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Tolerance to quaternary ammonium compound disinfectants may enhance growth of *Listeria monocytogenes* in the food industry

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Highlights

- Tolerance of QAC disinfectants studied in *L. monocytogenes* from meat-and salmon processing
- Efflux pumps genes *qacH* found in 22% and *bcrABC* in 8% of isolates
- No protective effect of *qacH* or *bcrABC* in bactericidal tests with QAC
- Residues of QAC found on surfaces after sanitation in meat processing plants
- *qacH* and *bcrABC* gave growth advantage at concentrations of QAC present after sanitation.

Abstract

The antibacterial effect of disinfectants is crucial for the control of *Listeria monocytogenes* in food processing environments. Tolerance of *L. monocytogenes* to sublethal levels of disinfectants based on quaternary ammonium compounds (QAC) is conferred by the resistance determinants *qacH* and *bcrABC*. The presence and distribution of these genes have been anticipated to have a role in the survival and growth of *L. monocytogenes* in food processing environments where QAC based disinfectants are in common use. In this study, a panel of 680 *L. monocytogenes* from nine Norwegian meat- and salmon processing plants were grouped into 36 MLVA profiles. The presence of *qacH* and *bcrABC* was determined in 101 isolates from the 26 most common MLVA profiles. Five MLVA profiles contained *qacH* and two contained *bcrABC*. Isolates with *qacH* and *bcrABC* showed increased tolerance to the QAC Benzalkonium chloride (BC), with minimal inhibitory concentrations (MICs) of 5–12, 10–13 and < 5 ppm for strains with *qacH* (two allele variants observed), *bcrABC*, and neither gene, respectively. Isolates with *qacH* or *bcrABC* were not more tolerant to BC in bactericidal tests in suspension or in biofilms compared with isolates lacking the genes. Water residue samples collected from surfaces in meat processing plants after QAC disinfection had bactericidal effect against *L. monocytogenes* when the sample BC levels were high (> 100 ppm). A sample with lower BC concentrations (14 ppm of chain length C-12 and 2.7 ppm of chain length C-14) inhibited growth of *L. monocytogenes* not containing *bcrABC* or *qacH*, compared to strains with these genes.

The study has shown that *L. monocytogenes* harbouring the QAC resistance genes *qacH* and *bcrABC* are prevalent in the food industry and that residuals of QAC may be present in concentrations after sanitation in the industry that result in a growth advantage for bacteria with such resistance genes.



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Keywords

Listeria monocytogenes; Benzalkonium chloride; Quaternary ammonium compound; Tolerance

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