



## Outer-membrane siderophore receptors of heterotrophic oceanic bacteria

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**ABSTRACT:** Pathogenic gram-negative bacteria use specific receptors to transport ferric siderophore complexes across their outer membrane during iron (Fe)-limited growth. Receptors such as these have not yet been characterized in oceanic heterotrophic bacteria. We examined four species of  $\gamma$ -proteobacteria for the presence of Fe-siderophore receptors with the use of a non-denaturing polyacrylamide gel electrophoresis binding assay and the siderophore ferrioxamine B (FB) labeled with  $^{55}\text{Fe}$ . Small-subunit rRNA sequence analysis assigned these bacteria to the genera *Pseudoalteromonas* and *Alteromonas*. Two oceanic species, *Pseudoalteromonas haloplanktis* (Neptune) and *Alteromonas macleodii* (Jul88), which were shown previously to transport and assimilate Fe bound to FB during growth, synthesized an outer-membrane FB receptor under Fe-limiting conditions. Only low concentrations of the receptors were detected in these bacteria when they were grown with high concentrations of Fe. The FB receptor of *P. haloplanktis* (Neptune) had an apparent molecular mass of 79 kDa and an externally oriented binding site. The molecular mass of the receptor of *A. macleodii* (Jul88) was 100 kDa. No FB receptors were detected by our methods in two coastal species, *Pseudoalteromonas rubra* (LMG1) and *Pseudoalteromonas piscicida* (PWF3). *P. haloplanktis* (Neptune) and *A. macleodii* (Jul88) also bound  $^{55}\text{Fe}$ -ferrichrome, a trihydroxamate siderophore like FB. Binding assays conducted with  $115 \text{ nmol L}^{-1}$   $^{55}\text{Fe}$ -FB in the presence of increasing concentrations of desferrioxamine B showed a progressive decrease in the amount of  $^{55}\text{Fe}$ -FB bound by the receptor protein, suggesting strong affinity of the receptor for the Fe-free siderophore. Our results provide the first demonstration of Fe-siderophore receptors in oceanic heterotrophic bacteria.

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