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Variations in O-antigen biosynthesis and O-acetylation associated with altered phage sensitivity in Escherichia coli 4s

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Abstract

© 2015, American Society for Microbiology. The O polysaccharide of the lipopolysaccharide (O antigen) of Gram-negative bacteria often serves as a receptor for bacteriophages that can make the phage dependent on a given O-antigen type, thus supporting the concept of the adaptive significance of the O-antigen variability in bacteria. The O-antigen layer also modulates interactions of many bacteriophages with their hosts, limiting the access of the viruses to other cell surface receptors. Here we report variations of O-antigen synthesis and structure in an environmental Escherichia coli isolate, 4s, obtained from horse feces, and its mutants selected for resistance to bacteriophage G7C, isolated from the same fecal sample. The 4s O antigen was found to be serologically, structurally, and genetically related to the O antigen of E. coli O22, differing only in side-chain α-D-glucosylation in the former, mediated by a gtr locus on the chromosome. Spontaneous mutations of E. coli 4s occurring with an unusually high frequency affected either O-antigen synthesis or O-acetylation due to the inactivation of the gene encoding the putative glycosyltransferase WclH or the putative acetyltransferase WclK, respectively, by the insertion of IS1-like elements. These mutations induced resistance to bacteriophage G7C and also modified interactions of E. coli 4s with several other bacteriophages conferring either resistance or sensitivity to the host. These findings suggest that O-antigen synthesis and O-acetylation can both ensure the specific recognition of the O-antigen receptor following infection by some phages and provide protection of the host cells against attack by other phages.

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