



Article

# Isolation and Characterization of Aquatic-Borne *Klebsiella pneumoniae* from Tropical Estuaries in Malaysia

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**Abstract:** *Klebsiella pneumoniae* is an opportunistic pathogen that is responsible for causing nosocomial and community-acquired infections. Despite its common presence in soil and aquatic environments, the virulence potential of *K. pneumoniae* isolates of environmental origin is largely unknown. Hence, in this study, *K. pneumoniae* isolated from the estuarine waters and sediments of the Matang mangrove estuary were screened for potential virulence characteristics: antibiotic susceptibility, morphotype on Congo red agar, biofilm formation, presence of exopolysaccharide and capsule, possession of virulence genes (*fimH*, *magA*, *ugE*, *wabG* and *rmpA*) and their genomic fingerprints. A total of 55 strains of *K. pneumoniae* were isolated from both human-distributed sites (located along Sangga Besar River) and control sites (located along Selinsing River) where less human activity was observed, indicated that *K. pneumoniae* is ubiquitous in the environment. However, the detection of potentially virulent strains at the downstream of Kuala Sepetang village has suggested an anthropogenic contamination source. In conclusion, the findings from this study indicate that the Matang mangrove estuary could harbor potentially pathogenic *K. pneumoniae* with risk to public health. More studies are required to compare the environmental *K. pneumoniae* strains with the community-acquired *K. pneumoniae* strains.

**Keywords:** *Klebsiella pneumoniae*; aquatic; anthropogenic contamination; antimicrobial resistance; virulence factors

## 1. Introduction

Bacteria of the *Klebsiella* genus are responsible for a variety of diseases in animals and humans [1]. Of the four disease-causing *Klebsiella* species, *K. pneumoniae* is the medically most important species as compared with *K. oxytoca*, *K. ozaenae* and *K. rhinoscleromatis*. *K. pneumoniae* has both clinical and non-clinical habitats [2]. Surface water, drinking water, soil, plants, sewage, and industrial effluent are the environmental reservoirs of *K. pneumoniae* [3,4]. In fact, due to its widespread nature, even in the environments apparently free from obvious fecal contamination, *K. pneumoniae* is usually considered as a member of total coliforms with insignificant public health risk [5]. However, Padschun and co-workers isolated potentially pathogenic *K. pneumoniae* from the aquatic environment in Germany that possess virulence factors such as pili, serum resistance and siderophore [6]. These virulence factors are commonly present in the clinical isolates which therefore suggest that the *K. pneumoniae* of