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DEVELOPMENT OF 3D PRINTED SERPENTINE FLUIDIC CHANNEL INTEGRATED WITH HEATING ELEMENT FOR LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) PROCESS

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Abstract
DNA-based point-of-care (POC) diagnostics require rapid, accurate, and portable platforms for detection of infectious diseases. This can be achieved by incorporating a loop-mediated isothermal amplification (LAMP) process for DNA amplification into the system. LAMP offers a promising in-situ solution, but maintaining consistent reaction conditions, such as a constant temperature, specifically at 65°C for 35 minutes to complete the LAMP process, remains a critical challenge. Therefore, this work presents the development of a 3D-printed serpentine fluidic channel integrated with a heating element for DNA amplification through the LAMP process. To assess their heating capabilities, heating testing was initially performed on several commercially available heating elements (Heater Cartridge, PTC 140, and PTC 230). PTC 230 heating element was chosen for its rapid heating performance (reaching 65°C in 54.78 seconds). Later, three serpentine fluidic channels of different diameters (1.6 mm, 1.7 mm, and 1.8 mm) were fabricated using a Masked Stereolithography Apparatus (MSLA) 3D printer. The developed portable LAMP device consisting of a fabricated serpentine fluidic channel on a PTC 230 heating element allows the sample to be heated at 65°C for 35 minutes. Sample flow inside each serpentine fluidic channel was measured and compared with the expected flow time of 35 minutes. It was observed that the fluidic channel with a 1.6 mm diameter shows the closest value of 34.33 minutes (percentage deviation of 1.91%) as compared to the other two channels. The optimized fluidic channel design (channel diameter of 1.6 mm) coupled with the rapid heating performance of the PTC 230 element (reaching 65°C in 54.78 seconds) for a portable LAMP device represents a significant step towards developing rapid, accurate, and portable POC diagnostic tools.

Author Keywords
3D printing; fluidic channel; heating element; loop-mediated isothermal amplification (LAMP)

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