonas maltophilia. The nucleotide sequence of the bacterial strains capable of degrading different PAHs were submitted to GEN BANK and their respective accession numbers (EU722312, EU722313 and EU722314) are obtained from National Centre for Biotechnology Information (NCBI).

The findings of the present study indicate that the halotolerant bacterial consortium isolated from saline environment degraded PAHs. The consortium also was capable of degrading PAHs at high salt concentration with an additional substrate (Yeast extract). The findings also suggest that the consortium could be employed for potential treatment of PAHs in crude oil contaminated saline wastewater.