

## Characterization of Extended-Spectrum Beta-Lactamase Genes From Carbapenem Resistant Enterobacterales

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### Structured Abstract

**Background:** Antimicrobial resistance (AMR) is a critical global health concern, particularly with Carbapenem-Resistant *Enterobacterales* (CRE). Carbapenem antibiotics serve as a last line of defence against these resistant bacteria. However, the presence of Extended-Spectrum Beta-Lactamase (ESBL) enzymes, which are resistant to a broad range of beta-lactam antibiotics making the treatment harder. This study aims to identify the presence of ESBL genes in isolated CRE, focusing on *Escherichia coli* and *Klebsiella pneumoniae* from recreational water.

**Methods:** The bacteria were isolated from recreational water in Malaysia. Antibiotic profiling was conducted using the Kirby-Bauer disk diffusion method. Antibiotics used in this study were cefotaxime (30 µg), gentamicin (10 µg), imipenem (10 µg), meropenem (10 µg), and rifampicin (5 µg). Selected isolates were subjected to Polymerase Chain Reaction (PCR) to amplify ESBL genes such as CTX-M and TEM genes.

**Results:** In this study, eight bacterial isolates were successfully isolated. For antibiotic profile, none of the presumptive *E. coli* was resistant while 50.0% of presumptive *K. pneumoniae* were resistant against cefotaxime. On the other hand, 12.5% of presumptive *E. coli* was resistant against each gentamicin, imipenem, meropenem and rifampicin. For presumptive *K. pneumoniae*, 25.0% was resistant against gentamicin while, 37.5%, 87.5% and 75.0% were resistant against imipenem, meropenem and rifampicin respectively. Six out of eight isolates were identified as multidrug-resistant (MDR). However, none of the isolates harboured ESBL genes such as CTX-M and TEM.

**Conclusion:** These findings suggest that the observed Carbapenem resistance in these isolates may be due to mechanisms other than the CTX-M and TEM genes. Possible contributors include other ESBL genes like blaSHV, porin mutations, efflux pumps, Type C Ampicillinase, or Carbapenemase-producing CRE genes. The detection of CRE and MDR bacteria in recreational water indicates possible sources of contamination. This can threaten humans by causing hard to treat illness by the spread of these in our water system. Further research is necessary to identify the exact mechanisms responsible for Carbapenem resistance in these isolates.

**Keywords:** CRE, MDR, ESBL, *E. coli*, *K. pneumoniae*

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