Host-Specific Patterns of Genetic Diversity among IncI1-I gamma and IncK Plasmids Encoding CMY-2 beta-Lactamase in Escherichia coli Isolates from Humans, Poultry Meat, Poultry, and Dogs in Denmark

CMY-2 is the most common plasmid-mediated AmpC beta-lactamase in Escherichia coli isolates of human and animal origin. The aim of this study was to elucidate the epidemiology of CMY-2-producing E. coli in Denmark. Strain and plasmid relatedness was studied in 93 CMY-2-producing clinical and commensal E. coli isolates collected from 2006 to 2012 from humans, retail poultry meat, broilers, and dogs. Multilocus sequence typing (MLST), antimicrobial susceptibility testing, and conjugation were performed in conjunction with plasmid replicon typing, plasmid multilocus sequence typing (pMLST), restriction fragment length polymorphism (RFLP), and sequencing of selected bla(CMY-2)-harboring plasmids. MLST revealed high strain diversity, with few E. coli lineages occurring in multiple host species and sample types. bla(CMY-2) was detected on plasmids in 83 (98%) isolates. Most (75%) of the plasmids were conjugative and did not (96%) cotransfer resistance to antimicrobials other than cephalosporins. The main replicon types identified were IncI1-I gamma (55%) and IncK (39%). Isolates from different host species mainly carried distinct plasmid subtypes. Seven of the 18 human isolates harbored IncI1-I gamma/sequence type 2 (ST2), IncI1-I gamma/ST12, or IncK plasmids highly similar to those found among animal isolates, even though highly related human and animal plasmids differed by nonsynonymous single nucleotide polymorphisms (SNPs) or insertion sequence elements. This study clearly demonstrates that the epidemiology of CMY-2 can be understood only by thorough plasmid characterization. To date, the spread of this beta-lactam resistance determinant in Denmark is mainly associated with IncK and IncI1-I gamma plasmids that are generally distributed according to host-specific patterns. These baseline data will be useful to assess the consequences of the increasing human exposure to CMY-2-producing E. coli via animal sources.

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