Development of Paper-Based Origami Biosensor Platforms for Colorimetric Detection of Biocontaminants

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Infectious diseases caused by bacteria from biological contaminants pose a great burden in terms of diagnosis and treatment, and millions of people worldwide die from bacterial infections. The detection of bacteria plays a critical role in safe water control, clinical diagnosis and control of contamination, but is inaccessible due to the high cost, complex devices and equipment required. First, for the drawing and production of paper-based sensor models, drawings were made in different designs using the Corel DRAW X7 program. Then, characterization studies were performed to select the biosensor model that can determine E. Coli in the most efficient way. Our theories in this sensor system sensing principle are based on specific antibody-antigen interactions. Finally, our sensors with different concentrations of bacteria were tested, and tried with real samples like tap water and beverages. After that, sensor characteristics have been individually studied. Two different biosensors were developed: a microchip capable of colorimetric measurement and a user-friendly origami biosensor. The lowest detection limit was calculated as 0.11 x 10*2 bacteria/ml and the widest dynamic linear working range as 10*2-10*7 bacteria/ml. The cost of E.coli detection analysis, with the microchip biosensor is 10 cents and the origami biosensor is only 15 cents. This study showed that biosensor systems we have developed can be easily produced at large scales since it does not contain complex devices and the visual results can easily be integrated with a smartphone app. Also, it will pave the way for the determination of bacteria in different environments ranging from safe water to biological fluids.

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