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Copper Ionization for Inactivating *E. coli*, Coliphage MS2, and *Bacillus atrophaeus* Spores in Irrigation Water for Fruits and Vegetables

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Abstract: Food borne outbreaks of gastroenteritis occur despite extensive measures by the industry to ensure a food supply free of microbial contaminants. Water used for irrigation in fields may be an important route for microbial contamination. A variety of chemical disinfectants can be used on farms, including copper ionization. Copper ionization uses a low voltage current to release positively charged copper atoms from electrodes suspended in water and is not harmful to humans, is relatively inexpensive, and requires little maintenance. However, there are few studies to determine the efficacy of copper for inactivating microbial contaminants in environmental waters. Therefore, the objective of these studies was to determine the kinetics of ionized copper for inactivating a suite of indicator organisms spiked into environmental water potentially used for irrigation on farms. *E. coli*, coliphage MS2, and *Bacillus atrophaeus* were propagated using standard methods then seeded into test waters at levels sufficient to follow a 99.99% reduction. Experiments were conducted at 25°C with two copper concentrations (1 and 4 mg/L). Samples were analyzed initially then over a 4 hour period. Copper concentrations remained constant providing a stable residual in test waters. Greater than 99% *E. coli* reductions were achieved with the low and high copper concentrations at 2 hours and at 30 minutes, respectively. Coliphage MS2 reductions of 98% and greater than 99.9% were achieved by low and high copper concentrations at 30 minutes and at 5 minutes, respectively. *Bacillus atrophaeus* spores were not reduced with the low or high copper concentrations over the 4 hour trials. In conclusion, copper ionization appears to be effective for reducing bacteria and viruses at concentrations of 1 and 4 mg/L in water but is not effective for bacterial spores at either copper concentration. Copper provides a stable disinfectant residual in water and appears to be relatively effective for bacteria and viruses. Therefore, copper ionization may be a superior alternative to other chemical disinfectants for inactivating microbial contaminants in irrigation water used on farms.

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