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Characterization of ESBL and Colistin Resistance Genes in Escherichia coli from Beef and Pork Production Chains

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The indiscriminate use of antibiotics in animal production has led to the rise of bacteria resistant to almost all types of antibiotics currently available. Over the past decade, the detection of Extended Spectrum Beta-Lactamases (ESBL) and genes related to colistin resistance has been observed. This raises concern about developing infections that cannot be effectively treated, as broad-spectrum beta-lactams and colistin are the last line of defense against multidrug-resistant (MDR) organisms. This study aimed to explore the beta-lactamase and colistin genes in the pork and beef production chain. To investigate the resistance distribution, 136 Escherichia coli isolates were obtained, 73 from beef and 63 from pork. The isolates were sequenced by whole genome sequencing (WGS) with 35x coverage. The generated reads were assessed for quality, cleaned, assembled and annotated using the following software Fastqc v0.11.9, ,Trimmomatic v0.39, Quast v5.0.2., SPAdes v3.15.5 and Prokka v1.14.5. Resistance genes were searched using ABRicate v1.0.1 through the Comprehensive Antibiotic Resistance Database (CARD) as database. Rstudio v4.3.0 software was used to analyze the data, searching for beta-lactam and colistin genes. In pigs, resistance genes encoding inactivation mechanisms were predominant: blaTEM-1 (n=30), EC-15 (n=23), BcII (n=14); EC-18 (n=13); BcI (n=12); EC-13 (n=12) related to cephalosporin resistance. The genes blaCMY-59 (n=7), blaCTX-M-8(n=7), blaCTX-M-15 (n=2), blaCTX-M-55 (n=1), blaSHV-12(n=1) have been identified and are associated with ESBL resistance. Four isolates had the MCR-1.1 gene, which confers resistance to colistin. In beef cattle, the study found that resistance genes encoding inactivation mechanisms were predominant. Specifically, EC-18 (n=37), BcI (n=11), BcII (n=11), EC-15 (n=8), EC-18 (n=7), and blaTEM-1 (n=7) were the most common. Additionally, ESBL genes such as blaCTX-M-55 (n=1) and blaSHV-12 (n=1) were identified, with only one isolate containing the mcr-1.1 gene. The study revealed a wide range of resistance genes in E. coli samples from the selected production chains. The higher presence of colistin resistance in pig samples is likely due to its broader use for treatment in the past. However, this practice was forbidden in 2016. Characterizing the most prevalent resistance genes in production chains is crucial for selecting the most appropriate antimicrobials for effective treatment and addressing the issue of antimicrobial resistance.

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