

## INTISARI

### EFEKTIVITAS ASAM HIPOKLORIT DALAM MEREDUKSI BIOFILM MULTISPESIES BAKTERI PEMBENTUK HISTAMIN PADA PERMUKAAN STAINLESS STEEL

Sanitasi permukaan kontak pangan penting untuk mencegah kontaminasi silang produk perikanan, namun keberadaan biofilm membuat mikroorganisme sulit dihilangkan dan meningkatkan risiko keamanan pangan. Salah satu kelompok bakteri patogen yang mampu membentuk biofilm adalah *Morganella morganii*, *Raoultella ornithinolytica*, dan *Klebsiella pneumoniae*. Biofilm multispesies lebih resisten terhadap agen antimikroba. Upaya pengendalian biofilm dengan metode disinfeksi berbasis klorin seperti natrium hipoklorit (NaOCl) umum digunakan, namun pada permukaan logam lebih rentan terhadap korosi, sehingga diperlukan alternatif yang lebih aman, yaitu asam hipoklorit (HOCl). Efektivitas HOCl dalam mereduksi biofilm dipengaruhi oleh konsentrasi dan residu organik pada permukaan. Penelitian dilakukan untuk mengetahui kemampuan *Morganella morganii* TK07, *Raoultella ornithinolytica* TN5, *Klebsiella pneumoniae* CK13.2 dan kombinasinya dalam membentuk biofilm multispesies, mengetahui efektivitas HOCl dalam mereduksi biofilm multispesies BPH pada permukaan *stainless steel* (SS) yang dikontaminasi residu organik (ekstrak daging tuna) serta membandingkan efektivitas HOCl dengan NaOCl dalam mereduksi biofilm multispesies BPH. Metode penelitian yang digunakan meliputi perhitungan biofilm secara kualitatif melalui pewarnaan kristal violet dan *ruthenium red*, sementara secara kuantitatif dilakukan menggunakan metode *Total Plate Count* (TPC) dan perhitungan persen reduksi, serta pengamatan morfologi biofilm dilakukan dengan SEM-FE. Hasil penelitian menunjukkan bahwa BPH dalam kondisi monospesies, dual spesies dan multispesies mampu membentuk biofilm kuat, kecuali pada kombinasi dual spesies (*M. Morganii* TK07 – *R. ornithinolytica* TN5) yang membentuk biofilm sedang. Konsentrasi HOCl berpengaruh terhadap penurunan jumlah bakteri dalam biofilm multispesies BPH pada kupon *stainless steel* yang dikontaminasi residu organik. Efektivitas HOCl 50 ppm setara dengan NaOCl 100 ppm dengan persentase reduksi hingga 99,40%. HOCl lebih efektif dibandingkan NaOCl sehingga dapat digunakan sebagai alternatif disinfektan berbasis klorin dalam mengendalikan biofilm multispesies BPH pada permukaan *stainless steel* yang terkontaminasi residu organik di lingkungan pengolahan perikanan.

**Kata kunci:** disinfeksi, HOCl, *Klebsiella pneumoniae*, *Morganella morganii*, *Raoultella ornithinolytica*

## ABSTRACT

### EFFECTIVENESS OF HYPOCHLOROUS ACID IN REDUCING MULTISPECIES BIOFILM OF HISTAMINE PRODUCING BACTERIA ON STAINLESS STEEL SURFACES

Surface sanitation of food contact surfaces is important to prevent cross-contamination of fishery products, but the presence of biofilms makes microorganisms difficult to remove and increases food safety risks. One group of pathogenic bacteria capable of forming biofilms is *Morganella morganii*, *Raoultella ornithinolytica*, and *Klebsiella pneumoniae*. Multispecies biofilms are more resistant to antimicrobial agents. Efforts to control biofilm using chlorine-based disinfection methods such as sodium hypochlorite (NaOCl) are commonly used, but metal surfaces are more susceptible to corrosion, so a safer alternative is needed, namely hypochlorous acid (HOCl). The effectiveness of HOCl in reducing biofilm is influenced by the concentration and organic residues on the surface. Research was conducted to determine the ability of *Morganella morganii* TK07, *Raoultella ornithinolytica* TN5, *Klebsiella pneumoniae* CK13.2 and their combinations in forming multispecies biofilms, to determine the effectiveness of HOCl in reducing multispecies biofilms of HPB on stainless steel (SS) surfaces contaminated with organic residues (tuna meat extract), and to compare the effectiveness of HOCl with NaOCl in reducing multispecies biofilms of HPB. The research methods used included qualitative biofilm calculation through crystal violet and ruthenium red staining, while quantitative methods were performed using the Total Plate Count (TPC) method and percentage reduction calculation, and biofilm morphology observation was performed with SEM-FE. The results showed that HPB in monospecies, dual-species, and multispecies conditions were able to form strong biofilms, except for the dual-species combination (*M. Morganii* TK07 – *R. ornithinolytica* TN5), which formed a moderate biofilm. The concentration of HOCl affected the reduction in the number of bacteria in the multispecies biofilm of HPB on stainless steel coupons contaminated with organic residues. The effectiveness of 50 ppm HOCl was equivalent to 100 ppm NaOCl with a reduction percentage of up to 99.40%. HOCl was more effective than NaOCl and could therefore be used as an alternative chlorine-based disinfectant in controlling multispecies biofilms of HPB on stainless steel surfaces contaminated with organic residues in fish processing environments.

**Keywords:** disinfection, HOCl, *Klebsiella pneumoniae*, *Morganella morganii*, *Raoultella ornithinolytica*