

Exploring Aldehydes as PQS System Targeting Agents to Combat *Pseudomonas aeruginosa* Biofilm-Associated Infections

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Abstract

Background: Quorum sensing (QS) is an important bacterial communication mechanism that regulates the expression of virulence factors and biofilm formation and contributes to antimicrobial resistance. In particular, the pseudomonas quinolone signal (PQS) system, mediated by autoinducers from the quinolone family, performs an important role in the pathogenicity of *Pseudomonas aeruginosa*. Disruption of QS pathways has become a new generation of antipathogenic and antivirulence therapies. Therefore, the use of QS inhibitors, especially those from natural sources, could be a promising strategy for biofilm prevention and control. Aldehydes are a group of plant secondary metabolites (*i.e.* phytochemicals) that exhibit a broad spectrum of antibiotic activity and have excellent properties in modulating bacterial cell-cell communication in biofilm communities.

Materials: The efficacy of three aldehydes (*P*-hydroxybenzaldehyde, vanillin and syringaldehyde) in disrupting the PQS system of *P. aeruginosa* was investigated using bioreporter strains. The aldehydes were also combined with the antibiotic tobramycin to evaluate their ability to prevent and control biofilms. The mass, metabolic activity, and cell culturability reduction of the biofilms were quantified.

Results: The results demonstrated that the aldehydes have the potential to inhibit the PQS systems by more than 80% even at sub-inhibitory concentrations (Figure 1). In addition, the aldehyde-tobramycin combination improved the efficacy of the antibiotic in preventing and removal biofilms while allowing a lower antibiotic dose.

Conclusion: This study has shown that the aldehydes tested are promising as PQS inhibitors and enhancers of antibiofilm activity of antibiotics against *P. aeruginosa*.

Keywords

Aldehydes, antibiofilm activity, antimicrobial combination, antibiotic resistance, biofilm infections, quorum sensing inhibition.

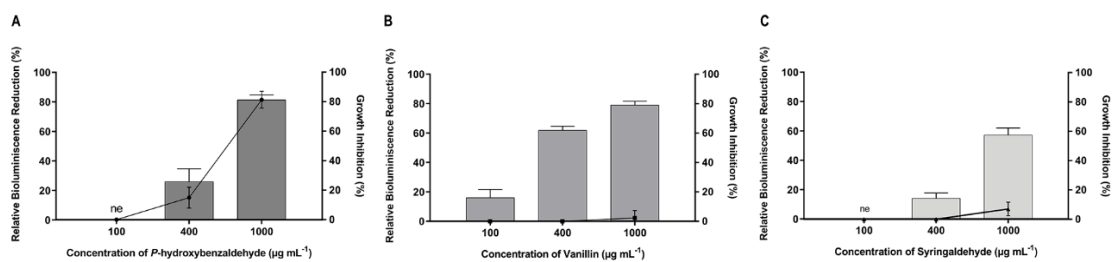


Figure 1 - Effect of increasing concentrations of *P*-hydroxybenzaldehyde (A), vanillin (B) and syringaldehyde (C) (100, 400 and 1000 $\mu\text{g mL}^{-1}$) on the PQS system of *P. aeruginosa* PAO1 (primary y - axis; bars) and growth inhibition (secondary y-axis; dashed line), ne = no effect.

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