Student Poster Competition 2018

Abstract Submission Form

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ABSTRACT DETAILS
Abstract Title: In-Field and Portable Measurement of Quaternary Ammonium Compounds by Microfluidic Distance-Based Paper Device Immobilizing Polydiacetylene Sensor
Abstract Content/Details (100-400 words): Quaternary ammonium compounds (QACs) are one of the major antimicrobial disinfectants extensively utilized in pharmaceutical and health care industries for surface cleaning. According to the US Environmental Protection Agency, 36.2% of industrial and institutional disinfection formulations contain QACs as an active ingredient. One of the major concerns in QAC utilization is an in-field and portable method to determine its level in fumigation solutions and on surface since its levels are crucial for effectiveness and worker's safety. Four common QACs include didecyldimethylammonium chloride (DDAC), cetyltrimethylammonium bromide (CTAB), benzyldimethyltetradecylammonium chloride (BAC), and cetylpyridinium chloride (CPC). DDAC and BAC have been reported to cause toxicity including eye and mucous membrane irritation, contact dermatitis, and asthma in work-related environment. Although commercial test kits are available for in-field measurement, they only allow a semi-quantitative analysis for QAC detection. In this work, a microfluidic distance-based paper device immobilizing polydiacetylene sensor has been fabricated as a non-skillful and non-instrumental method, which can serve as a novel in-field and portable device to determine levels of QACs in disinfection solutions. Three objectives of this study were to fabricate a distance-based

paper device, to validate and to apply the device for QAC determination in disinfection solutions. A blue polydiacetylene (PDA) sensor was filled in a technical pen coupled with an electronic plotter to plot PDA onto flow channel. QAC disinfectant solution was added into the sample reservoir and the analytes caused color change of PDA from blue to red. Sensing distances defined as lengths of red PDA were successfully correlated with QAC concentrations in ranges of 0.15-2 mM with correlation coefficients of 0.995. The fabricated devices were specific and sensitive to quantify DDAC, CTAB, BAC, and CPC with limits of quantitation of 0.04, 0.12, 0.02, and 0.25 mM, respectively. Accuracy (% recovery) and precision (%RSD) of the devices were in the range of 98.6 - 109.4% and 2.2 - 9.3%, respectively. Stability data demonstrated that the fabricated device was stable for 21 days. The fabricated device was successfully applied to detect levels of DDAC in five fumigation solutions and no statistical difference at 95% confidence interval by *t*-test was found in comparisons with the microplate reader method. In conclusion, the microfluidic distance-based paper device immobilizing polydiacetylene sensor could be applied as a novel in-field and portable device for quaternary ammonium compound quantitation. The device is simple, portable, and inexpensive, whereas the method is quantitative.

Graphical abstract