ABSTRACT

Most HIV viral load determination techniques available commercially are anchored on direct measurements of either HIV ribonucleic acid (RNA), provirus DNA, or viral antigen. Such techniques often require expensive reagents which makes the process expensive. This study reported the feasibility of label-free determination of HIV-1 viral load in plasma based on the consequence of the virus in the components of plasma. The study aimed to provide a relatively cheap and faster HIV-1 detection and further estimate the concentration of the virus without using any reagent. We subjected 22 HIV-1-infected human plasma samples to Raman peak height evaluation to develop a detection and concentration estimation model for HIV-1. Simultaneously, all the samples were examined for HIV-1 infection using qualitative polymerase chain reaction (PCR) test. The positive samples were further subjected to quantitative PCR to determine their corresponding viral load. Principal component analysis (PCA) and artificial neural network (ANN) were employed in Raman spectral analysis to enhance label-free detection of the HIV-1 in plasma. The quantification model results for HIV-1 yielded a good correlation with those obtained by the reference quantitative PCR method. HIV-1 viral load estimation based on the associated Raman spectral peaks centered at 1,270 and 1,446 cm^{-1} achieved a clinically accepted coefficient of determination ($R^2 > 0.9$). The viral detection sensitivity from the two associated peaks were 95 and 100 copies of the virus per milliliter of plasma, respectively, hence showing that the Raman-based model can be a potential HIV-1 diagnostic and viral load estimation tool.