

Investigating the Presence of Antibiotic Resistant Bacteria (ARB) in Ultraviolet (UV)-Treated River Water Used for Fresh Produce Irrigation

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Abstract

ARB have repeatedly been reported in irrigation waters used for fresh produce, posing a great threat to consumers of these often minimally processed foods. While UV-treatment has shown success in its ability to inactivate pathogens related to foodborne illness, its efficacy in reducing ARB with resistance genes has produced varied results. The study aimed to establish antibiotic resistance (AR) profiles of UV-resistant bacterial isolates found in rivers used for fresh produce irrigation in the Cape Winelands Region, aiding in understanding the role which contaminated waters potentially play in the dissemination of AR.

River water samples, originating from two rivers, were subjected to three consecutive doses of medium pressure UV irradiation ($3 \times 20 \text{ mJ.cm}^{-2}$), followed by a three-hour recovery period. *Escherichia coli*, coliforms and heterotrophic plate counts were monitored. The presence of *Salmonella* species (ISO 19250:2010) and *Listeria monocytogenes* (ISO 11290-1:2017) were also determined. Twenty-three UV-surviving isolates were identified using the VITEK[®]2 Compact Automated System and underwent antibiotic susceptibility testing (AST) towards nineteen antibiotics, as well as phenotypic screening for extended-spectrum beta-lactamase (ESBL)-production.

Identification of UV-surviving isolates revealed a high prevalence of *Escherichia coli* (32%) and *Enterobacter cloacae* complex (29%). All isolates screened for ESBL-production were ESBL negative. Of the twenty-three isolates which underwent AST, 65% were resistant to at least one antibiotic, 48% were resistant to two or more antibiotics, and 13% were identified as being multidrug resistant. Resistance to both cefalotin and amoxicillin/clavulanic acid (39% of isolates), and ampicillin (26% of isolates) was prevalent - a concerning finding as these antibiotics have been labelled as 'critically important' and 'highly important' antimicrobials for human medicine by the World Health Organization, and resistance may indicate antibiotic misuse in the Cape Winelands Region.

With a rise in outbreaks of untreatable disease related to AR being predicted, this study highlights the need for improved effectiveness in UV-treatment of irrigation waters, as well as the need for enhanced antimicrobial surveillance in the Cape Winelands Region to manage AR and minimise its dissemination.