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Paper-based microfluidic tests: A novel manufacturing method and application for detection of chloramphenicol

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A paper-based microfluidic device is a system of channels for liquid flow, organized in paper or similar porous carriers and used to detect various chemical compounds. The location and structure of the channels allow the sequence and speed of interactions of reagents to be monitored. The availability of cellulosic carriers, their porous structure, and ease of modification have increased interest in practical applications of paper-based microfluidics. We have developed a microfluidic system, which was manufactured by laser etching of a nitrocellulose membrane. The proposed treatment is carried out without contact, with high precision and productivity. Optimal modes of laser treatment have been found. A series of microfluidic systems for various types of biospecific analytical interactions were manufactured. An immunochemical assay for the detection of chloramphenicol was developed. A chloramphenicol-BSA conjugate was sorbed at one end of the carrier, and gold nanoparticles conjugated with specific antibodies were used as a marker. Narrowing of the channels slowed the liquid flow and increased the reaction time of the reagents. Sections of channels with a narrowed flow resulted in a local increase in the concentration of reacting components. The optimized channel shape allowed the sample and conjugate to flow freely and maximized the efficiency of specific interactions. The proposed assay system detected chloramphenicol at concentrations up to 0.4 ng/ml. The duration of the assay was 10 min. Traditional immunochromatography using the same immunoreagents is characterized by five-fold lower sensitivity. The approach is universal and easy to implement. In addition, it does not require synthesis of special reagents or complex chemical treatment of channels, shows high reproducibility of results, and can easily be implemented in immunoanalytical systems for the detection of antigens with different molecular weights.

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