低濃度的抗生素與消毒劑對細菌中抗藥性基因由水平基因傳播之影響

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摘要

抗生素抗藥性已成為全球公共衛生的重要議題，水平基因轉移(Horiziontal gene transfer, HGT)在傳播抗生素抗藥性基因(Antibiotic resistance genes, ARGs)佔有重要地位，因此本研究將探討細菌暴露在抗生素(四環黴素、黏菌素)和四級銨消毒劑的環境下，對接合作用(Conjugation)之影響，各實驗使用特定質體來進行接合作用試驗，以了解質體在細菌之間的轉移狀況，由結果得知，當細菌暴露在亞抑制濃度(Sub-inhibitory concentration)的抗生素和消毒劑下，接合轉移頻率顯著上升，研究細胞內 ROS 的產生、細胞膜通透性的變化以及與接合作用相關基因的表達量變化，以了解促進接合作用發生的可能原因。暴露在四環黴素下，細胞內活性氧的過度產生和細胞膜通透性的增加刺激了 ARG 的轉移，四級銨消毒劑改變了細胞外聚合物的組成和含量，黏菌素使得細胞膜通透性增加，利用掃描式電子顯微鏡觀察菌體表面發現經過黏菌素處理的細菌表面出現破損的情形，外膜蛋白基因(*ompF* 和 *ompC*)表達量上升，不論抗生素或是消毒劑皆調節了與接合作用相關得基因表達量。透過抗生素抗藥性試驗得知，質體從供體菌株轉移至受體菌株後能夠改變受體菌株的抗生素抗藥性表型。因此，應持續監測環境中殘留的抗生素及消毒劑含量，以降低 ARG 在各種環境中的傳播風險。

The impact of antibiotics and disinfectants on bacterial conjugation

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Outline

1. Introduction
2. Promotion of conjugation by environmentally relevant concentrations of tetracycline, facilitating plasmid transfer via horizontal gene transfer
3. Promotion of conjugation by quaternary ammonium compounds at environmental concentrations, facilitating plasmid transfer via horizontal gene transfer
4. Promotion of conjugation by sub-inhibitory concentrations of colistin, facilitating plasmid transfer via horizontal gene transfer
5. Conclusions

Abstract

Antibiotic resistance has become a significant global public health issue, and horizontal gene transfer (HGT) plays a crucial role in spreading antibiotic resistance genes (ARGs). Therefore, this study investigates the impact of bacterial exposure to antibiotics (Tetracycline, Colistin) and quaternary ammonium compounds (QACs) on conjugation. Specific plasmids were used in the conjugation experiments to understand plasmid transfer between bacteria. The results indicate that when bacteria are exposed to sub-inhibitory concentrations of antibiotics and disinfectants, the conjugation transfer frequency significantly increases. The study examines the production of reactive oxygen species (ROS), changes in cell membrane permeability, and the expression of conjugation-related genes to understand the possible reasons behind the promotion of conjugation. Exposure to tetracycline resulted in excessive ROS production and increased cell membrane permeability, stimulating ARG transfer. QACs altered the composition and content of extracellular polymeric substances (EPS), while colistin increased cell membrane permeability. Scanning electron microscopy (SEM) revealed surface damage in bacteria treated with colistin. Additionally, the expression levels of outer membrane protein genes (*ompF* and *ompC*) increased. Both antibiotics and disinfectants regulated the expression of genes related to conjugation. Antimicrobial susceptibility testing showed that after plasmid transfer from donor to recipient strains, the recipient strains exhibited changes in their antibiotic resistance phenotypes. Therefore, it is essential to continuously monitor the levels of residual antibiotics and disinfectants in the environment to reduce the risk of ARG spread across various ecosystems.

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