In vitro quenching of fish pathogen Edwardsiella tarda AHL production using marine bacterium Tenacibaculum sp. strain 20J cell extracts

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ABSTRACT: Quorum quenching (QQ) has become an interesting alternative for solving the problem of bacterial antibiotic resistance, especially in the aquaculture industry, since many species of fish-pathogenic bacteria control their virulence factors through quorum sensing (QS) systems mediated by N-acylhomoserine lactones (AHLs). In a screening for bacterial strains with QQ activity in different marine environments, Tenacibaculum sp. strain 20J was identified and selected for its high degradation activity against a wide range of AHLs. In this study, the QQ activity of live cells and crude cell extracts (CCEs) of strain 20J was characterized and the possibilities of the use of CCEs of this strain to quench the production of AHLs in cultures of the fish pathogen Edwardsiella tarda ACC35.1 was explored. E. tarda ACC35.1 produces N-hexanoyl-L-homoserine lactone (C6-HSL) and N-oxohexanoyl-L-homoserine lactone (OC6-HSL). This differs from profiles registered for other E. tarda strains and indicates an important intra-specific variability in AHL production in this species. The CCEs of strain 20J presented a wide-spectrum QQ activity and, unlike Bacillus thuringiensis serovar Berliner ATCC10792 CCEs, were effective in eliminating the AHLs produced in E. tarda ACC35.1 cultures. The fast and wide-spectrum AHL-degradation activity shown by this member of the Cytophaga–Flexibacter–Bacteroidetes group consolidates this strain as a promising candidate for the control of AHL-based QS pathogens, especially in the marine fish farming industry.

KEY WORDS: Edwardsiella tarda · Quorum sensing · Quorum quenching · N-acylhomoserine lactone · AHL · Lactonase · Tenacibaculum · Cytophaga–Flexibacter–Bacteroidetes · CFB

INTRODUCTION

In recent decades, the intensive farming of marine fish has registered a strong growth; however, infectious diseases continue to be a threat for this industry (FAO 2010). Due to the limitations of the use of antibiotics in aquaculture, in the search for alternative disease-control strategies, the efforts of researchers have been focused especially on the fields of new vaccines (Adams & Thompson 2006), probiotics (Tinh et al. 2008a, Wang et al. 2008) and enzybiotics (Hermoso et al. 2007). Since pathogenic bacteria coordinate the expression of many important genes, including their virulence factors, in a cell density-dependent manner through the production, liberation and sensing of signal molecules called autoinducers, the interception of this type of bacterial communication or 'quorum sensing' (QS) has also been proposed as a promising method to control pathogenic bacteria (Dong & Zhang 2005, Dong et al. 2007), especially in the field of aquaculture (Defoirdt et al. 2004). When the bacterial communication system is intercepted,