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Low-cost sample preparation and detection of contaminants for food safety

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Abstract

Contamination of food, water, medicine and ingestible household consumer products is a public health hazard that episodically causes millions of sicknesses and deaths worldwide. Existing laboratory methods require specialized scientific equipment, a stable laboratory environment, a continuous refrigeration chain, and/or specially trained staff to perform manual steps. Our aim is to automate, affordable diagnostic tests for contaminants and pathogens. We developed the LabReader, which employs a LED-based detection scheme for simultaneous fluorescence/UV measurements [1]. We introduced new methods to detect (di-) ethylene glycol in consumables _0.1wt% and alcohols _1ppb. Pathogens in water and foods were detected at _104 CFU/ml using nonspecific intercalating dyes. To gain both sensitivity and specificity for cell-based analysis, bioassays, such as DNA amplification, needed to be incorporated into the LabReader. Further, sample preparation had to be automated, which was achieved by combining the LabReader with the LabTube, a disposable platform for automated DNA extraction inside a standard laboratory centrifuge [2]. The LabSystem consisted of the LabTube for automated extraction and the benchtop LabReader for handheld DNA amplification/readout. DNA extraction of food bacteria (*E.coli* and *Alicyclobacillus*) was optimized inside the LabTube. The extracted DNA was amplified using the qualitative isothermal LAMP method and semi-quantitative real-time PCR. The combined extraction and amplification detection-limit of the LabSystem was _100 copies and the quantification-limit _1,000 copies.

Overall, the LabSystem is suitable for applications in a variety of food contaminations and for quality control, where it is hoped to reduce manual labor efforts and save lives.

Biography

Melanie Hoehl has pursued her PhD thesis at the Harvard-MIT Division of Health Sciences and Technology in the area of lowcost pathogen and contaminant detection. She holds a BA and MA in Chemical Engineering from the University of Cambridge, UK. She is currently working on the development of microfluidic platforms in the corporate sector “Research and Advance Engineering” at Robert Bosch GmbH in Germany.