B25 Gold Nanoparticles (AuNPs)/Aptamer-Based Paper Microfluidic Devices Developed for the Detection of Cocaine

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The goal of this presentation is to describe the development of AuNp/aptamer-based paper microfluidic devices for the presumptive determination of cocaine in acid and base form. Information provided will include the optimized design of the paper chip and the validation of this device.

This presentation will impact the forensic science community by demonstrating the application of this newly designed paper microfluidic device in the presumptive detection of cocaine. This new method is rapid, inexpensive, and specific toward the cocaine molecule.

Over the past ten years, a number of specifically targeted aptamers have been developed to identify illicit drugs. The most common detection methods involve Ultraviolet/Visible (UV/Vis) spectroscopy or gold nanoparticles. These tests were developed as rapid solution-based tests, similar to immunoassays; however, these tests are less convenient for field use. Many of these kits require infrastructure to keep and store the reagents because they can be sensitive to temperature, light, and age. An alternative platform for AuNPs/aptamer detection based on paper microfluidic devices has been investigated. A new chip design has been created that adapts the AuNPs and aptamers to a ready-to-use format. In the field, samples are dissolved in a carrier solvent in vials and then applied to the paper just before analysis. The devices can be used at crime scenes, in laboratories, and at any other locations where the suspected powders may occur. The paper chips are easy to prepare and inexpensive to operate. Furthermore, they can be conveniently stored for later uses.

The paper microfluidic devices are prepared using a wax-ink printer, thermal laminator, chromatography paper, aptamers, and gold nanoparticles. The wax-ink printer and a thermal laminator produce hydrophilic channels defined by melted wax on the paper. Next, gold nanoparticles and aptamers are prepared for the channel. Cocaine samples in acid/basic form are dissolved in solutions, then transferred to the chips. Cocaine next travels down the channel via capillary action, interacting with the aptimers and causing a color change to occur due to the aggregation of the nanoparticles. When cocaine is not present, the nanoparticles cannot aggregate and no color change occurs as aptimers are then free to bind gold. The entire process takes approximately five minutes. The applied aptamer is specific for cocaine. This presentation will also report a preliminary validation of this device, including tests for sensitivity, specificity, and stability against a variety of potential interferences.

The use of paper microfluidic devices permits the development of rapid, inexpensive, and easily operated tests for cocaine samples. These devices present a safe and convenient presumptive tool that can be used in the field.

AuNPs/Aptamer, Cocaine, Paper Microfluidic Device