Miniaturized Gel Electrophoresis System and Its Application to Fast Genetic Diagnosis of Periodontal Pathogens

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Slab gel electrophoresis (SGE) is very common in biological experiment, but it is tedious, labor-intensive, skill-dependent, and relatively slow. Herein, we developed a compact SGE system based on a biochip. Such a system can resolve the DNA fragments while recording the DNA migration process. By electrophoresis of 50 bp DNA ladder, we found that the 16 DNA fragments could be resolved with high resolution less than 15 min. Furthermore, we have performed fast genetic diagnosis of periodontal pathogens in this compact SGE system by combining the polymerase chain reaction (PCR) technology. Experiments demonstrated that Porphyromonas gingivalis (P.g), Tannerela forsythia (T.f), and Treponema denticola (T.d) were diagnosed within short time, and the electrophoresis of P.g showed that the limit of detection of this system was about 6.4 ng/μl. Such a low cost system is easy to operate, and can greatly improve SGE efficiency in the biological experiment, especially for the labs in the third world countries.

The deadline for abstract submission is March 30, 2017 (Hawaii Time).

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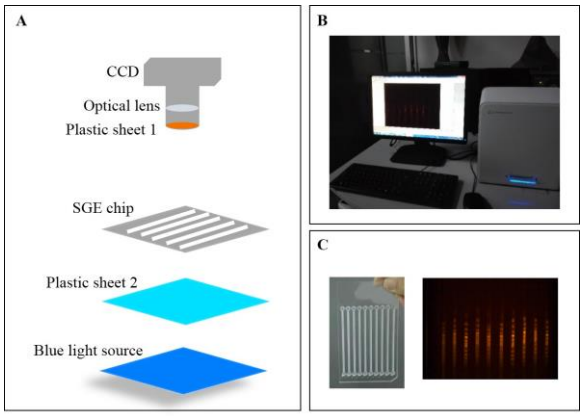

Fig.1 The miniaturized SGE system: (A) Schematic diagram. (B) The real SGE instrument. (C) The SGE chip.

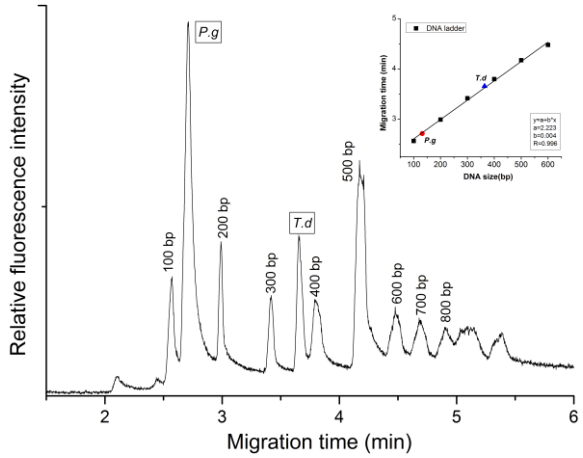

Fig. 2 Separation of mixture of PCR products (P.g and T.d) and 50 bp DNA ladder markers by CE. Electrophoresis conditions, polymers: 0.5% HEC (1300k); sample loadings: 100 V/cm (1.0 sec); total length and effective length of the capillary 6 cm/4 cm; electric field strength: 100 V/cm.

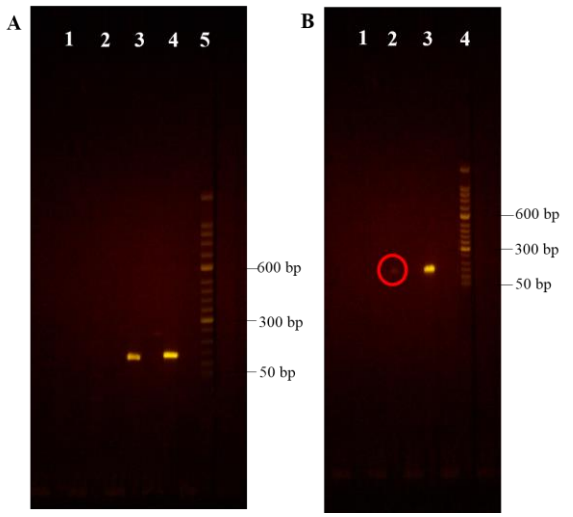

Fig. 3 (A) Separation of 50 bp DNA ladder (lane 5) and PCR products of P.g with different amplification cycles: 35× (lane 4), 25× (lane 3), 15× (lane 2) and 5× (lane 1). (B) Separation of 50 bp DNA ladder (lane 4) and PCR products of P.g without dilution (lane 3), diluted by 50 times (lane 2), and 100 times (lane 1).

REFERENCES:

[1] Chunxian Tao, Bo Yang, Zhenqing Li, Dawei Zhang, Yoshinori Yamaguchi, Real-time Tracking DNA Fragments Separation by Smartphone, Journal of Visualized Experiments, 2017, accepted.