Journal of Business and Hotel Management

Short Communication

A SCITECHNOL JOURNAL

The utilization of laser-induced nucleic acid amplification reaction on the surface of composite magnetic nanoparticles for rapid and semi-quantitative genes detection

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Abstract

Nucleic acid testing (NAT) is regarded as a highly sensitive and specific method for infectious disease screening. Among NAT technologies, polymerase chain reaction (PCR) and loop-mediated isothermal amplification (LAMP) are two common technologies in fundamental research and clinical applications for nuclei acid amplification, which the targeted genes at accurate thermal-control conditions. However, while implementing these two technologies in the external heater (e.g., PCR machine), indirect heat transfer not only leads to massive amounts of energy consumption but increases the cost of assembling a complicated and huge-volume thermal-control system. Therefore, a stable and direct internal thermal-control system is urgent to be developed for NAT. This study combined photo-thermal nanoparticles with LAMP technology, termed as photo-LAMP, which achieved a rapid semi- quantitative detection of Mycobacterium tuberculosis (MTB) bacteria nucleic acids. In this system, a set of six biotin-labeled primers was selected for targeting 16S rRNA gene of MTB bacteria, conjugated to the surface of photo-thermal nanoparticles through streptavidin-biotin interaction. Polypyrrole- modified iron oxide nanoparticles (i.e., photo-thermal nanoparticles) were utilized to be an internal heater for cell or bacteria lysis, maintained a suitable temperature for LAMP reaction and made fluorescent signal condense. Owing to magnetic properties of nanoparticles, the fluorescent intensity was enhanced by magnet. The results showed that photo-LAMP system was capable of semi-quantitatively detecting the targeted nucleic acids within 20 minutes and had lower limit of detection (LoD) than that of conventional PCR machine. Taken together, photo-LAMP system may become a promising and portable device for widely application of nuclei acid amplification.

Biography:

Pin-Kuan Yeh held a bachelor's degree with a major in biomedical science in Chang Gung University in Taiwan. Now he is a master's student with a major in biotechnology industry in Chang Gung University and study in microfluidic biochip laboratory. Besides his major, he had internship experience in Blusense-diagnostics Inc. to participate in the project of establishing production line automation with robotic arms. Furthermore, he teamed up with his classmates to participate in the International Genetically Engineered Machine Competition (iGEM) in 2017 at the Massachusetts Institute of Technology (MIT). He was passionate about research in engineering field, and he was the leader of engineering group in the team.

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Citation: Pin-Kuan Yeh; The utilization of laser-induced nucleic acid amplification reaction on the surface of composite magnetic nanoparticles for rapid and semi-quantitative genes detection; Wireless Conference 2021 ; Feb 26, 2021 ; London , UK.