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Label-free detection of mutations in the HIV genome using a surface plasmon resonance biosensor

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Abstract

Surface plasmon resonance (SPR) biosensors are optical materials that measure changes in the refractive index as they monitor non-covalent molecular interactions in real time. These utilise a label free analytical approach, which does not require dyes to produce a visible signal. In this study SPR was assessed for the detection of DNA hybridization between complementary DNA sequences within the pol gene of the human immunodeficiency virus (HIV) genome. HIV mutates rapidly due to its error prone reverse transcriptase enzyme. Some of these mutations make the virus to be resistant to antiretroviral drugs used to treat HIV infected individuals, rendering the drugs ineffective. In order to assess whether an infected individual expresses any drug resistant mutations, different bio-assays must be performed. However, these tests are expensive and require sophisticated equipment, which might be unavailable in resource limited settings. In a quest to simplify these tests so that they can be used in resource limited settings and reduce costs associated with HIV drug resistance testing, SPR capabilities were explored in this study. This was achieved by amplifying a 174 bp region of the HIV-1 pol gene using polymerase chain reaction (PCR). The detection was based on the hybridization between the PCR amplified DNA sequence and a biotinylated oligonucleotide probe immobilized onto an SPR sensor chip made of a gold coated slide. The acquired results indicated that the SPR-sensor-chip used was able to recognize changes in different wells and thereby able to differentiate between a sample with DNA hybridization and the one without. Based on these findings, this approach has potential to detect HIV drug resistance mutations with high efficiency in less time, at lower cost.